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HUMPHREYS & GLASGOW LIMITED

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANISATION

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VOLUME V

Pakistan.

[redacted]

July 1970

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VOLUME V

THE DEVELOPMENT OF THE EXISTING FERTILISER FACTORY AT MULTAN IN THE CONTEXT OF FUTURE FERTILIZER REQUIREMENTS.

CONTENTS

VOLUME 1

SUMMARY OF REPORT

This volume of the report is concerned with the development of the W.P.I.D.C. Multan fertiliser factory. Present production on the site consists of urea and ammonia nitrate limestone fertilisers based on ammonia produced in two plant units, each of about 100 MTPD capacity, which were erected 10 years ago. Production costs are not competitive with those of the modern nitrogen factories now under construction in Pakistan. H & G were asked to examine the existing production facilities and recommend development for the site. Any such development must be related to the future fertiliser requirements of West Pakistan and to projects already sanctioned to satisfy that demand.

The existing two ammonia units are recognised as uneconomic and further modification would not radically improve their economic position. Therefore the basic development of the site which is required is the shut-down of these units and the construction of a new ammonia plant of capacity of about 600 MTPD or higher. This unit would have centrifugal compression and production costs would be comparable with costs in other plants now being built. Concurrently with the construction of this plant, it would be necessary to build additional ammonia-consuming fertiliser plants.

The existing fertiliser plants and those under construction in West Pakistan will satisfy only a part of the future fertiliser requirements of West Pakistan. There are, however, two further sanctioned projects, each of which includes a 600 MTPD ammonia plant; if the production from these is added to that from existing plants, and those under construction, then demand will be satisfied up to 1975/76. These facts can be seen in the diagram attached. In fact, the projected deficit would not be large enough to justify the start up of a new plant at Multan until about 1977/78. It is therefore concluded that the construction of a new plant at Multan for start up before 1977/78 is only justifiable if one of the other sanctioned projects is abandoned.

The two projects which are sanctioned in principle, but are not yet under construction are:-

(a) Punjab Fertilisers Ltd. - Nitrophosphate project
(b) Hyesons - Urea project.

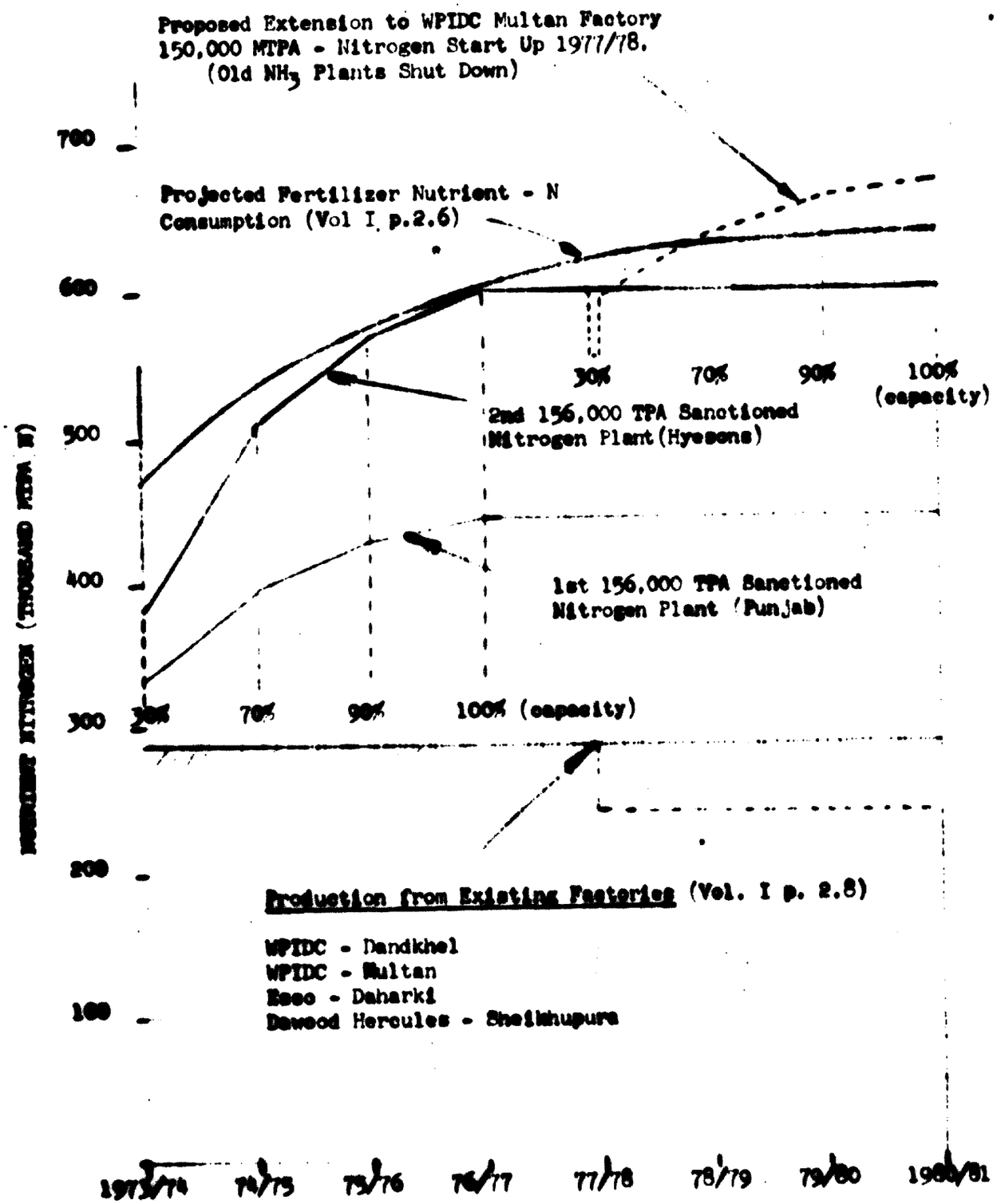
Two schemes for immediate development W.P.I.D.C.'s Multan site have analysed. Both schemes make maximum feasible use of W.P.I.D.C.'s existing plant and site factilities. They are:-

(i) A scheme based on 1000 MTPD urea, keeping in use the existing nitric acid and ANL plants, and

(ii) A scheme based on a nitrophosphate project.

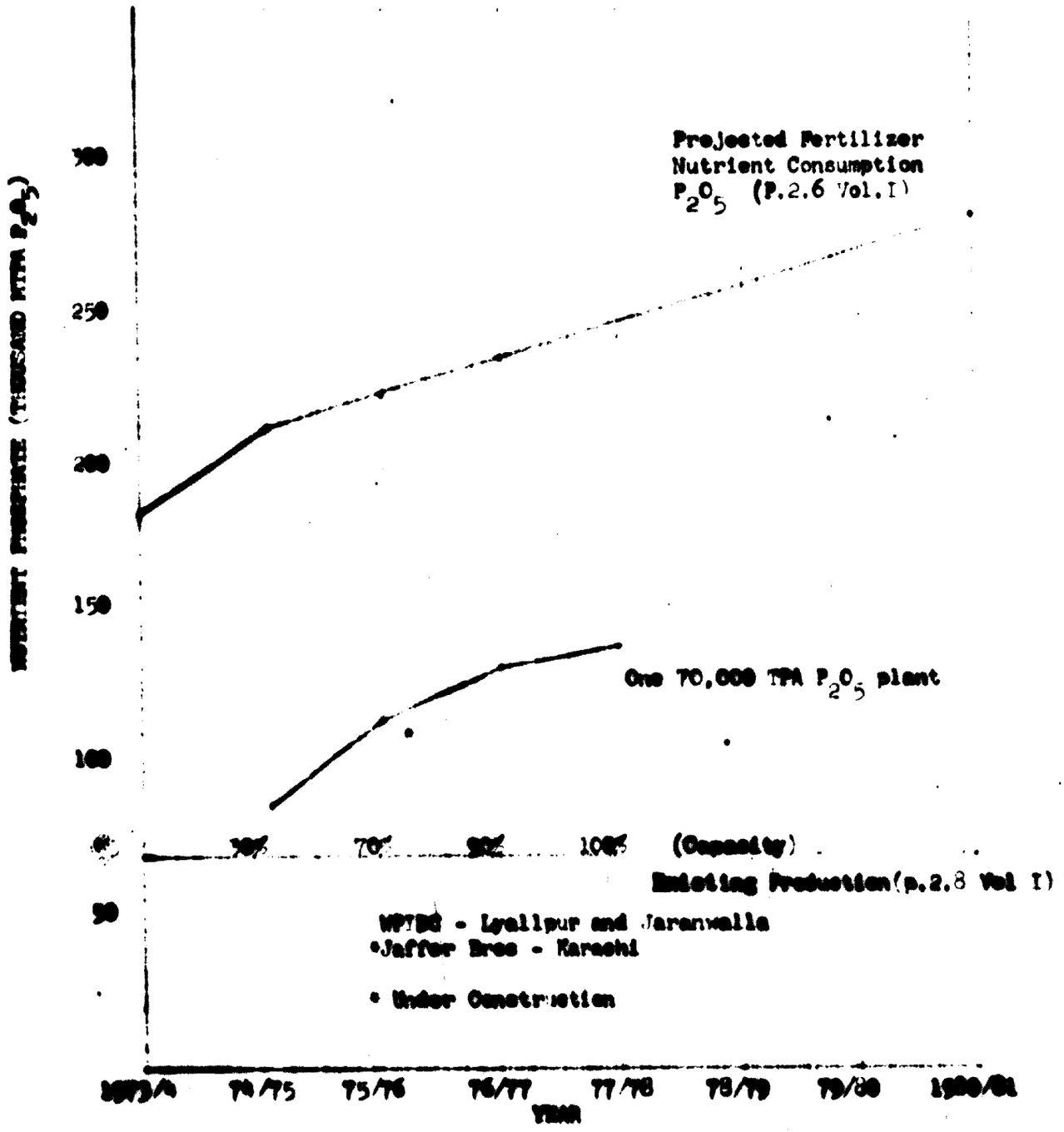
In the case of either scheme, there would be a significatnt saving to the Pakistan economy in both Rupees and foreign exchange as a result of incorporating the existing Multan facilities in the project.

If development of W.P.I.D.C.'s Multan site is further delayed, then the economic problems of the site will continue until a later development can take for start-up in 1977/78. Schemes for putting the site financing on a more favourable basis have been examined.



NITROGEN (THOUSAND MTPA N)

NITROGEN FERTILIZER CONSUMPTION AND PRODUCTION CURVES - WEST PAKISTAN



Phosphate Fertiliser Consumption and Production Curves - West Pakistan

VOLUME V

THE DEVELOPMENT OF THE EXISTING FERTILIZER FACTORY AT MULTAN IN THE CONTEXT OF FUTURE FERTILIZER REQUIREMENTS.

