OCCASION

This publication has been made available to the public on the occasion of the 50th anniversary of the United Nations Industrial Development Organisation.

DISCLAIMER

This document has been produced without formal United Nations editing. The designations employed and the presentation of the material in this document do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations Industrial Development Organization (UNIDO) concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries, or its economic system or degree of development. Designations such as "developed", "industrialized" and "developing" are intended for statistical convenience and do not necessarily express a judgment about the stage reached by a particular country or area in the development process. Mention of firm names or commercial products does not constitute an endorsement by UNIDO.

FAIR USE POLICY

Any part of this publication may be quoted and referenced for educational and research purposes without additional permission from UNIDO. However, those who make use of quoting and referencing this publication are requested to follow the Fair Use Policy of giving due credit to UNIDO.

CONTACT

Please contact publications@unido.org for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at www.unido.org

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

We regret that some of the pages in the microfiche copy of this report may not be up to the proper legibility standards, even though the best possible copy was used for preparing the master fiche

08015

Distr.
LIMITED

ID/WG.274/15
10 April 1978

ENGLISH

United Nations Industrial Development Organization

Expert Group Meeting on Fertilizer Plant Cost Reduction and Ways to Mobilize Sufficient Financing

Vienna, Austria, 11 - 14 April 1978

POSSIBILITIES OF REDUCTION OF INVESTMENT IN FERTILIZER PROJECTS IN DEVELOPING COUNTRIES *

by

R.R. Poricha**

* The views and opinions expressed in this paper are those of the author and do not necessarily reflect the views of his employer or of the secretariat of UNIDO. This document has been reproduced without formal editing.

** Manager (Planning) of the Fertiliser Corporation of India Ltd., Planning and Development Division, CIFT Building, P.O. Sindri PIN 828122, Dist. Dhanbad (Bihar), India.

id.78-1947

1.0 PREAMBLE

1.1 During Seventies the international economical situation and prices of commodities have undergone considerable change. This has also affected the international fertilizer scene. The economics of fertilizer industry - the prices of equipment and material on one hand and input - output prices on the other hand - have reached levels which were unimaginable a decade earlier. A few examples will highlight the situation. Table 1 gives the prices of some of the equipment for 600 tpd gas based ammonia plants in 1968 and 1978. Both the plants are at the same location and use the gas from the same field and are under one management.

Table - 1

	Equipment ordered in 1968	Equipment quoted in 1978
	$x10^6	$x10^6
1. Synthesis gas compressor and turbine	1.2	6.9
2. Air compressor and turbine	0.5	2.9
3. Boiler feed water pump and turbine	0.2	0.7
4. Ammonia refrigeration unit	0.5	2.3
5. Cold exchanger	0.1	0.3

The prices of other equipment of the two plants show similar trend.

1.2 - Table 2 shows the cost of similar equipment for two coal based ammonia plants. The plants are of identical design though located at two different places. The capacities of plants are 900 tpd ammonia. The equipment for the earlier plant had been ordered between 1971 and 1972 whereas for the second plant the quotations have been received in 1978.

Table - 2

	Equipment ordered in 1971 & 72	Equipment quoted in 1978
	$ x 10^6	$ x 10^6
1. Synthesis gas compressor & turbine	2.0	5.6
2. Refrigeration compressor & turbine	1.0	3.5
3. Shift converter	0.2	0.4
4. Saturator-water heater	0.3	0.7
5. CO_2 Absorber	0.2	0.5
6. CO_2 flash tower	0.1	0.4
7. H_2S absorber	0.1	0.3
8. Kopper Totzek gasifier	0.1	0.2

In parenthesis it may be mentioned that in the example the supplier of equipment for both the plants is same.

1.3 Below is another example - this is for 900 tpd ammonia plants based on fuel oil. The plants are of identical design though located at different places. Both the projects are procured under international competative bidding. The purchase orders for one was placed in 1973 where as those for the other were placed in 1974-75.

Table - 3

	Equipment ordered in	
	1972-73	1974-75
	$ x 10^6	$ x 10^6
1. Synthesis compressor and turbine	2.8	3.2
2. Nitrogen compressor & turbine	1.0	1.4
3. Oxygen compressor & turbine	1.4	2.3
4. Air separation and nitrogen wash units.	2.7	4.8
5. Urea reactor	0.4	0.6
6. Ammonia & carbamate pumps	0.7	1.1
7. CO_2 compressor	0.6	0.8
8. Ammonia converter	0.4	0.7

1.4.1 A decade back the inflation rate used to have a predictable course. However, from 1973 onwards not only the inflation has been high but it had become difficult to forecast the rate of inflation. In various countries it has followed an erratic course.

Table 4 gives the rate of inflation for some of the developed countries from which normally developing countries import their equipment.

Table - 4

(Base 1970 = 100)

	U.K.	France	Italy	Japan	USA	FRG
1968	85	77	76	77	91	84
1969	93	87	91	91	97	94
1970	100	100	100	100	100	100
1971	120	115	116	115	106	114
1972	129	131	135	133	110	125
1973	140	155	167	157	116	138
1974	177	183	214	196	134	160
1975	225	205	265	229	170	172
1976	265	227	315	258	185	177

(Source: Process Plant and Equipment Cost Estimate by O.P.Khar anda)

1.4.2 In the developing countries also the inflation rate has followed the same pattern though not enough published data is available for many of the developing countries. Table 5 gives the inflation rate for Saudi Arabia and India.

Table - 5

Inflation factor

	1970	1971	1972	1973	1974	1975	1976
Saudia Arabia							
Civil material cost(1970=100)	-	-	107	145	235	280	310
Construction cost (1966=100)	130	135	150	165	200	240	NA
India							
(1970=100)	100	108	114	122	157	180	178

(Source:Process Plant and equipment cost estimates by O.P. Kharbanda)

1.5 In this present inflationary economy the developing countries have been caught in vice. Not only the investment costs have gone up; the prices of raw-materials, fuels and utilities have also kept step with this inflation. This situation has particularly hit the fertilizer industry in developing countries and hence boosted up the production costs of fertilizers.

1.6 This naturally entails a considerable drain on any states' available fund growth of economy. Also high investment discourages the private entrepreneur from investing in the fertilizer production sector. Hence it has become necessary, especially for developing countries, to find ways and means to reduce investment in fertilizer projects. It is necessary to isolate and analyse various cost centers that comprise a fertilizer project investment. The magnitude of their increases and reasons for these have to be investigated. Based on these investigations, methods of the possible reduction in investment have to be found out.

2.0 [illegible]

2.1 This paper tries to investigate the capital structure of some of the nitrogenous fertilizer plants which have been recently commissioned or under advanced state of construction in India. It tries to isolate various cost centers and investigate their effect on the total investment. It also tries to investigate why some of these costs are high and whether

these can be reduced in future projects. Though the case histories analysed pertain to nitrogenous fertilizer industry, the conclusions drawn from this analysis will be relevant for phosphatic fertilizer industry also. And though these are specific to India, it is expected the Indian experience will find parallels in other developing countries.

