



REPORT

OF THE

**COMPTROLLER AND AUDITOR GENERAL
OF INDIA**

UNION GOVERNMENT (COMMERCIAL)

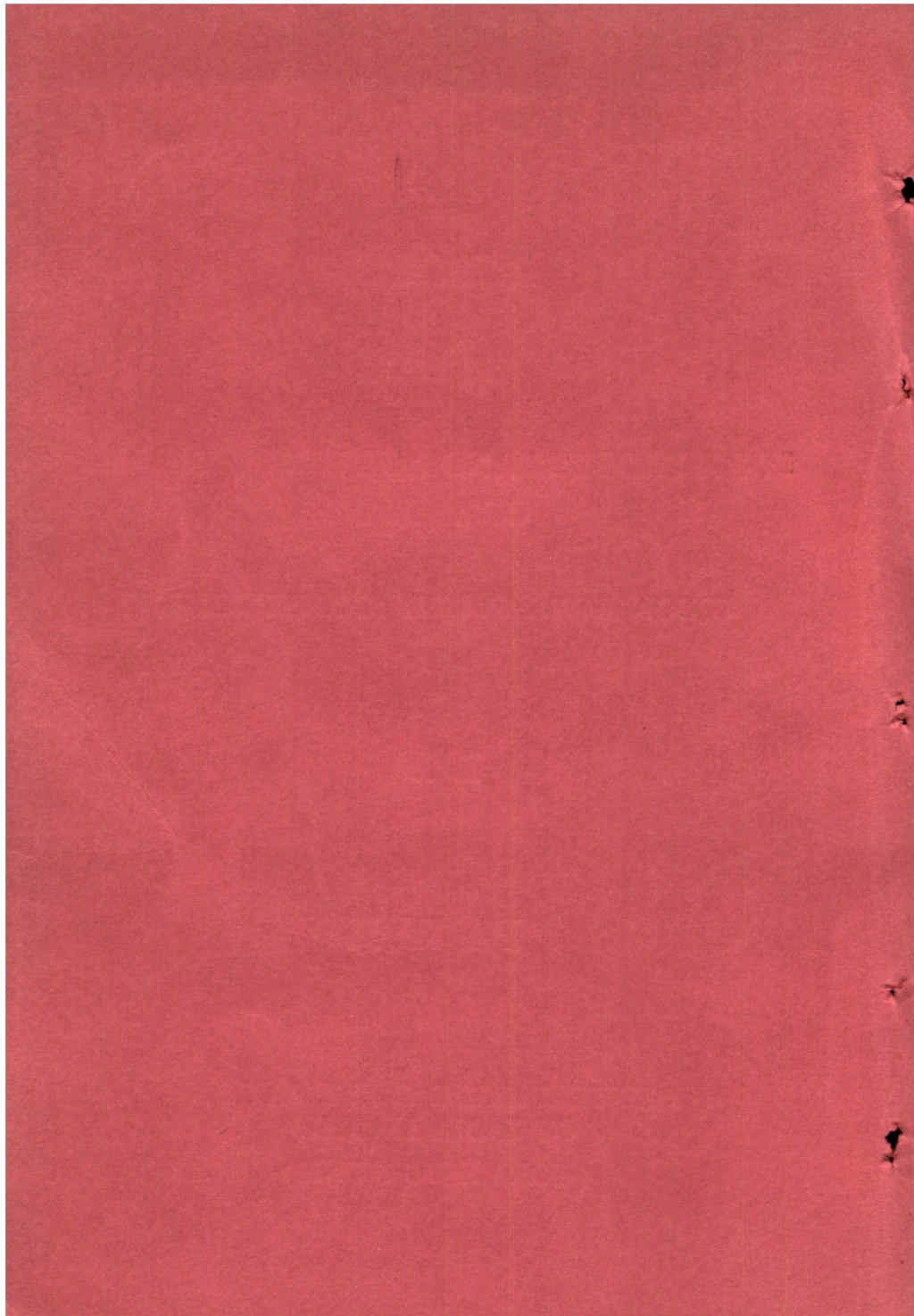
1979

PART II

**THE FERTILIZER CORPORATION
OF INDIA LIMITED
(GORAKHPUR UNIT)**

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THE FERTILIZER CORPORATION OF INDIA LIMITED
(GORAKHPUR UNIT)

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PREFATORY REMARKS

A reference is invited to paragraph 5 of the Prefatory Remarks contained in the Report of the Comptroller and Auditor General of India—Union Government (Commercial) 1978—Part III—the Fertilizer Corporation of India Limited—Trombay Unit wherein it was *inter alia* mentioned that the Reports on the working of other units of the Corporation were under various stages of finalisation.

2. This part contains the results of the appraisal undertaken by the Audit Board of the working of the Gorakhpur Unit (including Gorakhpur Expansion) of the Fertilizer Corporation of India Limited. The Report has been brought up to date by incorporating data up to 1977-78. 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 up to 8th March 1979.

- (6) Shri P. C. Asthana, Member, Audit Board and *Ex-officio* Director of Commercial Audit (Fertilizers and Chemicals), New Delhi with effect from 9th March 1979.
- (7) Shri Paul Pothan, Managing Director, Indian Farmers Fertilizers Co-operative Limited, New Delhi—Part Time Member.
- (8) Shri T. R. Visvanathan, Superintendent, Technical Services, Madras Fertilizers Limited, Madras—Part Time Member.
- (9) 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 Pothan who ceased to be a member in November 1976 consequent upon his appointment as part time non-official Director of the Fertilizer Corporation of India Limited.

3. The Report was finalised by the Audit Board after taking into account;

- (a) the results of discussions held with the representatives of the Ministry of Chemicals and Fertilizers and the Corporation at its meeting held on 19th March 1979, and
- (b) the additional information furnished by the Ministry in April, July and August 1979.

4. 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 and Shri A. S. Krishnamoorthy could not attend the meeting of the Audit Board held on 19th March 1979.

Gorakhpur Unit

1. *Introduction.*—Government had approved in April 1961 establishment of fertilizer factory at Gorakhpur in Uttar Pradesh, designed to produce 1.80 lakh tonnes of urea per annum (equivalent to 80,000 tonnes of nitrogen) by utilising petroleum naphtha from Barauni Refinery as feed-stock. As the foreign exchange cost of the project was to be met from loans offered by Japan, orders for the main plant and equipment were placed with a consortium of Japanese engineering firms.

The site for the factory was provisionally selected in March/April 1961 near Kusmi air strip. In November 1961, it came to the notice of the project authorities that the military authorities wanted to develop Kusmi air strip and, as such, there were objections to locating tall structures at the site from the Defence authorities. The site had, therefore, to be shifted and a new site was selected in April/May 1962. The land acquisition proceedings were initiated in October 1962 and part of the land was made available to the project authorities in January 1964.

A detailed Project Report with a tentative estimate of Rs. 26.57 crores was prepared in March 1964.

A formal contract for supply of the plant, equipment and for technical assistance (to be financed under the Yen loan) was executed in August 1963 with M/s. Toyo Engineering Corporation. In terms of the contract, the capacities of the Ammonia and Urea Plants were to be as follows :—

Ammonia Plant : 350 tonnes a day of 24 hours in 2 streams.

Urea Plant : 543.5 tonnes of un-coated urea prills per day of 24 hours in 4 streams.

The Project went into commercial production from January 1969, almost eight years after its approval by Government and some 5 years after the contract with the foreign suppliers was signed.

2. Capital expenditure decisions

2.1 *Project estimates.*—Initially, the capital cost of the Project was estimated at Rs. 26.57 crores. This estimate was approved by the Board in April 1964. Government, however, approved (May 1965) the project estimate for Rs. 26.50 crores. Subsequently, at the instance of the Corporation, Government agreed to raise the capital cost to Rs. 28.11 crores. The estimate was again revised to Rs. 33 crores in October 1966 and approved by Government in November 1967. In January 1970 (a year after commercial production had commenced in January 1969), the estimate was further revised to Rs. 34.90 crores and, after excluding items worth Rs. 0.25 crore which had not been taken up till then, Government's approval was sought in February 1970 to a capital outlay of Rs. 34.65 crores. Government informed the Corporation in March 1977 that since the revised estimate did not exceed the approved estimate by more than 10 per cent, the former could be approved by the Corporation itself. However, it was seen that in respect of the following items the actual expenditure exceeded the approved estimate by more than 10 per cent :—

	Approved Estimates	Actual expenditure
	(In crores of Rupees)	
Departmental charges	2.04	2.98
Financing charges	1.00	3.53

Government's approval was, therefore, necessary in terms of the instructions contained in the Ministry of Finance, Bureau of Public Enterprises O.M. No. BPE/1(185)/Adv.(F)/72 dated 24th November 1972.

Initial and revised estimates and the actual expenditure incurred were :

(In crores of Rupees)

Item	Original estimate, 1964	1st revised estimate, 1966	2nd revised estimate, 1970	Actual expenditure upto March 1971
1. Plant and equipment	14.92	16.01	16.08	15.88
2. Ocean freight, insurance, customs duty, etc.	2.91	3.94	4.15	4.14
3. Factory civil works	3.65	3.73	3.90	3.86
4. Departmental charges	0.92	2.04	2.98	2.98
5. Land & land development	0.73	0.85	0.97	0.88
6. Township	1.18	1.22	1.29	1.20
7. Financing charges	0.70	1.00	3.53	3.53
8. Others	1.52	1.71	1.90	1.61
9. Working capital	1.80	2.72	2.60	2.60
10. Credit for fertilizer produced during testing and commissioning	(-)0.22	(-)0.22	(-)2.75	(-)2.75
TOTAL	28.11	33.00	34.65	33.93
11. Deferred Revenue Expenditure.	—	0.16	0.25	0.25
GRAND TOTAL	28.11	33.16	34.90	34.18*

*Includes Rs. 14.27 crores in foreign exchange.

It will be seen that the estimates of 1964 had increased by Rs. 6.79 crores after taking credit of Rs. 2.53 crores for sale of fertilizers during testing and commissioning. This credit arose due to prolongation of the period of testing and commissioning from three months to twelve months.

The Management have attributed the increase of Rs. 6.79 crores over the initial estimate to the following :—

(In crores of rupees)

(i) Change in scope, shift in source of supply and price escalation	1.67
(ii) Inadequate provisions, increase in customs duty, departmental and financing charges	6.07
(iii) Devaluation of rupee in 1966 and others	1.58
	9.32
Less : Credit for sale of 77946 tonnes of urea produced during trial and test runs	2.53
	6.79

Note : Items (ii) and (iii) above include the effect of delay in the completion of the project and commencement of commercial production amounting to Rs. 1.86 crores referred to in paragraph 2.2

2.2 Delay in completion/commissioning of the project.—

According to the time schedule incorporated in the contract with the Japanese firm, the Plant was to be commissioned within 45 months. The scheduled dates for completion of various activities based on this time schedule and the actual dates were :—

Sl. No.	Item	As per contract		Actual	
		Commence-ment	Completion	Commence-ment	Completion
1	2	3	4	5	6
1	Basic engineering	August 1963	November 1963	August 1963	November 1963
2	Design and drawing of all equipment	August 1963	June 1964	August 1963	June 1964
3	Piping drawing	February 1964	November 1964	February 1964	December 1964
4	Scope drawings—civil	November 1963	August 1964	November 1963	July 1964 (major part)

1	2	3	4	5	6
5	Detailed drawings— civil	December 1963	October 1964	December 1963	November 1965
6	Site preparation	October 1963	May 1964	January 1965	December 1965 (Prilling)
7	Civil works	May 1964	August 1965	September 1965	March 1968
8	Fabrication of all equipment	February 1964	September 1965	February 1964	December 1965
9	Fabrication of piping	April 1965	November 1965	April 1965	January 1966
10	Transportation	August 1964	April 1966	October 1964	January 1966
11	Erection	May 1965	November 1966	January 1966	1st } Septem- stream } ber 1967
				2nd } stream }	March 1968
12	Local running and testing	August 1966	November 1966	August 1967	April 1968
13	Start up and guaran- tee test	November 1966	May 1967	April 1968	December 1968

Thus, compared to 45 months mentioned in the contract, completion and commissioning of the project took 64 months. According to the Management, the main reasons for delay in completion and commissioning were as follows :—

- (i) Initial difficulties and consequent delay in the acquisition of land.
- (ii) Delay in the preparation of scope drawing due to re-conducting of the soil tests on the advice of the plant suppliers. (The delay arose as suppliers had expressed certain doubts on the soil tests done by

the Central Water and Power Commission and wanted further investigation to be carried out to determine the safe bearing capacity of the soil. The second series of soil tests also conducted by the Central Water and Power Commission, however, confirmed the earlier results.)

- (iii) Lack of response from reputed contractors, low soil bearing capacity of the land necessitating the driving of additional piles in foundation.
- (iv) Defects noticed during the testing of the equipment in air separation and nitrogen wash sections.
- (v) Failure of some of the equipment, such as, nitrogen compressor, gasification pumps, etc. in the initial stages of testing and trial runs, necessitating replacement and lot of modifications at site.
- (vi) Extension of the period of guarantee test run. (Also refer paragraph 2.4).

The delay in completion of the project and commencement of commercial production resulted in the cost of the project increasing by Rs. 1.86 crores.

In May 1968, the Board had decided that, on completion of the project, a detailed report should be prepared highlighting the difficulties experienced and remedial measures adopted for the guidance of all the Units, particularly the new projects. No such report was prepared. It has, however, been stated by the Ministry (April 1979) that "the data has since been collected and the report would be finalised shortly".