SECTION I

1.1 Introduction

The West Pakistan Industrial Development Corporation's (W.P.I.D.C.) Fertilizer Factory at Multan, in West Pakistan, was set up for the manufacture of urea and ammonium nitrate limestone (ANL) fertiliser. The plant units were started up and have been in production since 1962/63.

The designed capacity of the plant is 204 metric tons per day (MTPD) of anhydrous ammonia converted into:

180 MTPD of crystalline Urea with 46% Nitrogen

and

300 MTPD of Ammonium Nitrate Limestone with 26.5% Nitrogen

The ammonia plant has been found to be under-designed, but both the ANL and urea plants have an excess capacity of about 15%. In order to balance the production of ammonia and utilise the excess conversion capacity a "Package" Ammonia plant with a daily capacity of 60 tons of ammonia was set up in 1967-68.

A plan for the further development of the site was devised by W.P.I.D.C. in the mid 1960's. This provided for the construction of a new nitrophosphate complex comprising a new large ammonia plant and nitric acid, nitrophosphate and ammonium sulphate-nitrate units.

This scheme was submitted for approval but has been shelved.

At present W.P.I.D.C. are carrying out modifications to the ammonia plant to improve output and plans exist for the improvement of the Urea plant on the site.

The objective of this study has been to consider where further development of the site would be appropriate and desirable for the Pakistan economy in view of current projects and the planned expansion of the fertiliser industry of West Pakistan.

1.1 Introduction - continued

In April/May 1970, members of the staff of Humphreys and Glasgow Ltd. together with their sub-contractors - Messrs. Chemical Consultants (Pakistan) Limited, and a representative of the U.N.I.D.O. Pak 26 team from Rawalpindi, visited the factory at Multan following a preliminary meeting at W.P.I.D.C. head office in Karachi.

An inspection of the site and factory took place, and discussions were held with the General Manager, Chief Engineer and other members of the staff at the factory.

The factory at Multan impressed the staff of Humphreys and Glasgow and Chemical Consultants as being an efficiently operated unit within the limitations imposed by the plant. The site is well placed to serve the agricultural areas of the country and the off-site units in particular clearly have a good life ahead. Therefore, it was tentatively concluded that it would be in the national interest to develop and modernise the site.

1.2 Acknowledgements

Humphreys and Glasgow Ltd. wish to express their appreciation of the help and information given to them in their work on the project by:

The Government Project Representative in Rawalpindi, the U.N.I.D.O. Project Manager, and Co-Project Mananger, and U.N.I.D.O. Experts.

The Directors, General Manager and Manager of Chemical Industries Division - W.P.I.D.C. head offices in Karachi and the General Manager, Chief Engineer and many members of the staff of the W.P.I.D.C. fertiliser factory at Multan.

SECTION 2

EXISTING PLANT AND FACILITIES

2.1 Location of the Plant

The factory is located on the outskirts of Multan City by the side of the Multan-Lahore highway. The factory rail sidings are connected by 1.5 miles of track to Piran Ghaib railway station on the Khanewal-Multan sector of Pakistan Western Railway.

Multan city is situated centrally in West Pakistan. The major consuming areas for fertilizers are within a radius of 200 miles from Multan.

2.2 History of the Plant

The fertilizer factory at Multan was the second fertiliser factory to be built in West Pakistan.

Pakistan Industrial Development Corporation (P.I.D.C.) entered into an agreement with ENSA, a French firm, on 20th January, 1958 to set up a complete nitrogenous fertilizer plant at Multan based on the use of Sui natural gas with a commercial capacity of 200 long tons per day of anhydrous ammonia; one half of which was to be converted into ammonium nitrate limestone (ANL) and the other half into Urea.

The agreement provided for a turnkey contract on deferred payment terms which included responsibility for the selection of processes, engineering of the plants, procurement, shipping, clearance, inland transportation, as well as erection and start up of the machinery and all ancillary services by October 28th 1960.

After various difficulties during the planning, erection and start-up of the plant, the project was completed and handed over to W.P.I.D.C. in April, 1963.

These difficulties have been well documented by W.P.I.D.C. and their consultants in the past and are not mentioned here except where they effect the future development of the site.

Further difficulties arising from the basic plant as handed over were overcome in the period 1964-65, and in the latter end of 1965 W.P.I.D.C. decided to give some consideration to balancing and modernisation of the plant - in particular to meet a shortage of ammonia from the original plant which severely restricted the fertilizer output from the factory.

A Girdler "Ammopac" package ammonia plant of 60 tons per day capacity was installed and at present this unit is under trial production.

2.3 Raw Materials

Sui natural gas in the main raw material used for the production of ammonia. A typical analysis of Sui gas has been given in Volume I.

Limestone, the other raw material, used as a filler, is obtained from W.P.I.D.C. limestone quarries located at Daudkhel.

2.4 Existing Plant and Facilities

2.4.1 Description

The existing factory is contained on a site of approximately 60 acres to the south of the Multan-Lahore road. A colony with housing accomodation for a large proportion of the factory staff and their families, complete with mosque, hospital, rest house, shops, school and post office also occupies an area of about 60 acres adjacent and to the north east of the factory site.

The factory is laid out with wide concrete or tarmac access roads and additional land exists within the plant boundaries for extension of the plant.

The factory consists of the following main plant units:

(a) Two parallel streams of ammonia production, each capable of producing 100 tons of ammonia per day.

(b) One urea plant with two parallel streams for some units, capable of producing 180 tons of urea per day - 46% N.

(c) One single stream nitric acid plant capable of producing 180 tons (100%) nitric acid per day.

(d) One single stream ammonium nitrate limestone plant capable of producing 330 tons per day of product - 26.5% N.

(e) One 60 tons per day "Package" ammonia plant.

In addition to the above main plant units the following facilities also exist on the plot:-

(i) Electrical Power Distribution:
6.3 KV

2.4.1 Description - continued

(ii) Steam Generation - Two natural gas fired 25 MT/hr., 15 Kg/cm^{2}g. steam boilers installed in separate boiler house. Steam mostly used in Urea plant.

(iii) Tube Wells - Five tube wells with total capacity of 250 MT/hr (56,000 igph).

(iv) Recirculating Cooling Water System -

a) Main System -

Water circulation rate - 6000 m^3/hr.
Five cell, induced - draught, reinforced concrete cooling tower.
System supplies cooling water to ammonia, urea and nitric acid plants.

b) Small System -

Water circulation rate 2000 m^3/hr.
Timber construction induced draught cooling tower.
System supplies cooling water to Ammopac plant.

There is no spare capacity in the above cooling water systems.

(v) Boiler Feed Water Treatment Plant -

Total capacity - 150 m^3/hr
To main plant - 100 m^3/hr
To Ammopac - 25 m^3/hr

Approximately half of the quantity used is demineralised.

(vi) Sui Gas Receiving Station - Gas is received at the factory site at 340 p.s.i.g. then reduced through a controller station to 175 p.s.i.g.

(vii) Product Storage - In R.C. and brick covered buildings:-

Urea (bagged) - 15,000 MT
ANL (bulk) - 25-27,000 MT

The above represents about three months storage.

(viii) Ammonia Storage - Two spheres each of 1000 MT capacity.

(ix) Bagging and Despatch facilities including railway sidings. Approx. 90% of all product is despatched by rail. Twenty five P.W.R. waggons will hold one days output from the plant.

(x) Workshop Facilities - These are described in more detail in Section 2.4.2. Housed in R.C. and brick building.

2.4.1 Description - continued

(xi) Stores Facilities - A main storage building and a separate material store - both in R.C. and brick, exists on the site.

(xii) Garage - A large R.C. and brick building provides facilities for garaging major vehicles and provides some maintenance facilities in conjunction with the main workshop.

(xiii) Laboratory Facilities are provided in a large R.C. and brick building. The building is large enough, without extension, to house the laboratory facilities required for a new plant of the size envisaged in this report.

(xiv) Effluent Treatment - At present, liquid effluent from the plant, after dilution, is run into an existing irrigation canal about 1 to 1½ miles from the factory after passing through a settling tank (there are two settling tanks - one can be cleaned whilst the other is in use). Effluent at present about 200 tons/hr.

(xv) Administration Buildings - These are of R.C. and brick construction. There is also a canteen and medical centre or hospital on factory.

(xvi) Housing Colony -

The housing colony includes accomodation for approximately 600 families and bachelors, in bungalows and quarters as follows:-

Bungalow		
B Type	11	including Rest House
B2 Type	15	including Post Office
C Type	20	including Rest House
C1 Type	15	
D Type	40	including male and female dispensary and Officers Mess
E Type Quarters	82	
FF Type Quarters	47	
F Type Quarters	162	
EF Type Quarters	96	
Bachelor Hostel	94	
	582	

2.4.2 Main Workshop

The main maintenance workshop houses mechanical, electrical and instrument sections in a reinforced concrete and brick building of approximately 200' x 130' x 30' to underside of crane.

The main workshop area is served by a 10,000 Kg capacity pendant controlled electrical operated overhead travelling crane and one bay is served by a 3000 Kg hand operated crane.

In the workshop there are 56 machines, consisting of 7 lathes (from 6000 mm centres down), 5-grinding machines, 3-milling machines, 2-shapers, 1-slotter, 1-seat cutter, 5-drilling machines, 1-horisental boring machine, 10-cutting machines and band saws, 1-pipe threading machine, 2-shearing and punching machines, 1-hydraulic press 10 & 50 tons, 1-mechanical hammer, 2-forges and blowers, 2-sheet bending machines, air-compressor, electric welding sets, metalising gun and accessories and various smaller machines and hand tools. In addition to this there is an instrument shop with testing equipment, an electrical shop capable of re-winding 550 h.p. - 6KV motors, small foundry with two furnaces capable of doing small castings, and a carpenters shop.

During a visit the following work was observed in progress - this list is not exhaustive but is indicative of the scope of the work carried out:-

Various small steel and bronze parts were being fabricated and machined.

Machining and shaping of large 36" diam. stainless steel heat exchanger baffles.

Repairs by welding to stainless steel pump impeller.

Replacement of C.I. pump casing by locally cast pump casing - machined and reassembled at Multan.

Retubing of stainless steel tube bundle in heat exchanger.

Rebuilding and repair to air fan rotor blading.

Fabrication of low pressure carbon steel vessel approx. 15 ft. long x 2'-6" diam. x ¼" thick then stainless steel lined internally.

Rewinding of electric motors - one of 550 HP was in progress (repair based on imported heavy copper insulated windings).

Fabrication of many small electrical spare parts - coils, contacts etc.

Sheet metal cladding for insulation.

Conveyor belt splicing and vulcanising.

Instrument calibration and testing.

Repairs to plant and building air conditioning units.

