REPORT OF THE COMPTROLLER & AUDITOR GENERAL OF INDIA UNION GOVT. 1978 PART 3

120

ERRATA

Page No.		*For*	*Read*
13	(a) Table—Sl. 1—Col. 3—item ii (c)	Plants	Plant
	(b) Table—Sl. 2—Col. 3—item (iii)	De-scalling	Descaling
20	Para—5.4 line 4	Specific	specific
27	Para—7 heading	Debottle necking	Debottlenecking
29	6th, 11th & 14th line from top	debottle necking	debottlenecking
34	(a) 18th line from top	Delete (.) after bracket.	
	(b) 23rd line from top	design	designed
37	2nd line from top	cummulative	cumulative
45	17th line from bottom	debottle necking	debottlenecking
49	11th & 16th line from top	hortensphere	hortonsphere
49	20th line from top	plant	plants
56	6th line from bottom	12.8	12.9
58	6th line from top	officiency	efficiency
59	1972-73—2nd col.	15 : 15 : 5	15 : 15 : 15
60	Table—1977-78 (last figure)	232 49	232.49
66	Table—1972-73 Col. 5	Insert '(a)' after the figure '8913'.	
70	15th line from bottom	co-relation	correlation
98	Col. 4—3rd figure	*1.309	*1.509

S/10 C&AG/78

TABLE OF CONTENTS

Pages

APPENDICES

PREFATORY REMARKS

A reference is invited to paragraph 5 of the Prefatory Remarks contained in Part I of the Report of the Comptroller and Auditor General of India—Union Government (Commercial) 1978—wherein it was *inter alia* mentioned that the report on the working of The Fertilizer Corporation of India Limited—an undertaking selected for appraisal by the Audit Board—was under finalisation. In this case, Audit Board consisted of the following members :—

(1) Shri Y. Krishan, Deputy Comptroller and Auditor General and Chairman, Audit Board up to 10th August, 1977.

(2) Shri T. Rengachari, Chairman, Audit Board and Ex-officio Additional Deputy Comptroller and Auditor General (Commercial) with effect from 11th August, 1977.

(3) Shri A. S. Krishnamoorthy, Member, Audit Board and Ex-officio Director of Commercial Audit (Coal), Calcutta.

(4) Shri M. P. Singh Jain, Member, Audit Board and Ex-officio Director of Commercial Audit, Calcutta up to 31st October, 1978.

(5) Shri A. C. Bose, Member, Audit Board and Ex-officio Director of Commercial Audit (Fertilizers and Chemicals), New Delhi.

(6) Shri Paul Pothen, Managing Director, Indian Farmers Fertilizers Co-operative Limited, New Delhi—Part Time Member.

(7) Shri T. R. Visvanathan, Superintendent, Technical Services, Madras Fertilizers Limited, Madras—Part Time Member.

(8) Dr. P. K. Narayanaswamy, Chairman and Managing Director, The Fertilizers and Chemicals, Travancore Limited, Alwaye—Part Time Member appointed in December 1977 in place of Shri Paul Pothen who ceased to be a part-time member in November 1976 consequent upon his appointment as part time non-official Director of The Fertilizer Corporation of India Limited.

2. After consideration of the Report by the Audit Board at its meeting held from 6th to 8th July 1977, the Report dealing with the following Units/Divisions and containing data up to 1975-76 was issued to the Ministry of Chemicals & Fertilizers on 28th September 1977 for acceptance of facts and comments, if any :—

(i) Sindri Unit (including Sindri Rationalisation and Modernisation as well as Jodhpur Mining Organisation).

(ii) Nangal Unit (including Nangal Expansion).

(iii) Trombay Unit (including Trombay Expansion).

(iv) Namrup Unit (including Namrup Expansion).

(v) Gorakhpur Unit (including Gorakhpur Expansion).

(vi) Durgapur Unit.

(vii) An overall summation of performance of the Fertilizer Corporation and its place in Fertilizer Industry in India as well as review on marketing activities, manpower and internal audit of the Corporation, as a whole.

The replies of the Ministry to the Reports on Trombay and Namrup Units were received on 19th July 1978 and 4th October 1978 respectively. The replies of the Ministry to the material relating to Nangal, Gorakhpur, Jodhpur Mining Organisation, Marketing, Manpower and Internal Audit were received in November/December 1978. The reply of the Ministry in respect of the remaining Units/Divisions is awaited (January 1979).

3. This part contains the results of the appraisal undertaken by the Audit Board of the working of Trombay Unit of The Fertilizer Corporation of India Limited. The Report has been brought up to date by incorporating data up to 1977-78.

4. The report was finalised by the Audit Board after taking into account;

(a) the result of discussions held with the representatives of the Ministry of Chemicals and Fertilizers and the Corporation at its meetings held from 4th to 7th October 1978; and

(b) the additional information furnished by the Ministry in November 1978 and considered in the meeting of the Audit Board held on 8th and 9th January 1979.

5. The Report on Namrup has also been finalised and is being printed as part IV of the Report of the Comptroller and Auditor General of India—Union Government (Commercial), 1978. The other Reports are under various stages of finalisation.

6. The Comptroller and Auditor General of India wishes to place on record the appreciation of the work done by the Audit Board and acknowledges with thanks the contribution, in particular, of the members who are not officers of the Indian Audit and Accounts Department.

NOTE.—Dr. P. K. Narayanaswamy could not attend the meeting of the Audit Board held on 8th and 9th January 1979 as he was away from India on tour to South East Asian Countries.

1. *Historical background*

1.1 Government had set up, in October 1954, a Fertilizer Production Committee to suggest possible locations of new fertilizer factories. One recommendation of the Committee was a fertilizer factory at Trombay to produce ammonia and double salt, based on refinery gases available from the then private sector refineries at Bombay. In March 1957, Government authorised initiation of the project and appointed a Negotiating Committee to determine prices for refinery gas, product pattern, etc. The Negotiating Committee recommended that the plant at Bombay should be designed to process both refinery gases and liquid fuels to produce ammonia, urea and double salt.

In September 1958, Government set up the Trombay Fertilizer Project Committee (Rao Committee) to determine the pattern of production at Trombay. The Committee recommended (January 1959) production of urea and nitrophosphate. In April 1959, Government accepted the report and the preliminary work on the project commenced in June 1959. Global tenders were invited in July 1959 but subsequently doubts were raised about the suitability of nitrophosphate for Indian soil conditions. Government decided in November 1960 that nitrophosphate to be produced should be 50 per cent citrate and 50 per cent water soluble instead of all citrate soluble as was previously proposed. This conclusion was based on the considerations that a product wholly meant for sugarcane might be used by the farmers on other crops and its separate marketing presented greater difficulties at that early stage.

The source from which the project was to be financed, was determined in 1960; the foreign exchange component of the cost of the project was to be met from U.S. AID funds. Consequently, a loan agreement was signed, by which plant and machinery were to be procured only from U.S.A.

six months normally taken for the purpose. This resulted in extra expenditure of Rs. 12 lakhs to the Corporation. Even after taking such a long time, the performance of the plant was not satisfactory due to poor performance of the catalyst and equipment failures and the Corporation had to take juridical possession of the plant;

(v) inordinate delays in construction and commissioning of the plants;

(vi) low production due to deficiencies in design and engineering and excess consumption of raw materials and power leading to higher cost of production and losses in operation.

The Committee on Public Undertakings examined the above report in 1968-69 and *inter alia* made the following observations in paragraphs 6.1 and 6.2 of its Twenty Sixth Report (Fourth Lok Sabha—February 1969) :--

"6.1 The examination of Audit Paras relating to the Trombay Unit of F.C.I. in the Audit Report (Commercial), 1968, in the preceding pages has revealed several unsatisfactory features.

6.2 The Committee are constrained to observe that there were a number of procedural and functional lapses on the part of the Management of which Government of India could have taken serious note but do not appear to have done so or exercised proper check and supervision. The Committee would urge that as suggested by them in Paragraph 2.27 an enquiry should be made to ascertain the reasons for entering into such defective agreements which have resulted in huge financial losses and continuous low production. Awarding of contracts to firms which had neither capacity nor experience to undertake them is also a sad affair. They would like to be informed of the findings of the enquiry, the names

of the officers found responsible for these lapses and the action taken against them."

On the above recommendation, Government set up a single member commission (Bedi Commission) in August 1969, under the Commission of Enquiry Act, 1952, to enquire into the matter. The Commission was to submit its report within 3 months but this period has been extended from time to time; the last such extension being upto March 1979.

The Ministry have stated (July 1978) that the Commission could not finalise its report for the following reasons :—

(i) One of the items referred to the Commission was the agreement for the supply of nitrophosphate plant concluded with M/s. Chemicals and Industrial Corporation of U.S.A. Since the dispute of the Fertiliser Corporation with the suppliers of the nitrophosphate plant was under arbitration by the International Chamber of Commerce, the Corporation did not want this item to be examined by the Commission till the arbitration proceedings were completed. The Commission did not agree to this as one of the witnesses filed a counter-petition stating that if the request of the Corporation was granted he would be required to face the Commission again after the arbitration proceedings were completed. The Corporation, thereafter, filed a writ petition in the High Court for stay of the Commission's proceedings which was granted.

(ii) The arbitration proceedings were completed in the last quarter of 1977, when the Corporation withdrew the writ petition. The Commission, thereafter, resumed its proceedings and has been given time upto 31st March, 1979 to submit its Report.

1.3 The claims of the Corporation against the plant suppliers of Nitrophosphate Plant and Methanol Plant for non-fulfilment of guarantees, defective equipment, design deficiency, etc., were

referred to arbitration in November 1968 (Nitrophosphate Plant) and October 1969 (Methanol Plant). The present position is :—

(a) In respect of the Methanol Plant, the Arbitrators appointed under the Indian Arbitration Act had given a majority award in favour of the supplier. The Corporation has filed (October 1974) a petition for setting aside the majority award in the Delhi High Court. The matter is pending in the High Court.

(b) In respect of the Nitrophosphate Plant, the Arbitral Tribunal constituted by the International Chamber of Commerce, Paris had concluded its evidence and the written arguments had also been filed with the Tribunal. The award is awaited.

The Ministry have stated (July 1978) that :

the Tribunal has withheld the award because the defendant in the case had not paid the arbitrator's fees fully. The Corporation now proposes to pay the amount in order that the award might be announced.

1.4 Later sub-paragraphs deal with operations of :—

(a) Trombay I and II from 1969-70 onwards; and

(b) Expansion schemes (also known as Trombay III, IV and V) and Diversification programmes being implemented in Trombay.

1.5 The Corporation has been reorganised with effect from 1st April, 1978 under the directives issued by the President under Article 110 of the Articles of Association of The Fertiliser Corporation of India Limited. Under the re-organisation, the Trombay Unit stands transferred to the newly incorporated Company of Rashtriya Chemicals and Fertilizers Limited.

2. *Plant complex*

The original plant complex comprised the following main plants :—

Sl. No.	Name of the Plant	Product	Designed capacity per day (in tonnes)	Stream efficiency in a year	Remarks
(1)	(2)	(3)	(4)	(5)	(6)
	Fertilizer Plants				
	Main				
1.	Ammonia	Ammonia	350	330 days	Intermediate product for urea and nitrophosphate and other industrial products.
2.	Urea	Urea	300	330 days	Nitrogenous fertilizer with 46 per cent of nitrogen.
3.	Nitrophosphate	Nitrophosphate	900	300 days. (produced by the carbonitric process)	Complex fertiliser with 16 per cent of nitrogen and 13 per cent of phosphates.
				or	
			1100	300 days (produced by the sulphonitric process)	Complex fertiliser with 12.9 per cent of nitrogen and 12.9 per cent of phosphates.
4.	Nitric Acid	Nitric Acid	320	330 days	Intermediate products for nitrophosphate.
5.	Sulphuric Acid	Sulphuric Acid	200	330 days	
	Auxiliary Plants				
6.	Bagging	—	2500	300 days	For bagging the finished products.
7.	Steam Generation	Steam	1090	—	With two boilers working and the third boiler as standby.
8.	Water Treatment	—	450 Gallons per minute	—	
	Industrial Chemical Plant				
9.	Methanol	Methanol	100	300 days	An industrial product

3. *Process*

The manufacturing process of the Fertilizer Plants and the Methanol Plant are given below in brief :—

(1) *Ammonia Plant.*—Raw gas (mainly hydrogen and carbon dioxide) is generated by the 'shell' partial oxidation process, when petroleum naphtha is reacted with preheated steam and oxygen, at a temperature of about 1400° Centigrade and at a pressure of 30 Kg./Cm^2, refinery gas can also be used after de-sulphurisation. The hot gases are then passed through waste heat boilers to recover heat in the form of steam and through the carbon monoxide conversion section where the carbon monoxide reacts with steam to produce carbon dioxide and hydrogen. Thereafter, the gases are processed for removal of carbon dioxide and hydrogen sulphide and further purified by a liquid nitrogen wash. The gases are then compressed to a pressure of 330 Kg./Cm^2 and passed through a converter containing a specially promoted iron oxide catalyst, where hydrogen and nitrogen are synthesised to produce ammonia. The ammonia produced is stored in the form of liquid anhydrous ammonia in a hortonsphere having a capacity of 1000 tonnes. As the quality of the gas supplied was below specifications, the Unit switched over entirely to naphtha from May 1966.

(2) *Urea Plant.*—Liquid ammonia and carbon dioxide from the Ammonia Plant are reacted in a specially designed reactor at a pressure of 220 Kg./Cm^2 at temperature of 185° Centigrade to produce urea. The reaction products, which contain about 30 per cent of urea, are processed under reduced pressure; un-reacted ammonia and carbon dioxide are drawn out and fed back to the reactor. The urea solution produced is concentrated in evaporators. The

concentrated urea melt is then sprayed through a prilling tower to produce prilled urea.

(3) *Nitric Acid Plant.*—The Plant has adopted the high pressure process designed by Messrs Chemical Construction Corporation of U.S.A. A mixture of controlled quantities of ammonia and air at a pressure of about 8 Kg./Cm^2 is passed over a platinum-rhodium catalyst at a temperature of about 900°C. After the heat produced by the reaction is recovered in the waste heat boilers, the nitrous oxide produced is oxidized to nitric oxide and absorbed in water to produce 60 per cent nitric acid.

(4) *Sulphuric Acid Plant.*—Sulphuric acid in 98 per cent concentration is produced in this plant by contact process from elemental sulphur.

(5) *Nitrophosphate Plant.*—The Plant suppliers (Messrs Chemical and Industrial Corporation of U.S.A.) were not able to demonstrate the performance of the Plant by the sulphonitric process with 50 per cent P_2O_5 water soluble. Because of design limitations, the Plant could also not achieve the rated output of 900 tonnes a day by the carbonitric process with all P_2O_5 in citrate soluble form. To make the best use of equipment already provided, the Corporation adopted a new process to step up capacity in terms of fertiliser nutrients. The new process is called phosphonitric process. In this process, a measured quantity of nitric acid (60 per cent concentration) is reacted with the ground rock phosphate in the first 3 reactors, giving phosphoric acid, calcium nitrate and excess of nitric acid. A measured quantity of sulphuric acid is used to fix the nitrogen content and water soluble P_2O_5 in the final product. To eliminate the calcium nitrate which is highly hygroscopic, di-ammonium phosphate in the form of granules is

fed. Ammoniation is also started from the 4th reactor and onward to 16th reactor. Temperature and pH are maintained in different reactors in such a way as to achieve the moisture content of 15—20 per cent, proper ratio of nitrogen and P_2O_5 and proper thickening of the slurry. The slurry is processed into granules, which are dried, cooled, screened and coated. For suphala, which contains potash, the requird quantity of potash is added to the 15th reactor to get the desired product. The plant can produce complex fertilisers of various N.P.K. formulations.

Product produced under the new process is 30 per cent water-soluble as against 50 per cent envisaged in the original project approved by Government.

The Ministry stated (July 1978) that, in taking a view on development of this product and the ultimate water solubility achieved, it would have to be borne in mind that the product was developed by the Corporation of its own and is being manufactured with the equipment which was intended for different process.

The Ministry have further stated (November 1978) as follows :—

"The new product based on the new process technology enabled F.C.I. to utilise the plant to almost its rated capacity in terms of nutrients. The new product has also certain special features of agronomical advantage. Whereas the originally specified carbonitric product 16 : 13 had no part of P_2O_5 in water soluble form, the new product had 30% of its P_2O_5 in water soluble form. The total nutrient content of the originally specified product was only 29 per cent (16 : 13), whereas the new product had 40 per cent nutrient content. . .
....."

(6) *Methanol Plant*.—Petroleum naphtha is vapourized by hot oil and the hydrogen recovered subsequently from the other stream. The mixture of 3 gases (hydrogen, carbon monoxide and carbon dioxide) is compressed to 320 Kg./Cm^3 pressure and then passed through a methanol synthesis converter containing zinc chromite catalyst. Converter outlet gas containing crude methanol is cooled in a condenser and methanol is separated. Unreacted gas is fed back into the converter. Crude methanol is purified to produce pure technical grade methanol.