A completion report for the project was prepared in the *pro forma* prescribed by the Ministry of Finance, Bureau of Public Enterprises in November 1969 and forwarded to the Ministry in November 1970. In this report, the scheduled dates

of completion of various activities were not compared with the time schedule prescribed in the contract with the Japanese firm but only with the latest schedule drawn up by the Corporation.

2.3 Steam Generation Plant.—The main contract of August 1963 with M/s. Toyo Engineering Corporation did not provide for the design and supply of equipment and material for the Steam Generation Plant. It was only in April 1964 that the Corporation entered into a contract (by exchange of letters) with M/s. Toyo Engineering Corporation for design, supply, supervision of construction and initial operation of a complete Steam Generation Plant at a total cost of Rs. 97.25 lakhs.

The erection of the main Plant was completed on 13th March 1968, by which time the Steam Generation Plant with all the 3 boilers should have also been completed and commissioned. Boiler No. 1, though not entirely complete, was commissioned in August 1967 to facilitate the initial trial of equipment and machines of the main Plant. Boiler No. 2 was completed in February 1968 and 2 boilers were operated for testing and production trial runs. The third boiler was completed by 30th April 1968. The left over work on boiler No. 1 could be taken up only after 1st June 1968 when the other two boilers were available and completed on 26th July 1968. The guarantee test runs of all the 3 boilers were completed in September 1968. While the guarantees relating to capacity, steam pressure and temperature were achieved, the thermal efficiency achieved was 81.77 per cent as against 88.43 per cent \pm 3 per cent provided in the contract. Consequently, Rs. 6.54 lakhs were recovered from the foreign suppliers, as a penalty.

It may be mentioned that the reduced thermal efficiency will have an adverse effect on coal consumption.

Owing to the longer time taken in completion and guarantee test runs of the Steam Generation Plant, the Corporation had to

incur an extra expenditure of Rs. 3.51 lakhs on the technical aid fee and living expenses of the foreign experts.

The Ministry have stated (April 1979) as under :—

- (i) The contract for ammonia and urea plant equipment was negotiated with the Japanese Consortium headed by M/s. Toyo Engineering Corporation on a single tender basis. It was the intention that all the off-site facilities such as Steam Generation Plant, water treatment plant, demineralisation plant, silo and bagging plant etc. which could be procured on a competitive basis would be dealt with separately and independently. Out of five parties who quoted, there was only one indigenous party whose quotation, being incomplete and not in accordance with the specifications, was not considered. Out of the remaining quotations tendered by foreign firms, M/s. Toyo's quotation was considered competitive and suitable.
- (ii) The contract with M/s. Toyo Engineering Corporation was for the supply of equipment, material and services for the steam generation plant and the responsibility for civil work as well as erection was that of Fertilizer Corporation of India. Schedule for supply of material was spelt out in detail in the contract and was adhered to by the party. There were, however, delays in carrying out the civil works and erection for which M/s. Toyo Engineering Corporation were not responsible.
- (iii) As two boilers were sufficient to meet the full load requirement of the plant, the boilers were never a limitation to either commissioning or operation of the plants at full load. However, because of delay in erection of the boilers, the Japanese supervisors had to stay for a longer period and for which additional payments were made to them as per the contract.

2.4 Guarantees

2.4.1 *Guarantee test runs of the Ammonia and Urea Plants.*—
 Clause 10 of the contract dated the 21st August 1963 provided that :—

- (a) Trial runs of Ammonia and Urea Plants were to be commenced on the completion of erection and terminated within 3 months after the start up of trial runs.
- (b) The guarantee test runs to demonstrate capacity, quality, specific consumption, etc. were to be completed within 3 months after the termination of trial runs. The duration of guarantee test runs was to be 120 continuous hours of operation out of continuous period of 132 hours.
- (c) In the event of failure to demonstrate the guarantee, the guarantee test period could be extended for 3 months more.
- (d) Expenses of the foreign experts for 6 months from the commencement of trial runs were to be borne by the Corporation and thereafter by the foreign supplier.

It was reported to the Board in August 1968 that the foreign suppliers intended to run the Plants for the guarantee tests immediately after the Plants were capable of giving the required production but, in the light of the experience gained at Trombay, it would be better if the guarantee tests were held only after the factory had run on full load for a couple of months. The benefits accruing from this proposal were stated to be that in this period not only would the production capacity and consumption of raw materials and utilities be more firmly established, but latent defects in the equipment would also be brought out and their reliability be more firmly proved.

The cost of extension of guarantee test runs by 2 months to be borne by the Corporation would be Rs. 6.10 lakhs (including Rs. 4.36 lakhs payable in Yen). The foreign suppliers had agreed to the proposal. The Board approved the proposal.

Both during initial commissioning of the plant and during the guarantee performance, defects, deficiencies and shortcomings, which affected continuous operation of the plant, were noticed. These defects were rectified by the suppliers at their cost. The factory achieved full production in October 1968. The two months' full load run started in October continued for 51 days (up to December 1968). After observing the performance of the Ammonia and Urea Plants during this period, the Corporation decided not to continue the guarantee test runs further. The justification for not conducting a run for two months on full load and abandoning the guarantee test runs provided in the contract, as reported to the Board in December 1968 and accepted by it, was as follows :—

- (a) During the full load run, five continuous runs comparable to the provision made in the contract, were held and all the guarantees were achieved except in respect of biuret content in the urea.
- (b) Considering the results achieved during the full load run, the foreign suppliers proposed that the guarantee test may not be held and their personnel relieved for being utilised on other commitments made by them. The foreign suppliers had assured the Unit that they would meet their other obligations under the contract in full.

The Ministry have stated (November 1978) that the guarantees in respect of biuret content in the urea were achieved in January 1969 and, accordingly, a letter to the effect that M/s Toyo Engineering Corporation have fulfilled the guarantee as per clause 11.2 (a) and (b) of the contract was issued in March 1969.

2.4.2 *Reduced capacity of compressors.*—The actual capacity was found to be 5,900 cubic metres per hour as against the designed capacity of 6,300 cubic metres. The foreign suppliers had agreed either to restore the capacity to the design value of 6300 NM³/hour each by installing a few equipment and doing some modifications or to afford a rebate of 7.75 million Yens on account of reduced capacity of compressors. M/s. Toyo Engineering Corporation had pointed out that even with the reduced capacity of 5900 NM³/hour each, it was not only possible to achieve but even to exceed the daily rated production of 350 tonnes of ammonia per day. The Corporation accepted the second proposal relating to the acceptance of rebate of 7.75 million Yens on the ground that there was not great advantage in trying to restore the capacity of Nitrogen Compressors to the original value of 6300 NM³/hour.

It may be mentioned that these compressors have been giving trouble in operation and maintenance right from the beginning and even the reduced capacity was not available to the full extent as mentioned in paragraph 10.2. (Also refer to para 4.2.4).

2.5 *Corrosion of the structure of the prilling tower.*—In December 1973, serious damage to the walls and floors of the prilling tower of Urea Plant, erected in 1968, was noticed. An engineer of Trombay Unit, after a physical survey, observed that such serious deterioration within 3 or 4 years was alarming and stated that there could be further damage beyond repair, if prompt action was not taken.

An expert of the Central Building Research Institute, Roorkee reported in March 1974 that the main cause of deterioration was vapourisation of urea and penetration of vapours by leakage through loose joints of aluminium casing inside the tower, condensation of the vapours in the pores of the concrete lining/structure, crystallisation and expansion of salts, resulting in bursting pressure causing cracking and spalling of concrete. He thought that deterioration could have been avoided had the reinforcement

been given an adequate cover and barrier type protective measures taken right in the beginning.

An engineer of the Unit deputed to study corrosion and remedial or protective measures in other fertilizer plants reported (March 1974) that protective treatment in the Madras Fertilizers, against urea corrosion was given during construction and, thereafter, no maintenance was required.

The prilling tower was repaired at a cost of Rs. 5.71 lakhs including the cost of paints (Rs. 2.16 lakhs).

In this connection, the Ministry have stated (July 1979) as follows :—

- (i) The question of giving anti-corrosive treatment was considered while finalising the scope drawings for civil works but, after obtaining the views of Toyo and the Corporation's own technical officer, it was decided that corrosion resisting coating would be considered later on after seeing the effect of urea on floors and walls.
- (ii) After commissioning the Plant, the concrete surfaces exposed to urea vapours and dust showed signs of corrosion and certain protective measures were taken from time to time during the period from October 1968 to September 1970 at a total cost of Rs. 0.69 lakh.
- (iii) While the protective treatment gave immense relief on a short term basis, the experience gained by Madras Fertilizers Ltd. in applying Epoxy treatment to their prilling tower in 1970-71 was studied and found to be more effective and implemented during the period from May 1974 to August 1975.

It will be observed that after September 1970 no protective measures were taken and it was only when serious damage to

the prilling tower was noticed in December 1973 that action was initiated to study the problem, resulting in implementation of the corrective measure from May 1974 to August 1975.

3. *Plant complex, technology and process of manufacture.*

3.1 *Plant complex.*—The plant complex of the Unit consists of the following main Plants :—

- (i) Ammonia Plant with a capacity of 350 tonnes per day of 24 hours in two streams.
- (ii) Urea Plant with a capacity of 543.5 tonnes per day of 24 hours in four streams.
- (iii) Steam Generation Plant—an auxiliary Plant.

A Mixing and Granulation Plant with a capacity of 36,000 tonnes per annum for the manufacture of N.P.K. fertilizers was also constructed (Refer paragraph 5).

3.2 *Process technology.*—As mentioned earlier, the feed-stock for this Plant is petroleum naphtha. There were two alternative processes viz., 'naphtha reformation' and 'naphtha partial oxidation' for the manufacture of ammonia available at that time. The Corporation selected the 'naphtha partial oxidation' process patented by 'Shell Gasification', as 'naphtha reformation' process was not considered a proven process at that time.

The main advantages of 'naphtha reformation' process as compared with 'partial oxidation' process are that it needs a lower capital investment and running costs and gives a higher on-stream efficiency. The Corporation stated (March 1977) that the reason for adoption of 'partial oxidation' process instead of 'naphtha reformation' process was to have flexibility in the use of naphtha. Moreover, the trial of 'naphtha reformation' process was undertaken in the year 1960 when Gorakhpur Fertilizer Project had been finalised.

The Ministry have further explained (April 1979) as follows :—

“The negotiations on process and other parameters with M/s. Toyo Engineering Corporation took place in August 1961. The consideration was limited to only proven processes at that time. Since the steam reformation process was still in the developmental stage this was not considered. During the negotiations naphtha partial oxidation process patented by Shell was considered the best suited and, accordingly, Toyo's offer submitted in July 1962 contained only Shell Gasification Process.”

For removal of carbon dioxide, Grand paroise ammonia washing process, for H_2S removal vetrocoke process and for synthesis of ammonia, the chemico process were selected, as these processes had worked well in Trombay Unit. However, during negotiations, the process for removal of CO_2 and H_2S was changed over to hot potash followed by MEA scrubbing as it was found simpler and involved less expensive equipment.

For Urea synthesis, Toyo Koatsu total recycle 'B' process was selected, as this was Toyo Engineering Corporation's own proven process.

3.3 Process of manufacture

3.3.1 *Ammonia*.—Naphtha is subjected to partial oxidation at a pressure of 30 atms and a temperature of $1200^\circ C$ — $1400^\circ C$ by treatment with oxygen and steam. The crude gas, comprising mainly of carbon monoxide, carbon dioxide and hydrogen with some impurities and carbon soot, passes through a waste heat boiler. After removal of the carbon soot, the gases, mixed with steam, are passed through a catalyst at 490 — $500^\circ C$ to oxidize carbon monoxide; the products being hydrogen and carbon dioxide. The carbon dioxide in the gas is separated

by scrubbing with hot potash, mono-ethanolamine and caustic soda.

Hydrogen with traces of carbon monoxide and methane is sent to the nitrogen wash unit where it is scrubbed with liquid nitrogen to remove impurities completely and a hydrogen-nitrogen mixture in the ratio of 3 : 1 is obtained. This mixed gas is compressed to a pressure of about 350 atms and passed over an iron catalyst at a temperature of about 500°C where the hydrogen and nitrogen combine to form ammonia.

3.3.2 Urea.—Urea is synthesised in the form of a solution, by a reaction between carbon dioxide and ammonia at a temperature of 185°C and at a pressure of 230 atms. The unreacted ammonia and carbon dioxide are recovered and are pumped back into the process.

Urea solution obtained is concentrated and the water evaporated in a series of concentrators and evaporators to produce urea crystals. The urea crystals thus produced are separated in centrifuges, dried, melted and prilled in a prilling tower and finally conveyed for storage and for bagging.

4. Performance analysis

4.1 Rated capacity.—A stream efficiency of 330 working days in a year had been assumed for the Ammonia Plant and 320 days for the Urea Plant. On this basis, the annual rated capacity would be 1.16 lakh tonnes for the Ammonia and 1.74 lakh tonnes for the Urea Plants.

The total quantity of ammonia required, on the basis of guaranteed consumption, to produce 1.74 lakh tonnes of urea was 1.06 lakh tonnes, leaving a surplus of 0.10 lakh tonnes of ammonia assuming production at the rated capacity in both Plants. The surplus ammonia was intended to meet the demand for liquid ammonia for industrial purposes.