2.4.2 Main Workshop - continued

Due to the difficulty in obtaining spares (some two years are required from first order to delivery in the case of most imported items) and due to the difficult foreign exchange position the workshop staff were tackling and producing their own replacement spares to prevent long plant outages.

The general impression was of a most resourceful and enthusiastic staff carrying out a vital function in keeping plant outages to a minimum. The workshop is a very valuable asset to the Multan Complex.

The existing workshop could accomodate a number of additional machine tools.

2.4.3 Factory Staffing

From information given to H&G Ltd. the following summary of factory staffing has been extracted.

Technical

	Operation	Maintenance	Bagging & Shipping	Civil	Sub-Total
Officers & Engineers	40	6	2	2	
Supervisors & Foremen	4	29	2	2	
Senior & Junior Operating Staff & Tradesmen including Chargemen	330	262	22	15	
Helpers etc.	72	46	181	9	
	446	343	207	28	1024

Non-Technical

including Manager, admin staff, accounts, medical staff, drivers guards, storekeepers, school staff, telephone, canteen, cleaners, peons		373			373
				TOTAL	1397

2.5 Production Units

2.5.1 Ammonia Plant

The plant was designed to produce 200 long tons/day of ammonia but the average production of the plant over a period of one year has been found to be no more than 75 to 80% of the rated capacity. When the plant catalysts have been newly replaced an output of 205 tons ammonia per day can be achieved, but to date this production cannot be sustained for more than 2 to 3 weeks as the activity of the catalysts - especially the ammonia synthesis catalyst - starts falling and the production of ammonia falls sharply.

Synthesis catalyst life has been low because of the presence of poisons such as water vapour and CO_2 in the synthesis gas mixture. The life of the synthesis catalyst is not more than 5 to 6 months. When it is replaced, the production of ammonia has fallen to about 80% of the rated capacity.

Power breakdowns and unscheduled failures of pumps and compressors also tend to reduce the yearly average production rate, even though a shutdown may be of 2 or 3 minutes duration, it takes many hours to re-start the plant and bring it to normal production again.

The production guarantees for the ammonia plant have never been met and, because of the inadequacy of the ammonia plant, the factory has been unable to achieve rated production.

Balancing Unit

A balancing unit rated at 60 tons per day of ammonia has recently been added to the factory to make up the ammonia required to run the ANL and urea plants at rated capacity.

This plant - a Girdler "Ammopac" unit, has been under trial production for many months but, due primarily to troubles encountered with the gas engine driven, single shaft, reciprocating compressors, it has not been able to maintain production for more than a few days at a time.

2.5.2 Urea Plant

There are no serious problems in this plant. Although the plant is guaranteed to produce 170 tons of Urea per day it can produce 205 MTPD.

The present Urea plant produces a crystalline product which is not very much liked by the farmers. Being crystalline, it is not sufficiently heavy to fall off crop leaves when broadcast.

2.5.2 Urea Plant - continued

W.P.I.D.C. stated that they were considering installing compacting rolls as an interim measure, and eventually installing an evaporation and prilling plant.

A proposal to combine the existing urea plant with a modern solution - recycle process (Inventa), which would increase the capacity of the existing plant from 180 to 280 MTPD. is also under consideration by W.P.I.D.C.

2.5.3 Nitric Acid Plant

The nitric acid plant is designed to produce 180 tons per day of nitric acid (100%) and when the climatic conditions are favourable can produce up to 206 tons per day.

2.5.4 Ammonium Nitrate Limestone Plant

The Plant, though designed to produce 295 tons of ANL, can produce up to 330 tons per day. The plant had only minor problems such as scaling of the dryer and presence of nitrate dust in the effluents from the plant., both these problems have been more or less solved successfully.

The ANL plant, when inspected, was very dirty. Huge piles of dust and product waste lay around the items of plant (not, admittedly, an unusual situation on such plants). The unit appeared to work well and certainly produced a very good product.

2.6 Operational Results

2.6.1 Production (Basis: letter CR(1)/CDM - 135 (2) 24th April, 1970 to Mr. Irshad Ahmad from Dr. A.K. Qureshi-W.P.I.D.C.).

The production in metric tons of Ammonium Nitrate Limestone and Urea since plant start-up is given below.

The % of rated output is based on:

ANL - 300 MT /day, 330 days/year

Urea - 180 MT /day, 330 days/year

2.6.1 Production - continued

Year	Ammonium Nitrate	% rated Output	Urea	% rated Output
1961-62	9,095	9	733	1
1962-63	63,970	65	27,870	47
1963-64	60,494	61	39,810	67
1964-65	75,325	76	44,229	75
1965-66	75,012	76	41,427	70
1966-67	79,501	80	47,591	80
1967-68	76,808	78	43,522	73
1968-69	73,574	74	48,722	82

2.6.2 Production Costs

Main Ammonia Plant

Total Production costs for the main ammonia plant (not including the Ammopac unit) are given in Table V.2.1. This is a detailed statement for the year 1968/69.

AML & Urea Plants

The summarised cost of production of AML and urea from 1962-63 to 1968-69 is tabulated below:- (Basis - 24.4.70 letter as for paragraph 2.6.1).

Year	Ammonium Nitrate Limestone	Urea
	Rs/ton	Rs/ton
1962-63	353.08	612.15
1963-64	339.39	554.14
1964-65	327.55	557.03
1965-66	364.10	608.60
1966-67	385.65	636.93
1967-68	391.34	664.00
1968-69	451.87	713.00

Production costs for the Ammopac unit were not available as the plant has not run for a long enough period to determine long term operating costs.

[redacted] M.P.I.B.C. - NATURAL GAS FERTILIZER FACTORY, MULTAN

Table V.P.I. - Production Costs - Ammonia* Year 1968-69

Production of Main Ammonia Plant 55,660,316 M.Ton

	Quantity	Value Rs.
1. [redacted]		
[redacted]: Sui Gas as raw material	6,38,05,865 M³	47,90,087.
[redacted]	6,31,34,490 KWH	44,73,395.
[redacted]	Cat.C.	
NH3 Synthesis catalyst	L/Ton 3-12-3-2 Lbs.	31,015.
Shift conversion catalyst	25-12-3-02	1,54,983.
Steam reforming catalyst	10-10-0-10	1,69,974.
		3,55,972.
2. [redacted]		
[redacted]		
Soda caustic	16,516 Kgs	23,943.
Salt	125.175 M/Ton	14,562.
Sodium triphosphate	1,490 Kg.	995.
Liquid chlorine	15.090 M/Ton	23,586.
Sulphuric acid	307.654 M/Ton	3,46,505.
Sodium sulphite	5,500 Kgs.	11,456.
Limestone	171.468 M/Ton	4,368.
Sodium tripoly phosphate	10,190 Kgs.	14,999.
		4,40,417.
[redacted]		
Soda Caustic	98,891 Kg.	1,46,960.
Lead acetate	6,000 Kg.	15,300.
		1,62,260.
[redacted]		
Formic acid	24,000 Kgs.	79,569.
Copper scrap	L/Ton 18-7-3-02 Lbs.	1,34,155.
Sodium dichromate	" 8-0-0-0 "	21,540.
		2,35,265.
3. [redacted]		
Management & supervision		1,50,467.
Shift labour		6,55,134.
		8,05,602.
4. [redacted]		
[redacted] and stores		9,02,005.
Labour		11,60,781.
		20,62,787.
5. [redacted]		
Insurance	... ...	2,10,527.
Depreciation	... ...	67,69,674.
Maintenance & Service cost	... ...	21,67,558.
Administration cost	... ...	10,53,411.
		1,02,01,171.
[redacted]		
6. [redacted]		
6% on capital cost of Ammonia Plant (Rs. 7,54,71,000.00)		47,16,938.
		TOTAL COST:-

* Source - Accountant - M.P.I.B.C. Multan.

SECTION 1

...roduction of Main Ammonia Plant 55,660,316 M.Ton

Quantity	Value Rs.	Unit Rate per M.Ton Rs.
6,38,05,265 M^3	47,88,897.80	86.27
6,31,34,490 MBH	44,73,398.16	85.37
Cat.A.		
L/Ton 2-18-8-2 Lbs.	31,015.00	.38
25-18-3-02	1,34,988.77	2.89
10-10-8-19	[illegible]	[illegible]
	[illegible]	[illegible]
16,518 Kgs	23,943.00	.45
185,173 M/Ton	14,368.21	.27
1,490 Kg.	995.00	.02
15,890 M/Ton	23,385.47	.44
507,084 M/Ton	3,46,305.60	6.46
5,500 Kgs.	11,498.00	.21
171,400 M/Ton	4,368.35	.08
10,190 Kgs.	[illegible]	[illegible]
	4,40,417.61	8.21
98,991 Kg.	1,46,980.15	2.74
6,000 Kg.	[illegible]	[illegible]
	[illegible]	[illegible]
24,980 Kgs.	79,369.68	1.48
L/Ton 18-7-3-02 Lbs.	1,34,155.48	2.50
" 8-8-0-0 "	[illegible]	[illegible]
	[illegible]	[illegible]
	1,30,467.72	2.80
	[illegible]	[illegible]
	[illegible]	[illegible]
	9,02,895.65	16.81
	[illegible]	[illegible]
	[illegible]	[illegible]
...	2,10,327.48	3.92
...	67,89,874.15	125.97
...	21,67,928.60	40.39
...	[illegible]	[illegible]
	[illegible]	[illegible]
		495.16
	47,16,988.00	87.90
	TOTAL COST:-	Rs. 541.06

SECTION 2

2.6.3 Product Selling Prices

The following product selling prices were given by W.P.I.D.C.:-

ANL - Rs 13 (87.5 lb bag) = Rs 328/MT
Urea (crystallised) - Rs 13 (50.6 lb bag) = Rs 565/MT

These selling prices include costs of distribution from the factory and agents selling commission.

W.P.I.D.C. said that they intend in future to sell bagged product, approximately 50% in 50 kg bags and 50% in small bags.

2.7 Product Marketing

The fertilisers produced at Multan are distributed through two Agencies:-

(a) Rural Supply Co-operative Corporation (RSCC).

(b) Pakistan National Oils Co. (PNO).

SECTION 3

ESTIMATED VALUE OF MULTAN SITE

The Site valuations are listed in Table V.3.1. They have been considered in the context of an extension to the plant starting up in 1973 and the existing facilities being recapitalised at that time. The table lists the values of the existing plant units and off-site and infra-structure facilities. With annual depreciation at 10% p.a. (straight-line), the plants units will be fully depreciated by 1973. Buildings, however, have been depreciated at 3% p.a. (straight-line).

In the tables three different valuations are placed on the site:

(i) Original cost

(ii) Written-down value in 1973

(iii) Estimated value as operating units in 1973. These values do not take into account such factors as the high costs of production associated with certain plant units.

Also listed are:

(iv) Estimated costs of erecting equivalent new plant.