2.2 For detailed analysis of investment a 900 tpd ammonia plant and the corresponding 1500 tpd urea plant have been taken as representative modern nitrogenous fertilizer project. Three feedstocks have been considered - naphtha, fuel oil and coal. The gas based example has not been given as there is not much difference in technology between a naphtha based ammonia plant and a natural/associated gas based ammonia plant; the latter is somewhat cheaper by 5 - 7%.

2.3 Some of the pertinent background information for the three projects under consideration are given below:

a- The coal based plant is under commissioning, the fuel oil based plant is about to be commissioned while the naphtha based plant is in the midst of construction.

b- The major orders for coal based plant was placed during 71-72, for fuel oil based plant in 1974-75 and that for naphtha in 1976-77.

c- The coal based project uses Kopper-Totzek process for gasification, Rectisol process for CO_2 removal and nitrogen wash for final purification. The fuel oil project uses Shell gasification for gasification, Rectisol process for CO_2 removal and nitrogen wash for final purification.

Naphtha based project uses Kellogg naphtha reformation, Benfield CO_2 removal and methanation for final purification.

d- The three projects use three different proprietory urea processes. Two are standard, but improved, total recycle processes while the third is stripping process.

e- In the model analysis presented in the paper differences due to adoption of different proprietory processes will not matter much. Our analysis shows that investmentwise there is not much radical differences among various proprietory processes - be it ammonia or urea - for similar feedstock and similar process sequences.

f- The modes of foreign exchange financing are different for the three projects. The coal based project is financed by two suppliers, a edit, several government to government credits and free foreign exchange. The fuel oil based plant is financed by a government to government credit and free foreign exchange. The naphtha based is financed by IDA credit.

g- Coal and fuel oil based plants have higher indigenous component than the naphtha based plants. This difference is due to method of financing.

h- The engineering contractors are differnt. The naphtha based plant is engineered by non-indigenous engineering contractor; the fuel oil based plant by a combination of an Indian and a non-indigenous engineering contractor. The coal based plant is engineered by an Indian contractor with limited help from licensors of the various processes.

i- The naphtha based plant is all in single stream. The fuel oil based plant is essentially in single stream except for the gasifiers. The coal based ammonia plant is essentially single stream except for gasifiers, some of the towers are also in two streams due to transportation limitations. The urea plant for

this project is in two streams.

j- All are grass-root projects.

2.4.1 The investments for the three projects considered is given at Tables 6, 7 and 8. The exchange rate assumed is Rs.8.5 = 1 US $.

Table 6

Nagothane Based Project

$ x 10^6

	Foreign Currency	Local Currency	Total	% of total investment
1. Ammonia and Urea Plants Equipment	40.8	17.3	58.1	29
2. Off-sites and Infra-structure Equipment	28.5	15.1	43.6	23
3. Spare	6.8	2.4	9.2	5
4. Civil Construction including Township	-	19.9	19.9	10
5. Erection including Supervision	8.5	8.2	16.7	8
6. Licences, Engineering and Procurement	12.2	1.3	13.5	7
7. Project Management	0.9	7.3	8.2	4
8. Working Capital	-	4.0	4.0	2
9. Miscellaneous	2.0	1.8	3.8	2
10. Financing Charges	15.6	4.8	20.4	10
Total	115.3	82.1	197.4	100

Note : a) Off-sites include an inplant power generation unit and a 10,000 tonnes atmospheric Ammonia storage.

b) Financing charges high due to high loan content and interest on them due to IDA financing.

Table I

Fuel Oil Based Project

$ x 10^6

		Foreign Currency	Local Currency	Total	% of total Investment
1.	Ammonia and Urea Plants Equipment	38.6	66.1	104.7	51
2.	Off-sites and Infra-structure Equipment	3.8	36.9	40.7	20
3.	Spares	3.6	1.9	5.5	3
4.	Civil Construction including Township	-	17.9	17.9	9
5.	Erection including Supervision	0.7	4.7	5.4	3
6.	Licence, Engineering and Procurement	9.3	5.9	15.2	7
7.	Project Management	0.1	2.2	2.3	1
8.	Working Capital	-	2.5	2.5	1
9.	Miscellaneous	0.6	1.8	2.4	1
10.	Financing Charges	-	7.9	7.9	4
	Total	56.7	147.8	204.5	100

Note : The equipment cost includes erection charges for compressors, steam generation, coal & ash handling & some off-sites under supply cum erection contract.

Table 8

Coal Based Project

	$ x 10^6 Foreign Currency	Local Currency	Total	% of total investment
1. Ammonia and Urea Plants Equipment	33.2	49.8	83.0	41
2. Off-sites and Infra-structure	0.9	22.6	23.5	12
3. Spares	4.2	6.3	10.5	5
4. Civil Construction including Township	0.5	22.7	23.2	11
5. Erection including Supervision	3.6	11.0	14.6	8
6. Licence, Engineering and Procurement	2.2	5.9	8.1	4
7. Project Management	-	12.5	12.5	6
8. Working Capital	-	3.4	3.4	2
9. Miscellaneous	0.2	0.7	0.9	-
10. Financing Charges	4.4	18.1	22.5	11
Total	49.2	153.0	202.2	100

Note : Financing charges are high due to prolonged time schedule.

2.4.2 Tables 9, 10 and 11 give the estimates on current cost basis (mid 1978) for the three similar projects. It also assumes similar scope and similar foreign exchange financing. Inplant power generation and atmospheric ammonia storage have not been included.

Table 2

Kashima Based Plant

$ x 10^6

	Foreign Currency	Local Currency	Total	% of total Investment
1. Ammonia and Urea Plants Equipment	33.0	63.6	96.6	42
2. Off-sites and Infra-structure Equipment	6.2	41.8	43.0	18
3. Spares	2.7	10.6	13.3	6
4. Civil Construction including Township	-	16.6	16.6	7
5. Erection including Supervision	3.2	13.3	16.5	7
6. Licence, Engineering and Procurement	7.3	9.4	16.7	7
7. Project Management	-	4.5	4.5	2
8. Working Capital	-	5.3	5.3	2
9. Miscellaneous	1.7	7.8	9.5	4
10. Financing Charges	-	10.5	10.5	5
Total	49.1	183.4	232.5	100

Table 10

Fuel Oil Based Plant

$ x 10^6

	Foreign Currency	Local Currency	Total	% of total investment
1. Ammonia and Urea Plants Equipment	38.0	77.0	115.0	43
2. Off-sites and Infra-structure Equipment	1.5	43.2	44.7	17
3. Spares	3.2	10.6	13.8	5
4. Civil Construction including Township	-	18.6	18.6	7
5. Erection including Supervision	3.2	13.8	17.0	6
6. Licence, Engineering and Procurement	7.2	10.4	17.6	7
7. Project Management	-	7.0	7.0	3
8. Working Capital	-	5.6	5.6	2
9. Miscellaneous	1.9	8.8	10.7	4
10. Financing Charges	-	15.5	15.5	6
Total	55.0	210.5	265.5	100