In this connection, the following features deserve mention :—

- (a) The Urea Plant though designed for a daily production of 543.5 te/day is, however, capable of producing, daily, 600 tonnes in all sections up to the crystallisation stage. But owing to the limitation of the prilling tower, the Plant's production is limited to 543.5 tonnes of prilled urea daily. The in-built surplus capacity in the earlier stages of the process could not thus be utilised.

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

“Higher capacity was generally possible during the winter months when the ambient temperature as well as cooling water temperatures were low. Main limitations were in the CO₂ compressors. With these limitations also, it was found possible to produce upto 570 to 600 tonnes per day of urea when the conditions were favourable. However, with these limitations, it was not possible to achieve higher production than the rated capacity on a continuous basis throughout the year. The excess capacity available in the different sections was made use of whenever ammonia was available and the ambient conditions were favourable.”

- (b) As against the stream efficiency of 320 days in a year assumed for the Urea Plant in this Unit, the stream efficiency reckoned for Urea Plants at Trombay, Namrup and Durgapur Units is 330 days. It may be mentioned that in the profitability analysis for the Expansion Project including the Unit and in the Report to the World Bank in connection with the Gorakhpur Expansion Project, a stream efficiency of 330 days had been assumed for the Urea Plant.

The Corporation stated (March 1977) that profitability analysis for 330 days was done on a specific request of the World Bank to enable them to make equitable comparison with other feasibility reports prepared on similar lines. The Ministry have, in this regard, stated (November 1978) as follows :—

“Although the stream efficiency for the Trombay, Namrup and Durgapur Units is assumed at 330 days, in the case of Gorakhpur even at the stage of Project Report, the stream efficiency was taken as 320 days. Subsequently, experience has also shown that 320 days is a more realistic stream efficiency in view of the corrosive nature of the Urea Plant and the Salt Sections. The report of the Inter-firm Comparison of Fertilizer Industry of India prepared by F.A.I in December 1975, also recommended 320 days as achievable stream efficiency for Urea Plants.”

- (c) Neither the Ammonia nor the Urea Plants had attained the rated capacities.

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

- (1) “Although both Ammonia and Urea Plants at Gorakhpur had not achieved 100 per cent of the annual rated capacity in any of the years because of various factors, the production performance of Gorakhpur Unit had been one of the best among the fertilizer units in India....
- (2) Regarding non-achievement of the rated capacity of Urea and Ammonia Plants, after expansion on consistent basis, the problems were referred to M/s. Toyo Engineering Corporation for their expert advice. The problems were also studied internally by the Unit and the Planning and Development Division. On the basis of recommendations received from M/s. Toyo Engineering Corporation as

well as on internal Examination, certain remedial measures have been taken or are in the process of being implemented.”

The detailed reasons for shortfall in production are discussed in para 4.2 below :

4.2 Actual production performance

4.2.1 *Ammonia Plant*.—The original and the revised planned production and actual production in the years 1970-71 to 1977-78 were :—

(Figures in lakhs of tonnes)

Year	Production as in original plan	Production as in revised plan	Actual production (Gross)
1970-71	0.97	0.96	0.93
1971-72	1.07	1.06	1.03
1972-73	1.06	0.89	0.94
1973-74	1.06	0.93	0.86
1974-75	0.98	0.98	0.97
1975-76	—	*1.19	0.80 0.11 (Expansion)
1976-77	1.39	1.22	1.30
1977-78	1.19	1.21	1.23

} (including production from Expansion plant)

*Based on Monthly Status Report for March 1976.

After expansion, the total capacity of the Ammonia and the Urea Plants was to be as follows :—

	Existing capacity	Expanded capacity
	—per day—	
Ammonia	350 tonnes	570 tonnes
Urea	543.5 tonnes	950 tonnes

As mentioned in subsequent paragraphs, the Expansion Project was completed in December 1975 and commissioned in January 1976. As a result, the *pro rata* addition to the capacity for 1975-76 would be around 0.18 lakh tonnes of ammonia (based on 330 stream days), increasing the overall capacity from 1.16 lakh tonnes of ammonia to 1.34 lakh tonnes in 1975-76. From 1976-77 onwards, the capacity of Ammonia Plant will work out to 1.88 lakh tonnes per annum.

It will be seen that the production planned was much below the installed capacity in all the years; even the revised plans, which were lower than the original plans, were not achieved, except in 1972-73, 1976-77 and 1977-78.

The main reasons for shortfall in the production were stated to be as follows :—

- (i) Frequent power failures and voltage dips in the electricity supplied by the Uttar Pradesh State Electricity Board.
- (ii) Restricted production of ammonia to suit the requirements of Urea Plant.
- (iii) Process unit failures.
- (iv) More maintenance than provided for.
- (v) Higher incidence of excise duty on naphtha consumed in the production of ammonia meant for direct sale.
- (vi) Strike for 34 days during 1972-73.
- (vii) Fire in cable trench in Ammonia Plant in September and November 1975.
- (viii) Start up of expansion stream in Ammonia Plant between 9th and 16th December 1975.

The Unit has not analysed how much of the shortfall was due to each factor. In fact, data relating to down time of the Ammonia Plant were not compiled, as it was stated to have been run to meet the requirement of the Urea Plant. Lower production caused by break-downs in the Ammonia Plant was generally shown under the Urea Plant.

The limitation of the Urea Plant and lack of direct sale of ammonia had thus led to under-utilisation of the capacity of the Ammonia Plant, thereby resulting in higher cost of production and production of lesser quantity of fertilizers.

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

“.....it may be clarified that the basic data in respect of down time of Ammonia Plant are available in the log books of the Plant and can be compiled. It was not compiled earlier for the purpose of the reporting because the shortfall in production from target was being reported on the basis of the end product and only such limitations in Ammonia Plant which resulted in the shortfall of end product was being reported”.

In regard to the restricted production of ammonia to suit the requirement of Urea Plant (referred to as item ii), the Ministry have explained (April 1979) as under :—

“For the production of 543.5 tonnes of urea which is the daily rated capacity of the plant, ammonia requirement would be 331.5 MT. As the ammonia plant capacity is 350 tonnes per day, the excess ammonia produced has to be stored on occasions when it is not possible to operate the urea plant on higher loads. The excess capacity in the ammonia plant was provided for the purpose of selling ammonia for industrial purposes. However, it has not been possible

to develop adequate market for sale of ammonia. Situations also arise when the ammonia plant is operating on full load and urea plant only on partial load because of maintenance requirement. Under these circumstances also excess ammonia has to be stored. As the storage capacity for ammonia is limited (about 800—1000 te) ammonia load had to be curtailed due to high stocks of ammonia on many occasions”.

4.2.2 *Sale of ammonia.*—During 1969-70 and 1970-71, the Unit sold 76.10 tonnes of ammonia to the Ammonia Supply Company, Delhi at Rs. 1500 per tonne. In January 1971, the Excise Authorities raised a demand for Rs. 0.65 lakh (at Rs. 869 per tonne) on the Unit for the excise duty payable on the naphtha used for producing ammonia, utilised for industrial use (*i.e.* not used for the production of fertilizer).

The Unit paid the amount in April 1971 and June 1971 but could not recover it from the firm. The duty could not be recovered from the firm as according to the legal advice obtained by the Corporation, a demand could be enforced only if ammonia itself was subject to duty.

The Ministry have stated (April 1979) that “the sale price of ammonia at Rs. 1500 per tonne was fixed based on the market conditions and did not take into account the impact of differential excise duty. As the cost of production of ammonia including differential excise duty worked out to Rs. 1475 approximately leaving a very little margin, the sale of ammonia was discontinued”.

4.2.3 *Urea Plant.*—As against the rated capacity of 1.74 lakh tonnes of urea per annum which was raised to 2.85 lakh tonnes following the commissioning of Expansion Plant in January 1976,

the production planned and achieved during the years 1970-71 to 1977-78 were as indicated below :—

(Figures in lakhs of tonnes)

Year	Production as in original plan	Production as in revised plan	Actual production
1970-71	1.57	1.57	1.47
1971-72	1.74	1.74	1.65
1972-73	1.74	1.45	1.51
1973-74	1.74	1.51	1.40
1974-75	1.61	1.61	1.58
1975-76	1.59	1.52	1.29
Expansion	0.35	0.22	0.16
1976-77	2.28	1.95	2.07
1977-78	1.95	1.95	1.93

It will be seen that the actual quantity of urea produced was less than the quantities planned to be produced during the years 1970-71 to 1977-78.

The main reasons for shortfall in production were stated to be power cuts, power failure and voltage dips. These were followed by trouble in the autoclaves and air separation units, leakage of ammonia pre-heaters, corrosion in the Urea Plant and lower capacity of carbon dioxide compressors in the summer. According to the data contained in the Quarterly Production Reviews, power cut or failure and voltage dips had accounted for shortfall (in terms of nitrogen) of 0.11 lakh tonnes in 1972-73, 0.13 lakh tonnes in 1973-74, 0.07 lakh tonnes in 1974-75, 0.15 lakh tonnes in 1975-76, 0.09 lakh tonnes in 1976-77 and 0.06 lakh tonnes in 1977-78. The detailed reasons for shortfall in each of the years 1970-71 to 1977-78 are given in Appendix I.

4.2.4 Remedial measures.—The table below indicates the measures initiated by the Management to stabilise production as

well as the latest position regarding their implementation, as furnished by the Ministry in November 1978 and April 1979 :—

Reason	Measures taken	Latest position
(1)	(2)	(3)
(i) Power break-down/shortage/ failure.	Captive power generation capacity of 25 MW was being established. Captive power would be utilised to run critical equipment to reduce the start up time after power failure or voltage dips on the supply from Uttar Pradesh State Electricity Board. The Electricity Board was also taking certain steps to avoid power break-down and failure.	The State Electricity Board commissioned in June 1978 400-220 KV System of transmission which is stated to have made improvement in the system. For 25 MW captive power plant, consultants have been entrusted with the work of making out detailed specifications and for issuing tender enquiries.
(ii) Leakage of urea autoclaves	The root cause of the repeated failure of autoclave linings since commissioning could not be established even by the Foreign suppliers. Till December 1974, one spare autoclave was available and repair of autoclave linings did not result in substantial loss of production. Thereafter, spare autoclave was shifted to the Expansion Project.	To get over this problem, the old damaged autoclave which had been left by Toyo has been repaired and installed as a spare.
(iii) Leakage of ammonia pre-heaters.	Leakage in pre-heaters resulted in increased down-time of autoclaves. To prevent carbamate solution going back into pre-heaters, quick closing valves had been provided and their performance was under observation.	Three of the pre-heaters which were leaking badly have been replaced and order for six more pre-heaters is being placed with Bharat Heavy Plate & Vessels Ltd. The performance of quick closing valves is being kept under close watch. In case,

(1)	(2)	(3)
(iv) Corrosion in Urea Plant	The poor performance of air compressors had resulted in severe corrosion in decomposers. New compressors were being procured indigenously.	the position does not improve, the replacement of carbon steel pre-heaters with the pre-heaters fabricated with stainless steel tubes will be considered. While one air compressor has been installed and is awaiting commissioning, another compressor is expected to be received shortly.
(v) Trouble in Air Separation Unit.	Kobe Steel Limited of Japan had recommended repairs to the column of Air Separation Unit under their supervision. Efforts were being made to undertake repairs with the expertise available in India. A scheme for alternative air intake tower for Air Separation Unit was also under implementation.	Repairs were carried out and the column was working satisfactorily. However, regenerators in both the boxes have suffered extensive corrosion and are to be replaced with 6 new regenerators, supply of which was expected from Japan in December 1978/January 1979. An alternate air intake tower has also been installed and will be connected to the air plant in April 1979.
(vi) Inadequate capacity of carbon dioxide compressors, etc.	(a) It had been decided to instal an additional carbon dioxide booster to get adequate pressure at the suction of the compressors. (b) A direct spray type cooler had also been recommended by the foreign suppliers to bring down the carbon dioxide temperature. Detailed drawings were being made.	Installed and commissioned in June 1975. Arrangements are being made to dismantle the surplus cooler at Sindri and transport it to Gorakhpur. The cooler is expected to be commissioned during 1979.

- | | | |
|---|---|--|
| | (c) Purchase order for after-cooler for turbo compressors in Ammonia Plant to obtain better output from oxygen compressor during summer months was under finalisation. | After detailed technical studies, proposal was dropped. Alternative studies are being made to find solution to this problem. |
| | (d) To avoid the problem of excessive pressure in the regenerators, modifications in the existing pipeline for carbon dioxide regenerators were under consideration. | Inter-connection of the old Unit with Expansion Plant has been completed. It has given some relief on the regenerator pressure. |
| (vii) Loss of vapour ammonia during high rate of liquid ammonia transfer to horton sphere. | Installation of an additional refrigeration compressor (declared surplus from sindri Unit). | Compressor has been installed and the piping inter-connections would be completed within forthcoming annual shutdown in 1979-80. |
| (viii) Inadequate capacity of refrigeration system for Ammonia synthesis and N ₂ wash during summer (After Expansion). | FPDIL has recommended the installation of additional condensors. | Suggestion reviewed and accepted and procurement action is being initiated. |
| (ix) Carbon leakage to old Co-conversion unit, causing fouling of heat exchangers and catalys. | In the old gasification unit only one carbon scrubber cooler has been provided in each train whereas in Expansion train 2 coolers have been provided as a subsequent technological advancement by Shell International. Additional coolers are now proposed to be provided in the old trains also. | Indent has been raised for the coolers. |

(1)	(2)	(3)
(x) Leakage from the glands of naphtha charge pump in gasification section.	To save naphtha and to avoid spreading of the same in surrounding area from safety point of view it is proposed to collect the leakage in a separate tank and re-utilize the same in the process.	Details have been worked out and sent to Chief Controller of Explosives, Nagpur for his approval prior to implementation.
(xi) Urea dust loss from whitlock evaporator.	The scheme to scrub the urea dust with circulating solution is being implemented.	Materials received and scheme would be completed in the forthcoming annual shut down during 1979-80.
(xii) More steam consumption in urea plant (expansion).	This is due to insufficient circulation of urea solution to recover heat from the process. Existing urea slurry circulation pumps are being replaced with pumps of higher capacity.	Scheme is expected to be completed during the forthcoming annual shut down during 1979-80.
(xiii) Loss of urea solution during shut down of expansion train.	Capacity of solution tank already provided in the expansion train is found to be less due to frequent shut downs and an additional tank is now being installed.	Order for the tank has been placed and is expected to be delivered shortly. Job would be completed during 1979-80.
(xiv) Dust pick up from the atmosphere in the cooling towers, thereby causing poor performance of the Heat Exchangers.	To reduce the dust content, a part of the cooling water is proposed to be cleaned through pressure filters.	NIT has been issued. Scheme is expected to be completed by December 1980.