It should be noted that the costs in column (iv) are based on 1970 costs and include escalation during the construction period 1970-73. No account has been taken of the scrap value of plant which would be shut-down. Generally speaking, such values are likely to be only marginally above the cost of site clearance and scrap recovery.

TABLE V 3.1

ESTIMATED VALUE OF M.P.I.D.C. MULTAN FERTILIZER COMPLEX

	(i) MULTAN ORIGINAL COST Rs	(ii) WRITTEN DOWN VALUES(1973) Rs	(iii) ESTIMATED VALUE OF EXISTING PLANT (1973) Rs	(iv) ESTIMATE OF EQUIVALENT NEW PLANT Rs
Ammonia Plant Buildings	6,113,000	4,239,600)		
Ammonia Plant Machinery	69,359,200	-)	23,200,000	50,000,000
Ammonia Storage Buildings	299,700	201,000	240,000	420,000
Ammonia Storage Plant	2,542,980	-	1,530,000	3,500,000
Nitric Acid Plant Buildings	1,295,000	856,000	990,000	-
Nitric Acid Plant Machinery	13,981,500	-	8,350,000	11,700,000
Ammonium Nitrate Buildings	2,038,500	1,417,000	1,625,000	2,380,000
Ammonium Nitrate Machinery	7,940,000	-	4,750,000	8,000,000
Ammonium Nitrate Storage Building	5,360,800	3,682,000	4,300,000	7,500,000
Ammonium Nitrate Storage Machinery	3,581,800	-	2,160,000	5,000,000
Urea Plant Buildings	2,383,500	1,525,000	1,980,000	3,300,000
Urea Plant Machinery	28,605,300	-	17,200,000	26,000,000
Urea Plant Storage Buildings	2,988,750	2,040,000	2,330,000	4,050,000
Urea Storage Plant	763,800	-	457,000	1,070,000
Cooling Tower Building	3,300,200	2,219,200	2,640,000	4,600,000
Cooling Tower Plant	4,099,500	-	2,410,000	5,700,000
Factory Main Sub-station	287,650	192,700	250,000	400,000
Factory Main Sub-plant	168,980	-	100,000	256,000
Workshop Inc. Garage	2,503,380	1,678,000	2,010,000	3,500,000
Workshop Inc. Machinery	2,986,250	-	1,750,000	4,100,000
Admin. Building Equipment & Furn.	5,455,550	3,692,850	4,300,000	7,650,000
Residential Buildings & Furn.	5,197,250	3,153,700	4,100,000	7,250,000
School, Mosque & Club	359,650	256,000	280,000	500,000
Market (5 shops)	52,100	37,500	41,000	75,000
Roads Colony	210,980	94,600	150,000	294,000
Housing Street Lighting & Dist.	579,100	-	340,000	820,000
Hospital Equipment, Laboratory & Furn.	1,324,500	263,000	880,000	1,850,000
Cost of Land & Devel.	929,500	929,500	1,115,000	1,115,000
Misc. Buildings, Transport etc.	11,887,540	3,500,000	4,800,000	14,300,000
Start-up costs, consultancy etc.	34,515,760	-	8,650,000	41,500,000
TOTAL COSTS	220,911,700	29,977,650	102,898,000	217,608,000

SECTION 4

ANALYSIS OF DEVELOPMENT SCHEMES

4.1 Scope of Possible Development

Any development of the site must have the objective of making the factory a production unit, which is commercially competitive with other projects now in progress in West Pakistan. By the time a development scheme initiated now is in operation, the existing units will have run for about 10 years, and will thus be well depreciated. For this reason, it is not necessary that the development project for the site has any specially advantageous characteristic. It will be sufficient to incorporate the existing facilities with a new large-scale fertiliser project. Plant units of the existing complex which become uneconomic to run can then be shut-down and their depreciated value can be written off as a part of the capital cost of the new project.

In view of other large scale developments taking place in W. Pakistan, it is important that the future plans for W.P.I.D.C.'s Multan site are made now. The commercial viability of the existing plants is liable to decrease as they reach the end of their working life.

The options open to W.P.I.D.C. at Multan are as follows:

a) Develop the site by building a new large-scale nitrogen fertiliser project.

b) Develop the site by undertaking a new large-scale nitrogen/phosphate fertiliser project.

c) Carry out further modifications to the ammonia and urea units. These might stretch the useful life of plants on the site as far as 1980. It is anticipated that by that time nitrogen and phosphate capacity additional to new production currently planned for West Pakistan (Hyesons and Punjab Fertilisers projects) will be required.

d) Make no further investment at the site with a view to shutting down in 3 to 5 years and using or selling the site for other industrial purposes.

The opportunity to undertake options a), b) or c) depends on the projections of fertiliser requirements in West Pakistan and on the progress made with the projects currently planned to meet that requirement. The data for nitrogen is shown in the graph in the summary.

4.1 Scope of Possible Development - continued

So far as nitrogen is concerned, the Hyesons and Punjab Fertilisers projects together with existing plants will satisfy requirements completely in about 1975/76. By 1977/78 however, with the imminent shut-down of the existing W.P.I.D.C. plants at Multan, unsatisfied demand will again reach a level sufficient to justify the construction of the next 600 MTPD ammonia plant. (See summary). This plant would need to start-up in 1977/78 and construction start in 1974.

There is considerable difficulty in making an accurate forecast of phosphate consumption in West Pakistan as current consumption is relatively low. The Punjab Fertilisers project includes the production of NP Fertiliser and there is a TSP/MAP plant under construction at Karachi. These projects, however, do not meet the estimated P_2O_5 consumption forecast for the period beyond about 1974/75.

Assuming that the Punjab Fertilisers project goes ahead, it would be unwise to proceed with a further, large competitive N/NP project in the same location at once. It would be advisable to see how the P_2O_5 fertiliser market develops in comparison with current predictions.

In summary, then, it is highly desirable that the next fertiliser project in West Pakistan is located at W.P.I.D.C.'s Multan site. This project could be in the near future only through co-operation between W.P.I.D.C. and either Hyesons or Punjab Fertilisers, or by W.P.I.D.C. alone, if either of these two companies withdrew. Failing this, W.P.I.D.C. must await further build-up of the nitrogen and phosphate market and delay development by 5 years; during this period steps must be taken to improve the commercial viability of the Multan site and are discussed in Section 4.6.

If a project of type (a) or (b)(above)could be undertaken at once, the first problem to be examined is the part to be played by existing units in the new project. This question is examined in the next four sections 4.2 to 4.5.

4.2 Ammonia Units

The minimum capacity for a single stream ammonia unit would be about 600 MTPD which is the minimum practical capacity for a plant employing modern centrifugal compressors and is also the size of plant being built on competitive sites.

Given that such a unit is to be built at Multan, it is necessary to consider what action should be taken in respect of the existing plants.

4.2.1 Modification of Existing Plants

The existing ammonia synthesis gas production units involve the use of very complex and unreliable units for removal of sulphur from the natural gas, and removal and recycle of CO from the ammonia synthesis gas.

Modification of the plants can be considered either against a short term period of operation, (say 3 years) prior to the start-up of a new large plant or a longer period (say 7 years) up to later development (case(c)4.1.) or final shut-down.

There are two ways in which these units may be improved.

(i) Installation of catalytic desulphurisation, low temperature CO shift, and methanation, or

(ii) Installation of catalytic desulphurisation only.

Alternative (i)

It is estimated that the maintenance on the desulphurisation and CO removal units amounts to about 20% of the total ammonia plant maintenance cost, i.e. Rs $0.2 \times (2.063 \times 10^6 + 2.168 \times 10^6)$
= Rs 846,000/year. (See Table V.2.1.)

The operating costs of the existing units are approximately as follows:-

Electricity 80 KWh/MT NH_3	Rs 8.48/MT NH_3
Desulphurisation Chemicals	Rs 3.02/MT NH_3
Scrubbing Chemicals	Rs 4.38/MT NH_3
	Rs15.88/MT NH_3

For 54,000 MTPA Ammonia this is Rs 857,520/year.

These two figures total Rs 1.7×10^6/year.

The catalysts required for the Desulphurisation, Low Temperature Shift and methanation reactors to carry out this duty are:

Zinc oxide (Desulphurisation &L.T. CO Shift Guard)

Cobalt Molybdate

L.T. CO Shift

Methanation

4.2.1 Modifications of Existing Plants - continued

The cost per year for these catalysts would be £ 8800 (C & F Pakistan). As we understand that the import of catalyst would be on cash-cum-bonus, and also liable to a 50% import duty (55% if clearance, forwarding, wharfage is included) the cost becomes:-

£ 8800 + (0.9 + 0.55) 8800 = £ 21,560 = Rs 245,800

If this figure is deducted from the present Rs 1.7×10^6 cost, Rs 1.454×10^6 are left to cover standing charges on the modifications. With interest (8%) Insurance (0.3%) Maintenance (3.0%) and Depreciation - at 33% (3 years), or 14.3% (7 years)-the permitted investment would be:

$$\frac{\text{Rs } 1.454 \times 10^6 \times 100}{(8.0 + 0.3 + 3.0 + 33.0)} = \text{Rs } 3.28 \times 10^6 \text{ for a plant life of 3 years.}$$

or:

$$\frac{\text{Rs } 1.454 \times 100 \times 10^6}{(8.0 + 0.3 + 3.0 + 14.3)} = \text{Rs } 5.68 \times 10^6 \text{ for a plant life of 7 years}$$

It would be expected that the modification would cost about Rs 3.0×10^6. It is therefore obvious that the modification would pay off only if the plant is to continue to operate for more than 3 years after completion of the modification.

Alternative (ii)

For the short term case, therefore, alternative (ii), modification to the desulphurisers only can be considered. This would be the most effective change of all since it would enable the reformers to operate more efficiently than at present.

The modification would involve the installation of a single catalyst vessel containing two catalysts for desulphurisation.

(a) A bed of Cobalt Molybdate catalyst, - used to hydrogenate the sulphur compounds to H_2S. The source of hydrogen may be a small part of the ammonia loop purge gas. The catalyst life is about 3 years.

(b) A bed of Zinc Oxide catalyst - used to absorb the H_2S formed in the first bed This catalyst would be changed each year on the annual shut-down.

The catalysts would operate at about 350° - 400°C, in the absence of steam, and so a gas fired heater would be installed. The sulphur-free gas would then be mixed with steam and passed to the existing mixed gas heater prior to entry to the reformer.

4.2.1 Modifications of Existing Plants - continued

The desulphurisation catalyst annual charge would be Rs 54,000. The vessel would cost about Rs 40,000 the heater Rs 85,500, and piping approximately Rs 119,500, giving a total of Rs 245,000.