4. *Rehabilitation of the Plant*

4.1 As Ammonia, Urea, Nitrophosphate and Methanol Plants were functioning much below their rated capacity mainly because of poor design, equipment deficiencies and certain operational problems, the General Manager of the Unit appointed a departmental Committee in March 1967 to go into all aspects of the problem and report within 10 days on the bottlenecks and measures required to reach the anticipated capacity. The Committee submitted its report in June 1967. The main findings of the Committee were :—

Sl. No.	Name of the plant	Factors responsible for shortfall in production	Equipment recommended for replacement/modification	Outlay involved (Rs. in lakhs)
(1)	(2)	(3)	(4)	(5)
1.	Ammonia Plant	(i) Low density naphtha feedstock	(i) Installation of higher capacity naphtha charge pumps	4.50
		(ii) Reduced oxygen supply	(ii) Provision of small drain tank	0.05

(1)	(2)	(3)	(4)	(5)
		(iii) Reduced capacity for conversion of carbon monoxide	(iii) Replacement of the entire tube bundle of the pre-heaters and procurement of one spare pre-heater	8.00
		(iv) Excessive reactor tripping	(iv) Replacement of the separator in the Oxygen Exchange	0.50
			(v) Provision of a spare reactor with waste heat boiler and additional steam drum	22.00
2.	Urea Plant	(i) Shortage of ammonia	(i) Installation of solution pumps	1.35
		(ii) Excessive interruptions	(ii) Provision of new draught fans in the prilling tower hopper	0.60
		(iii) Tripping of carbondioxide compressor	(iii) Replacement of centrifugal steam jacketed stainless steel pumps	0.35
			(iv) Provision for condensate injection	0.10
			(v) Ventilation system in salt handling section	2.00
			(vi) Installation of carbamate tank, pumps, etc.	2.25
			(vii) Provision for scrubber tanks, pipes, etc. in vent stack scrubber	3.00
			(viii) Provision for tanks, pipes, etc. in effluent disposal	1.50

(1)	(2)	(3)	(4)	(5)
3.	Nitrophosphate Plant	(i) Basic equipment design limitation	(i) Installation of higher capacity rock feeders	3.00
		(ii) Excessive interruption	(ii) Provision of additional blowers for reactors	0.50
			(iii) Replacement of existing screens by better quality and higher capacity screens	6.60
			(iv) Installation of higher capacity slurry pumps	3.50
			(v) Installation of Roll crushers in place of pulverizer	5.00
			(vi) Multi-cyclone, other piping and ducting modifications	5.00
			(vii) Replacement of existing product weighbelt	1.00
		(Of the above, replacements and modifications requiring Rs. 9.50 lakhs were recommended as immediate measures.)		
4.	Steam Generation Plant	(i) Excessive scaling on tubes	(i) Replacement of existing motors by higher capacity motors	0.50
		(ii) Inadequate capacity of boiler feed water pumps	(ii) Provision for an additional boiler	10.00
5.	Bagging Plant	(i) Low productivity of workers	—	
		(ii) Irregular supply of wagons	—	
		(iii) Choking and other equipment defects	Airconditioning the vulnerable areas in the bunker floor and the Bagging Plant floor	3.00
6.	Water Treatment Plant	Inadequate capacity	Provision of ion-exchange to demineralise water	3.00
7.	Methanol Plant	Disintegration of reformer catalyst	Replacement of existing catalyst by a better one	Not given
				87.30

According to the report, action to procure a number of items had already been taken.

4.2 The report was reviewed by another Technical Committee, appointed by the Managing Director of the Corporation in June 1967. This Committee (known as Sharma Committee) submitted its report in July 1967. It endorsed the recommendations of the earlier Committee with the following additions and modifications :—

Sl. No.	Name of the Plant	Modification or addition proposed
1.	Ammonia Plant . .	(i) Installation of Naphtha charge pumps not necessary immediately; instead modifications to the pipes be carried out and 6 variable speed motors be provided. (ii) (a) Frequenct cleaning of inter-coolers. (b) Installation of 2 more stacks with additional filters and butterfly valve. (c) Laying of 8" pipeline from Turbo-compressor of the Nitric Acid Plants. (d) Installation of new plug valves on reversing exchange system. (iii) Installation of a mixing vessel to mix gas and steam before injection into pre-heater. (iv) Provision of a spare reactor was not feasible. To improve on-stream availability of reactors, the Committee recommended provision of 3 more stream drums.
2.	Nitrophosphate Plant . .	(i) Action in providing multi-cyclone should be considered after experience was gained by using larger dust extraction ducts. (ii) Further study was called for before modifying the Oscillating conveyor which was under-sized. (iii) De-scalling of spherodizer with hammering arrangements should be done.
3.	Methanol Plant . .	To get proper life and continuity of operation, the furnace may be run under moderate operating conditions by lowering the temperature. In case, the catalyst disintegrates even at lower temperature, a new catalyst may be tried out.

4.3 Both reports were submitted to the Board of Directors in August 1967 with the following proposals which were approved by the Board :—

(a) Replacement, additions and modifications to the existing plants at a total cost of Rs. 100.20 lakhs.

(b) Installation of a Phosphoric Acid Plant (capacity 100 tonnes a day ; cost Rs. 150 lakhs) to eliminate import of di-ammonium-phosphate (also refer paragraph 5).

(c) Creation of a special cell for implementation of the project (including Phosphoric Acid Plant) within three years.

4.4 At the instance of the Ministry, a two member team of the Tennesse Valley Authority also studied the operation and maintenance of the Trombay Plant during October—December 1967. The major recommendations of the team were as follows :—

Ammonia Plant

(i) This plant had achieved only about 75 per cent of rated capacity, mainly on account of design limitation and low quality of feed-stock. The team recommended installation of a Naphtha Reformer to eliminate several existing problems and to permit a substantial increase in production.

(ii) The team suggested installation of additional filters to prevent stoppages in the heat exchangers to maintain the capacity of the air plant which could barely meet design capacity under optimal conditions.

Methanol Plant

The maximum productivity of the plant was about 60 per cent of rated capacity. Although the team concurred with the Unit's proposal to instal a naphtha distillation column to improve production economics by

providing a lighter naphtha feed-stock, it recommended re-designing of the reformers to attain the design capacity.

4.5 The General Manager of the Unit informed the Board in February 1968 that action had already been taken on the recommendations of the team relating to the Air Plant and distillation tower for the Methanol Plant. As regards the installation of a Naphtha Reformer in the Ammonia Plant and re-designing of the Reformer in the Methanol Plant, an integrated proposal for the installation of a reformer furnace with a capacity equivalent to 100 tonnes per day of ammonia inclusive of naphtha pre-treatment section with facilities for integrating with the existing Ammonia Plant was submitted to the Board. The proposal was estimated to cost Rs. 93.00 lakhs (including Rs. 36.50 lakhs in foreign exchange).

The Board remitted the above proposal to a Committee and desired that the Committee should examine in detail all the three reports as also the condition of the plants at Trombay and offer its final recommendations clearly indicating the remedial action to be taken.

4.6 The Committee offered the following recommendations, reported to the Board in April 1968 :—

(a) The proposal to instal an additional boiler and the problem of water treatment should be re-examined and a complete picture, after investigations on the lines indicated by the Committee, made available to it for further consideration.

(b) The proposal for improving the performance of the Ammonia Plant required a detailed examination in the light of certain points raised by the Committee and results of examination be made available to the Committee for consideration at the next meeting.

(c) As regards the installation of a supplementary furnace for the reformation of naphtha for the Methanol Plant, the Committee decided that the Planning and Development Division should make a detailed study and determine which of the two sizes (50 tonnes or 100 tonnes capacity) should be utilised together with economic evaluation of both the alternatives.

(d) The Committee approved of the implementation of certain recommendations made by the Tennesse Valley Authority team.

On the issues mentioned above, on which final recommendations had not been made, the Committee recommended in May 1968 that :—

(a) The installation of an additional boiler of 35 tonnes capacity may be approved.

(b) None of the alternatives for obtaining additional production capacity in the Ammonia Plant, should be considered. Instead a proposal to instal a supplementary reformer furnace of 100 tonnes capacity in the Methanol Plant, to raise the capacity in the Methanol reformer section to 140 tonnes methanol equivalent gas, may be accepted. Out of this, 100 tonnes could be utilised in the Methanol Plant and the balance of 40 tonnes could be compressed and diverted to the Ammonia Plant for augmenting ammonia production by 45 tonnes. With this arrangement, the Committee thought that there would be no need to go in for a fresh reformer specifically for the Ammonia Plant.

The Board approved the above recommendations in July 1968 and desired that the Planning and Development Division should immediately draw up the implementation schedule.

Another scheme was also under consideration to increase the production capacity of the Methanol Plant from 100 tonnes to

125 tonnes per day by removing bottle-necks in other sections of the Plant. Finally, the Board approved, in October 1968, the proposal for marginal expansion of the Methanol Plant at a cost of Rs. 34.93 lakhs (Rs. 25.93 lakhs for removing bottle-necks in sections other than the reformer and Rs. 8-9 lakhs for increasing the capacity of the proposed reformer furnace from 100 tonnes to 125 tonnes). A detailed feasibility report for the purpose (known as Supplementary Gasification facility) to serve the Methanol and Ammonia Plants at a total capital cost of Rs. 229.45 lakhs was drawn up and approved by the Board in June 1969.

4.7 At the instance of the Board, the progress in implementation of the programme for additions, modifications and replacements was reported on 11th February 1969. According to this report, out of 41 items, 19 items had been implemented ; four had been dropped or deferred ; work was in progress on the remaining 18 items. Progress on the remaining items and the actual expenditure were not reported to the Board thereafter, nor was the consequent improvement in the performance of various plants evaluated. According to the Ministry, no further progress report was submitted as the same was not asked for by the Board and there was no well developed management information system at that time.

The entire programme (including the setting up of a Phosphoric Acid Plant) was not completed within three years as desired by the Board in August 1967 ; the two major schemes, installation of the Phosphoric Acid Plant (approved by the Board in August 1967) and the Supplementary Gasification Scheme (initially approved in October 1968) took much longer time as explained in paragraphs 5 and 6, and the limitations in attaining the capacity of the plants continued.

The Ministry have stated (November 1978) as follows :—

(a) Out of 18 items, 3 were found unnecessary subsequently and the remaining 15 items had been completed between April 1969 and April 1976 at a cost of Rs. 57.86 lakhs.

(b) There was distinctive improvement in ammonia production from 1970-71 onwards.

5. *Phosphoric Acid Plant*

5.1 *Introduction.*—The Corporation decided in August 1967 to instal a Phosphoric Acid Plant (capacity 100 tonnes a day ; estimated cost Rs. 1.50 crores, including Rs. 0.54 crore in foreign exchange) on turn key basis. The proposal was justified by the following advantages :—

(i) There would be a saving of Rs. 37 to Rs. 44 lakhs per annum in foreign exchange, as the cost of sulphur imported for the manufacture of phosphoric acid would be less than the cost of di-ammonium phosphate, which was being used till then ; and

(ii) The Sulphuric Acid Plant which had been installed and which had become redundant consequent on the change in the process for manufacture of complex fertilizers, would be utilized.

The Plant was expected to be in operation within 24 months of the date foreign exchange was released and within 20 months of the date the contract was awarded. Government approved the proposal in principle in August 1968 and desired that tenders for supply of imported equipment should be invited only from Germany, Japan, U.S.A. and U.K.

Meanwhile, the Planning and Development Division expressed its interest in the Plant. The General Manager, Trombay was, however, against entrusting the job to the Planning and Development Division because, although the chemistry of the phosphoric acid process was relatively simple, engineering and building a plant within a reasonable time required considerable amount of expertise, background, experience and skill. On the contrary, the Planning and Development Division had expressed confidence in its ability to build the Plant based on the di-hydrate process developed by it. As the specifications of the by-product gypsum produced under the di-hydrate process would not be suitable for

manufacture of either cement or cardboard, the Board approved in January 1969 the entrustment of the Project to the Planning and Development Division but the design was to incorporate either the Nissan or N.K.K. hemihydrate process.

Consequently, the Corporation entered into an agreement in May 1970 with the International Ore and Fertilizer Corporation for the licence and process knowhow for the Nissan hemi-hydrate process ; this agreement was approved by Government in November 1970. For implementation, a memorandum of understanding was drafted, outlining the division of work and scope of responsibility between the Planning and Development Division and the Trombay Unit. In accordance with the memorandum, the responsibility of the Unit was limited to execution of civil works, procurement and erection of piping beyond the battery limits of the Plant and street lighting ; the rest was with the Planning and Development Division.

5.2 *Project estimates.*--The earlier estimates of cost (Rs. 1.50 crores) approved in August 1968 were revised by the Planning and Development Division in January 1971 to Rs. 3.22 crores. The estimates were further revised upwards by stages to Rs. 5.04 crores in February 1976. The Committee of Directors approved the latest estimates in July 1976. The revised estimate of Rs. 5.04 crores was approved by the Public Investment Board in June 1978. Approval of Government is awaited (November 1978).

The increase over the initial estimates of Rs. 1.50 crores was ascribed by the Unit to various causes including a change in scope (Rs. 0.96 crore) inadequate provision in the earlier estimates (Rs. 0.71 crore), price escalation and increase in financing charges, etc. (Rs. 1.84 crores).

Actual expenditure incurred on the project amounted to Rs. 4.96 crores upto 31st March 1978.

5.3 *Schedule of commissioning.*—According to the tentative time schedule drawn up in September 1970, the Project was to be completed by June 1973. In January 1973, the Planning and

Development Division estimated that the project would be ready for commissioning by May or June 1974 ; the Plant was actually ready for commissioning in November 1974. The Plant thus took over six years for completion after its approval by Government in August 1968. The Plant had not attained full production (March 1978), as mentioned in paragraph 5.5.

5.4 *Performance guarantee*

In Article 9 of the agreement between the Corporation and the International Ore and Fertilizers Corporation (Inter Ore) for the Nissan process, performance guarantees in respect of capacity, Specific consumption, recovery efficiency of P_2O_5 etc., are mentioned, to be based on 120 operating hours with one variety of imported rock, subject to a minimum continuous operation of 72 hours' duration. In case performance guarantee was not met even when conditions required for conducting such performance guarantees had been fulfilled, Inter Ore was responsible for liabilities to the extent of combined lump sum licence and know-how fees. It was further provided that if the guarantee demonstration was not successfully completed during the period of supervisory services for reasons outside Inter Ore's responsibility, the performance guarantee would be deemed to have been met.

As there were deficiencies and repeated failures of equipment which could not be rectified within the maximum period of one year from the start up stipulated in the contract within which Inter Ore was to complete the supervisory services, Inter Ore's contractual obligations were considered to have ceased and the performance guarantee tests were not carried out.

However, from the evaluation report of the test runs conducted from the 5th to 8th January 1976 in terms of the memorandum of understanding between the Planning and Development Division and the Unit, the following facts were noticed :—

(a) The data compiled by the Unit indicated that the Plant had not achieved guarantees with regard to

capacity, concentration of dilute phosphoric acid, strength of concentrated phosphoric acid, free sulphuric acid content of 30 per cent phosphoric acid and specific consumption of rock phosphate, sulphuric acid and steam. The Planning and Development Division did not, however, accept the data compiled by the Unit and gave their own figures.

(b) This aspect was further discussed in a meeting held on 22nd January 1976 between the Unit and the Planning and Development Division. A joint note of discussion was prepared which brought out that log sheets required to be signed by the shift operator incharge and Planning & Development Division representatives, had not been regularly signed and production of 30 per cent phosphoric acid was calculated with reference to the level of the tank and that of 50 per cent phosphoric acid on the basis of level indicators. Gypsum production was not measured. The data relating to production of phosporic acid and specific consumption of raw materials were computed afresh. This indicated that production capacity had not been achieved and that the specific consumption figures per tonne of P_2O_5 were lower than the guarantee except in the case of sulphuric acid. Recovery efficiency of P_2O_5 was, however, better than the guaranteed norm (97.5 to 98 per cent). The note also brought out certain deficiencies in the mechanical equipment.

In a note put up to the Board of Directors of the Fertilizer (Planning and Development) India Ltd. on 4th August 1978, the following position was *inter alia* brought out :—

(i) "The Process gurantees were available from Nissan as per the Licence Agreement. As per the provision in the Agreement with Nissan, after completion of

erection of the plant in December 1974, two supervisory personnel from Nissan were in Trombay from 5th/22nd November 1974 to 27th February 1975 for testing and commissioning. Unfortunately, steady production on the plant, for performance test on full load could not be attained during this period because of the technical failures of certain equipment and limitations on the availability of raw materials and utilities.....Moreover, during this period of operation, FCI operating staff was fully trained to run the plant on their own responsibility and accordingly P & D Division decided to run the plant and sort out all mechanical problems on their own before formal performance tests were taken."

(ii) "Based on the experience of initial runs on the Plant, it was clear that there was no limitation on the plant on account of system concept or design for which alone Nissan was responsible and could be held accountable."

(iii) "So far as the capacity of the Plant and the specific consumption guarantees were concerned, the same had been met except for the sulphuric acid consumption which was marginally high by about one per cent."

As regards item (iii) above, it will be seen from item (b) that the production capacity, based on the evaluation of the results of the test runs conducted between 5th and 8th January 1976, had not been achieved.

5.5 *Actual Production*

As against the rated capacity of 30,000 tonnes per annum or 100 tonnes a day, actual production during the three months, January to March 1975, was 1,148 tonnes. Production in 1975-76, 1976-77 and 1977-78 was 11,958 tonnes, 17,369 tonnes and 16,418 tonnes respectively. The shortage of phosphoric acid

had to be made good by the continued use of imported di-ammonium phosphate. Thus, the object of eliminating the import of di-ammonium phosphate conceived of in August 1967 had not been fully achieved.

In the quarterly production reports for 1975-76 the poor production performance of the Plant had been attributed to the following :—

(a) Repeated failures in dilute sulphuric acid supply line and rubber lining in the concentration section.

(b) Failure of fluorine scrubber circulating pump carbamate heat exchanger, fume exhaust fan, bearing of crystallizer gear box, etc.

(c) Less capacity of the bucket elevator.

In this connection, the Ministry have stated (November 1978) as follows :—

(a) But for the persistent failure of the rubber lining and other equipment, the production of phosphoric acid would have been much higher. While rubber lining failure accounted for loss of production to the extent of 24 per cent during 1975-76 to 1977-78, the failure of other equipment was responsible for shortfall in production to the extent of 30 per cent in 1975-76 and 5 per cent in 1976-77 and 1977-78.

(b) Trombay completely switched over to the use of indigenous rock (Udaipur rock) which has higher silica content as compared with the imported rock envisaged for the plant. This has resulted in a number of modifications and intensive maintenance.

6. *Supplementary gasification scheme to serve the Methanol and Ammonia Plants*

6.1 *Introduction.*—The scheme, approved by the Board in June 1969 and Government in November 1969 to restore the capacities of Ammonia and Methanol Plants, was to provide the

following facilities at a total cost of Rs. 2.29 crores (including a foreign exchange component of Rs. 0.82 crore) :—

(i) Installation of a new reformer furnace and related facilities to produce gas for production of 125 tonnes of methanol per day (*i.e.* 37,500 tonnes of methanol per annum based on 300 days stream efficiency).

(ii) Marginal modification in the synthesis loop of the Methanol Plant to step up production to 125 tonnes of Methanol per day.

(iii) Use of the existing reformer furnace (Girdler reformer) of an attainable capacity of 60 tonnes a day in the Methanol Plant to achieve an annual output of 1.19 lakh tonnes of ammonia at 360 tonnes per day based on a stream efficiency of 330 days or 1.16 lakh tonnes at 350 tonnes a day, as against the present attainable capacity of 320 tonnes.

(iv) Installation of a booster compressor to compress gas from the existing reformer to feed it to the Ammonia Plant.