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

- (a) Owing to ageing of boilers and deteriorating quality of coal, shortage of steam has been experienced in the operation of Ammonia and Urea Plants after expansion. To overcome this shortage which is estimated at 10—12 tonnes per hour at rated production level, it is proposed to instal a package boiler of the capacity of 10—12 tonnes per hour at low pressure using the tail gases from the nitrogen wash unit as fuel.
- (b) The high pressure nitrogen compressors which are of screw type have been giving trouble in operation and maintenance right from the beginning. The capacity of these compressors has also come down due to wear and tear on the rotors and the castings. It has, therefore, been decided to procure one operational compressor to augment the availability of high pressure nitrogen. Studies are being carried out by the Fertilizer (Planning and Development) India Limited on the type of compressor to be procured.

4.2.5 *Carbon recovery scheme.*—In the 'Shell' partial oxidation process of gasifying naphtha, carbon is produced as a waste product. Pelletisation equipment was installed (March 1968) at a cost of Rs. 8.60 lakhs as a part of the Gasification Section of the main Ammonia Plant to utilise the carbon. The scheme envisaged pelletisation of carbon with fuel oil, for use as fuel in the Steam Generation Plant. However, because of increase in the price of fuel oil from Rs. 140 per tonne (estimated initially) to Rs. 275 per tonne in July 1968, the scheme became un-economic and was abandoned. As a result, pelletisation equipment valued at Rs. 8.60 lakhs became idle.

In July 1968, the Board approved a scheme, similar to that being implemented in the Trombay Unit, for recovery of carbon

black by pelletising the carbon from the slurry with kerosene oil and further treatment of pellets. According to the Unit, the scheme on the Trombay pattern was not implemented at Gorakhpur because of the poor performance of the Trombay scheme designed by the Planning and Development Division of the Corporation.

In the absence of any scheme to recover carbon, it is being collected in the form of slurry, in a settling pond (area 4.29 lakh square feet ; construction cost Rs. 0.07 lakh).

About 7 tonnes of carbon are produced daily, which increased to 10 tonnes per day after expansion of the Plant. The quantity of carbon lying in the pond in July 1977 was estimated at 12,000 tonnes. Till June 1977 no solution had been found to the problem of disposal of the carbon. However, 1027 tonnes of carbon, on dry carbon basis, have been sold from 1974-75 to 1976-77.

The Corporation stated (March 1977) that problem of disposal of carbon had been time and again referred to the Planning and Development Division of the Corporation and other research institutions. The major consumption of superior type of carbon was in the rubber industry and the problem was being tackled.

The Ministry have stated (November 1978) that no specific solution to the problem of utilisation of the carbon slurry has emerged, as the carbon slurry coming from the plant is not suitable for the rubber industry.

5. Mixing and granulation Plant

In April 1972, the Board approved the setting up of a N.P.K. granulation plant with an hourly capacity of 5 tonnes at Gorakhpur, estimated to cost Rs. 62.15 lakhs (including Rs. 19.81 lakhs as working capital) to produce N.P.K. fertilizers of 17 : 17 : 17 grade from urea, triple super phosphate and potassium chloride. The proposed Plant was to be installed by the Planning and Development Division of the Corporation which had carried out pilot plant studies and had formulated a standard design.

Taking into account the scope and operational requirement of the plant, the original estimate was revised to Rs. 74.27 lakhs (including Rs. 17 lakhs as working capital) which was approved by the Board in July 1973. In October 1975, the Unit again revised the estimates of capital cost to Rs. 118.46 lakhs (including Rs. 39.90 lakhs as working capital). Actual expenditure upto September 1978 was Rs. 85.75 lakhs. Industrial licence required for the setting up of this Plant was applied in February 1973 and received in September 1976.

The Ministry have stated (November 1978) that the project estimate had been finalised at Rs. 92.09 lakhs and approved by the Board.

The following aspects were also noticed :—

- (a) When the Project was approved by the Board in April 1972, it was mentioned that the plant would be commissioned by December 1974, but due to delay in design, engineering and procurement action by the Planning and Development Division, this time schedule could not be adhered to. In the estimate of capital cost revised in October 1975, the date for completion was revised to February 1976. The Plant has not, however, been commissioned so far (November 1978). In this connection, the Ministry have stated (November 1978) as follows :—
 - (i) After the Plant was completed in February 1976, 60 modification jobs were carried out as per advice of the Planning and Development Division and the Plant was ready for commissioning in September 1976. The Plant could not, however, be commissioned due to non-availability of triple super phosphate from Sindri Unit and Hindustan Copper's Khetri Plant.
 - (ii) In October 1976, it was decided to commission the Plant with di-ammonium phosphate which was made available by January 1977. Commissioning was started on 26th January 1977 but could not

be proceeded with on account of various equipment problems. To overcome these problems, about 150 modifications were carried out between January 1977 and August 1978. In spite of these, it has not been possible to run the Plant on sustained load basis. Fertilizer (Planning & Development) India Limited are investigating the necessary modifications to finally commission the Plant satisfactorily.

- (b) In January 1976, the Management decided that the N.P.K. granulated mixture to be produced at Gorakhpur should be in the ratio of 2 : 2 : 1 or 1 : 1 : 0 instead of the initially contemplated ratio of 1 : 1 : 1, as the latter would meet considerable resistance from the farmers as well as from Government. Consequently, the N.P.K. grade to be produced at Gorakhpur was changed from 17 : 17 : 17 to 20 : 20 : 0. The Planning and Development Division of the Corporation informed (January 1976) the Unit that this change would entail not only modifications of the existing equipment but also provisions of certain extra equipment and that action to this effect was being taken.

The entire position in respect of profitability and marketability of various formulations based on TSP and DAP was reviewed by the Corporation and it was proposed (October 1976) to initially commission the Plant for 3 formulations *viz.*, 28 : 28 : 0, 20 : 20 : 0 and 15 : 15 : 15 based on DAP. It was also decided that the use of TSP would be considered after the production of TSP from Sindri Unit was stabilised.

The above position was brought to the notice of the Board of Directors in July 1977. Based on the profitability analysis of various grades of NPK, the following proposals were made :—

- (i) 20 : 20 : 0 and 15 : 15 : 15 grades being considered un-remunerative, to go in for the production

of 28 : 28 : 0 grade initially with the use of DAP from pool.

- (ii) To produce 28 : 28 : 0, 20 : 20 : 0 and 15 : 15 : 15 grades to match the market demands after the import of DAP directly by F.C.I.
- (iii) To produce 20 : 20 : 0, 17 : 17 : 17 and 15 : 15 : 15 grades after TSP from Sindri Unit was available on a regular basis.

The Board of Directors desired (September 1977) that a Committee of functional Directors might review quarterly the raw material to be used and the other products to be produced with a view to ensuring that no losses were incurred on operating the Plant.

- (c) The Plant was expected to yield a net profit of Rs. 19.40 lakhs according to the initial estimates of April 1972, Rs. 40.29 lakhs as estimated in July 1973 and Rs. 44.35 lakhs as estimated in October 1975.

It may be mentioned that in connection with the setting up of a similar Plant at Durgapur, the Durgapur Unit had reported (November 1972) that economic viability of a 5 tonne per hour Plant was doubtful.

The Ministry have stated (April 1979) that the comments of the Durgapur Unit were examined by the P & D Division and based on the observations of P & D Division the matter was further examined by the Executive Committee of functional Directors and it was decided to proceed with the scheme.

6. *Efficiency in the usage of raw materials and utilities*

6.1 Norms for consumption of the principal raw materials as indicated by the Plant suppliers, as fixed by the Tendolkar Committee in January 1971 and adopted by the Corporation in

July 1972 and actual consumption during the years 1971-72 to 1977-78 are mentioned below :—

Unit/output material	Design norms	Tendokar Committee's norms	Actual consumption									
			1971-72	1972-73	1973-74	1974-75	1975-76	1976-77	1977-78			
<i>Per tonne of ammonia</i>												
Naphtha (in Kgs.)	812	780	793	789	803	777	817	849	847			
Power (in KWH)	1580	1756*	1803	1864	1852	1776	1818	1895	1960			
Steam (in Kgs.)	1367	1458	1458	1675	1698	1541	1474	1186	1318			
<i>Per tonne of urea</i>												
Ammonia (in Kgs.)	610	600	623	626	612	617	617	627	638			
Power (in KWH)	210	295*	305	314	308	307	338	299	308			
Steam (in Kgs.)	2200	1750	1750	1832	1765	1832	1918	1745	1799			

NOTE :—Data for 1971-72 to 1975-76 are based on the 13th cost sheet and are in agreement with the figures contained in the Quarterly Production Review Reports except for 1974-75 and 1975-76.

*The norms for power are inclusive of power required for cooling tower.

It will be seen that :—

(a) Consumption of all the principal raw materials was higher than the accepted norms except steam per tonne of ammonia in 1976-77 and 1977-78 and steam per tonne of urea in 1976-77. Consumption in excess of the accepted norms, as reported by the Management to the Board in July 1975, cost around Rs. 30 lakhs. Out of this, more than Rs. 19.48 lakhs were contributed by excessive consumption of ammonia per tonne of urea.

The main reasons for the higher consumption, as mentioned in the Quarterly Production Review Reports, were briefly :—

- (i) Power failure and voltage dips.
- (ii) Plant shut-down.
- (iii) Changing of catalyst, tripping of gasification reactor, compressors, etc.
- (iv) Loss of ammonia in the Urea Plant through absorbent tank, recovery tower and gland leakages, etc.

It was noticed by the Management that loss of ammonia from the recovery tower vent gases, was 2.5 per cent and 1.2 per cent of the total production during summer and winter respectively as against the figure of 0.61 per cent indicated by Toyo Engineering Corporation. It was explained (September 1974) by the Unit that the recovery tower did not have enough capacity to take care of vapours from the ammonia reservoir and the concentrator and the operating temperature of the tower was also high. In order to reduce losses, installation of a pressure absorber, suggested by the Toyo Engineering Corporation in April 1972, was undertaken in the same year and completed by December 1974. According to the Ministry, the loss of ammonia from recovery tower had come down to the design figure after installation of pressure absorber.

In addition to the pressure absorber, following further schemes to improve ammonia efficiency in the Urea Plant were stated (July 1977) to have been completed :—

- (i) Installation of separate pump for de-humidifier.
- (ii) Installation of tube bank for gas condensers.
- (iii) Procurement of mechanical seals for carbamate booster pump.

It will, however, be seen from the data given in the table that, notwithstanding the implementation of above schemes, consumption of ammonia per tonne of urea was the highest in 1976-77 and 1977-78. The Corporation stated (March 1977) that specific consumption of raw materials and utilities was high due to power interruption from hydel and break-downs of equipment due to unforeseen troubles and other reasons (*i.e.* leakages, corrosion, etc.).

(b) The Mahadevan Committee, which reviewed the norms of Tendolkar Committee in July 1971, had mentioned in its report that a revision of the proposed norms would have to be considered later, as intermediate and final products were not accurately weighed or measured in many cases. The Committee thought that there would be positive improvement in consumption figures with the loss prevention measures and optimisation plan programmes being undertaken by the Units.

It will be seen that consumption continued to be significantly higher than the accepted norms. A Committee was appointed in November 1975 to review the norms. The Ministry have stated (November 1978) that Kachwaha Committee appointed for this purpose has recommended certain norms which are under consideration.

(c) Some improvement in consumption, particularly of ammonia and steam per tonne of urea was expected by the Unit after the completion of the Expansion Plant. The

Expansion Plant was commissioned in January 1976 but, except in respect of steam consumption there has been no improvement in the consumption of naphtha, ammonia and power, as will be seen from the data given in the table.