Table 11

Coal Based Plant

$ x 10^6

	Foreign Currency	Local Currency	Total	% of total Investment
1. Ammonia and Urea Plants Equipment	40.7	91.2	131.9	42
2. Off-sites and Infra-structure Equipment	1.3	60.2	61.5	19
3. Spares	4.2	14.1	18.3	6
4. Civil Works including Township	-	22.7	22.7	7
5. Erection including Supervision	3.3	16.7	20.0	6
6. License, Engineering and Procurement	6.5	13.0	19.5	6
7. Project Management	-	6.8	6.8	2
8. Working Capital	-	5.4	5.4	2
9. Miscellaneous	2.0	10.9	12.9	4
10. Financing Charges	-	17.0	17.0	6
Total	58.0	258.0	316.0	100

2.4.3 It may be mentioned that in all the above tables (6 to 11) indigenous currency of equipment and spares includes the duties and taxes for the corresponding items. Also the foreign exchange currency includes ocean transport while the indigenous currency includes inland handling and transport.

2.5 The above tables (6, 7 & 8) indicate that the main plant equipment at site is 29% to 51% of the total investment. Offsite & infrastructure equipment are 12% to 23%. These two cost centers with spares constitute nearly two third (67% to 76%) of the total investment. On mid 1978 price basis (Tables 9, 10 & 11), the respective figures are 42 to 43%, 17 to 19% and 65 to 67%. The main reasons of minor variations between two sets of figures are differences in time-scale and methods of financing on the earlier set of figures.

2.6 However, it is clear that equipment and spares constitute about two third of the project cost.

A serious investigation have to be made in these areas for possible cost reductions.

3.0 DESIGN PHILOSOPHY

3.1 Equipment for the main plant and the corresponding spares inventory form a substantial portion of the total investment. There are several probable areas where possible reductions in investment may be investigated.

3.2 The fertilizer plant operations in developing countries in their anxiety to have the benefits of latest technology insist that plants should be based on the latest process. Engineering

organisations also encourage this trend. Higher level technology with higher efficiencies are achieved at higher investments. In a developed country this is an acceptable feature because of the high cost of man-power and greater stress on efficient operations. However, in many of the developing countries the manpower is not as skilled as the new technology demands. It will require time and practice to develop that skill. Hence, these countries fall between two stools. They pay the penalty of high price of high level technology and do not achieve the high efficiency required. On both counts the cost of production goes up.

3.3 Another modern development which pushes the investment is the high level of instrumentation and automatisation. Earlier instrumentation used to be 7 - 10% of equipment cost. Now it goes as high as 15 - 17%. Whether such high level of instrumentation is necessary is a moot point. The claim is that to operate the complicated equipment and to achieve high efficiency this is necessary. But experience in many Indian plants show that often many of the instruments do not function due to diffective maintenance; even then the plants operate without much trouble. Engineering organisations should carefully review whether all the instruments they provide in a plant is absolutely necessary or they are just frills and have been provided only for marginal improvements.

3.4 Another modern trend has been provision of data loggers and computers for process plant control and TV monitoring of certain areas of the plant. Use of data loggers and computers increase the instrumentation cost excessively. Data loggers and computers may have their use in developed countries due to high

cost of manpower. Even in these countries, discussions with plant operators indicate that several operators consider its help for plant operation as rather marginal. Similarly is the case for TV monitoring. It may reduce the number of operators but does not increase the efficiency or smooth running of the plant.

3.5 Simpler flowsheets with less instrumentation and automatisation and without resort to exotic and complicated equipment and without much sacrifice of efficiency have to be developed. However, it is a moot point that in the present atmosphere of high competition and high cost, whether any engineering organisation can be persuaded to divert energy in this direction.

3.6 Fertilizer plant operators in their anxiety to play safe during operation of plant over a long period sometime ask for extra capacity in some of the critical equipment - in compressors, pumps, reactors, steam generation plants, DM plants etc. There is no objection to this requirement if it can be achieved at marginal cost. However, these play-safe devices build up and the ultimate result is that the project cost goes up. Whether the desired effect of having higher average production is achieved with these built in capacities in certain sections is a debatable point. Because the pipelines and exchanger surfaces are not designed for higher load, the extra production achieved may not be upto expectation. In the coal based project under consideration the extra cap city provisions may make upto 5% of the equipment cost. Advisability of provision of built-in extra capacity should be carefully studied. May be a simpler flowsheet with less complicated equipment and instrumentation be a solution.

3.7 Previous observation should lead to the impression that all modern trends in fertilizer plant technology are not suitable for developing countries. Any improvements which leads to considerable reduction in the cost of production (though there may be increase in investment) is an acceptable innovation for the developing country. However, there are certain innovations which are acceptable in economic terms for developed countries which may not be financially viable in other countries. For example, where associated gas is cheap or flared and does not have a market to put up a fertilizer plant there with all the innovation of fuel economy (necessarily requiring higher investment) may not be good choice from economic point view. Similarly, any higher investment that aims at reduction of manpower (which is quite acceptable in developed countries where manpower is costly) may not be useful in many developing countries (where manpower is not a problem) unless there is specific shortage of skilled manpower in a State.

3.8.1 Again it is essential to differentiate various methods of cost saving. Any cost saving due to changes in development of process concept or technology is welcome. But lowering of minimum engineering standards or use of inferior materials of construction are not acceptable. A valuable tool for analysing the areas of equipment and material where cost reduction may be possible without unduely lowering the efficiency, safety and reliability is the value analysis concept. The value analysis of fertilizer plants should concern itself with equipment size, type of equipment, extent of instrumentation, review of process design etc.

3.7.2 The concern of an engineering constructor is to design a sound and reliable plant. It is necessary that fertilizer plant operator and engineering contractor shall jointly take this type of study before an investment is made. However, in many of the developing countries the fertilizer plant operator does not have the necessary knowledge or facility to take up this type of study. Therefore, some international organisation or financing institution like UNIDO or World Bank should cooperate with fertilizer plant operators and engineering organisations to initiate value analysis studies for various types of fertilizer processes and plants - especially for developing countries.

4.0 SPARES

4.1 Spare inventory for each project works out to 3 to 6% of total investment. For India, on an average it is about 10% of the equipment cost. The corresponding figure for developed countries may be upto 4 per cent of equipment cost. The high spare inventory cost in India and other developing countries is due to several reasons.

4.2 Several of the critical moving equipment like compressors and pumps as well as catalysts are generally imported in many of the developing countries. Spares for these like rotors, impellers, piston rings, catalysts etc. hence, have to be imported. The lead time for receipt of these imported spares is quite high. Even if they are not imported (for example, some of the compressors, pumps and catalysts are now manufactured in India) the lead time for getting the spares is likely to be high. Hence the project necessarily has to keep these in its own inventory. Means by which this high inventory level can be reduced is to be investigated with the cooperation of equipment suppliers.