The Planning and Development Division of the Corporation was entrusted with the implementation of this scheme too; according to the memorandum of understanding mentioned earlier, procurement, erection and testing were the responsibility of the Planning and Development Division, while civil works were the responsibility of the Trombay Unit.

6.2 *Estimates of cost.*—In November 1970, the estimates were revised from Rs. 2.29 crores to Rs. 3.06 crores, including Rs. 0.79 crore in foreign exchange. The revised estimate was approved by the Board and Government in January and August 1971 respectively. The overall increase of Rs. 0.77 crore, despite decrease in civil works, etc. by Rs. 0.35 crore, was due to change in scope of electrical system, increase in cost of equipment and non-provision for spares, etc.

Actual expenditure on the project amounted to Rs. 3.46 crores and exceeded the sanctioned estimates by more than 10 per cent. This was approved by the Board of the Rashtriya Chemicals and Fertilizers Limited in August 1978. Government approval is awaited (November 1978).

6.3 *Schedule of commissioning.*—According to the memorandum of understanding, overall time schedule for the Scheme was to be jointly prepared by the Planning and Development Division and the Trombay Unit. No such joint time schedule was drawn up. While submitting the revised estimates, it was reported to the Board in November 1970 that if foreign exchange, import licence and industrial licence were cleared by Government early, it should be possible to commission the Plant around March 1973. Pre-commissioning tests were actually conducted from September 1973 and, after modifications, test runs for commissioning the Plant were started in November 1973 and scheduled to be completed in about four weeks' time. Because of abnormal pressure drops, failure of the catalyst, damage to the gas duct of the waste heat refractory system and other problems, the Plant started operation in February 1974 after repairs and modifications and a change of the catalyst.

6.4 *Fulfilment of the objective* : (1) *Ammonia.*—The scheme was *inter alia* intended to increase the capacity of Ammonia Plant by 13,200 tonnes per annum based on the gasification available from the original reformer of the Methanol Plant. As against this, only 2642 tonnes of ammonia were produced in 1974-75 and 1570 tonnes in 1975-76 from the gas of the Methanol Reformer. It was mentioned in the production report for the quarter ending March 1975, that, under the present condition of low and fluctuating frequency, it was not possible to process the gas from Methanol Plant through the nitrogen scrubbing unit in the Ammonia Plant. It was also stated that additional facilities for ammonia production for processing methanol gas estimated to cost Rs. 4.30 crores were contemplated and that the scheme had been included under the contingency plan. The scheme had not, however, been implemented.

Thus, the steps initiated by the Corporation in 1967 to rehabilitate the Ammonia Plant had not fructified (July 1978) and the Plant remains derated.

In this connection, the Ministry have stated (July 1978) as follows :—

(a) ".....the possibility of using redundant equipment from other plants of the Corporation to set up facilities for processing the reformer gas again by making operational the girdler reformer to produce 40 tonnes of gas per day was considered by the Corporation at a cost of Rs. 4.66 crores but was found uneconomical."

(b) "With the commissioning of the supplementary gasification facility, the Unit had the option to divert more gas to the ammonia plant for bringing up the capacity to the designed level of 350 tonnes per day. However, this could not be done due to fluctuating frequency in the supply of power which, in turn, affected the availability of air and consequently the refrigeration capacity. The fluctuation in frequency in power supply posed a major and continuing problem from 1973-74 onwards..... In order to overcome the effect of fluctuating frequency and the availability of air, the Corporation has gone in for an additional air compressor to supplement the supply of air, which is expected to be installed by November 1978. With the installation of air compressor and augmentation of air supply the plant should be capable of operating at the rated capacity. The constraints in availability of air could not be anticipated by the earlier committees or when the supplementary gasification was implemented as the problem of fluctuating frequency was not anticipated."

(2) *Methanol.*—Against the total capacity of 37,500 tonnes to be attained on implementation of the scheme, 29,144 tonnes (including 3653 tonnes from the old reformer and ammonia gas) of methanol were produced in 1974-75 and 27,038 tonnes (including 286 tonnes from the old reformer and ammonia gas) in 1975-76. The production in 1976-77 and 1977-78 was 35,956 tonnes and 41,610 tonnes respectively.

The Ministry have stated (November 1978) that production during 1974-75 and 1975-76 was below the attainable capacity mainly due to low off-take.

7. *Debottle necking schemes*

7.1 *N.P.K. Plant.*—The Nitrophosphate Plant was originally designed to produce 2.70 lakh tonnes of complex fertilizer by carbo-nitric Process or 3.30 lakh tonnes by sulphonitric process. The Plant was taken over from the contractor though it had not achieved its rated capacity. After modifications and replacement of certain equipment, the Plant was rehabilitated on the new process technology developed by the Corporation, so as to produce 2.10 lakh tonnes per annum of N.P.K. complex fertilizer with the composition 15 : 15 : 15. As a consequence, capacity in certain sections of the Plant became surplus.

While appraising the Trombay Expansion Project (Trombay IV) proposed by the Corporation, the World Bank had indicated (January 1972) that there was scope for substantial improvement in the operations of the existing N.P.K. and Urea Plants. Consequently, the Corporation prepared a scheme to utilise the spare capacity of the existing Plant sections by adding two granulator driers with matching equipment and connected civil works to augment production of complex fertilizers. The main features of the scheme were as follows :—

(a) Capacity was to be increased by 1.20 lakh tonnes of complex fertilizer of 15 : 15 : 15 composition, thereby raising the capacity to 3.30 lakh tonnes per annum.

(b) Phosphate required for the entire production of 3.30 lakh tonnes was to be met from the Phosphoric Acid Plant (under construction) of 30,000 tonnes capacity and from the nitric acid decomposition of rock phosphate (19,500 tonnes). Of the nitric acid required, 13,000 tonnes were to be found from the existing Nitric Acid Plant and the balance from the higher capacity Nitric Acid Plant proposed under Trombay IV Expansion Project. It was assessed that with the surplus nitric acid of 13,000 tonnes available from the existing Plant, it would be possible to produce 0.405 lakh tonnes of complex fertilizer per annum and this would be stepped up to 1.20 lakh tonnes per annum after the bigger Nitric Acid Plant was commissioned.

The requirement of ammonia for the additional production was to be met by import.

(c) The scheme was estimated to cost Rs. 2.74 crores and was considered to be viable on the basis of minimum additional production of 0.405 lakh tonnes per annum. It was expected to be completed latest by the end of 1974, by which time Phosphoric Acid Plant was to be ready.

The Board approved of the scheme in December 1972. Approval of Government to the scheme estimated to cost Rs. 2.67 crores (foreign exchange component—Rs. 0.48 crore) was received in June 1973 and it was to be completed within 18 months (*i.e.* December 1974).

The scheme was actually completed in August 1975 because of delay in placing orders for certain equipment such as venturi scrubber and motors for the blowers. There was, however, no production till October 1975, as the equipment were on trial run and there were also frequent failures of the equipment. No performance tests appear to have been carried out. The actual expenditure on the scheme amounted to Rs. 2.04 crores (including

Rs. 0.36 crore in foreign exchange). According to the analysis of component-wise expenditure furnished by the Ministry in November 1978, the saving in the actual outlay occurred under 'Plant and equipment' and 'Financing and other charges'.

The composition of the complex fertilizer 15 : 15 : 15 was changed after the commissioning of the debottle necking scheme. Instead of Suphala of 15 : 15 : 15 grade, the product obtained was A.P.S.N. of 20 : 20 : 0 composition. The Ministry have explained (November 1978) that the change in the product was necessitated on account of the following factors :—

(i) At the time of commissioning of the debottle necking scheme, it was noticed that the existing Plant could fully utilise the available production of nitric acid from the old Nitric Acid Plant. The debottle necking section was thus available for alternative use. Accordingly, a new product A.P.S.N. 20 : 20 : 0 was developed with the use of surplus dilute sulphuric acid from the Concentrated Nitric Acid Plant and phosphoric acid with the marginal use of nitric acid.

(ii) The proposal to produce A.P.S.N. was approved by the Board in March 1976. The new product enabled the Plant to produce more nitrogen and P_2O_5.

7.2 *Urea Plant.*—Modifications to the Urea Plant, to increase its designed capacity from 300 tonnes to 430 tonnes a day and to reduce consumption of ammonia and steam, were approved by Government in June 1973. These modifications were suggested after a study by M/s. Technip for which a sum of Rs. 1.42 lakhs was paid to them. The modifications were to cost Rs. 1.29 crores (including Rs. 0.54 crore in foreign exchange). By the time (September 1974), it was decided that it was possible to do so, Government had approved the Trombay V expansion scheme which made these modifications unnecessary.

8. *Diversification schemes*

8.1 *Introduction.*—Because of delay in stabilising production, the Plants were not operating at full capacity, leading to losses. To improve the profitability of the Unit, the following diversification schemes were launched with the idea to market the surplus intermediary products of by-products or converting marginal amount of intermediary products or by-products into highly remunerative industrial products for which there was a ready market :—

Sl. No.	Name of plant under diversification programme	Date of sanction	Date of completion/ commissioning	Uses
(1)	(2)	(3)	(4)	(5)
1.	Ammonium Bicarbonate Plant	January 1966	September 1968	Used in bakeries and pharmaceutical industries.
2.	Concentrated Nitric Acid Plant	February 1967	July 1972	Used by chemical industry.
3.	Sodium Nitrite/ Nitrate Plant	June/ September 1969	February 1973	Used in manufacture of pharmaceuticals, glass, dyes, intermediates, explosives, etc.
4.	Carbon Black Plant	October 1966	December 1970	Used in the rubber industry and for manufacture of printing ink, paints and dry cells.
5.	Methylamine Plant	November 1969	December 1974	Used in the manufacture of rayon tyre cord and leather, and in manufacture of industrial chemicals.
6.	Dimethylether Recovery Plant	April 1970	February 1973	A by-product from the Methanol Plant used as a replacement for methanol in certain processes.

NOTE.—The Dimethylether Recovery Plant commenced commercial production in October 1975.

A review of these schemes is indicated in the following paragraphs :—

8.2 *Ammonium bicarbonate Plant.*—The Plant was completed in September 1968 by the Planning and Development Division at a cost of Rs. 7.92 lakhs. Subsequently, an expenditure of Rs. 0.86 lakh was incurred on certain addition/modification. The Division supplied process design, engineering drawings, specifications, etc. for the Plant. Trial runs commenced in October 1968 and the Plant was put into commercial production from November 1968 though the Plant capacity and consumption norms were not proved.

As against the installed capacity of 4000 tonnes per annum, actual production from 1968-69 to 1971-72 ranged between 354 and 1262 tonnes. The production thereafter was as follows :—

Year	1972-73	1973-74	1974-75	1975-76	1976-77	1977-78
Production (in tonnes)	2171	1642	1922	2028	2452	2528

The cumulative profit earned by the Plant upto 1977-78 amounted to Rs. 43.54 lakhs.

The Ministry have explained (November 1978) that the production was planned dependent on the market requirements.

8.3 *Concentrated Nitric Acid Plant*

(1) *Background.*—Consequent on changes in the process of manufacture of complex fertilizers, the Corporation initiated a proposal to utilise the capacity rendered surplus in the Nitric Acid Plant to manufacture concentrated nitric acid for the Hindustan Organic Chemicals Limited—a Government Company—and other industries. Concentrated nitric acid is manufactured by adding concentrated sulphuric acid to weak nitric acid and then distilling the concentrated nitric acid. Sulphuric acid required for the purpose was also available from the Sulphuric Acid Plant which had become redundant as a result of the new process for manufacturing complex fertilizers.

The Project Report for production of 8000 tonnes of concentrated nitric acid involving a capital outlay of Rs. 39 lakhs was approved by the Committee of Directors in November 1966 and sent to Government in December 1966. Government also welcomed this proposal. Meanwhile, it was felt that, as the demand for the country, as a whole, would be 20,000 tonnes, it would be advantageous to plan for a bigger plant. In January 1967, the Corporation prepared a revised Project Report for setting up of a plant with a capacity of 20,000 tonnes at an estimated cost of Rs. 62 lakhs. The revised proposal was forwarded to Government in March 1967 and allocation of foreign exchange of $ 0.40 million was conveyed by Government in March 1968..

(2) *Award of turn-key contract.*—In February 1969, the Corporation awarded the contract for setting up of the Plant (capacity 60 tonnes a day in two streams) on turn-key basis at a cost of Rs. 62.61 lakhs (including Rs. 2.37 lakhs in foreign exchange) to M/s. Simon Carves India Limited. In addition, the Corporation was to reimburse the contractor for actual expenditure on ocean freight, customs duty, insurance premia, cost of spares, etc.

(3) *Acceptance of the Plant.*—According to the contract, the Plant was to be ready for commissioning by November 1970, after allowing for extensions granted for certain additional civil works. The Plant was actually completed and offered for inspection in September 1971. The commissioning of the Plant started in October 1971, on a single stream and the Plant was run intermittently between 19th January and 3rd February 1972. Meanwhile, the Unit submitted a proposal to the Board to modify the clause relating to the guarantee test run in the agreement on the following considerations :—

(a) There was a problem of disposal of dilute sulphuric acid obtained in the process of manufacture of concentrated nitric acid on account of delay in the setting up of Phosphoric Acid Plant with a capacity of 100 tonnes a day which was to consume dilute sulphuric acid. There was neither a ready market nor

adequate transport for regular disposal of such a large quantity of dilute sulphuric acid.

(b) There were limitations in the sale of concentrated nitric acid, as the Hindustan Organic Chemicals Limited was not ready to take the material and the demand from the market was around 100 tonnes per month only, equivalent to two days' production; the storage capacity was also limited to 300 tonnes.

The Board remitted (January 1972) the proposal to a committee for examination and report. The Committee recommended the modified procedure for guarantee tests which was approved by the Board in March 1972.

According to the modified procedure the pre-performance test was to be limited to 15 days on each stream separately instead of 60 days on both the streams simultaneously. This test was to be followed by a continuous run of 12 days on both streams together during which period a guarantee test run for 72 hours to prove capacity, specific consumption and quality was to be conducted. The modified procedure contemplated the possibility of interruption during the two 15 days' test run for reasons beyond the control of the contractor. In regard to 12 days' test run which had to follow the 15 days' run, no mention was made of the possibility of an interruption.

In accordance with the modified procedure, 15 days' test run on stream No. 1 was conducted from 5th to 19th May 1972 and the average production obtained was about 90 per cent of the capacity indicated in the contract. The test run on stream No. 2 had been conducted between 19th January and 2nd February 1972, before the procedure regarding guarantee test had been modified.

As regards continuous run on both streams, the test run was started from the 15th June but had to be stopped on the 20th June on the failure of the Sulphuric Acid Plant. The test run was resumed on the 11th July and continued upto the 16th July 1972. Though the modified procedure as specifically recommended by the Committee did not provide for any interruption

during the continuous run of 12 days, the test run conducted in two broken spells was considered by the Corporation as continuous because the interruption was caused by the failure of the Corporation. The Ministry have stated (July 1978) that the modified procedure approved by the Board only amended the period of guarantee tests and all the other clauses governing the tests including the exclusion of interruptions beyond the control of the contractor remained in force and hence the interruption in the 12 days' test run was excluded for the purpose of reckoning the continuous run. This period of 12 days also included the guarantee test for 72 hours from the 12th to the 15th July on which dates the Plant fulfilled the guarantees relating to capacity, quality and consumption. A perusal of the contract indicates that clauses 5 and 6 referred to pre-performance test runs and interruptions during those runs. The performance guarantee test run is covered by clause 7 and this does not envisage interruptions.

Because on the last day of the 12 days' test (*i.e.* 16th July 1972), one acid cooler coil had failed because of a crack, the Management decided that both streams of the Plant should be run again for 12 days continuously to assure that there was no further failure of the equipment. This continuous test run was conducted from the 5th to the 17th August 1972; the average production achieved was above 85 per cent of design capacity but did not reach the designed capacity on any day.

Considering the guarantees regarding capacity, quality and consumption as having been met in the test run conducted from the 12th to the 15th July 1972, the Unit issued the certificate of final acceptance on the 21st August 1972, subject to the following :—

(a) The defect liability period of 12 months would commence from 20th July 1972.

(b) The contractor would be liable to pay the penalty for delay in completion and would complete all the pending jobs within 3 months of that date.

(4) *Performance of the plant.*—A number of defects and deficiencies were noticed in the operation of the Plant during the warranty period. Only 5713 tonnes were produced from July 1972 to March 1973 being less than 40 per cent of the proportionate rated capacity. The Technical Consultant of the Corporation studied the problem of the Plant in November 1973 and observed that :—

(a) It appeared that the specifications of the Plant were very broad. Trouble started within three months of start up on account of poor and unsuitable quality of material arranged indigenously by the contractor. In the case of silicon iron pipes, the test reports indicated 15-16 per cent silicon content whereas actual tests conducted by an independent authority indicated this to be 13.5 per cent or lower.

(b) The following equipment had been found to develop trouble :—

Equipment	Nature of the defect
(i) Denitration towers	Developed pin hole leaks. Distribution trays corroded and ceramic liners were found to be damaged.
(ii) Bleacher pot	Silicon content ranged between 8 per cent and 13½ per cent as against specified percentage of 14—16.
(iii) Air Bleacher	Made of aluminium which is not suitable.
(iv) Cooler (v) Nitric Acid condensor	Silicon content of tubes was low.
(vi) Weak Sulphuric Acid transfer pump and export pump	Lead pumps with 5 per cent antimony used were not suitable.
(vii) Steam ejector	The body was cracked.
(viii) Storage tank for dilute Sulphuric Acid	Due to defects in welding and pin holes caused while welding, there was crack at the bolt hole.

In August 1974, the Unit prepared a rehabilitation scheme to be implemented in three phases, as given below :—

Phase I:—Repairs at a cost of Rs. 8.88 lakhs to be undertaken to step up production of concentrated nitric acid to 800 tonnes per month from December 1974 and to 960 tonnes per month from April 1975.

Phase II:—Repairs including replacements at a total cost of Rs. 32.19 lakhs to stabilise production at 16,000 tonnes annually from February-March 1976.

Phase III:—An additional train to obtain the design capacity of 19,800 tonnes.

The proposal to implement Phases I and II at a cost of Rs. 40.07 lakhs was approved by the Chairman and Managing Director in October 1975. Work was started in April 1975 and was in progress (April 1976). The Ministry have stated (July 1978) that the scheme covering Phases I and II has since been implemented and the plant has demonstrated the capacity of producing 60 tonnes per day.