In this regard, the Ministry have stated (April 1979) as follows :—

“Although, the Expansion stream of the ammonia plant and the urea plant have been designed with improved consumption efficiencies, the overall effect of the Expansion Project on consumption norms of the whole factory has been adverse. The main reason is that in the old plant, there were stand-by equipment available for almost all the major moving machines whereas for the Expansion Project, the stand-by equipment have been utilised and these have now to operate continuously. In the old plant, whenever any of the major moving machines was shut-down for repairs/maintenance, this was done after switching the stand-by equipment, thus maintaining continuity in the production of ammonia. In other words, the Gasifier Section did not have to shut-down. After the Expansion the situation has completely changed. In the event any of the major moving machines has to be taken out for repairs/maintenances, the gasifier has to be shut down which involves loss of Naphtha during the start-up. Similarly, whenever any of the major moving machines trips, the gasifier is either allowed to operate venting the gas into the atmosphere or shutdown depending upon the duration of the shutdown of the moving machines. In either case, loss of naphtha is involved.

The start-up of gasifier may take any thing from 6—8 hours after a shutdown. The start-up involves burning of naphtha which is vented into the atmosphere. In a typical start-up, the quantity of

naphtha to be burnt for venting the gases would amount to about 50 te. on each gasifier. In case there are 12 start-ups of this type during a year, these alone would account for additional consumption of 600 te. of naphtha for approximate production of 60,000 te. of ammonia (capacity of one stream). This would represent an additional consumption of 10 Kgs. of naphtha per tonne of ammonia. The lack of stand-by equipment would also explain the reasons for additional consumption of power and other utilities. This arises from the fact that even when the ammonia production is interrupted, a large number of equipment have to be kept in operation to reduce the time required for resumption of operations. The Air Plant, Cooling Tower Pumps and other utilities systems have to be kept in operation thus wasting power which ultimately gets reflected in increased consumption of power per unit of production."

(d) Because consumption of ammonia was higher than the norm, nitrogen efficiency of the Unit was lower than the expected efficiency, as given below :—

Year	Expected efficiency	Actual efficiency
	(in terms of percentage)	
1971-72	91.57	89.6
1972-73	91.57	89.2
1973-74	91.57	91.2
1974-75	91.57	90.5
1975-76	91.57	90.1
1976-77	91.57	89.09
1977-78	91.57	87.98

(e) In addition to the principal items of raw materials mentioned above, certain chemicals (e.g. potassium carbonate,

sodium hexameta phosphate, zinc oxide, etc.) are also used. Consumption of some of these items varied widely from year to year.

The Corporation stated (March 1977) that the norms of the chemicals had already been fixed and reviewed internally by the concerned departments but that for purposes of reporting only important norms were shown. The Ministry have further explained (November 1978) that "consumption of these chemicals can not always be correlated to the production level of Ammonia and Urea Plants and it is a function of time and condition of the plants. These norms are fixed at the beginning of the year and the variation from the actuals is reviewed on monthly basis".

6.2 Excess consumption of coal in the Steam Generation Plant.—Service steam at about 40 kg./cm² pressure is generated in the boilers of Steam Generation Plant, which are fired by coal. Normally 75 tonnes of steam are required per hour. The total installed capacity on service boilers is 135 tonnes per hour (3×45 tonnes/hour). Of the three boilers available, two are normally in operation and the third is kept as a stand-by. Steam utilised during the six years ending 31st March 1978 was as indicated below :—

(Figures in lakhs of tonnes)

Year	High pressure steam produced	Utilisation			Vented
		Ammonia Plant	Urea Plant	Steam Generation Plant	
1972-73	4.93	1.57	2.76	0.56	0.04
1973-74	4.51	1.46	2.46	0.55	0.04
1974-75	5.15	1.50	2.90	0.70	0.05
1975-76	5.20	1.83	2.78	0.53	0.06
1976-77	6.19	2.07	3.61	0.43	0.08
1977-78	6.31	2.00	3.47	0.79	0.05

It was noticed that during 1972-73 to 1974-75 there was excess consumption of coal (6,929 tonnes valued at Rs. 6.55

lakhs based on the average cost indicated in the cost sheet) computed on the norm of 166 kgs. of coal per tonne of steam produced.

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

- (a) The average actual consumption of coal was 171 kgs. in 1975-76, 179 kgs. in 1976-77 and 183 kgs. in 1977-78 as against the norm of 166 kgs. per tonne of steam produced.
- (b) The quality of coal began deteriorating after 1972-73, with the result that consumption of coal per tonne of steam started increasing. The Unit has been vigorously pursuing with the concerned authorities for getting a better quality of coal.
- (c) Apart from the quality of coal, consumption has also been affected by the ageing of boilers.

In this connection, it may be mentioned that the quality of coal supplied was within the design norm of ash content of 26.3 per cent. Further, as stated in paragraph 2.3, reduced thermal efficiency of the Steam Generation Plant had also an adverse effect on the consumption of coal.

7. Material management and inventory control

7.1 *Inventory holdings.*—The inventory held at the end of last two years was :—

(Figures in lakhs of rupees)

Sl. No.	Category	As on					
		31-3-1977			31-3-1978		
		Indi- genous	Impor- ted	Total	Indi- genous	Impor- ted	Total
1	2	3	4	5	6	7	8
1.	Raw Materials	51.55	—	51.55	55.51	—	55.51
2.	Packing materials	6.25	—	6.25	2.85	—	2.85

1	2	3	4	5	6	7	8
3. Stores & Spare Parts							
(a) Fuel coal	.	12.39	—	12.39	2.15	—	2.15
(b) Chemicals	.	16.30	6.75	23.05	8.93	3.95	12.88
(c) POL & Paints	.	19.49	—	19.49	14.99	—	14.99
(d) Catalysts	.	8.89	4.22	13.11	0.01	4.22	4.23
(e) General stores	.	27.08	—	27.08	30.75	—	30.75
(f) Regular consumption spares	.	11.82	44.47	56.29	9.92	31.86	41.78
(g) Insurance spares	.	39.60	297.42	337.02	67.70	354.22	421.92
(h) Construction stores	.	29.06	—	29.06	31.18	—	31.18
(i) Surplus stores	.	3.21	0.86	4.07	3.22	0.86	4.08
(j) Stores & spares at site	.	Break up not available		4.09	Break up not available		24.79
Total				525.65			588.75
4. Finished goods							
(a) Urea	.	223.64	—	223.64	288.49	—	288.49
(b) Argon gas	.	1.13	—	1.13	—	—	—
(c) N.P.K.	.	—	—	—	3.56	—	3.56

The following points were noticed in Audit :—

(a) A review of inventory holdings with reference to the norms indicated that holdings of the following items were in excess of the norms as on 31st March 1978 :—

Item	Norm for holding	Stock as on 31st March, 1978
(i) Naphtha	15 days	18.5 days
(ii) Chemicals Indigenous	2 months	2.5 months
(iii) General stores Indigenous	4 months	10.25 months
(iv) Regular consumption spares		
Indigenous	6 months	8 months
Imported	15 months	15.9 months
(v) POL & Paints	3 months	3.5 months

The Ministry have ascribed (April 1979) the following reasons for excess inventory :—

(i) “Originally construction stores were not included in the inventory of General Stores. Earlier, norms for General Stores was 6 months and, subsequently, reduced to four months *vide* decisions taken in 20th MMR meeting. Therefore, the excess inventory is the carry-over effect of previous norms (six months).

(ii) Stock on 31st March every year goes up as we have to procure and keep ready stock for Annual Shut Down which is generally scheduled in April/May.”

(b) Out of the total inventory of stores and spares of Rs. 588.75 lakhs on the 31st March 1978, insurance spares accounted for Rs. 421.92 lakhs and represented 71.7 per cent of the total holdings of stores and spare parts. Items which had not moved at all were valued at Rs. 68.92 lakhs including insurance spares of the value of Rs. 40.08 lakhs.

According to the Ministry the increase in the stock of insurance spares was mainly because of Expansion Plant for which all the machineries and equipment purchased and installed happened to be different from those that were earlier installed for the Unit. Such heavy procurements are not expected for new equipment in the future years.

(c) The value of surplus stores as on the 31st March 1978 was Rs. 4.08 lakhs as indicated in the annual accounts for 1977-78.

7.2 Fixation of Norms.—While norms have been fixed for the inventory of raw materials and most categories of stores and spares, no norms have been laid down for insurance spares. A Committee was constituted in April 1975 to review the existing norms in detail. The Committee recommended revised norms which were accepted tentatively with slight adjustments.

Appendix II incorporates the existing norms as well as the revised norms. In this connection, the Committee also observed (1976) as follows :—

- (a) In respect of regular spares, a detailed information regarding periodicity of the use of regular spares was not available and, as such, the Committee found it difficult to recommend a workable norm. As a large sum of money was involved in the inventory of regular spares of the different Units, the Committee considered that a more detailed study was necessary so as to fix the norms on more realistic basis.
- (b) A detailed study by the Norms Committee in collaboration with the Bureau of Public Enterprises was proposed in respect of insurance spares, imported spares, non-moving items, surplus items, etc.

The Ministry have stated (November 1978) that the Committee checked up with the Bureau of Public Enterprises about the specific norms separately fixed for this industry and it was understood that no specific norms as such have been fixed by Bureau of Public Enterprises separately for each industry.

7.3 Import of spares from Japan against Yen Credit.—Out of allocations (8867 million Yens) made under different Yen credits for the main plants and optional items, 8710 million Yens (Rs. 18.15 crores) were utilised upto the expiry of IVth Yen credit, leaving 157 million Yens (Rs. 32.68 lakhs) un-utilised. The Ministry of Finance (Department of Economic Affairs) had expressed their anxiety over the un-utilised Yen credit and advised the Corporation to take all possible steps to utilise it. To utilise the balance of 157 million Yens, the Corporation placed two orders in March 1970 for additional items of spares worth 102.7 million Yens (Rs. 20.78 lakhs) plus ocean freight on the Japanese firm which had supplied the Plant.

The value of the spares purchased against the un-utilised credit referred to above and provision for spares for the initial

two years' spares in the contract with the plant suppliers, totalled Rs. 125.77 lakhs (C. & F. basis) as per details given below :—

	(Rs. in lakhs)
(i) Initial two years' spares	94.96
(ii) Optional items	28.04
(iii) Erection surplus lump sum (excluding cables)	2.77
TOTAL	<u>125.77</u>

In April 1972, spares valued at Rs. 42.84 lakhs (landed cost) were declared surplus. It was stated that the spares declared surplus in April 1972 were mostly against the initial purchase of two years' requirement, the order for which was placed after obtaining the advice of the Planning & Development Division. In the absence of experience of the performance of the equipment supplied by the Japanese, the Corporation had, however, to depend on the manufacturer's recommendations for the spares to be purchased. Utilisation of surplus spares was constantly under review to utilise them for accelerated renovation or otherwise.

The Ministry have stated (November 1978) that "the situation changed due to expansion and all the items needed for accelerated renovation were drawn. The present position of the stock of spares declared as surplus is as under :—

	(Rs. in lakhs)
(1) Balance spares retained as insurance surplus	8.53
(2) To be disposed of	0.05
TOTAL	<u>8.58</u>

7.4 Import of spares for motorised dozer and scraper.—In November 1965, the Unit placed two orders for import of spares for the motorised dozer and the motorised scraper through Bharat Earth Movers Limited.

In December 1966, the consignment containing spares valued at Rs. 0.51 lakh (in foreign exchange) was shipped by the supplier. The consignment which was received in February 1967 could not be cleared firstly because of non-production of import licence and the shortfall in its value which came to be noticed only in March 1967. Due to lack of coordination between

the Unit and its Calcutta Office and the clearing agent, the goods could not be cleared even by November 1969 when the Port Commissioner intimated that some of the contents of the case had been pilfered and that the report had been lodged with the Police. Even thereafter the consignment was not cleared and, ultimately, when in May 1971 a joint inspection was carried out, it was found that most of the contents were not fit for use and, hence, it was decided not to clear the goods.

In the deal, a total loss of Rs. 0.51 lakh representing the value of spares and other expenses incurred thereon was suffered. The dozer for which the spares were imported, could also not be repaired for want of spares and had to be condemned and put up for disposal.

Although the full facts of the case were brought to the notice of the General Manager (Gorakhpur Unit) in April 1972 and to the notice of the Director (Finance) in June 1972, a probe by the Chief Auditor of the Corporation was ordered only in March 1975, for fixing responsibility. The report was submitted by the Chief Auditor in December 1976, but the matter was put up to the Board only in March 1978. In November 1978, the Board suggested framing of a suitable shipping manual for the guidance of the persons dealing with clearance.

The Ministry have stated (April 1979) that disciplinary proceedings were initiated against two officials at Calcutta Office and action for drafting the shipping manual has been initiated by the Hindustan Fertilizer Corporation.

7.5 Outstanding claims with the Customs authorities.—As cargoes of plant and equipment, etc. were to be cleared within 3 days, the consignments were, at times, got released by payment of customs duty higher than that applicable to the imports of fertilizer plants. Thereafter, a claim for refund of the customs duty paid in excess was lodged through the clearing agents.

Out of the total claims for Rs. 89.81 lakhs lodged with the Customs Authorities from time to time, claims aggregating Rs. 9.82 lakhs were awaiting settlement (November 1978).