4.2.1 Another method is that, where there are several plants in a country which use similar types of equipment and material, these projects should have a central pool where the common spares can be kept and each participant can draw his spares as per requirement on replacement basis. This system is being tried in a small way in India for catalysts and rotors for centrifugal compressors.

4.3 In India, it is found that to play safe many of the fertiliser plant operators do not differentiate between regular and insurance spares with the result that a substantial portion of spare inventory has very small turnover and in effect becomes blocked capital. Proper choice of spares is a matter of experience. It cannot be guided by thumb rule method of percentage of equipment cost or so many months of cost of production.

4.4 Again, it is seen that in many cases spares are not ordered with equipment, but much later. This system boosts up the cost of spares unnecessarily as late ordering of spares puts the project authorities under the mercy of the equipment supplier. Hence, project authorities should take it as an axiom to order the spares alongwith the equipment. However, this would require a sufficient knowledge of equipment at the time of ordering. Where experience is not available, help of the engineering contractor should be taken.

5.0 <u>Infra Structure & Offsites</u>

5.1 Infrastructures and Offsites may constitute as much as one fifth of the project cost. In India and quite likely in other developing countries, the sites chosen for setting up of fertilizer projects are in underveloped areas. Talcher, Ramagundam, Panipat, Khandla, Namrup are some of the examples in India. Before the entry of the project at site nothing normally exists in the area. Even approach

to the land has to be developed. For coal based projects this cannot be avoided as the project has to be by the side of the coal mines. But for other projects this is a result of a conscious policy by the government of the country to develop the underdeveloped areas. This is a laudable objective. However, the penalty in that the construction costs at these sites are comparatively higher than at places which have already some development or have easy communication. The quotations from contractors for construction may be higher by 10 - 30%. But there does not seem to be any way out of this dilemma. Country as a whole and projects in particular have to pay this penalty for country's development unless to reduce the cost of a project the government of the country bears at least part of this increase as social cost.

5.2 When compared with plants of developed countries, it is seen that cost of infrastructure and off-site facilities in developing countries form a higher proportion.

5.3 Some of the provisions in offsite facilities are due to location of the project in under-developed areas. For maintenance and repairs, these projects require well developed workshop facilities for mechanical, electrical, instrumentation and transport. These may amount to about one million dollars.

5.4 But there are other items which in normal circumstances should have been provided by State or other service organisations as a policy for opening an area for development.

In India, invariably the project has to bear the costs of railway siding and marshalling yard necessary for rail movement, high tension power lines from nearest available power station and the corresponding receiving substation, raw water pipelines and the pumping station from the nearest available water sources etc.

5.5.1 In one instance in India a project has to bare the whole cost of a battery of tube wells extending over several kilometers and water transport line (about 20 KM) from the tube well farm to the project site with a cost of ten million dollars.

5.5.2 In the coal-based project under consideration, the entire raw-water pipeline from nearby river under consideration the cost of raw water supply to project site costing about $ 2.8 million had to be borne by the project.

5.5.3 Similarly in another project under consideration expenses of 45 KM of railway line (costing about $ 12 million) and 45 KM of high voltage power transmission line have to be borne by the project.

5.6 In India for transportation of anhydrous ammonia, the tank cars necessary for transportation have to be supplied by the fertiliser plant operators though the national railways are the carriers and also charge normal tarrif for the same.

5.7 Even when a naphtha or fuel oil based plant is by the side of a refinery, the project has to provide storage facilities equivalent to more than a months storage to take care of the annual turn around the refineries. Normally, this should be the responsibility of the refineries.

5.8 Another infra-structure requirement which a project in a developed country does not bear but which becomes sometimes a necessity in a developing country is the provision of inplant power generation. This is due to either that sufficient power is not available or if available it becomes unreliable to frequent interruption, or voltage dips which are inimical to the longivity of or sustained production in the plant. In the naphtha-based plant under review, for production of inplant power of 7.5 MW the project has to spend 12 million dollars. Even many of the older plants in India propose to install inplant power generation facilities due to vagaries of power supply.

5.9 Serious thought has to be given how to reduce the incidence of these costs in the investment of the fertiliser project. Some of the infra-structure like supply of water, railway lines, provision of tank wagons should be borne by the State as part of their investment for the development of a particular area. Similarly, the suppliers of inputs like power and hydro-carbon feedstocks should be prepared to invest to supply these at the battery limit of the project. Some of these proposals necessarily impinge on the fiscal policy of the governments of the countries. Hence a careful analysis of the economics of these suggestions have to be studied.

5.10 In recent times another high investment center has been pollution control. Pollution control for effluents - gaseous and liquid - is necessary and must be provided. However, because of the high investment involved, pollution control system for fertilizer plant should be properly planned. It should form a part of the initial investment itself. By providing pollution control measures after the plant goes into production or after mechanical erection is completed, the investment goes up comparatively due to changes in piping systems, finding extra space for pollution control equipment and perhaps modification in some of the equipment themselves. Pre-planning of pollution control measures also ensures that proper pollution standards are taken and during design engineering stage of the fertilizer plant itself the pollution control system is properly integrated with the main plant if necessary, by suitable modification of equipment.

5.11 In India, especially for state owned projects, provision of township is usual. This is also the case in some of the developing countries and may constitute 2 - 3% of the project cost. As housing is a national problem, it should be investigated whether the investment for housing can be borne by the State especially for the low-income groups.

6.0 DUTIES AND TAXES

6.1 In developing countries duties and taxes like customs duty, sales tax or purchase taxes, local or municipal taxes, income taxes on foreign knowhow and expatriates etc. constitute a substantial portion of investment of a project. In the projects on reference they constitute 10% to 15 % of the project investment. These taxes are earnings to the Governments and local authorities.

6.2 Custom duty on equipment is normally an incentive to the indigenous industry to develop. But this forms a heavy burden on theproject. In the above three representative projects it is about 8% of the project cost (excluding corresponding contingencies and financing charges). In India arguments have been raised that for fertiliser industry either this should be waived or deferred and recovered at a latter date. In many developing countries, custom duty on imported equipment for core or vital sector has been removed or kept at a low level. Governments of developing countries should think how to give relief to the fertiliser projects without seriously affecting the earning of Government or discouraging the prospects of budding engineering industry. In this connection one point should be kept in view is that the fertiliser industry is not only an industry by its nomenclature but also an integral part of the agricultural front of the country.

6.3 What has been discussed about custom duty applies for local taxes also. In India this varies from 5 to 7% of the indigenous equipment cost. Some relief or moratorium in this area is also necessary especially as by installation of the project in the area the latter prospers.

6.4 Recently in India, another burden on the project has been the incidence of income tax on expatriates who come for supervision of erection and commissioning of projects. For a normal project it may be anywhere between $ 2.5 to $ 3.5 million dollars. This policy has been adopted to discourage indiscriminate use of expatriates in a project and to encourage indigenous expertise. One way to reduce or minimise this expenditure will be

a) to encourage foreign engineering contractors and imported equipment suppliers to train and employ local engineers and specialists, and

b) for the fertilizer plant operators to have a well chalked out programme from the beginning of the project to train his own personal in installation and commissioning of the projects in engineering contractor's other projects in the international field and in the fabrication shops of equipment suppliers.