The operating cost of the existing desulphurisation section is as follows:

Maintenance, say 7% of the ammonia plant maintenance cost = Rs 0.07 $(2.063 \times 10^6 + 2.168 \times 10^6)$ = Rs 296,200/year

Electricity (1.5 KWh/MT NH_3)	Rs 0.159/MT NH_3
Desulphurisation chemicals	Rs 3.02/MT NH_3
Total	Rs 3.179/MT NH_3
For 54,000 MT NH_3/yr this is	Rs 171,700 /year
Giving a total of	Rs 467,900/ year

Deducting catalyst charges (Rs 54,000/year), this leaves Rs 413,900/year to cover standing changes on the modification; the cost of the modifications is about half of this figure. The desulphuriser modification can therefore be justified even if the plant is only intended to operate a further year.

4.2.2 Viability of Existing Ammonia Plant in conjunction with a New Large Plant

The capacity of the existing plants is 250 MTPD. The viability of continuing to operate these plants when a new plant is running can be tested by comparing costs of operation in two cases:

i) Building a plant of about 600 MTPD capacity with existing units kept running.

ii) Shutting-down existing plants and building a new plant of about 850 MTPD capacity.

Ammonia Production costs are indicated in tables V.4.1 and V.4.2. In case (ii) above, the capital value of the existing plants to be written off must be allowed for. It is assumed that this amount is recapitalised with the cost of the new plant. The amount to be written off on shut-down in 3 years time (i.e. 1973) would be approximately as follows:

4.2.2 Viability of Existing Ammonia Plant in conjunction with a new large Plant

continued

	Rs x 10^6
Written-down value of Ammonia Machinery	0.00
Written-down value of Ammonia Buildings	4.24
Maintenance stores and spares (estimated)	0.75
	4.99

Hence the increase in cost per MT of ammonia made in the 850 MTPD plant will be given by the interest and Depreciation on this sum which is to be written off.

$$= \frac{4.99 \times 10^6}{280,500} \times \frac{(10+8)}{100} = \text{Rs } 3.2/\text{MT}.$$

(The "Ammopac" plant has been assumed transferred to a new user at its written-down value).

Table V.4.1 Production Cost-Ammonia

Centrifugal Plant 600 MTPD, 330 Day/Year

	Consumption Per MT.NH_3	Unit Cost	Production Cost Rs/MT NH_3	
Natural Gas (feed)	610 Nm^3	Rs 84.8/1000Nm^3	51.7	
Natural Gas (fuel)	315 Nm^3	Rs 84.8/1000Nm^3	26.7	
Electric Power	25 kWh	Rs 0.1060/kWh	2.7	
Cooling water	323 m^3	Rs 24.8/1000m^3	8.0	
Make-up water	2.8 m^3	Rs 0.54/m^3	1.5	
				90.6
Catalyst & Chemicals			5.6	
Variable Costs (Total)				96.2
Operation labour	5 operations + 1 supervisor/shift		1.3	
Day labour	5 men			
Maintenance (3% p.a. on Rs 80.0 x 10^6)			12.1	
				109.6
Administration (Multan annual cost)			9.4	
Interest (8% p.a. on Rs 80.0 x 10^6)			32.3	
Depreciation (10% p.a. on Rs 80.0 x 10^6)			40.4	
Insurance (0.3% p.a. on Rs 80.0 x 10^6)			1.2	
				192.9
Management (Ammonia)			0.8	
Stores Materials (for NH_3)			4.6	
Maintenance Labour (for NH_3)			5.9	
TOTAL COST OF AMMONIA (COST/Day)				Rs.304.2/MT

4.2.2 Viability of Existing Ammonia Plant in conjunction with a new large plant

Table V.4.2 - Production Cost - Ammonia

Centrifugal Plant 850 MTPD, 330 days/year

	Consumption Per MT NH_3	Unit Cost	Rs Cost/MT NH_3	
Natural gas (Feed)	610 Nm^3	Rs 84.8/1000 Nm^3	51.7	
Natural gas (Fuel)	315 Nm^3	Rs 84.8/1000 Nm^3	26.7	
Electric Power	25 kWh	Rs 0.1060/kWh	2.7	
Cooling Water	323 m^3	Rs 24.9/1000 m^3	8.0	
Make-up Water	2.8 m^3	Rs 0.54/m^3	1.5	
				90.6
Catalysts & Chemicals			5.6	
Variable costs (Total)				96.2
Operating Labour	5 operators + 1 supervisor/shift		0.9	
Day Labour	5 men			
Maintenance (3% p.a. on Rs 99.5 x 10^6)			10.6	
				107.7
Administration (Whalten annual cost)			6.6	
Interest (8% p.a. on Rs 99.5 x 10^6)			28.4	
Depreciation (10% p.a. on Rs 99.5 x 10^6)			35.5	
Insurance (0.3% p.a. on Rs 99.5 x 10^6)			1.1	
				179.3
Management (Ammonia)			0.6	
Stores Materials (Per NH_3)			3.8	
Maintenance Labour (Per NH_3)			4.1	
TOTAL COST OF AMMONIA (850 MT/Day)				Rs. 187.8/MT
Interest and Depreciation on written down value of old plant			1.8	
Cost of Ammonia				Rs. 189.6/MT

4.2.2 Viability of Existing Ammonia Plant in conjunction with a new large plant

For comparison with tables V.4.1 and V.4.2, the present cost of ammonia production at Multan is calculated by W.P.I.D.C. to be Rs 541/MT (Table V.2.1) for 1968/69. By 1973, with plant machinery written off this figure will be reduced to Rs 331.0/MT, assuming other costs unchanged.

The production cost of ammonia in the Ammopac plant is approximately Rs 450/MT when capital charges are added to estimated basic operating costs of Rs 145.5. Thus comparative daily production costs are as follows:-

Case (i)

600 MTPD Plant	Rs 204.2/MT	Rs 122,520/day
190 MTPD Plant	Rs 331/MT	Rs 62,890/day
60 MTPD Plant	Rs 450/MT	Rs 27,000/day
		Rs 212,410/day

Case (ii)

850 MTPD Plant	Rs 190.4	Rs 161,840/day

There is therefore an advantage of approximately Rs 50,570/day to be gained by building a larger ammonia plant and shutting down the existing ones.

4.3 Existing Urea Plant

4.3.1 Proposed Modification to Existing Urea Plant

Inventa have proposed a modification to the existing plant. The modification is designed to increase the capacity of the plant from 180 MTPD to 280 MTPD. It provides liquid recycle and prilling in place of crystallisation.

The cost of the modification in 1967 was quoted by Inventa as 4.9×10^6 Swiss Francs, equivalent to a Pakistan cost in 1971 of about Rs 8.6×10^6.

4.3.1 Proposed Modification to Existing Urea Plant - cont.

Operating savings result from this modification as follows:-

	EXISTING	MODIFIED	SAVING	UNIT COST	SAVING/MT OF UREA
NH_3	0.600 MT	0.585 MT	0.015 MT	Rs 190.4/MT	2.9
C.W.	140 m^3	110 m^3	30 m^3	Rs 0.0249/m^3	0.8
Elect.	509 kWh	380 kWh	129 kWh	Rs 0.1060/kWh	13.7
Steam	2.00 MT	1.80 MT	0.20 MT	Rs 15/MT	3.0
					Rs20.4

In addition to the saving of Rs 20/MT Urea, there is the benefit of increased capacity. On a 1000 MTPD Urea plant, the capital cost of the urea plant/MTPD of installed capacity is about Rs 67,000. Thus the increase in capacity is worth Rs 6.7×10^6. The saving on the production cost of the existing 180 MTPD capacity must therefore justify the remaining Rs 2×10^6. Even making due allowances for downtime and uncertainty in the performance which will result from modification, it appears to be attractive if the plant is required to continue in operation.

4.3.2 Action on Existing Urea Plant when New Urea Plant is Built

The problem is similar to that of ammonia considered in Section 4.2.2. When a new large Urea Plant is built, should the existing plant shut down?

Tables V.4.4 and V.4.5 give the production cost of urea from new plants of capacity 720 MTPD and 1000 MTPD. As stated in Section 4.3.1, the existing Urea plant would have to be modified. The costs of production in the modified plant fed with ammonia from a new 850 MTPD plant would be Rs 442.0/MT. (See Table V.4.3).

4.3.2 Action on existing Urea Plant when new urea plant is built - cont.

Table V.4.3 - Cost of Urea Produced in 1973 in Existing Urea Plant (Modified)

The 1968/69 cost of bagged urea was Rs 713/MT (Section 2.6.2). The plant machinery will have been written off by 1973, showing a saving relative to the 1968/69 figures of:

Interest (6.25%), depreciation (10%), on the capital cost of Rs 28.6×10^6 = Rs 4.65×10^6, which on 180 MTPD and 330 days/year is Rs 78.3/MT. The cost of production in 1973 from the depreciated plant would be Rs 634.7/MT.

By 1973, there are other cost changes to take into account:

(i) Ammonia price from new plant and reduced consumption due to modification of urea plant.

Cost reduction = $0.600 \times 541 - 0.585 \times 190.4$ = Rs 213.2/MT.

(ii) Increased power cost with reduced power consumption due to modification

Cost increase = $380 \times 0.106 - 509 \times 0.071$ = Rs 4/MT.

(iii) Reduced cooling water and steam consumptions due to modification.

Cost reduction = $30 \times 0.0249 + 0.2 \times 15.0$ = Rs 4/MT.

(iv) Interest (8%), Insurance (0.3%), Maintenance (3%) and Depreciation (10% over 10 years) on modification

= $0.213 \times 8.6 \times 10^6$ = Rs 1.83×10^6/year

i.e. Rs 20/MT Urea.

Thus 1973 cost of bagged urea from the Modified plant becomes

$635 - 213 + 4 - 4 + 20$ = Rs 442/MT

(Note: the 1968/69 rate of interest payable by W.P.I.D.C. was 6.25%. This is low by current standards and a figure of 8% has been used for any new project or recapitalisation).