7.6 Physical verification

Extent of coverage.—The table below indicates the extent of physical verification of stores and spare parts, the value of each of which was Rs. 1,000 or more :—

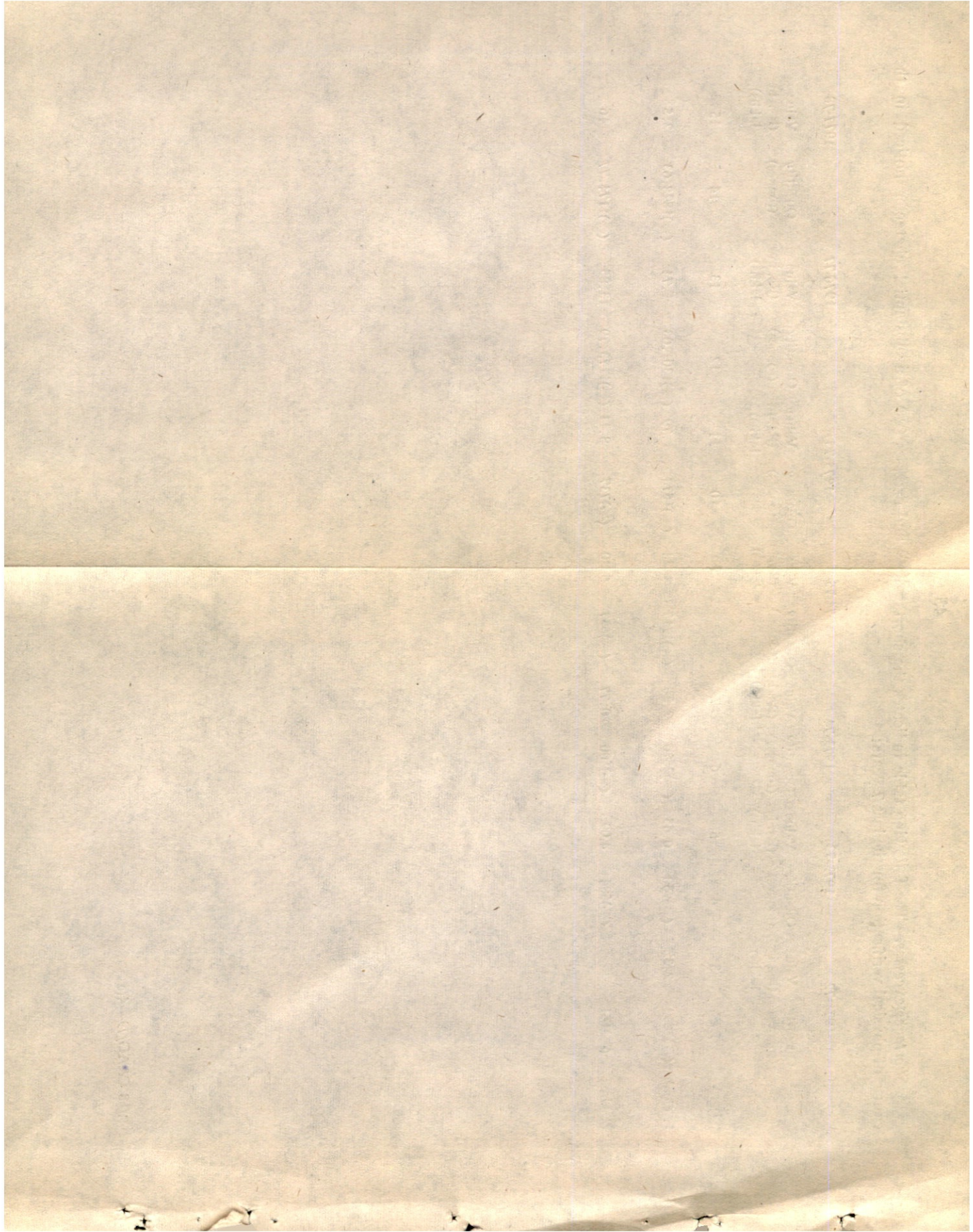
	1972-73		1973-74		1974-75		1975-76		1976-77		1977-78	
	Stores	Spares	Stores	Spares	Stores	Spares	Stores	Spares	Stores	Spares	Stores	Spares
1. Number of items in stock	1090	2152	809	1638	1226	1822	1262	1811	1360	1816	1548	2392
2. Value of items in stock (Rs. in lakhs)	63.03	148.45	50.50	123.06	66.29	132.4	94.5	139.13	150.86	206.84	139.00	290.54
3. Number of items verified	1018	1841	740	1638	1135	1818	1166	1809	1353	1816	1516	2327
4. Value of items verified (Rs. in lakhs)	55.53	135.65	45.57	123.06	60.21	131.65	86.3	139.07	147.79	206.84	137.67	282.03

As regards items of stores and spare parts each valued at less than Rs. 1,000 only 600 and 428 items were physically verified during 1972-73 and 1973-74 respectively. No such items were physically verified during 1974-75 and 1976-77. During 1977-78, however, 16118 items valuing Rs 28.55 lakhs representing 99.2 per cent quantity-wise and 99.3 per cent value-wise of the total items in stock are stated (April 1979) to have been verified.

Physical verification of plant and machinery and other fixed assets was not carried out till March 1974. With respect to furniture and miscellaneous equipment, physical verification was conducted in certain departments on selective basis only. No adjustments for shortage/excess were made in the Assets Ledger.

Shortages/excesses.—The following table indicates the shortages(—) and excesses (+) of a substantial character noticed in the course of physical verification for the last 7 years:—

	1971-72		1972-73		1973-74		1974-75		1975-76		1976-77		1977-78	
	Quantity (tonnes)	Value (Rs. in lakhs)	Quantity (tonnes)	Value (Rs. in lakhs)	Quantity (tonnes)	Value (Rs. in lakhs)	Quantity (tonnes)	Value (Rs. in lakhs)	Quantity (tonnes)	Value (Rs. in lakhs)	Quantity (tonnes)	Value (Rs. in lakhs)	Quantity (tonnes)	Value (Rs. in lakhs)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Coal	(—)3689	2.32	(—)950	0.65	(—)2820	2.36	(—)1117	1.24	(—)1578	1.79	(—)1301.03	1.74	(—)1828.63	2.5
2. Urea	(—)161		(—)584	4.09	(—)100	0.77	(—)557	5.20	(—)737	8.11	(—)1173.79	13.85	(—)1174.77	16



It will be seen that there were continuous shortages of coal. In terms of percentage of total quantity of coal handled, the shortages ranged between 1.23 and 1.53 during the period 1974-75 to 1977-78. In respect of urea, shortage was the highest in 1977-78. The following reasons were assigned by the Management for shortages in 1974-75 :—

Coal

- (i) Fly away of coal fines while unloading by tippler, dropping from a height during storage and also during handling by dozer-scraper.
- (ii) Wash away of coal fines during the rainy season and mix-up of coal with earth during spread over.
- (iii) Inherent error in the measurement of stock of coal and errors in the weighbridge and belt-weigher used for calculating receipt and consumption respectively.

Urea

- (i) Erratic performance of the product belt-weigher of the Urea Plant and its inherent 'drift' from the 'Zero' setting during operation.
- (ii) Inherent 'drift' in the zero setting of the weighing machine at Bagging Plant.
- (iii) Unaccounted losses during handling of material from Urea Plant to Silo and from Silo to Bagging Plant.
- (iv) Loss of material during rainy season on account of the hygroscopic characteristic of urea.

7.7 *Shortage of coal in transit.*—The Unit entered into a running contract with the National Coal Development Corporation for supply of a lakh of tonnes of selected 'B' coal, F.O.R. colliery sidings between June 1974 and May 1975. As against 0.68 lakh tonnes despatched by the National Coal Development Corporation according to the railway receipts, the actual quantity received according to the weighbridge at Gorakhpur was 0.65 lakh tonnes;

there being thus a shortage of around 3602 tonnes (5.26% of the total quantity despatched), valued at Rs. 3.59 lakhs (including freight at Rs. 47 per tonne).

In a note submitted to the Board for the write off of the shortage, the transit loss was ascribed to errors in weighment of coal at the despatching colliery station, pilferage and spillage en route, loss on account of dry-age and transshipment.

The write off sanction was awaited (February 1977). The following measures were stated to have been taken to minimise losses in future :—

- (i) The weighbridge was being checked and adjusted periodically.
- (ii) Loaded wagons were being re-weighed at the loading point in the collieries.
- (iii) Arrangement was also to be made to supervise the transshipment so as to reduce pilferage at Manduadih transshipment point.

The Ministry have stated (November 1978) that the Chairman and Managing Director had appointed a Committee to report on the losses. The Committee's report is still awaited. Meanwhile there were transit shortages of 12437 tonnes valued at Rs. 9.48 lakhs during 1975-76, 1976-77 and 1977-78. In terms of percentage to the total quantity of coal handled in transit, the shortage in transit worked out to 5.32 in 1975-76, 4.18 in 1976-77 and 3.25 in 1977-78.

8. Profitability analysis

The Plant was deemed to have gone into commercial production from January 1969. During the 3 months January to

March 1969, the Unit earned a profit of Rs. 15.07 lakhs. Income and expenditure thereafter up to 1977-78 were as follows :—

	(In crores of rupees)								
	1969-70	1970-71	1971-72	1972-73	1973-74	1974-75	1975-76	1976-77	1977-78
<i>Income</i>	11.15	11.45	16.03	13.20	15.67	23.12*	18.99*	42.38*	43.67*
(i) Sales	0.07	0.09	0.13	0.16	0.46	0.19	0.23	0.25	0.26
(ii) Other Income	1.11	0.27	0.07	0.02	0.19	0.08	1.76	2.34	2.89
(iii) Closing stock	1.48	2.91	0.85	2.43	1.98	3.63	2.91	1.87	3.02
(iv) Transfer of stock to other Units									
TOTAL	13.81	14.72	17.08	15.81	18.30	27.02	23.89	46.84	49.84
<i>Expenses</i>	0.20	1.11	0.27	0.07	0.02	0.19	0.08	3.73	2.34
(i) Opening stock	—	—	—	0.29	2.24	1.48	0.01	8.99	14.75
(ii) Purchase of finished goods	0.44	0.49	2.40	1.43	2.01	4.45	5.27	2.83	0.78
(iii) Transfer of stock from other Units	2.22	2.63	3.09	2.85	3.14	5.87	6.06	10.68	10.27
(iv) Materials consumed	0.82	0.93	1.15	1.21	1.53	1.81	2.13	2.17	2.98
(v) Salaries and wages	2.09	2.40	2.71	2.86	2.81	4.32	4.77	8.23	8.18
(vi) Power and fuel	0.42	0.49	0.34	0.26	0.23	0.45	0.37	0.79	0.78
(vii) Freight & handling charges	1.14	1.23	1.33	1.80	1.73	2.64	2.29	3.69	3.42
(viii) Excise duty	0.49	0.44	0.57	0.78	0.69	1.22	1.86	2.41	3.05
(ix) Repairs and maintenance									
(x) Other expenses (including share of central office expenses, provision of doubtful debts, etc.)	0.52	0.55	0.64	0.50	0.56	0.81	0.86	1.93	1.70
(xi) Interest	1.15	0.93	0.83	0.73	0.59	0.50	0.67	1.22	1.18
(xii) Depreciation	2.29	2.31	2.35	2.78	2.82	2.85	2.89	4.62	4.63
(xiii) Profit on operations	2.03	1.21	1.40	0.25	(-)0.07	0.43	(-)3.37	(-)4.45	(-)4.22
TOTAL	13.81	14.72	17.08	15.81	18.30	27.02	23.89	46.84	49.84
Net profit after past period adjustment	1.99	1.20	1.27	(-)1.24	(-)0.55	0.29	(-)3.35	(-)4.58	(-)5.75

*Excludes Fertilizer Pool Equalisation charges.

- (i) Turnover included sales of imported material and products of other Units valued at Rs. 1.76 crores in 1972-73, Rs. 4.34 crores in 1973-74, Rs. 5.95 crores in 1974-75, Rs. 5.28 crores in 1975-76, Rs. 9.24 crores in 1976-77 and Rs. 15.15 crores in 1977-78. The decrease in sales turnover in 1975-76 over that of 1974-75 was mainly due to reduced off-take of urea.
- (ii) The cumulative loss, after setting off profits, amounted to Rs. 10.88 crores as on 31st March 1978.

Profitability of the Unit generally declined from 1969-70 to 1973-74 when an operating loss of Rs. 0.07 crore was incurred. In 1974-75, the operating profit earned was Rs. 0.43 crore despite the price advantage of Rs. 4.66 crores that accrued on account of increase in the price of urea effective from June 1974. From 1975-76 onwards, the Unit is incurring losses.

The Ministry have stated (November 1978) that "against the price increase of Rs. 950 per tonne, the price advantage to the Unit was only marginal as the unit had to pay back to the Government the FPEC charges amounting to Rs. 610 per tonne. The price of input like naphtha, coal, electricity and bags etc. also increased by Rs. 200 per tonne during the year. Besides, there was increase in *ad valorem* excise duty by Rs. 45 per tonne leaving a marginal price advantage of Rs. 95 per tonne only to the Unit".

The main reasons for the decline in profitability were :—

- (a) Higher cost of production caused, *inter alia*, by increase in the cost of naphtha, power, coal and bags and increased specific consumption of raw materials and utilities.
- (b) Under-utilisation of capacity; particularly in the Ammonia Plant.
- (c) Higher inventory of stores and spares.

- (d) Quicker consumption of spares under 'accelerated renovation' programme being implemented from 1974-75.
- (iii) In the profitability projections of the Unit, after commissioning of the Expansion scheme, submitted to the Board in April 1974, a net profit (after provision for interest) of Rs. 1.89 crores was anticipated at the full rated production of 2.85 lakh tonnes of urea (based on 300 stream days). This computation was based on an average net realisation of Rs. 828.74 per tonne and average cost of production of Rs. 742.26 per tonne, leaving a margin of Rs. 86.48 per tonne. The break even point of the Unit which was 99.64 per cent, was expected to become 79.09 per cent.