During 1973-74, 1974-75 and 1975-76, 4856 tonnes, 6556 tonnes and 10,033 tonnes respectively of concentrated nitric acid were produced. During 1976-77 and 1977-78, the production is stated to have gone up to 13,560 tonnes and 14,990 tonnes respectively.

In this connection, the Ministry have stated (November 1978) as follows :—

(a) "The Consultant's Report of November 1973 was basically intended to review the performance of the Plant from its commissioning and identify areas where further improvements were necessary."

(b) "It would also have to be noted that the plant being highly corrosive, the equipment failures pointed out by the Consultant could occur repeatedly and have to be continuously rectified as part of the maintenance programme."

(5) *Operating results.*—The operation of the Plant upto 31st March 1978 resulted in a cummulative profit of Rs. 170.24 lakhs after setting off a loss of Rs. 24.90 lakhs incurred in 1975-76.

8.4 *Sodium Nitrite and Nitrate Plant.*—At the instance of the Director General, Technical Development, the Board decided (June 1969) to set up a Sodium Nitrite and Nitrate Plant, as an import substitution measure. The Project Report, prepared in September 1969, envisaged a Plant with the capacity to produce 1000 tonnes of nitrite and 3000 tonnes of nitrate at a cost of Rs. 35.32 lakhs (including Rs. 2.99 lakhs in foreign exchange). The Project was estimated to save annually foreign exchange equal to Rs. 34 lakhs.

The Plant was completed by the Planning and Development Division and Trombay Unit jointly in August 1972. It was, however, commissioned for commercial production only in February 1973, after certain modifications were made at a cost of Rs. 3.01 lakhs. The nitrate and nitrite produced were found to be impure. Therefore, further modifications were made at a cost of Rs. 2.07 lakhs and the Plant was restarted in July 1974. Production was much less than the rated capacity as will be seen from the data given below :—

Year	Sodium Nitrite		Sodium Nitrate		Profit(+) Loss(—) (Rs. in lakhs)
	Capacity	Actual production	Capacity	Actual production	
	(in tonnes)		(in tonnes)		
1972-73	1000	119	3000	663	12.36
1973-74	1000	133	3000	1372	2.45
1974-75	1000	220	3000	1096	(—) 3.62
1975-76	1000	64	3000	674	(—) 9.53
1976-77	1000	573	3000	474	(—)17.06
1977-78	1000	1322	3000	1194	0.09

The Unit could not meet the demand of customers routed by the State Trading Corporation in 1973 to avoid imports.

It was noticed that no guarantee tests for capacity, quantity and specific consumption were conducted. In fact, not only was capacity not achieved, as mentioned above, but consumption of raw materials was higher than the norms mentioned in the Project Report. The value of raw materials consumed in excess of the norms aggregated Rs. 24.61 lakhs, as per details given below :—

	1974-75	1975-76	1976-77	1977-78	Remarks
Value of excess consumption (Rs. in lakhs)	6.19	3.28	6.17	8.97	Excess consumption for 1974-75 and 1975-76 is on the basis of the ratio of 1 : 3 of Sodium Nitrite to Sodium Nitrate and on the ratio of 1 : 1 for the years 1976-77 and 1977-78.

It was mentioned in the Production Report for the quarter ending 31st March 1976 that production was reduced as it was uneconomic and that the Plant was under experimental run by the Planning and Development Division.

The initial estimate of 1969 stood at Rs. 35.32 lakhs. It was revised to Rs. 53.46 lakhs in December 1971 and approved by the Board in April 1972. This estimate was further revised to Rs. 61.72 lakhs in February 1973. The actual expenditure on the project, however, amounted to Rs. 57.15 lakhs.

The Ministry have stated (July 1978) as follows :—

(a) With a number of modifications, the planned capacity of Sodium Nitrite, the principal product, was not only brought upto rated capacity but was considerably increased. .....The ratio of Nitrite to Nitrate has also improved.

(b) There has been a distinct improvement in the trend of consumption. Continuous efforts are being made to bring actual consumption close to norms laid down.

8.5 *Carbon Recovery Plant.*—About 8 tonnes of carbon per day is produced during the gasification of naphtha. The Plant suppliers (M/s. Chemico) had suggested (1963) either pelletisation or filtering of the carbon from the slurry by the use of filters. The Corporation decided to utilise this carbon for making pellets by a fuel oil pelletisation scheme at a cost of $ 71,000 (Rs. 5.33 lakhs), for use in the boilers. It was later (1966) found that use of fuel oil pellets was uneconomical. Besides, only 50 per cent of the pellets produced could be used. The scheme was, therefore, abandoned after Rs. 5.33 lakhs were spent.

In October 1966, the Board approved of a scheme to recover carbon for sale to outside parties. In April 1968, the Planning and Development Division prepared a Project Report for the scheme to cost Rs. 10 lakhs, which was approved by the Board in July 1968 and envisaged pelletisation of carbon from slurry by using kerosene/mineral turpentine instead of fuel oil. It was anticipated that the carbon recovered would be suitable for paints and pigment industry and it would take two years to develop the market fully.

The Carbon Recovery Plant was completed at a cost of Rs. 12.82 lakhs in December 1970. It could not be operated continuously because of equipment failures. Neither was the designed capacity of 7 tonnes a day achieved, nor did the product conform to standards as volatile contents were higher than the limits specified.

In September 1973, the Board decided that, as the Plant had proved to be an uneconomic proposition, alternative means of disposal of the carbon effluent should be considered and, simultaneously, efforts should be made to increase production and reduce cost of production.

The Unit stated (February 1976) that it had placed an order for a filter so that carbon could be filtered from the slurry for sale in the market. Meanwhile, 5 to 7 tonnes of carbon were being discharged daily as an effluent in the Sion creek along with a lakh gallons of cooling water.

The new proposal estimated to cost Rs. 13.3 lakhs, was stated to have been completed by September 1976.

The Plant produced 76 tonnes in 1971-72, 347 tonnes in 1972-73, 58 tonnes in 1973-74, 121 tonnes in 1974-75, 99 tonnes in 1975-76, 1157 tonnes in 1976-77 and 1142 tonnes in 1977-78. As costs were higher than the sale prices, losses were suffered each year from 1972-73 to 1977-78, totalling Rs. 50.71 lakhs.

In this connection, the Ministry have stated (July 1978) as follows :—

> ".....Carbon Recovery system is an obligation as a pollution control measure. In any case whether to make a useful commercially acceptable product or not, expenditure on pollution control will still have to be incurred.. All that was attempted was as per international practice where in the process of effectively countering pollution we could also develop a commercially useful product. Due to reliance on indigenous know-how and other design constraints, as this is one of the few attempts in this direction by the P & D engineers, difficulties and deficiencies encountered were unavoidable."

8.6 *Methylamine Plant.*—In November 1969, Government approved of a proposal to set up a Methylamine Plant of a capacity of 4000 tonnes per annum, as an import substitution measure, at an estimated cost of Rs. 160.14 lakhs (including Rs. 35.55 lakhs in foreign exchange).

The Plant was commissioned in December 1974 and produced 462 tonnes of methylamine upto March 1975. It was reported to the Board in July 1975 that the earlier demand projection had not come true and, considering the requirement of the country, the planned production of 3600 tonnes in 1975-76 had been curtailed to 835 tonnes; for lack of demand, however, only 339 tonnes, 458 tonnes and 624 tonnes were produced in 1975-76, 1976-77 and 1977-78, respectively.

The Plant suffered a total loss of Rs. 30.53 lakhs upto 31st March 1978.

In this connection, the Ministry have stated (November 1978) as under :—

> "Pesticides manufacturers are the major consumers of methylamines. Pesticides market in the country has not grown as anticipated earlier. As a result there has been a time lag in the growth of methylamines consumption. .....It is expected that the methylamines plant will break-even in 1978-79 at an estimated sale of about 1100 tonnes."

8.7 *Dimethylether recovery plant.*—In April 1970, the Board approved the proposal of the Corporation to set up a Dimethylether Recovery Plant of the capacity of 825 tonnes per annum at an estimated cost of Rs. 16 lakhs (including foreign exchange component of Rs. 0.80 lakh) to recover in liquid form dimethylether then being vented as gas from the Methanol Plant.

According to the Project Report, dimethylether can replace methanol in certain processes, such as in preparation of dimethyl sulphate or dimethylamine which were being imported. Demand for the product was expected to be around 440 tonnes per annum. It was also stated that even if the market demand did not materialise, the entire production could be utilised as raw material in the Methylamine Plant which was being set up.

The Plant was set up with the assistance of the Planning and Development Division at a cost of Rs. 10.42 lakhs and commissioned in February 1973.

Commercial production was started from October 1975, as the industrial licence for manufacture of dimethylether was received only in January 1975 because of delay in furnishing complete information to the Ministry. The production for the period from October 1975 to March 1976, 1976-77 and

1977-78 was 15.89 tonnes, 22.6 tonnes and 19.95 tonnes respectively and the total loss suffered on the operation of this Plant amounted to Rs. 9.85 lakhs upto 31st March 1978.

While the insignificant production as compared with the installed capacity has been stated to be due to lack of market demand, another factor responsible for low production is inability of the Unit to utilise this product as a raw material in the Methylamine Plant, as initially contemplated. Because of this, the Methylamine Plant has to use mathanol as raw material which is costlier than Dimethylether—a waste product. In this connection, the Ministry have stated (November 1978) as follows :—

> Dimethylether is found to contain CO^2 which has to be removed before it can be used as raw material for the production of methylamine. Trombay has developed a process system for CO^2 removal which is currently being implemented.

8.8 *Overall working results.*—According to the Ministry, the primary objective of Diversification Schemes was to productively utilise the intermediates, co-products, where and when available, after meeting the requirement of the fertilizer manufacturing programme based on prevailing economics, market and plant conditions. The attempt was to maximise contribution to the fixed cost and ensure optimum profitability.

The Ministry have further stated (November 1978) that :

(i) As against a total investment of Rs. 315.69 lakhs, the cumulative profit earned upto 31st March 1978 amounted to Rs. 106.75 lakhs, after charging interest and depreciation.

(ii) Most of these plants are based on indigenous technology and many of them needed extensive trials and experimentation.

9. *Trombay Expansion*

9.1 *Trombay III, IV and V.*—The original expansion project (Trombay III) envisaged setting up of a single stream Ammonia Plant based on naphtha with a capacity of 1000 tonnes per day. Ammonia was to be converted into urea and di-ammonium phosphate which, in turn, was to be used for production of complex granular fertilizers of different compositions. The capacity of the Urea Plant was to be 1200 tonnes a day and that of the complex Plant of 900/1500 tonnes a day in terms of di-ammonium phosphate/di-ammonium phosphate urea complex. As the assumption that sufficient naphtha would be available from indigenous sources or imports was not fulfilled, in May 1969, the Ministry asked the Corporation to prepare a detailed feasibility study for the Project based on imported ammonia.

9.2 The Corporation prepared a detailed Project Report in July 1969 to utilise 1.79 lakh tonnes of imported ammonia to produce complex fertilizer. The revised project was termed as Trombay IV.

In July 1970 Government approved of the Project estimated to cost Rs. 43.60 crores, including Rs. 10.03 crores in foreign exchange. The Project envisaged setting up of a Complex Fertilizer Plant, Nitric Acid Plant, Phosphoric Acid Plant, Sulphuric Acid Plant, Steam Generation Plant and Water Treatment Plant. On completion, it was to produce 6.60 lakh tonnes of complex fertilizers with the composition 20:20:0 with 60% of water soluble P_2O_5. The plant facilities were to be flexible to produce any of the N.P.K. varieties. The process to be employed for producing complex fertilizers was to be the sulphate recycle process developed by Messrs Stamicarbon of Holland. For the imported ammonia, terminal facilities for unloading and storage at the jetty were to be installed by the Corporation.

In November 1970, the Corporation entered into an agreement with Messrs Stamicarbon of Holland for the licence, know-how and supply of basic design package for the N.P.K. process

based on the sulphate recycle process or crystallisation process. The contract for installation of the terminal facilities at a cost of Rs. 134.52 lakhs was awarded in May 1971 on turn-key basis to Messrs Uhde of West Germany. In October 1971, the Corporation reassessed the capital requirements for the Project at Rs. 57.68 crores (including Rs. 16.43 crores in foreign exchange).

As the foreign exchange requirement was substantial, Government posed the Project to the World Bank for financing. An appraisal mission of the Bank examined the Project in December 1971 and came to the following conclusions :—

(a) Project was not suitable for financing due to complexity of the processes, high capital cost, difficulties of marketing a relatively low nutrient product with low phosphate water solubility and low economic return.

(b) The Corporation should first study the possibility of increasing production in the existing N.P.K. and Urea Plants which were working at 60—65 per cent of the capacities. Based on the increased production capacities of these Plants, the size and scope of the expansion project should be determined.

After finalising the debottlenecking schemes (refer paragraph 7), the scope of the Project was revised as follows :—

(a) The revised scheme was based on 1,00,000 tonnes of imported ammonia and was to use crystallisation process for production of N.P.K. fertilizers. For balancing the product to N.P. ratio and improving the water solubility, external source of P_2O_5 in the form of di-ammonium phosphate or phosphoric acid or triple-superphosphate was to be used.

(b) The plant complex would comprise a Nitric Acid Plant and a Nitrophosphate Plant. The capacity of

the Plant was to be 3,75,000 tonnes per annum of complex fertilizers of the grade of 20 : 20 : 0.

The capital cost of the revised Project was estimated by the Corporation at Rs. 37.5 crores (including foreign exchange component of Rs. 13.80 crores). This did not include the capital outlay on ammonia terminal facilities.

The proposal was forwarded to the Ministry on 8th January 1973 in anticipation of Board's approval which was accorded on 27th January 1973. Meanwhile, the supply of ammonia in the international market became uncertain and the World Bank declined to consider the Project unless a definite source for ammonia was finally tied down. As it was not possible to enter into a long term contract for import of ammonia, the Ministry decided in August 1973 that the Corporation should go ahead with Trombay V Expansion (which would incorporate an Ammonia Plant based on fuel oil and an Urea Plant) in such a way that both Trombay IV and V could be implemented within a gap of one year at the most. In the intervening period, the ammonia required for Trombay IV and the debottle necking schemes was to be procured from indigenous sources and spot purchases abroad.

The Corporation prepared in November 1973 a feasibility report for setting up of a 900 tonnes per day Ammonia Plant and 780 to 860 tonnes per day Urea Plant under Trombay V. The estimates of capital cost for Trombay IV and V were prepared afresh in the light of price increases in plant and equipment and raw materials and amounted to Rs. 44.01 crores (including foreign exchange component of Rs. 18.99 crores) and Rs. 111.40 crores (including foreign exchange component of Rs. 27.80 crores) respectively. In June 1974, the World Bank agreed to give $ 33 millions as loan for Trombay IV. The Ministry approved in October 1974, implementation of both expansion schemes at the capital costs referred to above. According to the approved project, Trombay IV was to commence commercial production in April 1977 and Trombay V in April 1978.

The following features of the project deserve mention :—

(a) As the World Bank had evinced interest in the Trombay IV expansion scheme approved by the Board in January 1973, the Corporation, in consultation with World Bank experts, had invited tenders from internationally reputed firms for selecting the best process technology and engineering contractor. The firms were to quote :—

(i) firm lumpsum fee for licence, basic engineering and detailed engineering ;

(ii) fixed lump sum f.o.b. price for proprietory items of equipment, if any ;

(iii) estimated f.o.b. cost of other equipment under European conditions ;

(iv) fees for procurement of equipment for the project ; and

(v) estimated erected cost of the plants under European conditions.

Four tenders were received for the Nitric Acid Plant and two for the Nitrophosphate Plant. These were remitted to a Technical Committee for evaluation. After examination, the Committee considered the offers of Messrs P-Bamag and Uhde for Nitric Acid Plant and that of Messrs Power Gas and Uhde for Nitrophosphate Plant. On the recommendation of the Committee, the Board accepted the offer of Messrs Uhde for both the Plants, as the fees quoted by them for engineering including licence fee were lower and the estimated erected cost of the Plants would be lower in the case of Nitrophosphate Plant and comparable in the case of Nitric Acid Plant.

In view of the several significant clarifications needed in the package bid and adjustments made by the Corporation for comparison of bids and also possible impact of currency revaluation, the World Bank advised that all firms should be requested to re-tender so that more accurate capital cost estimates could be work-

ed out. Accordingly, tenders were re-invited in March 1973 from the firms earlier contacted. Three firms quoted for Nitrophosphate Plant and four for Nitric Acid Plant. In the case of Nitric Acid Plant, the contract was finally awarded to Davy Power Gas, Berlin, as the lumpsum fee for engineering, licence and know-how and procurement charges and also the total cost were lower as compared to Uhde. In the case of Nitrophosphate Plant, the contract was awarded to Uhde, as their offer was more advantageous technically and cheaper than what was offered by Davy Power Gas, though the firm lumpsum price for engineering, licence, know-how and procurement assistance was higher by Rs. 17.72 lakhs. The contracts were finalised in June 1974 for design, engineering and procurement assistance.

The overall lumpsum price for engineering, licensing and know-how as also as for procurement assistance quoted on retendering was higher by Rs. 42.14 lakhs than the earlier offers accepted in February 1973.

The higher expenditure has been ascribed (July 1978) by the Ministry to fluctuations in the rate of exchange, change of specifications in the Nitrophosphate Plant and settlement of procurement charges in keeping with the quantum of work, mandays etc. to be utilised as against the *ad hoc* basis of 3 per cent of the f.o.b. cost adopted in earlier proposal.

(b) In August 1975, the position regarding completion of Trombay IV was reviewed and it was found that the commercial production would start from November 1977 due to delay in delivery of certain major equipment for the Nitric Acid, Nitrophosphate and Steam Generation Plants. The project cost was also revised, in November 1975, from Rs. 44.01 crores to Rs. 76.27 crores, as explained below :—

(In Crores of rupees)

(i) Change in scope	6.40
(ii) Change in parity and price escalation	15.82
(iii) Increase in financing charges, variation in customs duty due to change in rates or prices and other reasons.	10.04
	32.26

The revised estimate was approved by the Board in July 1977. Approval of Government is awaited (November 1978). Actual expenditure upto 31st March 1978 totalled Rs. 73.76 crores and a further sum of Rs. 2.23 crores was expected to be incurred. The Plant started trial production from 1st April 1978. According to the Unit Management, the Plant has gone into commercial production from 1st January 1979.

(c) As a result of the change from the sulphate recycle process to the crystallisation process for the manufacture of complex fertilizers in Trombay IV, the basic design fee of Rs. 8.64 lakhs paid to Messrs Stamicarbon of Holland for supplying the basic package based on sulphate recycle process became infructuous. The amount was written off by the Board in June 1975.