4.3.2 Action on existing Urea Plant when new urea plant is built - cont.

Table V.4.4 - Production Cost of Urea (720 MTPD, 330 days/year)

	Per MT	Unit Cost	Cost/MT (Rs)	
Ammonia	0.57 MT	Rs 190.4/MT	108.5	
Carbon dioxide	0.77 MT	-	-	
Electric Power	125 kWh	Rs 0.1060/kWh	13.3	
Cooling Water	87 m^3	Rs 0.0249/m^3	2.2	
Steam	0.80 MT	Rs 15/MT	12.0	
				136.0
Operating Labour (3 operators + 1 supervisor/shift)				
Day Labour (3 men)			0.7	
Maintenance (3% p.a. on Rs 52.2 x 10^6)			6.6	
				143.3
Administration - (Rs 0.7 x 10^6 p.a.) (Estimate)			2.9	
Interest - (8% p.a. on Rs 52.2 x 10^6)			17.6	
Depreciation - (10% p.a. on Rs 52.2 x 10^6)			22.0	
Insurance - (0.3% p.a. on Rs 52.2 x 10^6)			0.7	
				186.5
Management (Urea) (Rs 200,000/p.a.) (Estimate)			0.8	
Stores Materials (for Urea) (Rs 1.0 x 10^6 p.a.) (Estimate)			4.2	
Maintenance labour (for Urea) (Rs 0.2 x 10^6 p.a.) (Estimate)			0.8	
TOTAL COST OF BULK UREA (720 MT/Day)				192.3
Cost of bagging (Estimate)			91.5	
TOTAL COST OF BAGGED UREA (720 MT/Day)				Rs. 283.8/MT

4.3.2 Action on existing Urea Plant when new urea plant is built - cont.

Table V.4.5 - Production Cost of Urea (1000 MT/Day, 330 days/year)

	Per MT	Unit Cost	Cost/MT(Rs)	
Ammonia	0.57 MT	Rs 190.4	108.5	
Carbon Dioxide	0.77 MT	-	-	
Electric Power	125 kWh	Rs 0.1060/kWh	13.3	
Cooling Water	87 M^3	Rs 0.0249/M^3	2.2	
Steam	0.80 MT	Rs 15.0/MT	12.0	
				136.0
Operating Labour (3 operators + 1 supervisor/shift)			0.5	
Day Labour	(3 men)			
Maintenance	(3% p.a. on Rs 71.1 x 10^6)		6.5	
				143.0
Administration (Rs 0.7 x 10^6 p.a.) (Estimate)			2.1	
Interest (8% p.a. on Rs 71.1 x 10^6)			17.2	
Depreciation (10% p.a. on Rs 71.1 x 10^6)			21.5	
Insurance (0.3% p.a. on Rs 71.1 x 10^6)			0.6	
				184.4
Management (Urea) (Rs 200,000 p.a.) (Estimate)			0.6	
Stores Materials (for Urea) (Rs 1.0 x 10^6 p.a.) (Estimate)			3.0	
Maintenance labour (for Urea) (Rs 0.2 x 10^6 p.a.) (Estimate)			0.6	
TOTAL COST OF BULK UREA (1000 MT/Day)				188.6
Cost of bagging (Estimate)			90.9	
TOTAL COST OF BAGGED UREA (1000/MT Day)				Rs.279.5/MT

Footnote: Capital cost build-up for 1000 MT/D Urea Unit

It is assumed that the existing urea unit will have been modified in 1971 at a cost of Rs 8.6 x 10^6 giving a depreciated value of this modification in 1973 of Rs 6.9 x 10^6. Thus the urea plant capital cost is built up as follows:

	Rs
Basic cost of 1000 MTPD unit	62.7 x 10^6
1973 written down value of existing plant	1.5 x 10^6
1973 written down value of modification	6.9 x 10^6
TOTAL	71.1 x 10^6

4.3.2 Action on existing Urea Plant when new urea plant is built - cont.

It is now possible to compare costs of production of Urea from the modified plant and 720 MTPD plant, with that from the 1000 MTPD unit.

(280 x 442) + (720 x 283.8)	=	Rs 328,100/day
1000 x 279.5	=	Rs 279,500/day
Difference		Rs 48,600/day

It is concluded, therefore that if the site development is based on the construction of a new large urea plant, then the old plant should be shut down and the written down value recapitalised in the new project.

4.3.3 Action on Existing Urea Plant if Multan site is combined with a Nitrophosphate Project

In these circumstances action on the urea plant is less clear cut. The plant would have to be modified and, as shown in table V.4.3, production costs then become Rs 442/MT. This allows a margin of Rs 70/MT below the ex-works price of Rs 510/MT. The plant is basically sound, and it was concluded that it should be kept running in its modified form together with the Nitrophosphate complex.

4.4 Nitric Acid Plant

Again we consider the alternative cases of running the existing plant in parallel with a new plant or shutting the existing plant down and building a larger new plant.

The 1968/69 cost of nitric acid produced in the existing 180 MTPD plant is estimated at Rs 250/MT. The plant machinery will have been written off by 1973 showing a reduction in cost of:

Interest (6.25%), depreciation (10.0%) on the capital cost of Rs 13.98 x 10^6 - Rs 2.27 x 10^6/year, which on 180 MTPD and 330 days/year - Rs 38.2/MT.

Hence at the new ammonia cost of Rs 190.4/MT, and with power at Rs 0.106/kWh, the production cost of nitric acid in the existing plant in 1973 would be

Rs 250 - 0.292 (541.1 - 190.4) + 145 (0.106-0.071) - 38.2

= Rs 114.5/MT.

The alternative new plants (890 MTPD and 1070 MTPD) have capital costs of Rs 33.8 x 10^6 and Rs 36.0 x 10^6 respectively. The plant machinery of the existing plant will have been fully depreciated by 1973 leaving only Rs 0.86 x 10^6 for the written down value of buildings in the existing plant, which must be included in the capital cost of the larger new plant. This gives Rs 36.86 x 10^6 as the effective capital cost of the 1070 MTPD plant.

4.4 Nitric Acid Plant - continued

Tables V.4.6 and V.4.7 give the production costs of Nitric Acid from plants of capacity 890 MTPD and 1070 MTPD.

Table V.4.6 - Production Cost of Nitric Acid - 890 MTPD, 330 days/year

	Per MT	Unit Cost	Cost/MT (Rs)	
Ammonia	0.285	Rs 190.4/MT	54.3	
Electricity	20 kWh	Rs 0.1060/kWh	2.1	
Process Water	0.34 m^3	Rs 1.5/m^3	0.5	
Cooling Water (Circ)	100 m^3	Rs 0.0249/m^3	2.5	
Boiler Feed Water	0.69 m^3	Rs 1.5/m^3	1.0	
Catalyst	0.095 gms	Rs 30.0/gm	2.9	
Steam Export	0.65 MT	Rs 15/MT (credit)	- 9.8	
				53.5
Operating labour (2 operators + 1 supervisor/shift)			0.5	
Day Labour (2 men)				
Maintenance (3% p.a. on Rs 33.8 x 10^6)			3.5	
				57.5
Administration (Multan cost) (Rs 300,000 p.a.)			1.0	
Interest (8% p.a. on Rs 33.8 x 10^6)			9.2	
Depreciation (10% p.a. on Rs 33.8 x 10^6)			11.5	
Insurance (0.3% p.a. on Rs 33.8 x 10^6)			0.3	
				79.5
Management (Nitric Acid) (Rs 100,000 p.a.)			0.3	
Stores Materials (for Nitric Acid) (Rs 1 x 10^6 p.a.) (Estimate)			3.4	
Maintenance Labour (for Nitric Acid) (Rs 200,000 p.a.) (Estimate)			0.7	
TOTAL COST OF NITRIC ACID				Rs 83.9/MT

4.4 Nitric Acid Plant - continued

Table V.4.7 - Production Cost of Nitric Acid - 1070 MTPD, 330 days/year

	Per MT	Unit Cost	Cost/MT(Rs)	
Ammonia	0.285 MT	Rs 190.4/MT	54.3	
Electricity	20 kWh	Rs 0.1060/kWh	2.1	
Process Water	0.34 m^3	Rs 1.5/m^3	0.5	
Cooling Water (Circ)	100 m^3	Rs 0.0249/m^3	2.5	
Boiler Feedwater	0.69 m^3	Rs 1.5/m^3	1.0	
Catalyst	0.095 gms	Rs 30.0/gm	2.9	
Steam Export	0.65 MT	Rs 15/MT (credit)	- 9.8	
				53.5
Operating Labour (2 operators + 1 supervisor/shift)			0.4	
Day Labour (2 men)				
Maintenance (3% p.a. on Rs 36.86 x 10^6)			3.1	
				57.0
Administration (Multan cost) (Rs 300,000 p.a.)			0.8	
Interest (8% p.a. on Rs 36.86 x 10^6)			8.4	
Depreciation (10% p.a. on Rs 36.86 x 10^6)			10.4	
Insurance (0.3% p.a. on Rs 36.86 x 10^6)			0.3	
				76.9
Management (Nitric Acid) (Rs 100,000 p.a.)			0.3	
Stores Materials(for Nitric Acid) (Rs 1 x 10^6 p.a.)(Estimate)			2.8	
Maintenance Labour (for Nitric Acid)(Rs 200,000 p.a.)(Estimate)			0.6	
		TOTAL COST OF NITRIC ACID		Rs.80.6/MT

Daily production costs for the two alternatives would be:

(890 x 83.9 + (180 x 114.5 = Rs 95,890

1070 x 80.6 = Rs 86,350 /day

Difference Rs 8,930 /day

4.4 Nitric Acid Plant - continued

Thus on the basis of production costs only, there is a small margin in favour of shutting down the existing acid plant. However, it could equally be decided to maintain this unit in operation on grounds of:

(i) Improved operating flexibility.

(ii) Once the capital for the old plant is fully depreciated, production costs will be lower.

4.5 Ammonium Nitrate Limestone Plant

This unit is of low capital cost and has relatively low operating costs. The savings to be made by shutting down are small. It is therefore recommended that it is kept in operation and is integrated into whichever development scheme is selected.

4.6 Delayed Development of W.P.I.D.C. Multan Site

4.6.1 Introduction

As pointed out in Section 4.1., assuming that the Hyesons and Punjab Fertilisers projects both proceed, then the opportunity to commence re-development of the Multan site will be delayed some 5 years; the existing plant must run up to about 1977/8 if case (c) of Section 4.1 is adopted. Action must therefore be taken in respect of three factors.

(i) For the urea to be marketable in competition with prilled product, the plant must be modified from crystallisation to prilling.

(ii) Ammonia supply must be secured either by modifying the plant to include low temperature shift, methanation and desulphurisation or by buying in ammonia and carbon dioxide from a larger production facility.

(iii) The financial structure of the site must be adjusted to put it on a competitive basis with other plants. W.P.I.D.C. must be able to market its fertilisers without subsidy.

The modification of the urea plant prilling has been shown to be attractive in such a situation (Section 4.3.2).

4.6.2 Ammonia Supply

In considering continued operation of the plant for a further 10 years, the question of ammonia supply is a major problem. Production costs on the present plant (Rs 541/MT in 1968/69) are most unattractive; installation of the equipment for low temperature shift and methanation should be undertaken if the life of the plant is to be extended for this length of time (Section 4.2). The economics of ammonia production would be improved by writing off the current book value of the plant.

If the plant is to be written off, a more attractive alternative would be the purchase of ammonia and carbon dioxide produced in a large capacity unit. The opportunity for this could arise with the Punjab Fertilisers project, which is to be located in the Multan area. The production cost in a 850 MTPD plant is calculated at Rs 190.4/MT ammonia (Table V.4.2).