The sale price of urea was increased from June 1974. There was also an increase in the cost of naphtha, coal and power in 1974-75 and later.

It was seen from the cost sheet for 1975-76 that the net sales realisation (after excluding excise duty and freight) was around Rs. 1206 per tonne and average cost of sales was Rs. 1460 per tonne.

The Corporation stated (March 1977) that, while input costs were higher due to increasing costs of raw materials, the sale price of urea was controlled by Government. However, efforts were being made to reduce the cost of production.

9. Costing

As in the case of other Units, Gorakhpur Unit follows a system of process costing for ascertaining the cost of urea.

Estimates of cost are prepared each year on the basis of plan of production and compared with actual cost. In Appendix III estimated and actual costs and average selling prices

per tonne from 1970-71 to 1977-78 are mentioned. It will be seen that costs have risen continuously from 1972-73 onwards. The increase in costs was attributed *inter alia* to higher consumption of raw materials and utilities, under-utilisation of capacity, high inventory, etc.

10. Gorakhpur Expansion

10.1 *Introduction.*—In July 1969, the mission from the International Bank for Reconstruction and Development observed that the capacity of the Gorakhpur Plant could be substantially improved by utilisation of extra capacity available in the equipment of the existing Plant, with marginal additions in points where such extra capacity did not exist. After obtaining the advice of M/s. Toyo Engineering Corporation, Government agreed (October 1970) in principle, to the expansion of the capacity of the existing Plant as follows :—

- | | |
|-------------------|--|
| (1) Ammonia Plant | from 350 tonnes a day to 579 tonnes a day. |
| (2) Urea Plant | from 543.5 tonnes to 950 tonnes per day. |

The Expansion scheme was to be executed with the assistance of M/s. Toyo Engineering Corporation ; the foreign exchange component was to be financed by the World Bank.

The Project was to be implemented as follows :—

- (i) M/s. Toyo Engineering Corporation were to supply the design packages for the additional streams in Ammonia and Urea Plants and the Corporation was to carry out the detailed engineering and design from the process data made available by the suppliers.
- (ii) Excepting for the procurement of proprietary items (ammonia synthesis converter, additional urea reactor etc. from M/s. Toyo Engineering), the Corporation was responsible for the rest of foreign and indigenous procurement.
- (iii) Erection and commissioning of the Plant were to be supervised by M/s. Toyo Engineering Corporation.

Technical know-how for partial oxidation of naphtha and carbon dioxide removal was obtained by the Corporation from Shell Research Limited, London and Ben Field Corporation, U.S. respectively.

10.2 *Agreements.*—In June 1972, the Corporation entered into a contract with M/s. Toyo Engineering Corporation for the supply of :—

(A) Basic designs and engineering for,

- (i) process unit designed to produce 570 tonnes of liquid ammonia by (a) increasing capacity of the existing Ammonia Plant to 380 tonnes with suitable modifications to the relevant sections and (b) providing an appropriate train to the existing Ammonia Plant with a design capacity equivalent to 190 tonnes per day; and
- (ii) for a process unit designed to produce 950 tonnes of un-coated, prilled urea per day by (a) increasing the capacity of the existing Urea Plant to 600 tonnes with suitable modifications to the relevant sections and (b) by providing to the existing Urea Plant with a design capacity equivalent to 350 tonnes per day.

(B) Licences and know-how.

- (C) Contract equipment, *viz.*, one ammonia converter including cartridge, one urea synthesis tube with let down valve, one connecting piping, one set of cylinder liner, piston rod, piston ring and neck bush.

For the supplies and services, the firm was to be paid 638.59 Million Yens (Rs. 1.92 crores).

In terms of the contract, the foreign suppliers were to demonstrate performance guarantees with respect to production

capacity, qualities of the product and consumption of raw materials and utilities, subject to the conditions that :—

- (i) new trains and additions and modifications to the existing Plants were designed, engineered and constructed by the Corporation in accordance with their basic design and engineering; and
- (ii) the Corporation and the supplier investigated and tested the existing Plant prior to the commencement of guarantee test run and steps were taken by the Corporation to ensure that the existing Plant could produce 380 tonnes per day of ammonia and 600 tonnes per day of urea on a sustained basis.

While the performance guarantee was fulfilled for the new trains of the Ammonia and Urea Plants, no such test was conducted for the existing Plants.

As the Corporation had not been able to operate the existing Plants at full load, as requested by the suppliers during the last 2 years and as there was no possibility of the test on full load being held prior to the expiry of the contract in June 1976, the suppliers requested (February 1976) the Corporation to waive the guarantee for the existing Plant. On the basis of the data obtained from running of the existing Plant on high capacity, they, however, agreed to give further technical advice along with specification sheets. This was accepted by the Corporation.

The Corporation stated (March 1977) that the Urea Plant achieved a capacity of more than 950 tonnes a day during the guarantee test but that Ammonia Plant could not achieve capacity because of limitation of the existing Air Separation Plant and reduced capacity of Nitrogen compressors. The Ministry have further explained (April 1979) as follows :—

When the studies for the expansion of the Plant were taken up, it was noticed that the capacity of the

Nitrogen Compressors had actually come down to 5300 NM³/hour to 5500 NM³/hour (as against the capacity of 5900 NM³/hour—a reduced capacity which had been accepted from Toyo Engineering Corporation during guarantee tests—as referred to in para 2.4.2.). These machines had also been giving extremely poor performance inasmuch as the breakdowns were frequent. It was, therefore, decided to instal another Compressor with 7000 NM³ per hour to take care of the additional requirement of nitrogen. Steps are also being taken to renovate the old machines by replacing the casing as well as the rotors to bring up their capacity to 5900 NM³ per hour. As far as the capacity of the Air Separation Plant is concerned, this has come down because of leakages in the regenerators which are proposed to be replaced in the coming shutdowns.

Workmanship guarantee for the contract equipment was valid for 18 months from the date of shipment or 12 months from the initial start up of the Plants, whichever was earlier. Due to delay in supply of a few items by other suppliers and piping required for the project, the erection could not be completed before August 1975. As the shipment of contract equipment was completed by August 1973, the workmanship guarantee expired in February 1975. The Corporation requested (November 1975) the suppliers to extend the workmanship guarantee of the contract equipment upto 31st December 1976 *i.e.* 12 months after the expected date of commissioning. This request was not accepted by the suppliers.

The Ministry have stated (November 1978) that, as regards delay in supply of a few items by other suppliers, liquidated damages amounting to Rs. 5 lakhs (approx.) were recovered.

10.3 *Project estimates.*—Government approved of the Expansion Project in January 1972 at an estimated cost of

Rs. 11.83 crores (including approximately Rs. 6 crores in foreign exchange). The Expansion Plant was to be commissioned by March 1975. The estimated cost was revised in April 1975 to Rs. 18.39 crores, with a foreign exchange component of Rs. 8.70 crores, on the assumption that the project would be completed by August 1975 and commercial production established by October 1975. The revised estimates were approved by the Board in November 1975 and by Government in October 1978.

A broad break-up of the original as well as the revised estimates is given below :—

	(in crores of rupees)			
	Original	Estimates	Revised	Estimates
	Foreign currency	Total	Foreign currency	Total
Total manufacturing facilities	6.49	10.90	8.15	16.45
Financing charges	—	0.66	—	0.75
Spares	0.16	0.23	0.55	0.85
Margin for working capital	—	0.04	—	0.04
Deferred revenue expenditure	—	—	—	0.30
	6.65	11.83	8.70	18.39

Actual expenditure up to its completion amounted to Rs. 18.26 crores including Rs. 8.70 crores in foreign exchange.

The main reasons for increase in cost, as intimated by the Ministry, were as follows :—

	(in crores of Rs.)
(a) Change in parity	2.56
(b) Price escalation	0.65
(c) Inadequate provision	0.78
(d) Increase in the customs duty etc.	1.59
(e) Additional provision	0.63
(f) Increase in the departmental charges	0.20
(g) Others	0.15
	6.56

10.4 *Delay in completion of the Project.*—According to the Development Credit Agreement between Government and International Development Association, the Project was to be completed in July 1974. In September 1972, it was anticipated that the Project would be completed by the end of December 1974.

The time schedule was revised in February 1973 and December 1973, the expected dates of erection and commencement of production as per revised schedules and the actual dates of completion were :—

	As per schedule of		Actual date
	February 1973	December 1973	
Erection	March 1965	August 1975	October 1975
Commencement of production	May 1975	October 1975	January 1976

There was thus a delay of 7 months with reference to the schedule of February 1973 for completion of erection and commencement of production, attributed to the following :—

- (i) Delay in receipt of the import licence, resulting in delay in the import of structural steel leading to delay in civil construction of plant buildings.
- (ii) Delay in procurement by the Planning and Development Division, resulting in delay of receipt of material at site leading to delay in mechanical and piping erection.
- (iii) Oil crisis due to which international supply position became acute due to scarcity of raw materials, non-availability of ships, restriction in working hours in foreign countries, etc.

10.5 Procurement of spares, etc.

Spares for Air-Separation and Nitrogen Wash Plants.—In January 1973, the Corporation issued a letter of intent on Kobe Steel Limited for the supply of Air-Separation and Liquid Nitrogen Wash Plants. In their offer, made in September 1972, valid upto the end of January 1973, Kobe Steel Limited had also indicated the bulk of the recommended spare parts with prices for two years' normal operation and maintenance of the Plants.

The contract for the supply of two years' spares was not, however, finalised with the contract for the main plants and equipment. At the instance of the Corporation, Kobe Steel Limited had supplied (November 1972) separately item-wise prices of spares as discounted by 25 per cent with the following footnote :—

“The above prices are discounted by 25 per cent subject to the condition that these spares are ordered within one year after the contract for Air-Separation and Nitrogen Wash Plants.”

As all items were not covered by this list, quotations for additional items were obtained in July 1973 and an order was placed in December 1973 in the belief that the offer was valid upto the 31st January 1974 in terms of the footnote quoted above. Kobe Steel rejected the purchase order on the ground that it had not been placed within the validity date (*i.e.* 31st January 1973). As regards the contention of the Corporation that the offer was valid upto the 31st January 1974 in terms of the above footnote, they clarified that there were two different aspects of the matter; first was the validity of the proposal itself and second was the rate of discount mentioned in the original and revised quotations. It was clearly mentioned in the proposal that the validity of all prices including that of spare parts was upto 31st January 1973 and extension thereof was subject to confirmation.

As these spares were essential for commissioning of the plants and project schedule depended on their delivery, the firm was requested to intimate revised prices.

The firm submitted a revised offer in March 1974 which was found to be four times the prices originally quoted. After negotiations by a Committee deputed for this purpose to Japan, the final prices agreed to by the Corporation were two and a half times the original prices. The additional payment on this account was Rs. 15 lakhs.

The case was reported to the Board on 10th February 1975. While approving the proposal, the Board directed that the entire procedure be studied to ensure timely action. The Board also constituted a Committee to study the matter in all its aspects and make recommendations. The report of the Committee was submitted to the Board in August 1975 and contained the following recommendations :—

- (i) The initial list of spares should be scrutinised by the Planning and Development Division and orders placed alongwith the equipment.
- (ii) To the maximum extent possible, it should be ensured that suppliers quote for spares when quoting for the equipment.
- (iii) Whenever offers for spares are not received with the quotation for equipment, suppliers should be persuaded to make offers within a reasonable time.

10.6 *Argon Recovery Plant.*—In February 1972, the Board approved installation of a Unit to extract 40 cubic metre per hour of argon gas of 99.9 per cent purity from the Air-Separation Plant being set up under the Expansion Project; the installation of such a plant with the Air-Separation Unit of the existing Plant was not found to be technically and economically feasible.

The Argon Recovery Plant was estimated to cost Rs. 70.50 lakhs (including Rs. 37.52 lakhs in foreign exchange). Government approved in November 1972 the setting up of this Plant as an adjunct to the Expansion Project. The Plant was completed in June 1975 and regular production commenced in August 1975. The estimate of capital cost was revised to Rs. 90.50 lakhs in July 1975 and the expenditure incurred thereagainst amounted to Rs. 80.66 lakhs.

The following other facts deserve mention :—

- (a) According to the purchase order placed in July 1973, the shipment of the Plant was to be completed by January 1974. In the event of failure to adhere to the delivery schedule, liquidated damages were recoverable from the supplier. There was a delay of about 4 weeks in the shipment, for which liquidated damages amounting to 1.03 million Yens (Rs. 0.31 lakh) were claimed by the Corporation in August 1975, but were subsequently waived.

As to the reasons for the waiver of the liquidated damages, the Ministry have stated (April 1979) that the shipping arrangement was not the responsibility of the supplier, but was to be made by the Shipping Co-ordination Committee, Ministry of Transport and Shipping. M/s. Kobe Steel Limited had intimated the readiness of the cargo for shipment on 24-12-1973 as against the due date of the shipment viz. 2-1-1974.