6.5 Another income tax imposed on knowhow and consultancy. The tax has been put as a disincentive for purchase of foreign knowhow and use of foreign consultancy and encourage indigenous capabilities. However, in fertilizer industry there are some engineering knowhow which have to be imported because they are not available in the country and will take considerable expenses and time to develop these. Hence the Governments of developing countries should allow tax concessions on certain types of knowhow based on general technological development in the country.

6.6 For the three case histories chosen, the incidence of taxes duties (with corresponding financing charges) works out to 7.5 to 9.5%. Due to these taxes and duties in these projects, the costs of production of Urea have increased by 4 to 5%.

7.0 LICENCE, ENGINEERING AND PROCUREMENT CHARGES

7.1 Licence, basic engineering, detailed engineering and procurement charges vary from 4% to 7% of the total investment. They are $ 13.5 million for naphtha based, $ 15.2 million for fuel oil based and $ 8.1 million for coal based plants (Tables 6 7 and 8). The low fees for the coal based plant is due to the fact that two identical coal based plants were engineered at the same time.

7.2 As can be seen the foreign exchange for licence, basic engineering, design engineering and procurement charges for naphtha based plant is highest. This is not always the case. For other naphtha based plants engineered by an Indian Engineering Organisation, they are lower. In this particular case this is high due to the specific reason that the design engineering has been done by a non-indigenous engineering contractor. Coal based project case has the lowest foreign exchange as this has been almost wholely engineered by an Indian Engineering Organisation.

7.3 The manhour charges for engineers and draftsman in developed countries are much higher than those in developing countries - atleast when compared to Indian conditions. The latter is one third to half of the former. The output is no way inferior. It has been found that wherever an Indian Engineering Organisation is associated and a substantial portion of the work is done by the Indian Engineers, the engineering expenses has come down. Indeed many of the reputed international engineering organisations in other fields use Indian engineering organisations for detailed engineering. However, this confidence has not permeated to the fertiliser engineering field as yet. Hence these organisations should be persuaded to use as much of indigenous engineering capabilities as possible of the country where they are building the plants, if these

capabilities are available in that country.

7.4 International lending institutions like World Bank and Asian Development Bank should devise procedures (by providing incentive) for use of indigenous capabilities in design engineering similar to what world bank for indigenous equipment vis-a-vis imported equipment. Transfer of design engineering technology by international firms to either their indigenous branch offices or indigenous engineering organisations in developing countries should be encouraged.

7.5 Licence and basic engineering charges quoted by licensors are gradually on increase. The plea given by licensors is that universal flogging animal - international inflation. However, the complete effect of inflation should not be passed on to licence and basic engineering fees as a substantial part of the data passed on to the client had been generated before the unprecedented inflation has started.

8.0 ABSTRACT WITHDRAWAL DELAY

8.1 One of the banes of project execution in developing countries is long project execution period. In a normal well executed project in India this may be less than 25% of that required for developed countries. But on an average it is much more than this. A table of the actual time schedule of some of the projects which went or will go on stream in seventies is given below :

Table 12

	Total time for Project Execution
1. Project A (Gas Base) Grass-root	43 months
2. Project B (Naphtha) Grass-root	60 months
3. Project C (Naphtha) Grass-root	50 months
4. Project D (Fuel Oil Base) Expansion	58 months
5. Project E (Fuel Oil Base) Repeat Design	46 months
6. Project F (Fuel Oil Base) Grass-root	48 months
7. Project G (Nitro Phosphate Expansion)	48 months

8.2 Though there has been improvements in the time schedule of the projects in recent times, still it is not fully satisfactory. In all these projects the owner has done the civil works and erection. It is the experience in India that giving full responsibility to one contractor - be a foreign contractor or an Indian contractor - achieves a quicker time schedule than when the project is divided among various authorities. However, the former type of contract execution has its own drawback - especially if the contractor is a non-indigenous one. It tends to curb the indigenous expertise. Also quality control of equipment and installation as well as adaptation of the project to local conditions becomes difficult. Hence methods have to be found to reduce the time ~~schedule~~ schedule within the limits of parameters required by developing countries.

8.3 One of the causes of project delay is poor management and poor monitoring of the project execution. A good monitoring system will allow to identify sufficiently in advance the points and areas where the project is being delayed so that early remedial actions can be taken to rectify them. Similarly good management and monitering will determine what advance action has to be taken for timely execution of the project. Many projects in developing countries start with CPM/PERT Charts, but it is rare. It used as a tool for project execution. This is mainly due to lack of experience of the project management. Hence it is advisable that if the project management does not have the expertise then either they should appoint the engineering contractor to monitor the project or appoint a specialist in this particular discipline to advise the xxx owner. The extra expenditure on this account more than be compensated by saving in time and hence expenditure.

8.4 Another area where the delay occure is the delay in equipment delivery - both imported and indigenous - especially the latter. This is due to lack of tight follow up at the supplier's shop after an order is placed. Similar to monitoring, the advice of the engineering contractor or specialist reganisation may be taken for help in follow up.

8.5 Even if the project is executed as per schedule sometimes delays occur during the commissioning of the plant. More than one project in India had its time schedule lengthened by more than year due to troubles in commissioning stage. These troubles in commissioning stage occur mainly due to defects in design and lack of close inspection during fabrication of equipment and erection of plant. Hence selection of proper engineering contractor, close and efficient inspection service at all stages of the project is an absolute necessity.

8.6 In many developing countries clearance by Government of the imported list of equipment and material is a legal requirement. Indian experience is that if it is not efficiently handled this is an area which will create delays during ordering of equipment stage. There are instances in India that repeated quotations from some party had to be asked as validity of quotations expired before the Government cleared the items for placement of purchase order for the imported equipment. Each requotation entailed an increase in prices. The main cause of these delays is the lack of a rapport between the project authorities and concerned Government officials and unimaginative applications of rules. Governments should be requested to simplify the rules and consider each case on its merits and with sympathy.

8.7 In projects where the services of the engineering contractor is limited to supply of engineering, another source of delay, has sometimes, risen. In their anxiety to supply the client with their latest experience the engineering contractor has suggested modifications in design or equipment capacity and layout at the very late stages of procurement or project execution. In one fuel oil based project in India, a number of modifications were suggested by the licensors after purchase orders on equipment had been placed. This has not only increased the equipment cost but also lengthened the project schedule by about six months. In the coal based project under review, at the final stages of erection a series of modifications had to be made to take advantage of the experience gained by another similar plant which went on stream at that stage. Though this may result in smooth operation of the plant, there has been a delay

of two to three months in the project execution. In a Middle East Project reported in the recent Lahore seminar of UNIDO, the engineer contractor suggested modifications in foundation design, after the foundation has already been prepared. One or two similar instances had occured in India also. These last minutes modifications change the rythem of the system of execution of project, increases the equipment and material cost and also increases the management and financing charges due to lengthening of the time schedule.