Taking ammonia at say Rs 240/MT, it would be possible for W.P.I.D.C. to produce bagged urea in a modified plant at Rs 471/MT in 1973, when an ammonia supply should become available. This is to be compared with an ex-plant price of Rs 510/MT. It has been assumed that the urea plant modification would be carried out in 1971 and would be depreciated over a period of 10 years.

There is, of course, the problem of transporting ammonia and carbon dioxide over the distances from the new plant to the W.P.I.D.C. Multan site. The best solution for this would be by pipeline, at a possible cost of Rs 5.0×10^6, assuming a distance of approx. 7 miles.

Given a life of 10 years for the modified urea plant, the standing charges on the line would be approximately Rs 0.9×10^6 p.a., and would then amount to about Rs 3.0/MT Urea. This would not materially affect the argument in this case.

4.6.3 Improving the Financial Structure of W.P.I.D.C. at Multan

The current high production costs at Multan are primarily the result of two factors. The first is the high consumption of electricity. The second is the combined effect which relatively low capacity and low rates of annual depreciation now have on the fixed element of production costs of ammonia (See Table V.2.1. Production Costs - Ammonia - Year 1968-69). Production costs of urea could be put on a more competitive basis for operation of the site for a period of 10 years by writing off the current book value of the ammonia and urea plants and depreciating the modification cost of the urea plant over the next ten years on a straight line basis. Again adopting W.P.I.D.C.'s accounting basis, production costs are given in Table V.4.8.

4.6.3 Improving the Financial Structure at Multan - continued

Table V.4.8 - Production Cost of Urea from Modified Urea Plant depreciated over 10 years from 1973, and book value of ammonia plant written off.

Production cost of Ammonia on written-off plant (Table V.2.1) Rs 541.06 - Rs 125.97 - Rs 87.90 = Rs 327.19/MT. Adjust this cost for increase:

i) In gas cost from Rs 7.51/100 Nm^3 to Rs 8.48/100 Nm^3

and

ii) In power cost from Rs 0.0708/kWh to Rs 0.106/kWh.

This gives:

Rs 380.2/MT NH_3

Now from Table V.4.3 the cost of urea with ammonia at Rs 380.2/MT will be:

Rs 442 + Rs 0.585 (380.2 - 190.4)

= Rs 553.0/MT

This cost of production is well above the subsidy-free limit of Rs 510/MT. (Section 5.2.3).

This would remain the case even if the cost of the modification was also written off (production cost Rs 530/MT urea).

4.7 Development Scheme Recommendations

The preferred development of the site is based on the construction of an ammonia plant with capacity in excess of 600 MTPD in the near future. This expansion could be combined with either a new urea project or a nitrophosphate project. These options are analysed in more detail in Section 5. When considered against forecast fertiliser consumption for Pakistan, such a project cannot be additional to Hyssons and Punjab Fertilisers projects in the near future.

If expansion is to be delayed until a start-up date of about 1977/78 when the next project appears necessary, then the urea plant must be modified. Also a new ammonia supply must be negotiated or the ammonia plant modified. If all existing plants are to continue to operate, then the financial structure of the site should be adjusted to put it on a competitive basis free of subsidies. The delayed expansion project would not, of course, be able to utilise any of the existing plant units, but many of the utility units could still be incorporated. The final project, however, would be rather different from the schemes outlined in Section 5. It would need to be the subject of a later study.

SECTION 5

RECOMMENDED DEVELOPMENT PROJECTS AND FINANCIAL ANALYSIS

5.1 Introduction

In Section 4 two schemes were selected for further analysis

Scheme A - Urea development project

Scheme B - Nitrophophate development project

Scheme A and B are analysed in Section 5.2 and 5.3 respectively. As pointed out previously these schemes assume immediate development of the Multan site becomes possible either through combination with the planned Punjab Fertilisers or Hyesons project or as a replacement for one of them.

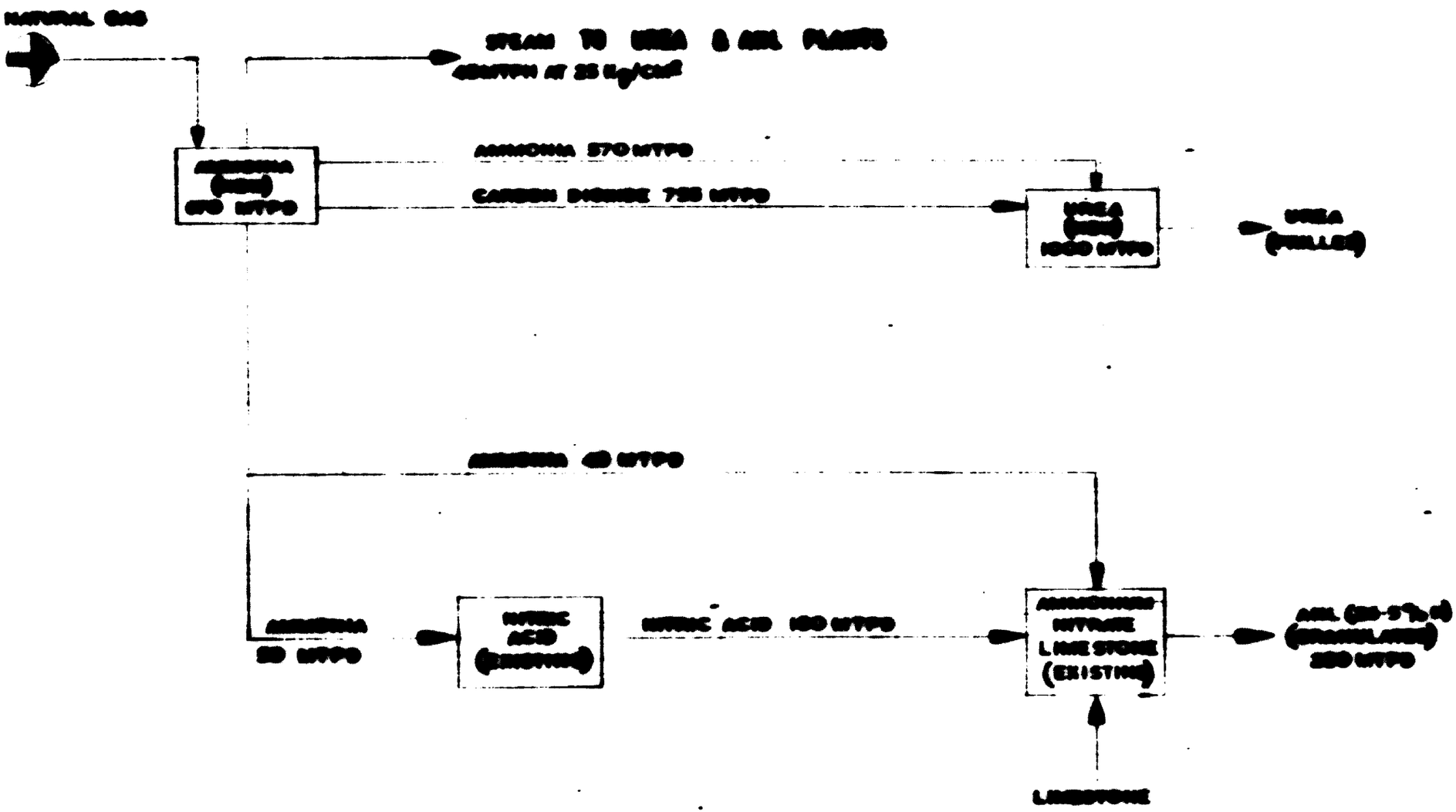
5.2 Urea Development Project

5.2.1. Description of Scheme

A block diagram for the project is shown in Figure V.5.1. the implementation of this scheme is shown on the Plot Plan - Drawing No. 1669-L51-2. Existing Ammonia and Urea units will be shut down. A new 670 MTPD ammonia plant will feed a new 1000 MTPD urea plant and existing nitric acid and ammonium nitrate limestone units.

The facilities included in this scheme are as follows:-

a.	Ammonia Plant	670 MTPD	New
b.	Urea Plant	1000 MTPD	New
c.	Nitric Acid Plant	180 MTPD	Existing
d.	ANL Plant	280 MTPD	Existing
e.	Ammonia Storage		Existing
f.	ANL Storage bagging, Distribution		Existing
g.	Urea Storage, Urea bagging and Distribution		Existing storage plus new storage, new bagging and distribution
h.	Cooling Towers		Existing cooling towers used and new towers and facilities added for additional 6000 m^3/hr circulation rate.
i.	Tube Wells		Existing wells used and two new 50 MT/hr wells added.



UNIDO — CI/SER

BLOCK DIAGRAM — AMMONIA/UREA PLANT —

SCHEME X

U.P.I.D.C. — MULTAN — WEST PAKISTAN

Fig. V.5.1.

5.2.1 Description of Scheme - continued

j.	Demineralisation Plant	Existing water treatment plant used. Additional base exchange plant 60 m^3/hr added.
k.	Effluent Treatment Facility	Capital sum included for this facility.
l.	Workshop	Capital sum included for additional workshop heavy lift bay and additional machinery.
m.	Stores	Capital sum included for additional store capacity.
n.	Sub-Station	Existing. New lines from sub-stations
o.	All Administrative Facilities and Infra-Structure	Existing.
p.	Rail Sidings	Existing.

Product storage for the two schemes has been assessed on the basis of 30 days output at rated capacity. It is assumed that any additional storage over and above this capacity would be outside the plant and outside the jurisdiction of W.P.I.D.C. i.e. marketing companies "Godowns" etc.

5.4.2 Capital Costs

The capital costs for the scheme are listed below. They are appropriate to July 1970. They include allowance for anticipated escalation during the construction period starting in mid 1970.

	Rs	Rs
Ammonia Plant	84,250,000	
Urea Plant	68,700,000	
Demin + Effluent Facilities	3,270,000	
Extensions to Workshop and Store	6,120,000	
Extensions to Cooling water and Tube Wells	3,030,000	
Extensions to Urea Store, Bagging	3,300,000	
Start-up + Consultancy Costs	12,200,000	
		174,870,000
Written down cost of existing facilities (1973)	29,980,000	
		204,850,000
Interest on Foreign Exchange Loan during Construction + Commissioning	12,000,000	
Total		Rs. 216,850,000

5.2.2 Capital Costs - continued

The detailed breakdown of these costs is shown in Table V.5.1. The following have not been included in the costs.

(i) Land cost - land already owned by W.P.I.D.C.

(ii) Interest on Rupee investment during construction and commissioning - none payable by W.P.I.D.C.

(iii) Cost of lost production from existing plant during start-up of new plant. Careful scheduling of construction and start-up should enable production loss to be minimised.