(d) As already mentioned, the turn-key contract for installation of ammonia terminal facilities was awarded to Messrs Uhde in May 1971 at a lumpsum price of 3.174 million DMs (Rs. 65.38 lakhs) for supplies and Rs. 69.14 lakhs for services. The total estimated cost of the Project was Rs. 173.73 lakhs including civil works, customs duty, insurance, etc., to be arranged by the Corporation. Actual expenditure on the scheme was Rs. 251.46 lakhs. The revised estimate, based on actual expenditure, stands included in the figure of Rs. 76.27 crores mentioned in item (b) above.

The contract with M/s. Uhde, approved by Government in August 1971, was effective from the 15th July 1971. The installation was to be ready, after erection and testing, within 21 months from that date, provided the storage tank foundation was handed over by the Corporation within 9 months.

The installation was accepted in January 1974. As there was delay in handing over the foundation and in supply of water for hydraulic testing, it was considered by the Management that there was no delay on the part of the contractor.

The following guarantees were to be proved by the contractor before the installation was accepted by the Corporation :—

(1) Storage capacity of tank—Minimum 15000 tonnes net.

(2) Take over unloading rate of ammonia from ship—Minimum 700 tonnes per hour.

(3) Transfer rate of ammonia to factory—Minimum 30 tonnes per hour.

While the guarantees at (1) and (2) above were deemed to have been fulfilled, the guarantee at serial (3) could not be proved, as the hortensphere could not take ammonia at 30 tonnes per hour at a low temperature. However, Messrs. Uhde contended that the guarantee could not be proved as insulation of the pipeline had not been completed by the Corporation. While liquid ammonia was being transferred from the terminal to the hortensphere in May 1974, 500 pipe supports got damaged and skidded. As a result, nipples got stuck and welding cracked. Damage was rectified in May 1974 at the cost of Uhde. The Ministry have stated (July 1978) that pumping rate of 30 tonnes per hour can only be tested when Trombay IV plant go into operation.

So far the terminal facilities have been used for storing both imported and indigenous external ammonia purchased from IFFCO to the following extent :—

	1973-74	1974-75	1975-76	1976-77	1977-78
	(figures in tonnes)				
Imported	5106	..	26958	16456	43175
Indigenous	..	4233	15007	12205	..
TOTAL :	5106	4233	41965	28661	43175

The Ministry have stated (November 1978) that till 1980 when Trombay V Ammonia Plant was likely to be commissioned, the Corporation may have to import about 96,000 tonnes of ammonia in 1978-79 and 1,24,000 tonnes in 1979-80. Further,

these terminal facilities will also be used for the Trombay V Plant which would otherwise have required a separate storage tank of at least 5,000 tonnes capacity; additional requirements of ammonia for NPK Expansion Plant of IFFCO and the surplus ammonia from the proposed Thal Project will also be handled beyond 1980 by these installations.

(e) For Trombay V, Government informed the Corporation in May 1975 that the feed-stock for the Project should be naphtha with a provision for changing over to natural gas instead of fuel oil as initially contemplated. It was further stated that French credit could be made available and the Corporation should plan to utilise the same to the maximum extent possible.

The Corporation, therefore, drew up an implementation plan in June 1975, utilising French credit (300 million FF *i.e.* Rs. 55.20 crores), Austrian credit ($ 30 million, *i.e.* Rs. 22.50 crores) and Dutch credit (unspecified). It was decided that the Planning and Development Division would be the prime agency for execution with the assistance of a foreign consultant who would be in a position to supply the licence, basic design documents, supervision for preparation of detailed engineering, construction, commissioning and other similar services. The consultants were to be selected on the basis of competitive offers received from a few selected firms with sufficient past experience. Selection was to be completed by 1st October 1975 which would be the zero date for commencement of the schedule.

The Corporation originally intended to adopt the Technimont process for the production of urea but after a technical and economic evaluation of other processes, *viz.*, Snam and Stamicarbon, it was decided (November 1975) to adopt the Snam Progetti process, as the capital and operating costs under this process were lower than the other two.

The Corporation has stated (February 1977) that contract for the urea process has been awarded to Snam Progetti and that other draft agreements have been finalised and sent to

Government for approval. In this connection, the Ministry have stated (November 1978) as follows :—

(i) The earlier sanctioned estimate of Rs. 111.40 crores was revised to Rs. 169.97 crores based on the use of associated gas only and has been approved by the Board of Rashtriya Chemicals and Fertilizers in August 1978. Actual expenditure upto 30th September 1978 amounted to Rs. 40.77 crores.

(ii) While agreements for technical know-how have been finalised with M/s. Snam Progetti, Haldor Topsoe and Benfield, those for design, engineering and procurement have been entered into with Snam Progetti and Fertilizer (Planning and Development) India Ltd.

(iii) Expected date of commercial production was July 1980.

10. *Production Performance*

Fertilizer Group of Plants

10.1 *Ammonia Plant*

10.1.1 *Rated capacity.*—The rated capacity of the Plant is 350 tonnes per day or 1.16 lakh tonnes per annum based on 330 stream days. The Plant could not, as mentioned in paragraph 4, attain the rated capacity. In March 1969, the maximum attainable capacity of the Plant was assessed by a Committee headed by the then Chairman and Managing Director at 320 tonnes a day or 1.06 lakh tonnes annually till the Supplementary Gasification Scheme was implemented. Thereafter, the rated capacity of Ammonia Plant was to increase to 360 tonnes a day or 1.19 lakh tonnes annually. As mentioned in paragraph 6, the Supplementary Gasification Scheme was completed in February 1974, but its benefit did not accrue to the Ammonia Plant for the reasons explained in paragraph 6.4. The Plant could not attain even the reduced rated capacity of 320 tonnes or 1.06 lakh tonnes annually so far, as detailed below.

Production.—Production of ammonia as for the years 1969-70 to 1977-78 was :—

	Plan		Actual production
	Original	Revised	
(1)	(2)	(3)	(4)
	(In lakhs of tonnes)		
1969-70	0.87	0.80	0.74
1970-71	0.92	0.82	0.83
1971-72	0.90	0.88	0.88
1972-73	0.96	0.94	0.95
1973-74	1.00	0.98	0.87
1974-75	1.09	0.95	0.79
1975-76	1.02	0.82	0.81
1976-77	0.86	0.86	1.03
1977-78	0.92	0.97	1.03

It will be seen that the production improved considerably in 1976-77 and 1977-78. It was, however, still less than the rated capacity.

The figures of actual production include quantities of ammonia gas utilised in the Methanol Plant for production of methanol. After excluding the quantities of ammonia gas so diverted, the net ammonia available for production of fertilizers and industrial products (other than methanol) was as follows:—

Year	Gross quantity of ammonia that could have been produced	Ammonia equivalent gas transferred to Methanol Plant	Net quantity of ammonia available
(1)	(2)	(3)	(4)
			(in lakhs of tonnes)
1969-70	0.74	0.04	0.70
1970-71	0.83	0.07	0.75
1971-72	0.88	0.06	0.82
1972-73	0.95	0.09	0.86@
1973-74	0.87	0.07	0.80
1974-75	0.79	0.01	0.78
1975-76	0.81	Insignificant	0.81
1976-77	1.03	-do-	1.03
1977-78	1.03	-do-	1.03

@Includes 1132 tonnes as a result of stock adjustments.

Utilisation of ammonia equivalent gas in Methanol Plant in 1974-75 and 1975-76 tapered off due to implementation of the Supplementary Gasification Scheme.

Utilisation of ammonia gas, based on naphtha, in the Methanol Plant had led to a demand by the Excise authorities for payment of excise duty at a higher rate, on naphtha used for purposes other than manufacture of fertilizers. The demand so raised by the Excise authorities for the period April 1966 to December 1972 and liability assessed by the Unit thereafter upto 23rd July 1973 amounted to Rs. 447 lakhs. On the 23rd July 1973, the Ministry of Finance declared Trombay Unit to be a refinery in relation to naphtha, thereby excusing it from payment of duty at the higher rate.

The Corporation filed (April 1975) a revision petition with the Ministry of Finance against the orders of the Appellate Collector of Central Excise. Pending outcome of revision petition, the Corporation has treated the above amount as a contingent liability.

The Ministry have stated (July 1978) that the Central Excise Authorities passed order in May 1977 that the case regarding realisation of excise duty from Fertilizer Corporation of India—Trombay should be decided *de novo* by the Assistant Controller of Central Excise. The matter is stated to be still (November 1978) pending.

10.1.3 *Reasons for shortfall.*—An analysis of the reasons for shortfall in production with reference to rated capacity made by the Unit in the 'Production and Efficiency Reports' attributed the slippage in production mainly to low equipment performance, break downs and longer time taken for maintenance. The Corporation has stated (February 1977) that power problem was another factor responsible for shortfall.

A major constraint in increasing production of ammonia would appear to be shortage of compressed air which has been

attributed to fluctuating frequency. In the production report for the quarter ending 31st March 1976 it was mentioned that the following steps were being taken in this regard :—

(a) An additional air compressor of 10,000 NM^3/hour capacity was being bought from the Bharat Heavy Electricals Limited.

(b) Two expansion engines were being imported and two continuous dew point analysers were being procured to monitor the moisture content entering the air box.

(c) A new instrument air compressor had been ordered to augment the instrument air supply.

The Ministry have stated (November 1978) that the air compressor is expected to be operational in November 1978 ; a dew point analyser, new instrument air compressor and one of the expansion engines have already been installed. The installation of the second expansion engine is in progress.

10.1.4 *Impact of shortfall.*—The total quantity of ammonia required for production of fertilizers (Urea and N.P.K. 15:15:15), nitric acid (an intermediate product of N.P.K.) and ammonium bicarbonate and methylamine (industrial products) was around 1.12 lakh tonnes, based on the rated capacities of these plants and the normal consumption of ammonia as designed. Ammonia actually available, including quantities produced, imported and purchased from the Indian Farmers Fertilizers Co-operative Limited were as follows :—

Year	1970-71	1971-72	1972-73	1973-74	1974-75	1975-76
Quantity (in lakhs of tonnes)	0.76	0.82	0.85	0.82	0.87	1.24

Shortage of ammonia resulted in under-utilisation of the capacity of the Urea Plant in particular and of the N.P.K. Plant upto 1974-75. Because of substantial imports and increase in

procurement of ammonia in the country in 1975-76, ammonia was no longer in short supply. Even then, there was shortfall of 19,000 tonnes in the production of urea in 1975-76, with reference to the rated capacity. The Ministry have stated (July 1978) that this was due to break downs of carbamate pump, ammonia charge pump and recovered ammonia compressors etc.

During 1973-74, 1974-75 and 1975-76, the Unit procured the following quantities of ammonia by import and from the Indian Farmers Fertilizers Co-operative Limited :—

Year	Imported (in tonnes)	Indigenous (in tonnes)
1973-74	5,106	Nil
1974-75	..	4,233
1975-76	26,958	15,007

Had the Plant achieved the attainable rated capacity of 320 tonnes a day the import could have been eliminated in 1973-74 and reduced considerably in 1975-76.

10.2 *Urea Plant.*—The Plant is designed to produce daily 300 tonnes of urea. On the basis of a stream efficiency of 330 days, the annual rated capacity is 99,000 tonnes. Production as planned and actual for the years 1969-70 to 1977-78 were as follows :—

Year	Plan		Actual Production
	Original	Revised	
(1)	(2)	(3)	(4)
	(Figures in lakhs of tonnes)		
1969-70	0.60	0.70	0.58
1970-71	0.68	0.61	0.64
1971-72	0.73	0.55	0.61
1972-73	0.64	0.67	0.56
1973-74	0.86	0.75	0.57
1974-75	0.99	0.71	0.63
1975-76	0.64	0.72	0.80
1976-77	0.77	0.79	1.04
1977-78	0.94	0.89	1.06

Higher production of urea in 1975-76 was because ammonia limitation was overcome by purchase of ammonia from external sources (imports and indigenous ammonia bought from Indian Farmers Fertilizers Co-operative Limited).

According to the analysis made by the Unit, the major factors responsible for shortfall upto 1975-76 were lack of ammonia and carbondioxide (when Ammonia Plant tripped) and breakdown of equipment. Production in 1976-77 and 1977-78 exceeded the rated capacity on account of over-rated production on certain days.

N.P.K. Plant Complex

10.3 *N.P.K. Plant*

10.3.1 *Rated capacity.*—As mentioned in paragraph 7.1, the original processes for producing complex fertilizers were not successful and the Unit had adopted a new process of its own to produce complex fertilizers. After experiments with various N.P.K. formulations, the production of N.P.K. of 15:15:15 grade was stabilised by 1972-73. In this process, potash was introduced in addition to nitrogen and phosphate. The main raw materials required for its production are ammonia, nitric acid, sulphuric acid, rock phosphate, di-ammonium phosphate and muriate of potash. Di-ammonium-phosphate (which contains 18 per cent nitrogen and 46 per cent phosphate) was to be used till the Phosphoric Acid Plant of the Corporation was set up to produce P_2O_5. Of the above, rock phosphate, muriate of potash and di-ammonium phosphate are imported. The Unit has switched over to rock phosphate available from the Udaipur mines from January 1976.

As against the original capacity of 900 tonnes a day of 16:13:0 grade and 1,100 tonnes a day of 12.9:12.8:0 grade, the capacity with the new process was fixed at 700 tonnes a day for 15:15:15 grade and 600 tonnes a day for 20:20:0 grade. Assuming a stream efficiency of 300 days in a year, the capacity was 2.10 lakh tonnes per annum of the former grade and 1.80 lakh tonnes of the latter grade. It was stated (February

1976) that the attainable capacity was determined on the best judgment of the Management and no Committee was constituted to study and fix the capacity.

As mentioned in paragraph 7.1, the annual capacity to produce the 15:15:15 grade was to increase by 1.20 lakh tonnes under the debottlenecking scheme on the installation of a Nitric Acid Plant under Trombay IV Expansion. Till then, the accretion to the annual capacity was to be around 0.41 lakh tonnes based on 13,000 tonnes of nitric acid available from the existing Nitric Acid Plant after allowing for the existing requirements of the N.P.K., Concentrated Nitric Acid and Sodium Nitrate Plants.

The debottlenecking scheme and the Phosphoric Acid Plant were completed in August 1975 and January 1975 respectively.

As capacity for different compositions had not been determined and as the number of days on which the Plant was operated for each composition was not recorded, it was not possible to assess the capacity utilisation during 1969-70, 1970-71 and 1971-72, actual production of the different grades during these years being 1.09 lakh tonnes, 1.37 lakh tonnes and 2.04 lakh tonnes respectively. In 1972-73, 1973-74 and 1974-75 when only 15:15:15 grade was produced, actual production was, however, more than the capacity of 2.10 lakh tonnes fixed for this grade.

In 1975-76, the Plant produced not only N.P.K. of 15:15:15 grade but also 20:20:0; the combined production of these two grades being 2.03 lakh tonnes. In addition, 0.13 lakh tonnes of a new product, A.P.S.N. of 20:20:0 grade, was produced from the debottlenecking section of the Plant. The capacity for this product has been assessed (July 1978) at 222 tonnes per day. Although, according to the approved Project Report, this section was to produce N.P.K. 15:15:15 grade only, A.P.S.N. 20:20:0 was produced for the considerations mentioned in paragraph 7.1. Evaluation of capacity utilisation in 1975-76 was also not possible in the absence of availability of data relating

to plant operation for 15 : 15 : 15 grade, 20 : 20 : 0 grade and A.P.S.N. 20 : 20 : 0 respectively.

The Plant had budgeted from 1972-73 to 1974-75 for production of 15:15:15 grade at a level higher than the capacity of 2.10 lakh tonnes and in fact produced 2.46 lakh tonnes in 1972-73. It was also seen from the production and officiency report for January 1974 that for determining production plans, the capacity of the Plant had been reckoned at 800 tonnes a day. Further, production on certain days was higher than the capacity, termed as over-rated production.

In view of these indications, there would appear to be a need for evaluation of the capacity of the Plant to ;

(a) fix the capacity on a more realistic basis and

(b) remove constraints, if any, in the Plant which inhibit a higher rate of production.

10.3.2 *Actual production.*—The following table indicates the production of complex fertilizers as planned and actual for the years 1969-70 to 1977-78 :—

Year	Composition of Complex Fertilizers	Plan		Actual production
		Original	Revised	
(1)	(2)	(3)	(4)	(5)
		(in lakhs of tonnes)		
1969 70	20 : 20 : 0	1.80	0.35	0.22
	15 : 15 : 15		0.25	0.59
	18 : 18 : 9		0.35	0.12
	14 : 10.5 : 14		0.20	0.12
	15 : 7.5 : 15		0.20	0.03
	15 : 7.5 : 10		..	0.01
	20 : 10 : 0		..	..
		1.80	1.35	1.09

(1)	(2)	(3)	(4)	(5)
1970-71	20 : 20 : 0	0.55	0.04	0.04
	15 : 15 : 15	0.60	0.59	0.57
	20 : 20 : 2	..	0.38	0.56
	18 : 18 : 9	0.60	0.28	0.20
	14 : 10.5 : 14	0.15	..	..
	15 : 7.5 : 15	0.15	..	..
		2.05	1.29	1.37
1971-72	15 : 15 : 15	0.80	1.35	1.34
	20 : 20 : 2	0.50	0.34	0.45
	18 : 18 : 9	0.50	0.24	0.25
		1.80	1.93	2.04
1972-73	15 : 15 : 5	1.50	2.13	2.46
	18 : 18 : 9	0.50	..	..
1973-74	15 : 15 : 15	2.10	2.37	2.13
1974-75	15 : 15 : 15	2.40	2.37	2.11
1975-76 Existing Plant	15 : 15 : 15	2.10	1.94	1.81
Debottlenecking Plant	15 : 15 : 15	0.34	0.23	..
Existing Plant	20 : 20 : 0	..	..	0.22
Debottlenecking Plant	A.P.S.N. 20 : 20 : 0	..	..	0.13
1976-77	15 : 15 : 15	1.21	1.88	1.82
	20 : 20 : 0	0.74	0.17	0.59
	A.P.S.N. 20 : 20 : 0	0.20	0.23	0.29
1977-78	15 : 15 : 15	2.14	2.13	2.14
	20 : 20 : 0	Nil	0.10	0.13
	A.P.S.N. 20 : 20 : 0	0.16	0.01	0.15

In this connection, the following features deserve mention:—

(i) Analysis of the shortfall with reference to the attainable capacity of the Plant in the Production and Efficiency Reports indicated that production of

complex fertilizers was limited mainly on account of shortage of ammonia, and nitric acid, process stabilisation and process troubles, plant shut down and equipment breakdown and bad quality of raw materials (in 1975-76). While shortage of ammonia was overcome in 1975-76 by procurement of ammonia from outside (imports as well as indigenous purchases), shortage of nitric acid continued.