8.8 In the coal based plant under review, it is estimated that due to delay in project executionby about 30 months; the over run on account of increase in material cost and erection cost, management charges and financing charges has been of the order of $ 20 million. This almost comes to about 11.5% of the total investment. In terms of cost of production of Urea, this has been increased by 4.5%.

9.0 MODE OF FINANCING

9.1 In many of the developing countries financing of the foreign exchange component of a project is dependent upon the credits from other countries or from equipment suppliers or from international financing institutions.

9.2 The credits from Governments of the developed countries with presently normally applicable conditions have certain draw-backs. Majority of these credits are tied i.e. these credits can be utilised only in the donor country. Normally, there should not be any objection for the purchase of equipment only from the donor country. However, the draw back is that competition among suppliers become restricted. This sometimes increases the cost of equipment. In addition to above, if there is an

inflationary atmosphere in the doner country, the increase becomes still higher due to provision made by the supplier to accommodate possible inflation. Below are given recent quotations (1977) for some of the imported equipment from the credit giving countries vis-a-vis the cost of same equipment for acceptable quotations under international competitive bidding.

Table 11

		$ x 10^6	
		Supplier's Quotation	International Competitive Bid Quotation
1.	Secondary Reformer	1.3	0.7
2.	Ammonia Converter Intervals	2.2	1.5
3.	B.F.W. Pump and Turbine	2.0	0.6
4.	High Pressure Heat Exchangers	2.2	1.1
5.	H.G. Boiler	4.4	2.5

The table is self-explanatory.

9.3.1 If the credit is suppliers' credit, some more new factors are introduced. In addition to the disadvantages of restricted bidding, there are markups added to the cost by the agency which supplies equipment under suppliers's credit. For one of the suppliers' credit at one time under negotiationfor an FCI project the items of mark-up included and indicated by the agency are as follows :

Table 14

Percentage of Mark-ups on Ex-works Price

1.	Procurement Expenses	3.75%
2.	Despatch Expenses	7.00%
3.	Contract Management Expenses	7.70%
4.	Site Risk Insurance & Compensation	1.00%
5.	Pre-financing Charges	6.5 %
6.	Other Charges	4.65%
7.	Price Escalation, Contingency, Risk etc.	3.1 %
8.	Profit	4.0%
		35.7 %

The f.o.b. cost will be 1.07 times the ex-works cost.

9.3.2 On the above basis cost of f.o.b. equipment under suppliers credit is about 27% higher than if the equipment had been purchased on cash payment. This price difference is in addition to any possible increase (if any) in price due to restricted bidding. However, all suppliers credit does not have such high increases. India has received suppliers credit with as low a markup as 10%.

9.4 In a developing country like India the foreign exchange cost of imported equipment only now-a-days is about 15% of the total investment (other components of foreign exchange like services are not generally covered by suppliers credit). If we assume that increases due to suppliers credit and restricted bidding is about 25% on the true f.o.b. cost, the incidence of suppliers credit markup on the total project cost (taking into account corresponding customs duty and financing charges) will be of the order of 5% (i.e. there will be

an increase of 5% in the project cost). This figure will go up still higher if the import content of equipment supply goes up. If it is Government to Government credit (restricted bidding) the increase will be one third to half of the above figure depending upon whether services also are included or not.

9.5 Generally credits are given to help the donor country's industry. Hence it is natural that the credits are tied to purchase the equipment from the donor's country. However, due to implication of increase in project cost due to restrictive bidding and suppliers' credit system, efforts should be initiated to persuade the donor countries to allow their credit to be utilised for purchase of equipment on international competitive bidding, if not for the whole credit, at least for a substantial part of it.

9.6 From the point of view of the project, the proposed method of foreign exchange financing will be project country's own reserve of foreign exchange or from international financing institutions or a group of institutions which allows unrestricted international competitive bidding for equipment and services. Experience of India has been that under international competitive bidding, the responses from various suppliers have been very encouraging and that the fertiliser plant operator is able to get very competitive and technically acceptable offers. Another method of financing may be a modified form of international competitive bidding supported by a consortium of donor countries who pick up their share of credit when the bidder from that country wins the contract. India does not have much experience in this type of foreign exchange support.

9.7 While requesting for quotations from various parties, on the basis of the foreign exchange provided by the project owner's own country, some developing countries sometime face a peculiar situation. The quotations received from some developed countries

is higher than if they had submitted them to clients of their own countries or to other developed countries. This double standard is inexplicable. Investigation should be made by some international organisations why this is so and how to remove these types of anomalies; perhaps UNIDO may be of help in this respect.

9.8.1 Developing countries, in order to promote the nascent engineering industry, often restrict the import of equipment, if they are manufactured in the country. However, this laudable purpose sometime yield counter productive results. Sheltered under the Government protective regulations, these indigenous manufacturers do not try to regulate their costs especially if the number of indigenous supplisrs are limited. Hence in some cases the indigenous cost of equipment is much higher than the corresponding cost quoted under international competitive bidding (ICB) by the same supplier. Below are the prices of some equipment costs under international competitive bidding and the corresponding cost for similar equipment under maximum indigenation principle.

Table 15

		$ x 10^6	
		ICB	Non-ICB
1.	Coal Fired Steam Generation Plant	6.3	8.1
2.	Synthesis Compressor	3.24	4.9
3.	Nitrogen Compressor	1.4	2.1
4.	CO_2 Compressor	0.9	1.3
5.	Air Compressor	1.7	3.5

9.8.2 The Governments of developing countries should see that while giving protection to indigenous engineering industry, the industry should not take undue advantage of this protection.

9.8.3 In addition to high cost, often the delivery schedule of indigenous equipment are erratic. The delay in some of the recent projects in India is to a substantial extent due to indigenous supply. One of the reasons for delay in the coal based plant discussed here is due to indigenous suppliers. Though in recent times, the delivery schedule position has considerably increased, still there is scope for further improvement. It is reported one of the main causes of delay in the supply of indigenous equipment is lack of raw material (which in many cases have to be imported). In that case Governments of respective countries should seriously think of material banks in the country and also help the engineering industry to have perspective plans. Governments of developing countries should seriously examine this problem. India sometime allow import of equipment (even though available in India) on the basis of longer time schedule of Indian equipment. Perhaps other countries have similar relaxations. But by the time the delay in time schedule is detected it is already too late to switch over to imported supplies. Hence at the beginning of the project itself Governments should allow import of equipment on the basis of past experience.