- (b) It was indicated in the agreement that 44 man-months were required to erect and commission Air-Separation and Nitrogen Wash Plants including the Argon Recovery Plant. This period was extended to 50 man-months and again to 62 man-months, entailing an additional expenditure of 38.48 million

Yens (Rs. 11.45 lakhs). It was stated (March 1976) that frequent power failures, two fires in cable trenches and interruption in power were responsible for prolongation of the stay of the foreign personnel. It was noticed that, apart from these factors, the following also contributed to the delay :—

- (i) Critical equipment fabricated and tested in Kobe Works, was found leaking during pressure test. Besides, certain items were not received in the first instance.
- (ii) Teething troubles faced during commissioning on account of faults, attributable both to the Unit and to the foreign supplier (Kobe Steel).
- (c) From August 1975 to February 1976, the Plant recovered 0.28 lakh cubic metres of argon gas as against the proportionate rated capacity of 1.68 lakh cubic metres. Pending development of a market study and subsequently as cylinders were not available, some quantity of the argon gas had to be vented into the atmosphere.

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

- (i) The performance of the plant is now satisfactory and the plant is producing argon gas at the full rated capacity.
- (ii) 3000 cylinders were purchased in April 1975. Another 2000 cylinders were procured and received in May-June 1976. Even with 5000 cylinders, the frequency of venting of argon gas may depend on the low turn round of cylinders from the customers.

- (iii) Fertilizer Corporation of India Limited has now appointed dealers who are having their own cylinders. In addition, about 500 cylinders are being diverted from Talcher for filling argon gas.

10.7 *Increase in capacity.*—After implementation of the expansion programme, the annual capacity for production of urea increased by 1.11 lakh tonnes, the overall annual capacity of the Unit after expansion, rising to 2.85 lakh tonnes.

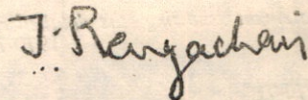
As mentioned in paragraph 4.1, the original capacity of 1.74 lakh tonnes per annum of Urea Plant was based on a stream efficiency of 320 days in a year. In the Expansion Project, the stream efficiency has been assumed as 300 days, although in the profitability study made by the Unit at the instance of the World Bank, it was mentioned as 330 days.

The Corporation stated (March 1977) that, as the expansion train was implemented to utilise the spare moving machines of the existing Plants, the stream efficiency of 320 days a year was reduced to 300 days a year.

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

“The expansion stream was implemented to utilise the spare moving machines. Now no spare moving machines are left and hence the earlier stream efficiency of 320 days was reduced to 300 days. This fact was also reported to the Board of Directors as item No. 6 of the 134th meeting held on 17-5-1971 and the profitability was calculated on 300 days per year at the annual capacity of 2.85 lakh tonnes of urea per year. In the Industrial Licence application made, this

figure of 2.85 lakh tonnes per year was also indicated
(based on 300 stream days per year.”

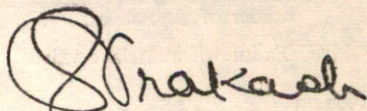


New Delhi

The 11-1-1980.

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

Countersigned



New Delhi

The 11-1-1980.

(GIAN PRAKASH)
Comptroller and Auditor General of India

APPENDIX I

(Referred to in paragraph 4.2.3.)

Statement showing the detailed reasons for shortfall in production from 1970-71 to 1977-78

1970-71

- (i) Power failures/voltage dips including non-availability of power for 5 days in August 1970 due to strike in the Uttar Pradesh State Electricity Board.
- (ii) Shut-down of one urea synthesis tube (E) for 55 days due to leakage through its titanium lining.
- (iii) Prolonged annual shut-down in May 1970 due to adoption of slow down tactics and refusal to work on overtime and on holidays by the maintenance staff.
- (iv) Non-availability of imported spare parts due to delay in opening letter of credit and in customs clearance.
- (v) Severe corrosion problem of various equipment in the Urea Plant.

1971-72

- (i) Power failure and voltage dips.
- (ii) Raw material shortage.
- (iii) Leakage through titanium lining of autoclaves 'D' and 'E'.
- (iv) Failure of discharge header of the autoclaves.
- (v) Corrosion of gas distributor in L.D.H.
- (vi) Bursting of distance piece of autoclave (E) and leakage from exchange header of autoclaves.
- (vii) Failure of autoclave valves.

1972-73

- (i) Voltage dip from hydel.
- (ii) Power supply cut for 3 days due to strike in the Uttar Pradesh State Electricity Board.
- (iii) Shut-down of one stream of ammonia due to 40 per cent power cut imposed from 15th March 1973.

- (iv) Shut-down of Air Separation 'A' Unit due to heavy leakage from regenerator bottom drain silo.
- (v) Labour trouble.
- (vi) Bursting of outlet header of 'A' stream of urea autoclave.
- (vii) Strike of 34 days in the factory.

1973-74

- (i) 40 per cent power cut between 1st April 1973 and 14th June 1973 and again from 12th January 1974 to 31st March 1974.
- (ii) Complete shut-down of Plant due to power cut from 8th May 1973 to 11th May 1973, 28th January 1974 to 31st January 1974 and 28th February 1974 and 15th March 1974.
- (iii) 21 incidents of power failure and 13 incidents of voltage dips.

1974-75

- (i) Complete power cut for 26 days.
- (ii) Power cuts/interruptions/voltage dips and frequency fluctuations.
- (iii) Titanium lines leakage of autoclaves and break-down of air compressor for decomposers.
- (iv) Tripping of oxygen compressor (6 times) and power failure due to local fault.

1975-76

- (i) Power supply limitations, power failure and voltage dips.
- (ii) Leakage from the titanium liner of autoclaves 'E' and 'A', failure of valves and break-down of inlet nozzle for autoclave 'B' etc.
- (iii) Trouble in Air Separation Units, fire in cable trench in Ammonia Plant, break-down of nitrogen compressor and valves of the Steam Generation Plant.
- (iv) Start up of expansion stream.

1976-77 and 1977-78

- (i) Power failure voltage dips/power cut.
- (ii) Planned shut down (1976-77).

APPENDIX II

(Referred to in paragraph 7.2)

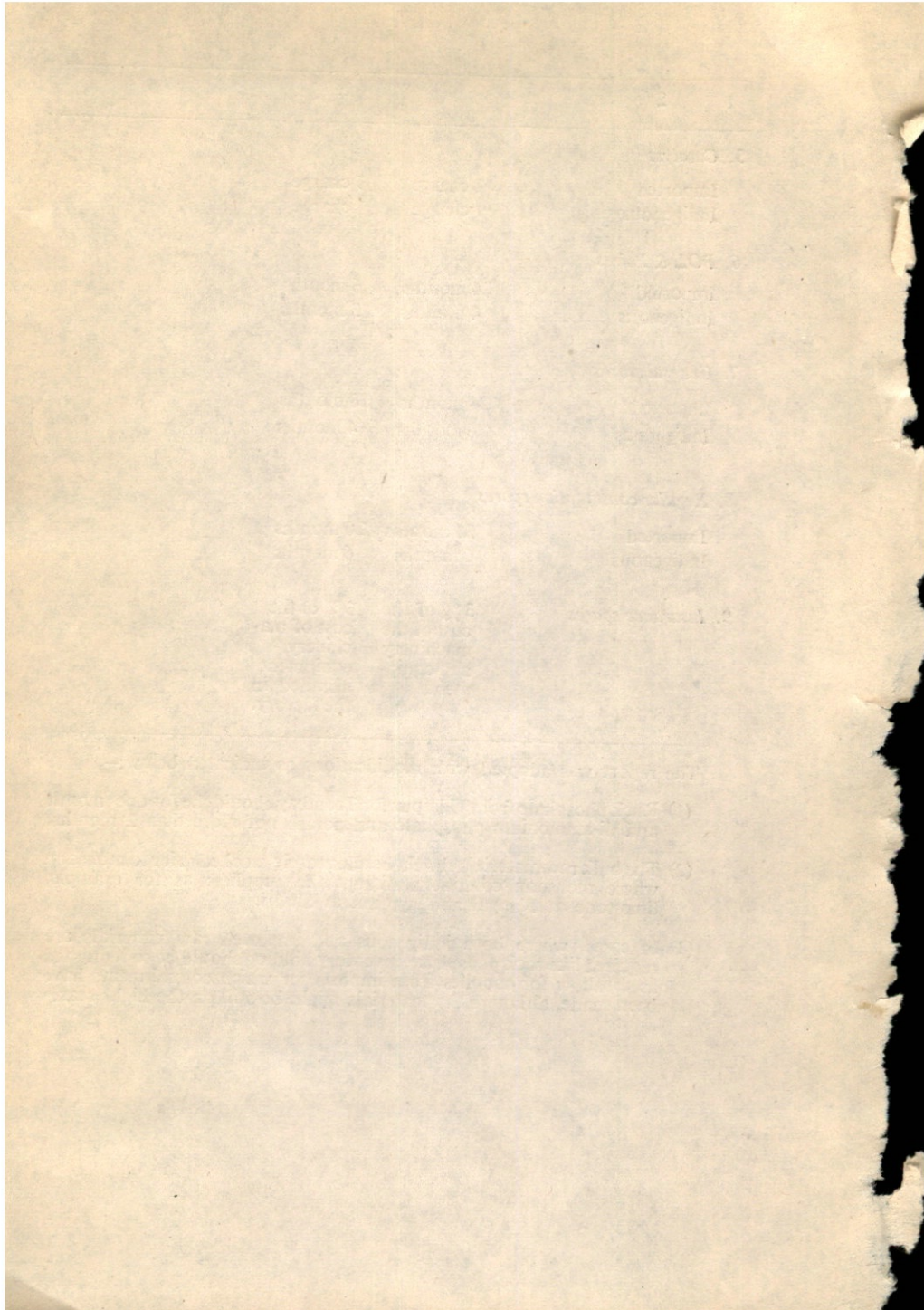
Statement of norms of holding inventory

Sl. No.	Name of the category	Norms (No. of month's consumption)		Remarks
		Existing norms	Revised norms	
1	2	3	4	5
1. Raw materials				
	Imported	(1) 6 months	6 months	(1) <i>Sindri</i> for Namrup 1. Coke 0.2 month 4 months for 2. Naphtha 05 „ Trombay 3. Sulphur 6 months and Sindri 4. Gypsum (rainy season) 3 months
	Indigenous	1 month	No change suggested	Gorakhpur Naphtha 0.5 month
2. Packing materials				
	Imported	6 months	1 month	
	Indigenous	1 month	No change suggested	
3. Fuel				
	Imported	6 months	-- do--	
	Indigenous	1 month	(2) 0.5 month	(2) For Sindri (steam coal) 0.5 month Gorakhpur (coal) 0.7 month
4. Chemicals				
	Imported	9 months	9 months	(3) For Trombay
	Indigenous	4 months	(3) 2 months	1 month

1	2	3	4	5
<i>5. Catalyst</i>				
	Imported	1 charge	1 charge	
	Indigenous	1 charge	1 charge	
<i>6. POL & Paints</i>				
	Imported	24 months	6 months	
	Indigenous	4 months	3 months	
<i>7. General stores</i>				
	Imported	24 months	18 months	
	Indigenous	6 months	4 months	
<i>8. Regular consumption spares</i>				
	Imported	24 months	20 months	
	Indigenous	6 months	6 months	
<i>9. Insurance spares</i>				
		3% of the cost of the machinery and equipment	3% of the cost of machinery/ equipment installed in the factory.	

The report was adopted with modifications as indicated below:—

- (1) Rock phosphate from Udaipur for Trombay should be for one month and di-ammonium phosphate and potash not more than 2 months.
- (2) The bulk raw materials should be adequately stocked prior to monsoon where monsoon conditions disrupt the supplies; as for example, limestone at Nangal and gypsum at Sindri.
- (3) In cases, where both indigenous and imported raw materials are required like rock phosphate, inventory holding should be so regulated as to allow for supplies from imports for which commitments have been made, although the materials might be still on the high seas.



APPENDIX III

(Referred to in paragraph 9)

Statement showing the budgeted cost, actual cost and net sales realisation per tonne

(Figures in rupees per tonne)

	1970-71		1971-72		1972-73		1973-74		1974-75		1975-76		1976-77		1977-78	
	Budget	Actual	Budget	Actual	Budget	Actual	Budget	Actual	Budget	Actual	Budget	Actual	Budget	Actual	Budget	Actual
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
I. Cost																
(i) Variable cost	266.33	278.66	293.77	284.62	306.11	316.11	360.18	359.77	503.75	554.30	708.63	746.78	795.78	815.73	810.01	859.66
(ii) Fixed cost	301.23	343.50	307.91	328.11	306.05	383.57	400.65	420.23	443.93	437.06	457.76	612.19	592.04	556.77	662.86	632.44
(iii) Total :	567.56	622.16	601.68	612.73	612.16	699.68	760.83	780.00	947.68	991.36	1166.39	1358.97	1387.82	1372.50	1472.87	1492.10
(iv) Cost per tonne (Gross)	559.96	613.83	593.61	604.52	603.96	690.84	751.70	770.65	936.31	979.47						
(v) Bagging	47.50	50.63	52.00	55.21	60.00	58.98	60.00	54.23	84.00	74.55	73.00	66.52	73.40	71.83	74.00	75.75
(vi) Selling and distribution expenses	21.19	10.18	18.33	11.46	17.67	11.68	20.10	19.27	16.86	21.66	28.67	34.92	37.07	35.85	33.02	47.04
(vii) Total :	628.65	674.64	663.94	671.19	681.63	761.50	831.80	844.15	1037.17	1075.68	1268.06	1460.41	1498.29	1480.18	1579.89	1614.89
II. Net sales realisation																
	745.60	755.42	735.40	751.77	761.30	775.11	805.10	813.10	1116.00	1100.88	1242.00	1200.25	1254.40	1242.98	1239.52	1499.00

NOTE :—Cost data for 1975-76 are per tonne (Net).