(ii) As a result of limitation of nitric acid, the Unit could not achieve the extra production of 0.405 lakh tonnes per annum from the debottlenecking scheme, which envisaged augmentation of capacity of complex fertilizers by 1.20 lakh tonnes per annum (0.405 lakh tonnes on the basis of nitric acid to be available from the existing Nitric Acid Plant and 1.20 lakh tonnes on the commissioning of the Nitric Acid Plant in Trombay IV Expansion). Trombay IV Expansion went into commercial production by 1st January 1979 as against April 1977 envisaged earlier. Accordingly, the Unit could not reap the full benefits of the debottlenecking scheme till January 1979.

(iii) As installation of Phosphoric Acid Plant was delayed and rated capacity production was not attained, the use of imported di-ammonium phosphate had to be continued. The quantities of imported di-ammonium phosphate used during the last five years were as follows :—

Year	Quantity (in tonnes)	Value (Rs. in lakhs
1973-74	40,722	422.55
1974-75	40,400	808.51
1975-76	23,644	601.93
1976-77	29,590	645.40
1977-78	10,687	232 49

10.4 *Nitric Acid Plant*

10.4.1 The rated capacity of the Plant is 320 tonnes a day. With a stream efficiency of 330 days, annual capacity is 1.056 lakh tonnes. The Plant did not achieve the rated capacity except in 1976-77, as given below :—

(In lakhs of tonnes)

Year	Plan		Actual production	Sales
	Original	Revised		
1969-70	0.77	0.54	0.47	0.09
1970-71	0.81	0.53	0.61	0.13
1971-72	0.76	0.77	0.81	0.12
1972-73	0.81	0.83	0.94	0.15
1973-74	0.898	0.99	0.85	0.16
1974-75	1.056	0.90	0.80	0.05
1975-76	0.99	0.86	0.85	0.04
1976-77	0.90	0.90	1.06	0.08
1977-78	0.93	0.92	0.98	0.08

The shortfall in production from 1973-74 to 1975-76 was ascribed to the following :—

(i) Failures of nitric acid supply pumps and line.

(ii) Poor performance of turbo-compressor.

(iii) Leaky tail gas heater and poor absorption efficiency on account of plugging of cooling coils in the absorption towers.

On the efficiency of the Plant, the Tennese Valley Authority's team had observed in its report (December 1967) that :

"This plant appears to be well designed and has given less trouble than any of the plants. We have been told of the failures of some of the cooling coils in the absorption towers. We were also told of the trouble experienced with the vessel at the time of start up and the measures taken by the Contractor. The

number of coil failures to date has not had any significant effect on the production. We believe additional failures will occur and expect that within another year enough will have occurred to affect production. There have been discussions of various proposed schemes to effect repairs. It is suggested that it might be advantageous to try some of these while there is yet time. Then, if it were seen that the coils would have to be replaced, they could be obtained before they were urgently needed".

It will, however, be seen from the reasons mentioned above that the failure of cooling coils continued to be a major factor affecting production.

In this connection, the Ministry have stated (November 1978) that the following measures have been taken to improve the performance of this Plant :—

(a) Several improvements in the maintenance techniques as well as in the trouble shooting have been done. Two intercoolers which were in parallel earlier were converted into series and this considerably improved the production.

(b) To reduce the leakages, the technique of seal welding was adopted.

(c) Original pumps which were failing, frequently due to corrosion, have been replaced.

(d) Replacement of coils involved a major shut down and almost amounted to re-fabrication of absorption tower. Alternatives in the form of increasing tray height were, therefore, considered in re-storing absorption efficiency.

10.4.2 Consequent on the change in the process of producing complex fertilizer it was thought that nitric acid would be surplus to requirements for complex fertilizers. To utilise the surplus,

the Unit, launched on the following schemes as referred to in paragraph 7 and 8 :—

Name of the Scheme	Date of approval	Date of implementation	Requirement of nitric acid at full capacity	Remarks
				(Tonnes)
1. Concentrated-Nitric Acid Plant	February 1967	July 1972	21,186	
2. Sodium Nitrite/Nitrate Plant	June 1969	February 1973	3,344	
3. Debottlenecking of N.P.K. Plant	December 1972	August 1975	13,000	To produce 40,500 tonnes of N.P.K. Also refer paragraph 7.

Although schemes at serial nos. (1) and (2) are not operating at full capacity, the Unit has experienced limitation of nitric acid in the production of N.P.K. fertilizers from the existing plant and with the modifications for removal of bottlenecks in the N.P.K. Plant.

10.5 *Sulphuric Acid Plant*

10.5.1 *Introduction.*—The Plant has rated capacity of 0.66 lakh tonnes of concentrated sulphuric acid of 98 per cent concentration with a stream efficiency of 330 days in a year. The Plant, however, became redundant when the original products and process of complex fertilizers were abandoned. The Committee on Public Undertakings had recommended in para 2.48 of their 26th Report (1968-69) that, in view of the demand for sulphuric acid in the country, steps should be taken to sell larger quantities of sulphuric acid. Government had stated in May 1972 that every effort was being made to increase the sales.

To utilise the surplus capacity of sulphuric acid, the Unit set up a concentrated Nitric Acid Plant which went into production in July 1972. In addition, sulphuric acid was also used in the complex fertilizers and the Phosphoric Acid Plant which commenced production in January 1975.

10.5.2 *Expansion of capacity.*—The Unit had entered into a contract in 1974 with the Design Engineering Division of the Fertilizers and Chemicals Travancore Limited (FACT) for Conversion of the Sulphuric Acid Plant to double absorption system for pollution control and at the same time for increasing the capacity of the Sulphuric Acid Plant to 300 tonnes a day (or 99,000 tonnes per annum). The scheme estimated to cost Rs. 136.54 lakhs (including foreign exchange of Rs. 27.94 lakhs) was sanctioned by Government in March 1975. This estimate was further revised to Rs. 155.86 lakhs (including foreign exchange of Rs. 38.18 lakhs) which was sanctioned by the Ministry in November 1977. The scheme was completed and commissioned in June 1977 at a cost of Rs. 143.59 lakhs.

10.5.3 *Production and sale.*—Production, sale, etc. of sulphuric acid during the period 1969-70 to 1977-78 were as follows :—

(Figures in lakhs of tonnes)

Year	Production Planned		Actual production	Sales	Utilisation in		
	Original	Revised			N.P.K. Plant	C.N.A. Plant	Phosphoric Acid Plant
1969-70	0.17	0.18	0.18	0.14	Not indicated as production was mainly for sale		
1970-71	0.18	0.24	0.24	0.22		—do—	
1971-72	0.35	0.32	0.30	0.24		—do—	
1972-73	0.43	0.41	0.45	0.26	0.02	0.17	..
1973-74	0.54	0.51	0.38	0.20	0.03	0.15	..
1974-75	0.66	0.38	0.25	0.04	0.02	0.23	0.04
1975-76	0.66	0.41	0.43	0.01	0.03	0.31	0.21
1976-77	0.47	0.46	0.56	..	0.03	0.41	0.27
1977-78	0.64	0.73	0.69	0.09	0.003	0.45	0.20

It will be seen that from 1974-75 quantities produced were less than the requirement of sulphuric acid of the other plants. Consequently, the Unit had to purchase 0.43 lakh tonnes of sulphuric acid during the period from 1974-75 to 1977-78.

The Unit has assigned (January 1976) the following reasons for non-attainment of rated capacity for the years 1973-74 to 1975-76 :—

(a) Concentrated Nitric Acid Plant limitation.

(b) Acid cooler tube leakage and sulphur furnace leakage.

(c) Absorption tower pump trouble.

(d) Economiser tube leak.

(e) Sulphur pump and gun failure.

(f) Failure of main blower coupling.

(g) High pressure drop.

(h) Boiler feed water pump trouble and non-availability of process water.

It was stated further that the major factors restricting the full capacity utilisation were high pressure drop in the system because of the use of indigenous catalyst and poor performance of certain equipment. Attempts were being made to procure imported catalysts and spares etc. to improve the performance of the Plant.

10.6 *By-Product Plant.*—Argon gas is produced by purifying the crude tapped from the Air Separation Units of the Ammonia Plant. It is used for arc welding of stainless steel, copper, aluminium, thin sheets of mild steel, etc. The rated capacity of the Plant is 1.11 lakh cubic metres per annum. The production was much higher than the rated capacity from 1971-72 onwards. Till 1977-78, a quantity of 11.29 lakh cubic metres was produced; the average annual production in the last seven years being 1.60 lakh cubic metres of argon gas

The Ministry have stated (November 1978) that the production of argon was nearly doubled by the modifications effected by Trombay engineers.

10.7 *Methanol Plant.*—The Methanol Plant set up in October 1966 was designed to have a rated capacity of 100 tonnes a day, but because of design deficiencies etc., its attainable capacity was fixed at 60 tonnes a day or 18,000 tonnes annually. As mentioned in paragraph 4, steps were initiated in 1967 to rehabilitate the Methanol Plant and the Supplementary Gasification Scheme was approved by Government in November 1969 to increase its capacity to 37,500 tonnes per annum. The scheme was implemented in February 1974. Actual production was as follows:—

Year	Attainable capacity	Production Planned		Actual production
		Original	Revised	
(1)	(2)	(3)	(4)	(5)
1969-70 . .	18000	18000	11000	8973 3903 (a) 12876
1970-71 . .	18000	14000	14750 7750	14048 6828 (a) 20876
1971-72 . .	18000	18000	15575 10106	15919 5758 (a) 21677
1972-73 . .	18000	28500(d)	16736 7813	15982 8913 24895
1973-74 . . .	18000	27000(d)	25798	13906 7213 (a) 3046 (b) 24165

(1)	(2)	(3)	(4)	(5)
1974-75 . .	37500	30000	30323	25491 2955 698 29144 (c)
1975-76 . .	37500	30000	27376	26752 232 54 27038 (c)
1976-77 . .	37500	24000	33068	33659 2248 49 35956 (c)
1977-78 . .	37500	36000	37125	41390 220 41610 (c)

NOTES:—(*a*) Indicates methanol produced from ammonia gas diverted from the Ammonia Plant.

(*b*) Indicates methanol manufactured from the gas from new reformer being installed under Supplementary Gasification Scheme to serve Methanol and Ammonia Plants.

(*c*) The first figure represents production from the new Reformer, the second figure from the old Reformer and the third figure represents methanol produced from gas diverted from the Ammonia Plant.

(*d*) The targets were higher than the attainable capacities in 1972-73 and 1973-74. The former were fixed after taking into account the additional production expected from implementation of the Supplementary Gasification Scheme.

(i) It will be seen that during the years 1969-70 to 1976-77 quantities produced were less than the attainable capacity and less than the planned production except for 1976-77. Further upto 1973-74, a substantial portion of methanol was produced from gas diverted from the Ammonia Plant. After 1973-74, less gas was diverted, as the new reformer included in the Supplementary Gasification Scheme had been installed. An analysis of the

reasons for shortfall made in the Production and Efficiency Report indicated that process troubles and stabilisation, low equipment performance, leaks in the reformer and harp assembly and high stocks of methanol (in 1974-75 and 1975-76)—were mainly responsible for non-attainment of capacity upto 1975-76.

The Ministry have stated (July 1978) as follows :—

> "The main problem in the Methanol Plant was the capacity limitation of the reformer and the unsatisfactory nature of the catalyst. The reformer has design deficiencies and even with the best catalyst available in the market, only 60 per cent of the capacity utilisation was possible. With supplementary gasification, the plant is producing to full capacity".

(ii) It was noticed from the accounts of the Unit for 1969-70 and 1971-72 that 4,139 tonnes of methanol were also imported during these years. These imports and direct import, if any, of methanol and of intermediate products based on methanol by actual users were necessitated by the poor production of the Plant.

(iii) After installation of the new reformer 'Selas' included in the Supplementary Gasification Scheme, the old reformer (Girdler) with gasification section for production of methanol was utilised to a negligible extent; gas produced from the section being 2955 tonnes in 1974-75, 232 tonnes in 1975-76 and 2248 tonnes in 1976-77. There was no production from the old reformer in 1977-78.

11. *Stream efficiency.*—After providing for normal down time, Ammonia and Urea Plants are expected to have a stream efficiency of 330 days in a year and Complex Fertilizer and Methanol Plants a stream efficiency of 300 days per year. In Appendix I is incorporated the normal and actual down-time of these plants from 1969-70 to 1977-78 and the principal reasons for excessive down-time. It will be seen that :

(a) the stream efficiency of all the plants upto 1975-76 and Complex Fertilizer Plants upto 1977-78 was much lower than the stream efficiency envisaged ;

(b) lower stream efficiency was mainly caused by longer maintenance time, process troubles and stabilisation, raw material limitation (applicable to urea and complex fertilizers only) and labour trouble (in 1973-74 only) ; and

(c) excessive down-time in 1971-72 to 1973-74 in the Complex Fertilizer Plant, in 1976-77 and 1977-78 in the Urea Plant and in 1977-78 in the Methanol Plant was more than made good by the over-rated production.

A preventive maintenance schedule is prepared in advance every year to reduce excessive down-time and progress is discussed in the quarterly production performance reports. A technical cell was also created (1971-72) to investigate major break-downs and to suggest remedial measures.

12. *Overall nitrogen efficiency* :—The nitrogen efficiency represents the ratio of nitrogen present in the input to the nitrogen available in the end product. The Unit does not work out the nitrogen efficiency in respect of each product (*e.g.* urea, complex fertilizers and various industrial products) separately and compare it with the norms laid down therefor. The overall nitrogen efficiency of all the products taken together is computed. The statistics so compiled indicated the following overall efficiency during 1970-71 to 1977-78 :—

	1970-71	1971-72	1972-73	1973-74	1974-75	1975-76	1976-77	1977-78
Overall percentage of nitrogen efficiency .	85.5*	87.7	89.6*	88.3	86.1	84.2	87.8	88.4

*As per Annual Reports of the Corporation, the figures are 84 per cent for 1970-71 and 89.8 per cent for 1972-73.

It may be mentioned that no product-wise standards for nitrogen efficiency have been laid down by the Corporation in respect of Trombay Unit. The Unit stated (April 1977) that it

had indicated the standards to control the various efficiencies internally in its monthly Production and Efficiency Reports. Standards and actual efficiencies attained in respect of urea and suphala during 1973-74 to 1977-78 were as follows :—

Product	Standard	Actual				
		1973-74	1974-75	1975-76	1976-77	1977-78
Urea	88.7	88.9	86.3	82.5	89.4	89.9
Suphala 15 : 15 : 15	92.1	92.5	90.08	89.1	92.3	91.2
20 : 20 : 0	91.3	Not produced		90.9	89.9	90.6

It has further been clarified (April 1977) by the Unit that standard nitrogen efficiency in respect of suphala had been computed on the basis of 60 per cent P_2O_5 from phosphoric acid and the balance from di-ammonium phosphate for 15 : 15 : 15 grade and use of phosphoric acid for 20 : 20 : 0 grade ; these efficiencies were only indicative and yet to be established based on the actual use of phosphoric acid. As it was not possible to use various constituent raw-materials in the proportion adopted for the fixation of standards, co-relation of actual efficiency against the standards was not practicable.

13. *Usage efficiencies*

13.1 *Introduction.*—Because of design and equipment deficiencies mentioned earlier, consumption of raw materials, utilities, etc., in the original plant complex (Trombay I and II) was more than the designed norms.

In its report submitted in May 1968, the Tendolkar Committee had recommended the following specific consumption figures of principal raw materials when sustained and steady operation of the plants was achieved :—

(i)	Naphtha per tonne of ammonia	764 Kgs.
(ii)	Ammonia per tonne of urea	650 Kgs.
(iii)	Ammonia per tonne of nitric acid	304 Kgs.
(iv)	Sulphur per tonne of sulphuric acid	340 Kgs.

In January 1971 a further review of consumption norms for all Units of the Corporation was entrusted to a Technical Committee headed by Shri Tendolkar. On the Trombay Unit, the Committee observed that :—

> "Trombay has not been able to achieve the current accepted norms (except occasionally as shown in the best achievement) in the last two years. It is, therefore, considered necessary that Trombay should attempt to achieve the present accepted norms on the yearly average, before the Trombay norms are revised. We do not feel that there is any necessity to raise consumption figures than the current accepted norms".

The accepted norms *vis-a-vis* the guaranteed norms are indicated below :—

	Guaranteed as per design	Accepted norms
(i) Naphtha per tonne of ammonia	764 Kgs.	800 Kgs.
(ii) Power per tonne of ammonia	1452 KWH	1926 KWH
(iii) Steam per tonne of ammonia	1309 Kgs.	1509 Kgs.
(iv) Ammonia per tonne of urea	620 Kgs.	630 Kgs.
(v) Power per tonne of urea	213 KWH	252 KWH
(vi) Steam per tonne of urea	2467 Kgs.	2200 Kgs.
(vii) Ammonia per tonne of nitric acid	304 Kgs.	304 Kgs.
(viii) Power per tonne of nitric acid	295 KWH	319 KWH
(ix) Naphtha per tonne of methanol	982 Kgs.	1400 Kgs.
(x) Power per tonne of methanol	654 KWH	996 KWH
(xi) Sulphur per tonne of sulphuric acid.	340 Kgs.	360 Kgs.
(xii) Power per tonne of sulphuric acid	60 KWH	60 KWH

NOTE :—Because of adoption of the new process for the production of complex fertilizer, the guaranteed figures of consumption as in the design were not applicable. The Committee recommended norms of consumption of raw materials for the complex fertilizer of 20 : 20 : 0 composition, production of which was discontinued from 1972-73. These figures have not, therefore, been indicated.

13.2 *Consumption efficiency*.—A comparative study of the actual consumption of principal raw materials and utilities in the various plants (fertilizer as well as industrial chemical plants) with the design norms and accepted norms for the years 1969-70 to 1977-78 is indicated in Appendix II. It will be seen that the guaranteed norms were, by and large, revised upwards and actual consumption was higher than the revised norms in the following cases :—

(1) Naphtha and steam per tonne of ammonia in all the years except for naphtha in 1972-73 and steam in 1976-77 and 1977-78.