10.0 CONTRACTS

10.1 UNIDO is now engaged in preparing model contracts for fertiliser industry. While preparing these contracts the claims of the fertiliser plant operators to protect himself against defective design or defective operation or defective supply of equipment should naturally be taken into account by providing more rigorous and higher liability clauses. There is some suggestion to hold the engineering contractor responsible for consequential damages. Also suggestions have been put forward to increase the quantum of performance

bonds given by the contractor. By themselves these requirements will certainly help the fertilizer plant operator getting a well designed plant which will operate smoothly. However, an argument has been put forward among others, by engineering contracts themselves - that if these conditions are put into contracts in the way it is demanded by clients - the engineering contractors and equipment suppliers may be forced to increase their quotations to protect themselves against possible payment of penalties. The validity of this argument should be investigated and some ways have to be devised to get the protection required by the fertilizer plant operator without increasing the cost of the project disproportionately. Some of the suggestions made at the Lahore seminar of UNIDO is worth investigating in depth. Insurance coverage and/or bonus clause may be some of the possible solutions.

10.2 For smooth running of plant in the initial stages and to train the local operators there has been suggestions to appoint the engineering contractor as management contractor or consultant. There has also been suggestions from international financing institutions to this effect for some of the developing countries. From operation point of view these suggestions are commendable especially in those countries where skilled operators are scarce. However, this necessarily will increase investment for the project. According to a TVA estimate made in 1975, the expenses required may be of the order of $ 1.2 million. According to another estimate made in 1976 for a developing country the figure was $ 1.5 million. With the present day costs, these figures are likely to go up further. This is so because these specialists from engineering contractors mainly come from developed countries and the per diem rates quoted for these are rather high - as high as $ 400 per day tax free. Solution from this impasse may be utilisation skilled technicians from other developing countries who are building up this expertise. At least in certain developing countries, the specialists are as good as those in

developed countries. At the present time the per diem rate from these countries are much less than those of developed countries. In addition these specialists will be much more familiar with peculiar problems confronted by developing countries. In fact some of the developing countries are taking advantage of this and from reports available, the employers are quite satisfied with the performance.

10.3 For supervision of engineering, erection and commissioning in India the per diem rate charged by the expatriates have increased inordinately in the last few few years. Perhaps this is experience of other developing countries also. The per diem rate of European expatriates were $ 80 in 1968-70. Now it stands at more than $ 400 per day. While negotiating with engineering contracts attempts should be made to verify the various components which supposedly make up the per diem rate and how they compare with the per diem rates quoted by the same bidders for developed countries.

10.4 Another area where the contract can be made use of as a tool for reducing the cost of the project, especially for knowhow and engineering contracts, is to introduce suitable clauses to curb the tendency of the engineering contractors to introduce modifications and improvements in the midst of advanced stages of implementation of the project. Contributions to increase in project cost due to this tendency has already been discussed in a previous section (8.7). Though in a normal contract, usually there is a clause that the engineering contractor cannot introduce any modifications after engineering is completed without the consent of the client, usually the client succumbs to the persuation of the engineering contractor in his anxiety to have the latest innovations of technological development. Before agreeing for this innovations both the client and the engineering

contractor should discuss the financial implications, not only on the ultimate cost of production of the fertiliser but also on the investment and time schedule of the project under execution. If such a financial review is done, in many cases it may be found that such modifications may not be worth taking for that particular project. If, inspite of such findings, the engineering contractor insists on modifications, the client should be entitled to recover all or some of the costs from the engineering contractor.

11.0 FINANCING CHARGES

11.1 Financing charges for a project may vary from 5 to 10% of the project cost depending upon type of financing and debt-equity ratio adopted for the project. In India the interest rate for long-term Government loans is about 10 - 25% and for commercial loans it is about 13- 14% while short-term loans attract interest from 13 to 17%.

11.2 Though fertilizer is a vital industry and directly related to availability of food to people, the interest rate charged for the long and short term loans for the project either by government or commercial lending institutions are treated on par with any other industry. The burden of financing charges is quite substantial. Will it not be possible to treat fertilizer industry on par with utility industry, loan for which attracts a lower interest rate in some of the countries?

11.3 Among all types of foreign credits, credits which allow international competitive bidding so that project authorities can shop around the world and get the most competitive

prices are naturally preferred by Project Authorities. However, from the project authorities point of view there is one flaw in this type of credit. Normally an entrepreneur tries to spend his equity first and then the loan or he spends equity and loan in certain ratio. This is done to keep the financing charges of the project down. However, in IDA credit, the interest on loan is calculated from the time the disbursement of IDA loan is made even though equity capital will be available. This naturally boosts up the financing charges. The high financing charges of naphtha based plant alternative given in this study is mainly due to this.

11.4 Some of the loans given by International Financing Institutions or governments to the recipient government with only a minor service charge. However, the government gives loan to the project at their normal interest rate. In the case of India it is 10.25%, though the loan is specifically made for the project. Thus the benefits of low service charges of these loans is not passed on to the project. This difference may be as high as 9.5%. This is an area where investigations can be made to find out whether the recepient government can be persuaded not to charge extra interest on these loans except the service charges.

12.0 MISCELLANEOUS

12-1 Repetetive design

An area where there is a possibility of reduction in investment is that where a country has several fertilizer projects to be executed in a short-span of time, repetetive use of one design for all these plants can be adopted,

as has been done in USSR and Peoples Republic of China. Repetetive use of design not only can save some portion of the design engineering charges but also there may be considerable saving in the cost of equipment as repeat orders on the same supplier can be placed. However, the latter may not be possible for imported equipment if the source of the imported equipment is different for different projects. But repeat orders can be placed on indigenous supplies. Repetetive design and repeat orders will also help to reduce the spare inventory. The above procedure may reduce the project cost by 2 to 3%.

12.2 Expansion projects: If expansion projects are initiated at the existing project sites, there will be a considerable saving on infra-structure and offsite facilities. Of course some investment have to be made to increase the capacities of some service facilities like water and power supply, cooling towers etc. However, the investment will be only for marginal improvements. Some of the facilities like workshops, laboratories, safety facilities, administrative facilities need not be increased. The reduction in project cost - depending upon extent of expansion will be between 8 - 12%. However, expansion will not always be possible due to raw material availability or market conditions for finished products. Also expansion of existing large fertilizer complexes may create transport bottlenecks and excessive concentration of industry in a particular area.

12.3.1 Project report: Subsequent to the preparation of feasibility report, detailed project report is necessary. Preparation of an accurate, a reliable detailed project report

before a final investment decision is taken will help the fertilizer plant operator to take a correct approach in selecting process steps, type of equipment, required built-in safety factors, extent of offsite and infrastructure required and their division among the plant operators, utility and raw material suppliers and government. The report should be detailed one discussing pros and cons of various alternative approaches. It should also have estimates based on reliable data and as far as possible on quotations. It should also point out areas where there is likely to be cost increases and suggest probable methods for their control. Detail approach on implementation schedule and division of responsibility between the plant operator and engineering contractor should be included. Implications of various types of financing should be indicated to the former. Management tools necessary for execution and control of projects should discussed. It is preferable that during the preparation of the report, extensive consultations and discussions with several probable licensors and engineering contractors should take place.

12.3.2 Normally a feasibility or project report should not be entrusted to an organisation whose normal function is that of an engineering contractor. Inspite of all the good intensions of the engineering contractor, who is entrusted with the preparation of the report, to be impartial, he, by very nature of his experience, will tilt towards types of plants and methods of execution with which he is familiar. The preparation of feasibility reports should preferably be entrusted to independent organizations who do not act as engineering contractors i.e. to independent consultants or consulting organizations.