(2) Ammonia per tonne of urea in all the years except in 1971-72 to 1973-74 and 1976-77 and 1977-78. Consumption of ammonia per tonne of urea reached the figure of 676 Kgs. in 1975-76 against the accepted norm of 630 Kgs. and design norm of 620 Kgs. Excess consumption of ammonia with reference to the accepted norm of 630 Kgs. on 0.80 lakh tonnes of urea produced in 1975-76 was of the order of 3680 tonnes valued at Rs. 68 lakhs approximately.

(3) Sulphur per tonne of sulphuric acid in 1969-70, 1974-75 and 1975-76 (in 1970-71 to 1973-74 and 1976-77 to 1977-78 consumption was much below the norm).

(4) Power per tonne of urea in 1969-70, 1970-71 and 1972-73 to 1974-75.

(5) Steam per tonne of urea in 1969-70, 1972-73, 1973-74 and 1974-75.

(6) Power per tonne of methanol in all the years, except in 1974-75 to 1977-78. Steam per tonne of methanol varied widely from year to year.

(7) Consumption of naphtha per tonne of methanol was higher than the design norms for selas Reformer upto 1977-78.

The incidence of excess consumption over the accepted norms, computed by the Management and reported to the Board in July 1975 after allowing for the savings arising from consumption lower than the accepted norms in certain cases was Rs. 120.24 lakhs for 1974-75. Out of this, Rs. 71.84 lakhs were accounted for by higher consumption of naphtha alone. The following facts also deserve mention :

(a) Raw materials and utilities consumed for production of suphala of 15 : 15 : 15 composition have varied widely from the norms laid down by the Unit. Similarly, wide variations have been noticed in the consumption of raw materials, power, etc. used in the production of concentrated nitric acid, phosphoric acid and methylamines as compared with the design norms.

The Corporation has stated (February 1977) that consumption was higher than the design norms in respect of Concentrated Nitric Acid, Phosphoric Acid and Methylamines Plants as the Plants had to be shut down and started due to equipment problems.

(b) The Mahadevan Committee which had reviewed the norms mentioned in the Tendolkar Committee Report had made the following observations in its report of July 1971 :—

(i) *Ammonia Plant.*—With the considerable operating experience, efforts should be made to reduce the steam input to the reactor to the flow sheet level and consequently reduce the oxygen consumption. It was an anomaly that the Trombay Plant with a vapour naphtha feed required more naphtha per tonne of ammonia as compared with the Gorakhpur Plant which was on liquid feed. Suitable steps should be taken to reduce the consumption of naphtha.

(ii) In the following cases, a lower norm of consumption was recommended :—

	Accepted norm	Recommended norm for	
		I & II qtrs.	III & IV qtrs.
Power per tonne of ammonia (KWH)	1926	1800	1700
Steam per tonne of ammonia (Kgs.)	1509	1400	1300
Ammonia per tonne of urea (Kgs.)	630	620	610
Steam per tonne of urea (Kgs.)	2200	2000	1800
Ammonia per tonne of nitric acid (Kgs.)	304	300	295
Power per tonne of nitric acid (KWH)	319	310	300
Sulphur per tonne of sulphuric acid (Kgs.)	360	340	330

It will be seen from the data given in appendix-II that there was no reduction in the consumption of naphtha per tonne of ammonia ; instead it was continuously higher (except in 1972-73) than the prevalent norm. Similarly, the Plant could not, by and large, achieve the reduced norms of consumption recommended by the Mahadevan Committee.

In this connection, the Ministry have stated (November 1978) as follows :—

(i) The Mahadevan Committee's report was only a study and the norms suggested by it were not final. Following the study of Mahadevan Committee, another Committee (Kachwaha Committee) was appointed in 1975. The Committee has already (March 1977) given its recommendations.

(ii) Regarding the consumption of naphtha, Mahadeven Committee had recommended reduction of steam input in the reactor. The attempted reduction has resulted in more failures of the feed stock pre-heater coils, whereupon the steam flow has been restored to original figures.

(c) Instead of computing the consumption of a raw material during the year by totalling the actual consumption recorded every month, it is derived for accounts purposes indirectly by deducting the closing stock from the opening stock plus the receipt of raw material during the year. The quantities in the opening and closing stocks of raw materials, stored in bluk, are computed by a survey. The consumption of raw materials, is thus computed and not, in any sense, directly measured. The figures of consumption so derived differed from those shown as consumed in the production records. Losses, if any, arising among other things, from pilferage, spillage, bags not accounted for and excess filling of bags, would also remain undetected under the present method of computing consumption.

In regard to the method of computation of consumption, the Tendolkar Committee in its Report of May 1968/January 1971 had also observed as follows :—

(i) "The Committee's recommendations include putting in more extensive as well as more reliable means for quantitatively assessing all the important outputs from the respective plants. Till such means of measurement are in position, the Committee feels it can at best give broad outlines for a basis on which these figures can be assessed for the purposes of costing and accounting..... Such a study can possibly be taken up after the plant attains and maintains a fairly steady and sustained operations and the principal means of measuring the main inputs and outputs are standardised on reliable basis."

(ii) "There is no accurate way of measuring the quantity of sulphur fed to the plant.....".

The Corporation has stated (February 1977) that :—

(i) The monthly consumption of all raw materials and intermediary products is summed up on the basis of the daily recordings indicated by flow meters and weighto-meters. The consumption figures read off the instruments are subject to accepted tolerance limits. In rare occasions when there is a failure of the instruments, consumption may also have to be reported on the basis of immediately preceding trend. Thus, the reported consumption could not be taken as 100 per cent correct especially where bulk items are fed into the process. For the purpose of accounts, the shortages or excesses noticed in the surveys are adjusted as part of consumption.

(ii) For measuring the quantity of sulphur fed to the Plant, the Unit was not able to locate a reliable meter. A special type meter had since been located and was being imported.

(d) Norms for consumption of certain chemicals such as caustic soda, potassium carbonate, mono-ethanol-amine etc., in the production of ammonia, etc. have not been laid down. No attempt has been made to analyse whether consumption of these chemicals is at optimal level. The Corporation has stated (February 1977) that the consumption of these items is related more to time than to production and that their consumption is reviewed from time to time with reference to past data.

14. *Profitability analysis*

The Unit commenced production in November 1965. Except for 1968-69 when a profit of Rs. 40.46 lakhs was earned, it incurred losses upto 1969-70; the cumulative loss upto 31st March 1970, after taking into account the profit earned in

1968-69 was Rs. 10.74 crores. Thereafter, the Unit has been earning profits excepting for 1975-76 when it incurred a net loss of Rs. 1.39 crores.

As on 31st March 1978, the cumulative profit, after adjusting the losses, was Rs. 26.65 crores.

Sales, expenditure and profits made/loss incurred from 1969-70 to 1977-78 were as under :-

(Rs. in crores)

Income	1969-70	1970-71	1971-72	1972-73	1973-74	1974-75	1975-76	1976-77	1977-78
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
I. Net Sales	20.42	29.20	33.84	36.23	48.56	59.83	@	@	@
II. Other income	0.15	0.26	0.29	0.52	0.48	0.42	0.65	0.76	1.17
III. Closing stock	3.87	3.42	1.01	0.21	2.36	9.52	13.72	10.89	1.86
IV. Transfer of stock to other Units	0.42	1.34	6.60	4.28	2.04	7.45	59.04*	76.54*	81.09*
V. Subsidy on Urea								—	1.42
VI. Subsidy on Complex Fertilizers								3.93	4.25
Total	24.86	34.22	41.74	41.24	53.44	77.22	73.41	92.12	89.79

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Expenses									
I. Opening stock	1.98	3.87	3.42	1.01	0.21	2.36	9.52	13.72	10.89
II. Purchase of finished goods	0.17	1.66	5.07	0.63	13.45	10.90	—	—	—
III. Transfer of stock from other Units	6.56	6.98	4.68	3.24	1.29	2.01	—	—	—
IV. Material consumed	5.63	7.93	10.38	12.23	14.44	28.66	34.56	34.72	30.19
V. Salaries and wages	1.09	1.26	1.44	1.60	1.91	2.56	2.40	2.46	3.16
VI. Power and fuel	2.27	2.51	2.95	3.16	4.15	7.54	10.01	11.42	12.47
VII. Freight and handling charges	0.53	0.81	2.09	1.11	0.30	0.65	1.21	2.24	2.25
VIII. Excise duty	0.89	0.65	0.61	0.80	0.85	1.07	4.10	5.58	7.28
IX. Other expenses (including share of the central office expenses, training expenses, provision for doubtful debts etc.)	1.02	1.40	1.72	1.43	1.50	2.21	3.14	4.68	5.66
X. Repairs and maintenance	1.70	1.34	1.97	2.17	1.89	3.21	4.43	5.80	6.26
XI. Interest	2.01	1.74	1.46	1.51	1.15	0.79	1.65	1.73	1.03
XII. Depreciation	3.39	3.43	3.47	4.21	4.36	4.97	2.97	2.44	2.69
XIII. Profit on operations	(—)2.38	0.64	2.48	8.14	7.94	10.29	(—)0.58	7.33	7.91
TOTAL	24.86	34.22	41.74	41.24	53.44	77.22	73.41	92.12	89.79
XIV. Net profit after past period adjustments	(—)3.02	0.31	2.48	6.71	4.71	10.11	(—)1.39	7.59	6.87

@The accounts of the West South Marketing Zone which started functioning separately from Trombay Unit have been separated from the Unit's accounts from Ist April 1975.

*Excludes pool equalisation charges of Rs. 2.68 crores in 1975-76, Rs. 1.56 crores in 1976-77 and Rs. 0.77 crore in 1977-78.

In this connection, the following facts deserve mention :—

(a) Sales/transfer of stocks to other units and industrial products increased from Rs. 20.42 crores in 1969-70 to Rs. 76.54 crores in 1976-77 and Rs. 81.09 crores in 1977-78, of which transfer of industrial products accounted for Rs. 20.38 crores (27 per cent of the total) in 1976-77 and Rs. 22.61 crores (28 per cent of the total) in 1977-78. A major portion of turnover of industrial products was contributed by the sale of methanol.

(b) Profit or loss for each product is not worked out by the Unit. However, profit/loss statement as prepared on the basis of final accounts and furnished by the Ministry in November 1978 indicated the following trends in the profitability of different products :—

Product	Profit (+)/Loss(—) (Rs. in lakhs)					
	1972-73	1973-74	1974-75	1975-76	1976-77	1977-78
(1) Fertilizers						
(i) Urea	(—)69	(—)131	(—)311	(—)464	(—)139	(—)44
(ii) Suphala	536	549	700	106	403	238
(2) Industrial Products						
(i) Methanol	91	85	326	276	303	365
(ii) Others	250	247	106	12	167	229
(3) Imported/Other Units' products	4	43	204	9	(—)2	..

(c) There was a substantial increase in expenditure on materials consumed, power and fuel and on repairs and maintenance in 1974-75 as compared with 1973-74, mainly on account of (i) increase in the prices of naphtha, rock phosphate, di-ammonium phosphate, muriate of potash, sulphur, power, fuel oil and refinery gas, (ii) higher rate of specific consumptions and (iii) major repairs to the plant; increase in expenditure on these heads was Rs. 18.93

crores. Nevertheless, the profit on suphala increased from Rs. 5.49 crores in 1973-74 to Rs. 7.00 crores in 1974-75 because of an increase in the average selling price of suphala from Rs. 1,022.92 per tonne in 1973-74 to Rs. 1,733.90 per tonne from 1st June, 1974. The average sale price of urea was also increased from Rs. 871.79 per tonne in 1973-74 to Rs. 1,150.94 per tonne in 1974-75. This increase did not offset the increase in cost, partly because the capacity of the Plant was under-utilised; the loss on urea was higher in 1974-75 than in 1973-74.

(d) In the original budget for 1975-76, the Unit anticipated a profit of Rs. 13.24 crores. This was scaled down to Rs. 0.69 crore in the revised budget for 1975-76 on account of following factors :—

(i) Reduction in the volume of sales and sale price (Rs. 405 lakhs).

(ii) Increase in the cost of materials and utilities and specific consumption; the use of imported ammonia and sulphuric acid procured indigenously from outside sources alone accounted for increase in cost by Rs. 1.76 crores as compared with the cost of production of these items in the Unit's own Plants.

(iii) Increase under fixed costs and other items.

(iv) Payment of excise duty on suphala.

The Unit actually closed the financial year with a loss of Rs. 1.39 crores after taking into account past period adjustments.

(e) The improvements in working results during 1976-77 and 1977-78 were mainly on account of subsidy on urea and complex fertilizers (Rs. 393.45 lakhs during 1976-77 and 567.24 lakhs in 1977-78) and

also increase in production and sale of fertilizers and industrial products.

(f) The cumulative profit of Rs. 26.65 crores upto 31st March, 1978 excludes the following contested liabilities and accruals which can be anticipated :—

(i) Differential duty of Rs. 4.47 crores payable on naphtha utilised for purposes other than manufacture of fertilizers (refer paragraph 10.1.2).

(ii) Duty of Rs. 15.08 crores demanded by the Excise Authorities for the period, March 1970 to February 1975 at 15 per cent *ad valorem* on the production of suphala. The Corporation approached the Ministry of Finance for exemption from payment of duty but the request was rejected and the Corporation was asked to pay the duty by 31st March, 1978. Payment has not, however, been made so far (November 1978). This may be reduced by the duty drawback of Rs. 4 crores admissible on the imported raw materials used in its manufacture during the same period.

15. *Cost control*

15.1 *System.*—As in the case of other Units, Trombay Unit is also following a system of process costing for ascertaining the cost of production of the various end products and intermediate products.

The following features of the system deserve mention :—

(a) While the product-wise costs are worked out, profit or loss is not worked out for each product and reconciled with the profit or loss shown in the financial accounts. The Corporation has stated (February 1977) that whenever there was any significant change in the input or output, the product-wise profitability was worked out invariably.

(b) Based on the plan of production as mentioned in the original budget estimates and the revised estimates, the variable and fixed costs of each product are estimated and actual costs based on actual production are compared *inter - se*. The estimates of cost so drawn up are treated as standard costs. In certain cases, standard costs differ from these estimates on account of the adoption of a different volume of anticipated production.

As stated above, the estimated costs of production are based on the revenue budgets for a given volume of production for a particular period. The establishment of standard costs, based on the attainable capacity and norms of consumption for raw-materials and utilities, and the calculation of variances between these standard costs and the budgeted and actual costs, would serve as a more effective managerial tool for purposes of cost control.

15.2 *Actual costs*

Standard costs fixed in the manner described above and the actual costs of production in the years 1975-76 to 1977-78 are given in Appendix III.

An analysis of the data given in the Appendix indicates the following features :—

(a) The budgeted cost varied widely from year to year in a number of cases, such as ammonia, urea, phosphoric acid, ammonium bi-carbonate, concentrated nitric acid, sodium nitrate/nitrite. As compared with the budgeted cost, actual cost was, by and large, much higher in 1975-76; in 1976-77 and 1977-78, these were, however, lower than the budgeted cost. The increase in actual cost in 1975-76 and decrease in 1976-77 and 1977-78 over the budgeted cost in these years occurred both under variable and fixed elements of cost.

(b) There was sharp decline in the cost of production of a number of products, like ammonia, urea, complex fertilizers, methanol and concentrated nitric acid during 1976-77 and 1977-78 as compared with the data for 1975-76. In the case of sodium nitrate/nitrite and concentrated nitric acid, the cost of production varied widely from year to year.

16. *Material management and inventory control*

16.1 *Inventory holdings.*—The following table indicates the break-up of inventory holdings as at the end of last two years :—

(Rupees in lakhs)

	As on 31st March 1977	As on 31st March 1978
1. RAW MATERIALS	108.12	313.64*
2. PACKING MATERIALS	17.46	8.61
3. STORES AND SPARES		
(i) Chemicals	24.91	30.34
(ii) Catalysts	53.20	110.21
(iii) General Stores	72.80	59.37
(iv) Regular consumable stores	391.05	457.72
(v) Petrol, Oil & Lubricants	8.12	8.81
(vi) Insurance Spares	163.13	186.39
(vii) Surplus Stores	49.99	51.43
(viii) Construction Stores	3.89	2.99
(ix) Fuel Oil	4.30	2.37
(x) Low Sulphur Heavy Stock	..	28.16**
(xi) High Speed Diesel Oil	..	0.49**
	771.39	938.28
4. FINISHED GOODS	1071.34	169.10***
GRAND TOTAL 1 to 4	1968.31	1429.63

*Inventory of Rs. 54 lakhs pertains to Trombay IV being imported rock-phosphate.

**Inventory of Rs. 28.65 lakhs pertains to Trombay IV.

***This figure does not include Trombay Unit's stock of finished goods held by West South Marketing Zone amounting to Rs. 610.41 lakhs.

(a) The increase in the inventory of stores and spares as on 31st March, 1978 has been stated (November 1978) to be due to addition of new items for the Expansion plant as well as rise in prices.

(b) An A.B.C. analysis of some of the stores and spare parts as on 31st March, 1978 indicated the following position :—

Category of items	No. of items	Value of annual comsumption (Rs. in lakhs)	Percentage of total annual consumption	Value of stock as on 31-3-1978 (Rs. in lakhs)
A. Class	960	375.49	89.31	196.13
B. Class	2260	39.56	9.41	67.48
C. Class	4236	5.38	1.28	13.66
No movement	31218	..	..	552.10
	38674	420.43	100.00	829.37

It will be seen that items with no movement aggregated Rs. 552.10 lakhs and constituted over 67 per cent of the value of the total inventory of stores and spares.

16.2 *Stock verification*

Annual physical verification of stores has revealed significant shortages and excesses each year since 1969-70. The shortages and excesses found in the years 1972-73 to 1975-76 were as

follows (Data for 1976-77 and 1977-78 were not made available) :—

(Quantity in tonnes & value in lakhs of Rupees)

Description	Excesses								Shortages							
	1972-73		1973-74		1974-75		1975-76		1972-73		1973-74		1974-75		1975-76	
	Qty.	Value	Qty.	Value	Qty.	Value	Qty.	Value	Qty.	Value	Qty.	Value	Qty.	Value	Qty.	Value
Raw materials																
Rock phosphate	—	—	1068	5.10	—	—	—	—	602	1.23	—	—	268	2.03	706	4.08
Di-ammonium phosphate	2644	23.54	78	0.80	—	—	93	2.11	—	—	—	—	1523	37.37	—	—
Sulphur	—	—	42	0.16	—	—	—	—	50	0.17	—	—	1296	10.73	742	5.79
Muriate of Potash	—	—	—	—	980	10.89	—	—	709	3.22	2138	14.05	—	—	436	4.60
Ammonia	—	—	—	—	—	—	—	—	—	—	—	—	—	—	724	7.96
TOTAL		23.54		6.06		10.89		2.11		4.62		14.05		50.13		22.43
Finished products																
Urea	259	2.01	347	2.74	425	4.29	131	1.54	—	—	—	—	—	—	—	—
N.P.K.	7653*	43.79	942*	6.28	—	—	—	—	—	—	—	—	3357*	40.72	2595@	38.71@
TOTAL		45.80		9.02		4.29		1.54						40.72		38.71

*Indicates suphala 15:15:15

@Includes 2009 tonnes of suphala 15:15:15 valued at Rs. 28.23 lakhs, 61 tonnes of suphala 20:20:0 valued at Rs. 0.88 lakh and 525 tonnes of A.P.S.N. 20:20:0 valued at Rs. 9.60 lakhs.

The shortages and excesses referred to above were noticed on the basis of physical verification conducted on survey basis and adjusted in the accounts of respective years. The main reasons attributed for shortages and excesses noticed were :—

1972-73 : The net excess in suphala constituted 3.05 per cent of the total production. It was attributed to total system errors, such as machine variation, starvation switch error, etc. and inaccuracy of measurement.

Shortages in rock phosphate, muriate of potash and sulphur were considered within the accepted range of variation.

Excess in di-ammonium phosphate represented 4.8 per cent of the total quantity handled and was due to variation in bulk density and error in reporting consumption.

1973-74 : No reasons for excess in urea and suphala were given by the Committee constituted to report in the matter, or for the shortages in muriate of potash which was 3.24 per cent of the total quantity received.

Excess in rock phosphate represented 2.28 per cent of the quantity handled and could be due to survey error.

1974-75 : The net shortage in suphala was 1.59 per cent of the total production and was attributed to normal handling loss and to probable errors in reporting production and in survey.

Net excess in urea represented 0.73 per cent of the total production and was considered normal. Similarly, the shortage in rock phosphate was considered negligible.

Net shortage in di-ammonium phosphate represented 4.17 per cent of the total quantity handled. Apart from normal handling loss and under-statement of issues there was an extra-ordinary loss on account of unexpected leakage in the silo during monsoon.

Shortage in sulphur represented 8.22 per cent of the total quantity handled. The loss was due to formation of sulphur sludge, furnace leakage and interrupted operations, loss in handling and storage, etc.

Excess in muriate of potash represented 1.82 per cent of the total quantity handled and was mainly due to over-reporting of consumption by the feeding machine.

1975-76 : Shortage of rock-phosphate represented 1.04 per cent of quantity purchased and was considered normal.

Shortage of sulphur represented 6.72 per cent of the quantity purchased. The loss was due to formation of sulphur sludge, leakages and interrupted operations and over-reporting of consumption on the basis of design figure.

Net shortage of muriate of potash was 1.12 per cent of quantity purchased and was attributed partly to under-reporting of consumption and partly to normal loss.

Shortage of ammonia represented 8.1 per cent of the ammonia received through tank wagons. The shortage has been attributed to problems in decanting the wagons fully and also partly due to errors in reporting consumption and production which were not adjusted on day-to-day basis.

Net shortage in suphala (15 : 15 : 15) which represented 1.1 per cent of the total production, was considered normal. Similarly, shortage of suphala (20 : 20 : 0) which represented 0.3 per cent of the total production, was considered negligible.

Shortage of A.P.S.N. was 4.15 per cent of the total production. Although Committee was of the

opinion that survey results could not be taken as final, it recommended adjustment of shortage as a measure of prudence.

Excess in urea was after adjusting a quantity of 12.192 tonnes received short by the Marketing Department and represented 0.2 per cent of total production.

The Board had desired that detailed reports should be submitted in respect of shortage of :

(i) di-ammonium phosphate valued at Rs. 37.37 lakhs found in 1974-75 (report to include loss by leakage in the silo during monsoon); and

(ii) sulphur valued at Rs. 5.79 lakhs and A.P.S.N. (20 : 20 : 0) valued at Rs. 9.60 lakhs found in 1975-76.

As regards loss of ammonia left over in the tank wagons noticed in 1975-76, the Board decided that the matter should be taken up with Indian Farmers Fertilizers Co-operative Limited and understanding reached with them regarding sharing of the loss. The Ministry have stated (July 1978) that IFFCO has not yet agreed to share the loss.

As regards the shortage of di-ammonium phosphate, the Corporation stated (February 1977) that :

The report was submitted by the General Manager in July 1976 and put up to the Board in August 1976. According to the report which was noted by the Board, the shortage in relation to total P_2O_5 input and output (after taking into account the consumption of rock phosphate, di-ammonium phosphate and phosphoric acid in 1974-75) was only 1.32 per cent and could be considered within reasonable limits. As regards measurement of loss

on account of leakage in silo, the report indicated that this had been noted for the future.

It may also be mentioned that the Board had appointed in August 1970 a firm of chartered accountants at a fee of Rs. 0.36 lakh to review the system of measurement and computation of inputs and outputs. The firm, in its report submitted in July 1971, stated that :—

(a) Stock differences arose due to absence of measuring device, incorrect recording, limitation of physical verification, spillage losses, losses arising from excess filling and unaccounted despatches, etc.

(b) Existing procedures and records were totally inadequate.

(c) There was inadequate control on issue and consumption of empty bags.

(d) The existing practice of writing off shortages determined at the year end was erroneous and misleading.

The report of the firm was considered by the Internal Consultative Committee of the Corporation in January and April 1972. While the Committee accepted certain recommendations made by the firm, others were remitted to two separate Committees, one of the Committees was to fix norms for losses in respect of raw materials and finished products and the other was to finalise a manual on receipt and consumption of raw materials, reporting of production, despatch of finished products and physical verification of raw materials and finished stocks. The first Committee submitted its report in April 1975 which, after being considered by the Internal Consultative Committee in September—December 1975 and May 1976, was remitted by the Board of Directors (February 1977) to a Committee of 4 Directors for taking a final decision on behalf of the Board;

this is awaited (December 1978). The Report of the second Committee was submitted in January 1976 and is yet (December 1978) to be considered by the Internal Consultative Committee.

T. Rengachari

NEW DELHI ;
The 23-4-1979

(T. RENGACHARI)
Chairman, Audit Board and
Ex-officio Additional Deputy
Comptroller and Auditor General (C)

Countersigned

Gian Prakash

NEW DELHI ;
The 23-4-1979

(GIAN PRAKASH)
Comptroller and Auditor General of India

APPENDICES

APPENDIX—1

(Referred to in Paragraph 11)

Statement showing the details of normal downtime and actual downtime of Ammonia, Urea, Complex Fertilizer and Methanol Plants together with the reasons for excessive downtime

A. Actual downtime and normal downtime.

Plant	69-70	70-71	71-72	72-73	73-74	74-75	75-76	76-77	77-78
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
					—days—				
Ammonia									
Actual downtime	136	107	92	79	98	139	135	71	71
Normal downtime	35	35	36	35	35	35	36	35	35
	101	72	56	44	63	104	99	36	36
Less over-rated production	—	—	—	7	5	—	—	—	—
Excess downtime	101	72	56	37	58	104	99	36	36
Loss of production (in tonnes) 320 tonnes per day upto 1973-74; 350 tonnes per day from 1974-75 onwards	32320	23040	17920	11840	18560	36400	34650	12600	12600
Urea									
Actual downtime	181	182	190	212	205	174	110	40	38
Normal downtime	35	35	36	35	35	35	36	35	35
	146	147	154	177	170	139	74	5	3
Less over-rated production	9	30	27	33	29	7	12	22	26

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Excess downtime	137	117	127	144	141	132	62	(—)17	(—)23
Loss of production (tonnes)	41100	35100	38100	43200	42300	42240	18600	(—)5100	(—)6900
320 tonnes per day in 1974-75, rest 300 tonnes per day.									
Complex Fertilizers									
Actual downtime	191	167	93	102	113	115	122	113	138
Normal downtime	65	65	66	65	65	65	66	65	65
	126	102	27	37	48	50	56	48	73
Less over-rated production	8	30	66	148	15	13	46	20	4
Excess downtime	118	72	(—)39	(—)111	33	37	10	28	69
Loss in Production (Tonnes)	70800	43200	(—)23400	(—)66600	(—)26400	29600	6980	30800	75900
600 tonnes per day upto 1972-73 and 800 tonnes per day from 1973-74.									
Loss in 1975-76 at 700 tonnes for 15: 15: 15 and 600 tonnes for 20:20:0 For 1976-77 and 1977-78 the break-up is not available.									

Methanol									
Actual downtime	216	132	109	102	133	122	141	74	32
Normal downtime	65	65	66	65	65	65	66	65	65
	151	67	43	37	68	57	75	9	(—)33
Less over-rated production	..	1	8	3	..	..	..	9	14
Excess downtime	151	66	35	34	68	57	75	—	(—)47
Loss of production (tonnes) at 60 tonnes per day upto 1973-74 and 120 tonnes from 1974-75 onwards	9060	3960	2100	2040	4080	6840	9000	—	(—)5640

B. Reasons for Excessive downtime.

Reasons	1969-70	1970-71	1971-72	1972-73	1973-74	1974-75	1975-76	1976-77	1977-78
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Maintenance of Plants									
Ammonia	45	22	32	18	33	56	36	15	7
Urea	48	60	42	2	7	33	58	13	8
Complex Fertilizers	60	45	30	39	30	49	59	61	80
Methanol	23	29	20	23	26	46	6	18	9
Planned Shutdown									
Ammonia	54	21	21	19	25	26	24	19	22
Urea	28	17	14	23	9	9	17	10	10
Complex Fertilizers	12	23	16	18	26	11	11	18	21
Methanol	83	43	21	36	46	30	38	39	21
Process troubles & stabilisation									
Ammonia	10	15	16	19	2	3	4	4	1
Urea	7	3	2	2	3	3	3	2	1
Complex Fertilizers	77	60	25	20	13	12	15	17	24
Methanol	48	49	32	4	4	1	2	—	—
Raw material limitation									
Ammonia	—	6	—	—	3	—	—	—	—
Urea	92	89	132	185	167	83	17	12	12
Complex Fertilizers	42	38	22	20	14	29	15	17	9
Methanol (bad quality Naphtha)	41	—	—	—	—	—	—	—	—

*Power failure & Fluctuation**									
Ammonia	2	2	8	12	12	21	21	10	13
Urea	—	—	—	—	—	5	11	1	3
Complex Fertilizers	—	—	—	—	0.1	0.2	7	—	—
Methanol	2	4	2	10	5	2	29	—	1
Labour trouble, strike & shutdown									
Ammonia	—	—	—	—	14	—	—	—	—
Urea	—	—	—	—	18	—	—	—	—
Complex Fertilizers	—	—	—	—	23	2	—	—	—
Methanol	—	—	—	—	—	1	—	—	—
Low equipment performance									
Ammonia	—	—	—	—	—	—	—	22	23
Urea	—	—	—	—	—	—	—	—	—
Complex Fertilizers	—	—	—	—	—	—	—	—	4
Methanol	—	—	—	—	—	—	—	14	—

*including low and fluctuating frequency.

APPENDIX—II

(Referred to in Paragraph 13.2)

Statement showing the design norms, accepted norms and actual consumption of raw materials, utilities, etc.

Raw Materials/ Utilities	Unit	Design norms	Accepted norms	Actuals								
				1969-70	1970-71	1971-72	1972-73	1973-74	1974-75	1975-76	1976-77	1977-78
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Ammonia												
Naphtha	M.T.	0.764	*0.800	0.885	0.811	0.824	0.795	0.866	0.877	0.876	0.801	0.806
Power	MWH	1.452	*1.926	2.087	1.898	1.833	1.660	1.768	2.039	2.009	1.710	1.786
Steam	M.T.	1.309	*1.309	2.331	2.173	2.109	1.782	1.891	2.283	2.150	1.471	1.449
Nitric Acid (100%)												
Ammonia	M.T.	0.304	*0.304	0.318	0.316	0.310	0.301	0.302	0.309	0.305	0.305	0.304
Power	MWH	0.295	*0.319	0.326	0.316	0.310	0.293	0.305	0.317	0.316	0.305	0.317
Steam	M.T.	1.300	1.440	1.355	1.312	1.430	1.406	1.440	1.411	1.402	1.454	1.440
Sulphuric Acid												
Sulphur	M.T.	0.340	*0.360	0.361	0.338	0.328	0.341	0.338	0.430	0.361	0.343	0.339
Power	MWH	0.060	*0.060	0.084	0.078 (—)	0.074	0.057	0.064	0.068	0.057	0.058	0.069
Steam	M.T.	1.152	—	0.531	1.012	0.921	0.698	0.718	0.860	0.766	0.637	0.757
Urea												
Ammonia	M.T.	0.620	*0.630	0.759	0.661	0.622	0.618	0.624	0.642	0.676	0.623	0.620
Power	MWH	0.213	*0.252	0.270	0.267	0.252	0.260	0.260	0.275	0.243	0.236	0.239
Steam	M.T.	2.467	*2.200	2.666	2.181	2.180	2.271	2.544	2.389	2.085	2.180	2.192

Methanol

Naphtha:

Selas Reformer	M.T.	1.084	—									
Girdler Reformer	M.T.	0.982	*1.400	1.529	1.258	1.286	1.228	1.373	1.253	1.038	1.109	0.993
Power	MWH	0.654	*0.996	1.635	1.596	1.369	1.445	1.435	0.904	0.884	0.842	0.753
Steam	M.T.	No norm fixed		0.794	1.242	0.586	0.657	0.761	1.023	1.157	1.700	2.902

Suphala (15:15:15)

D.A.P.	M.T.	—	0.190	0.186	0.181	0.191	0.184	0.190	0.195	0.110	0.110	0.043
Rock Phosphate	M.T.	—	0.185	0.190	0.210	0.191	0.182	0.180	0.194	0.190	0.192	0.188
M.O.P. (KCL)	M.T.	—	0.260	0.267	0.245	0.257	0.255	0.271	0.260	0.268	0.262	0.260
Ammonia	M.T.	—	0.070	0.105	0.066	0.071	0.068	0.067	0.073	0.092	0.086	0.099
Nitric Acid	M.T.	—	0.323	0.352	0.319	0.332	0.317	0.320	0.331	0.337	0.326	0.318
Sulphuric Acid	M.T.	—	0.032	0.019	0.026	0.016	0.008	0.011	0.007	0.003	0.019	0.030
Power	MWH	—	0.060	0.065	0.043	0.045	0.035	0.040	0.040	0.047	0.045	0.066
Steam	M.T.	—	0.059	0.013	0.047	0.053	0.059	0.064	0.067	0.072	0.041	0.047

Concentrated Nitric Acid

Nitric Acid	M.T.	1.070	1.038	1.057	1.053	1.065	1.056	1.050
Sulphuric Acid	M.T.	3.250	3.036	3.170	2.624	3.133	3.061	2.931
Power	MWH	*0.030	0.072	0.104	0.075	0.056	0.048	0.044
Steam	M.T.	0.700	0.576	0.858	0.811	0.873	0.664	0.689

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Phosphoric Acid												
Rock Phosphate	M.T.	3.180							4.423	3.156	3.196	3.214
Sulphuric Acid (98%)	M.T.	2.908							3.594	3.126	2.904	2.873
Power	MWH	0.160							1.264	0.534	0.361	0.390
Steam	M.T.	2.300							5.964	4.079	2.717	2.971
Methylamines												
Ammonia	M.T.	0.409							0.734	0.648	0.490	0.509
Methanol	M.T.	1.350							1.828	1.688	1.474	1.541
Power	MWH	Not mentioned							0.616	0.670	1.014	0.704
Steam	M.T.	in the D.P.R.							23.155	19.794	14.280	12.930

Note : 1. Actual consumption is based on the figures booked in cost accounts. Some of these figures do not tally with the specific consumption reported in the Quarterly Production Report for 1973-74 and 1974-75. The Quarterly Production Reports for the earlier period were not available.

2. *Norms of consumption as referred to in the Tendolkar Committee's Report of 1971.

APPENDIX—III

(Referred to in paragraph 15.2)

Statement showing comparative study of budgeted costs and actual costs of production

(Figures in rupees)

Products	1975-76		1976-77		1977-78	
	Budgeted	Actual	Budgeted	Actual	Budgeted	Actual
1. Ammonia*	1311.28	1842.70	2053.90	1538.41	1843.22	1503.10
2. Urea	1363.83	1810.61	1735.01	1379.86	1544.04	1391.58
3. Complex Fertilizers						
(i) 20 : 20 : 0	NA	1563.87	1526.42	1335.02	NA	1429.79
(ii) 15 : 15 : 15	1450.19	1480.80	1429.19	1217.56	1335.88	1224.78
(iii) A.P.S.N. 20 : 20 : 0	—	2036.51	2154.36	1652.54	1840.60	1713.48
4. Methanol	2784.15	2523.49	3061.34	2376.70	2745.80	2191.80
5. Nitric Acid*	431.58	636.24	668.97	506.51	658.73	558.97
6. Sulphuric Acid	258.69	344.31	253.30	279.21	339.78	307.87
7. Phosphoric Acid	—	—	4106.41	3584.20	3464.15	3465.99
8. Ammonium Bicarbonate	948.10	1189.33	1351.15	1258.31	1257.94	1170.87
9. Concentrated Nitric Acid	913.88	2123.62	2304.87	1594.23	2014.39	1473.06
10. Sodium Nitrate/Nitrite	3186.54	4833.56	—	5616.33	4832.09	3928.36
11. Methylamine	—	—	18032.53	18170.84	18152.88	16442.64

* Figures denote cost of production of ammonia and nitric acid used for fertilizer production.

Note : Cost of production of urea excludes production of technical grade urea.

MGIPRRND—S/10 C&AG/78—TSS I—5-4-78—1920

PAG. 66. III. 78
1920—1979 (DSK. III)

Price : *Inland* *Rs.* 11.50.
Foreign £ 1.35 *or* $ 4.14

PRINTED BY THE MANAGER, GOVT. [illegible] A PRESS, RING ROAD, NEW DELHI-110064
AND PUBLISHED BY THE CONTROLLER OF PUBLICATIONS, DELHI-110054, 1979.

MGIPF—113NAL/79—50,000—4-12-79.