12.4 Notice for Tenders: By preparation of definitive and complete notice for tenders - as it be for engineering contractor or for equipment supply or for management contractor - there is possibilities of reduction in investment. If the specifications and responsibilities are kept vague, the tendency of tenderers generally is to cover various real or imaginary eventualities and hence boost up the price. The grey areas should be eliminated if possible or should be kept to the minimum. Cooperation of the consultant who has prepared the detailed project report should be helpful.

12.5 Definite economies in the project investment is possible by using CPM/PERT as a management tool, for example, where the delivery schedule of equipment and/or time of installation is less investment on them can be done at a latter phase of the project schedule so that investment on these is deferred and the corresponding financing charges saved.

12.6 Similarly, the project authorities should review whether some of the offsites can be installed after the plant goes into production. This may be possible for non-plant buildings and to a minor extent for the workshop facilities. This will reduce the initial investment.

13.0 CONCLUSIONS

13.1 Several areas where reduction in project investment is possible have been discussed in the study. Some of the methods suggested can be initiated by the plant operators and some by the engineering contractors. Others can be implemented only with the cooperation of governments of developing countries and financial institutions. Several of the suggestions also require in depth study.

13.2 A review of the design philosophy of modern fertiliser plants will be necessary keeping in view the special requirements of developing countries. Simplication of flowsheets and equipment, less emphasis on automatisations are some of the areas which can be investigated. Help of value analysis method should be taken.

13.3 Persuading equipment suppliers to open spare inventory banks in some developing countries or a group of countries should be explored. Similarly a group of fertiliser plant owners, in a country in opening a spare inventory bank should be investigated.

13.4 Use of experienced personnel and specialists from developing countries (wherever such expertise exists) instead of from developed countries or engineering contractors personnel should be explored.

13.5 Specifications for tenders and provisions of contracts should be made more complete to minimise the areas of ambiguity. Contracts should be made equitable.

13.6 Use of repetetive design and expansion of existing plants should be explored.

13.7 The plant operator should have a strong project team who is well conversant with modern concepts of project management and project monitoring so that delays in project execution and/or overruns in expenditure are anticipated and remedial actions are taken.

13.8 There should be a strong inspection team both of the engineering contractor as well as project authority for vigorous inspection both at the supplier's workshop and at erection and construction site and continuous follow-up on

the progress at both these places.

13.9 CPM/PERT should be vigorously used as a project management tool.

13.10 International competitive bidding with the support of international financing institutions or a consortium of donor countries should be seriously pursued.

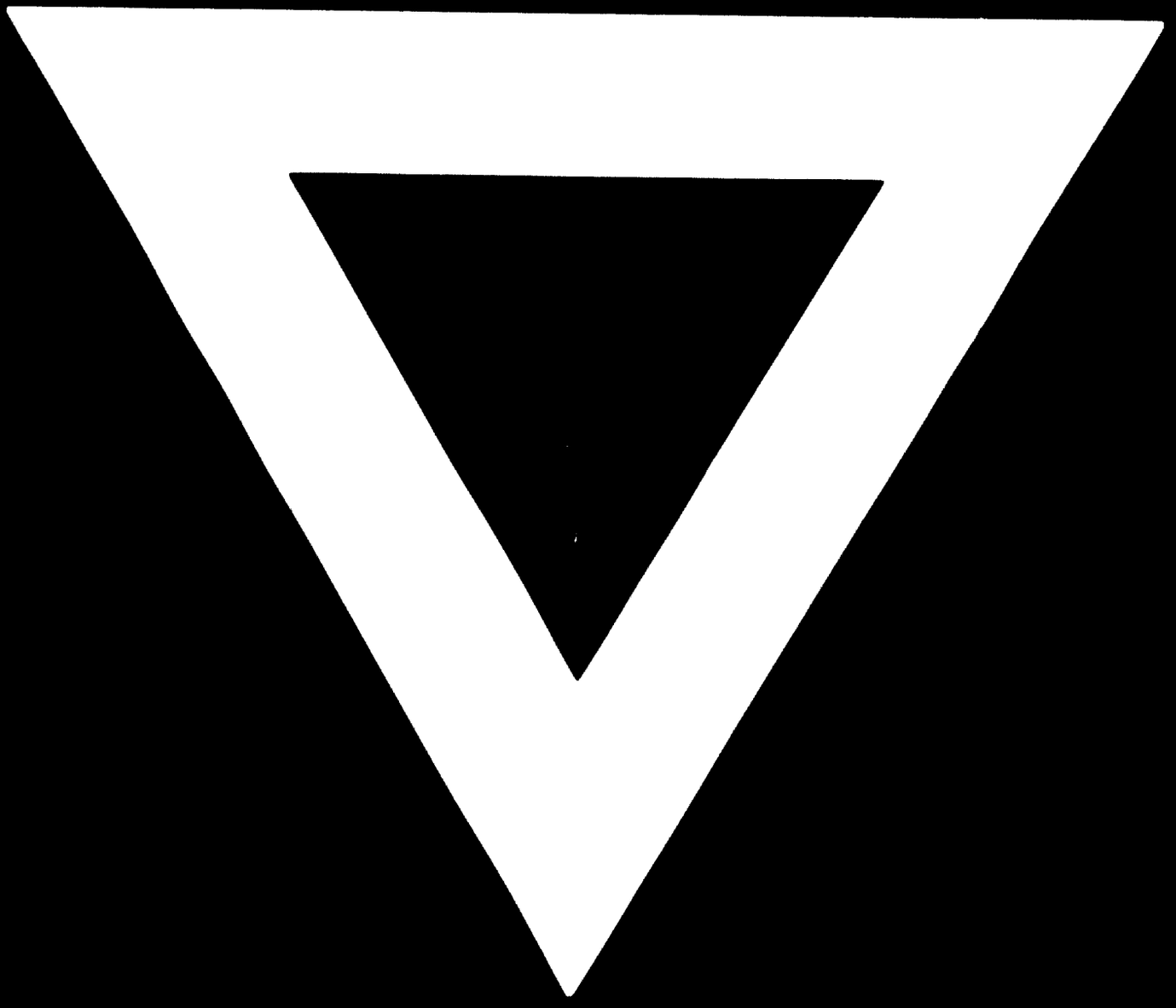
13.11 Reduction in interest rate as a special case for fertiliser industry is a worth-while area for further investigation.

13.12 Governments of developing countries should review the implications of removal or reduction or placing a moratorium on custom duties and other taxes for the imported goods for the fertilizer projects.

13.13 Governments of these countries should also review to what extent some of the infra-structures and offsite necessary for a fertilizer project can be financed by the government as a social cost for development of a particular area.

13.14 In countries where there are legal requirements which are required to be fulfilled before equipments are imported, investigations should be made to simplify the procedure so that delays are avoided.

C-664



78.11.06