TABLE V.5.1. CAPITAL COST BREAKDOWN-SCHEME A (UREA)

	Foreign Exchange (Rs millions)	Local (Rs millions)
Equipment, spares, freight & insurance, escalation	78.5	-
Engineering & fees, supervision of construction and commissioning	22.0	-
Construction, Civil, Local equipment, services, freight, escalation	-	32.4
Import Duty	-	29.8
	100.5	62.2
Start-up + Consultancy Costs	9.7	2.5
Interest on Foreign Exchange loan during construction and start-up	12.0	-
Written down value of existing facilities (1973)	-	30.0
Totals	122.2	94.7
Overall Total		216.9
Working Capital		14.0

5.2.2 Capital Costs - continued

This total capital cost can now be compared with the cost of the same facilities including infrastructure on a completely new site. The capital cost for a new site is estimated by taking the necessary items from column (iv) in Table V.3.1 and adding these to the new items listed above. The costs of new off-site facilities for a greenfield site and for infrastructure are included. On this basis the total capital for a new project is estimated at:

Rs 334 million, (foreign exchange Rs 212 million)

Thus the local currency advantage in siting such a project at W.P.I.D.C.'s plant is about Rs 27 million and the benefit in foreign exchange is $19 million; the total saving is about Rs.117 million.

The estimated 1973 value of existing facilities included in the project is Rs 60 million as running plant (Urea and ammonia plants are excluded as they would be shut down); the written down value is about Rs 30 million. A realistic valuation on the site would lie between these extremes since the units which will continue to run would be relatively small by modern standards and new offsite facilties must be grafted onto existing units, instead of the larger units which would be built on a greenfield site.

Of the valuation of Rs 60 million, however, Rs 16 million are represented by general site facilities. The plant and utility units represent Rs 44 million. Reducing these by 25% to allow for the factors mentioned above and adding back the Rs 16 million, a figure of Rs 49 million is reached as a "realistic" valuation.

5.2.3 Production Costs and Sales Revenue

Operating costs for the scheme are listed in table V.5.2. Also included in the table are Sales Revenue and Net Cash Flow. Rupee investment is shown as a single payment.

Selling prices to farmers are quoted in Section 2 as

ANL Rs 328/MT

Urea Rs 565/MT

Effective ex-works selling prices were obtained by deduction costs of transport and sales agents' commission. These total approximately Rs 55 for urea and Rs 40 for ANL giving ex-works prices of

ANL Rs 288/MT

Urea Rs 510/MT

Sales Revenue in a full year of production is:

ANL	92,400 MTPA		Rs 26.6 million
Urea	330,000 MTPA		Rs 168.2 million
		Total	Rs 194.8 million

All the figures in the table are on a 1970 basis.
The cash flow resulting from the project is attractive and shows a very high DCF rate of return to WPIDC. This implies that a lower selling price structure could well be accepted for the project. Alternatively, the Government may consider it desirable to retain constant fertiliser selling prices and thus allow the effects of rising production costs (due to increasing feedstock, utility and labour costs) to reduce the profit margins in later years.

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SECTION 1

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SECTION 2

5.3 Nitrophosphate Development Project

5.3.1. Description of Scheme

The block diagram is shown in Figure V.5.2. The implementation of the scheme on the Multan site is shown in the Plot Plan - Drawing No. 1669-L51-3. Existing ammonia plants and nitric acid plant will be shut down, but other units will continue to operate. A new 740 MTPD ammonia plant will supply a new 1070 MTPD high pressure nitric acid plant, the neutralisation sections of the nitrophosphate plant and the existing urea plant. The urea plant is modified for prilling and higher capacity. The existing ANL plant continues to operate, advantage being taken of its over-capacity, and a new one of 550 MTPD capacity is installed. A phosphate rock store is installed and facilities must be provided for taking by-product calcium carbonate away from the site (this is not all used in the ANL plants). A new store for NP fertiliser is provided and existing sidings into the plant are extended to carry additional feed phosphate rock and product fertiliser. The ANL store is extended. Additional ammonia storage is added to allow operation of the downstream plants during ammonia plant shut down. The existing nitric acid plant could be left available for use to increase operating flexibility.

The facilities included in the scheme are as follows:

a.	Ammonia Plant	740 MTPD	New
b.	Urea Plant	280 MTPD	Existing, modified
c.	Nitric Acid Plant	1070 MTPD	New
d.	Nitrophosphate Plant	970 MTPD 22:22:0	New
e.	ANL Plant	330 MTPD	Existing
f.	ANL Plant	550 MTPD	New (Granulation onwards, only)
g.	ANL Storage, bagging, distribution		Existing
h.	Urea Storage, bagging, distribution		Existing
i.	NP Storage, bagging, distribution		New

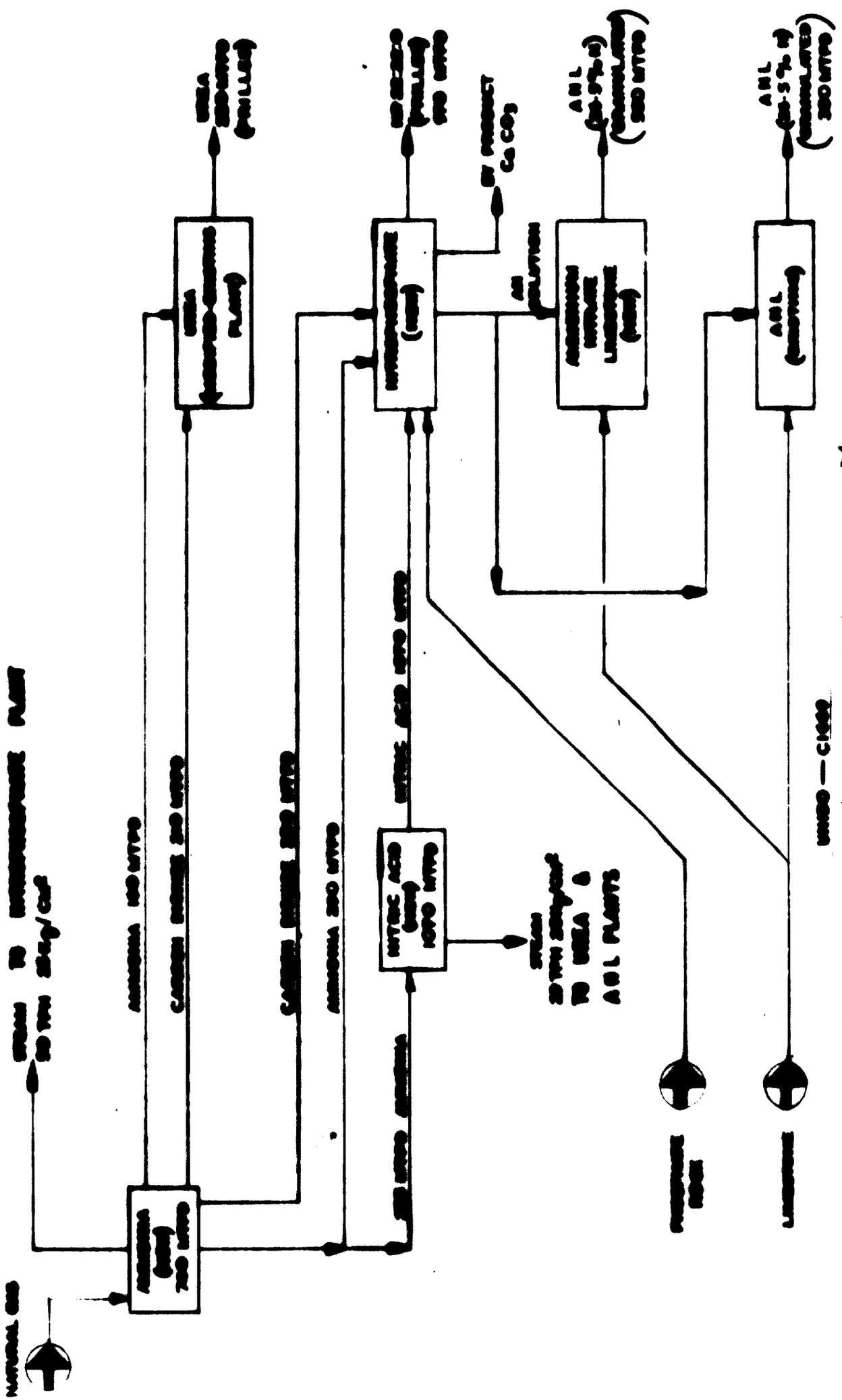

Fig. V.5.2.

5.3.1 Description of Scheme - continued

j.	Phosphate Rock Store	New
K.	Calcium Carbonate Store	New open unit store plus new dry store.
l.	Ammonia Storage	Existing plus new capacity.
m.	Cooling Towers	Existing cooling towers - used and new towers and facilities added. i.e. additional 9000 m^3/hr circulation rate.
n.	Tube Wells	Existing wells used plus three new wells (i.e. extra 150 m^3/hr)
o.	Demineralisation Plant	Existing plant used plus new 100 m^3/hr plant.
p.	Effluent Treatment Facility	Capital sum included for this facility.
q.	Workshop	Capital sum included for additional workshop heavy lift bay and additional machinery.
r.	Stores	Capital sum included for additional store capacity.
s.	Rail Sidings	Existing plus additional as shown on layout drawing.
t.	Sub-Station	Existing

The ammonium nitrate limestone plants will be fed with by-product ammonium nitrate from the nitrophosphate plant. If the nitrophosphate plant is operating at reduced capacity because of low market requirements for phosphate it would still be possible to use the neutralisation facilities on the existing ANL plant to maintain ANL production rates.

The product handling sidings capacity for Scheme 'B' has been increased by the addition of two lines to the south of the existing ammonium nitrate storage, and small additional lengthening of the existing sidings. It is intended that phosphate rock imports and calcium carbonate exports are dealt with by the lines shown between the main workshop and the new ammonia plant as shown on drawing No. 1669-L51-3.

5.3.2 Capital costs

The capital costs for the scheme are listed below and these also are on a July 1970 basis.

	Rs	Rs
Ammonia Plant	92,000,000	
Urea Plant Modification	7,700,000	
Nitric acid Plant	36,000,000	
Nitrophosphate Plant	70,500,000	
ANL Plant	15,350,000	
Phosphate Rockstone	2,170,000	
Demin & Effluent Facilities	4,950,000	
Extensions to workshop and store	6,120,000	
Extensions to cooling water and tube walls	4,400,000	
Ammonia storage	3,670,000	
NP store, bagging etc.	3,300,000	
New rail sidings	640,000	
Start up and consultancy costs	18,500,000	
		265,300,000
Interest on Foreign Exchange during construction and start-up	18,000,000	
		283,300,000
Written down cost of existing facilities (1973)	30,000,000	
Total		313,300,000

The detailed break-down of these costs is shown in table V.5.3.

This total capital cost can now be compared with the cost of the same facilities including infra-structure on a completely new, green-field site. The capital cost for the new site is estimated by taking the necessary items from column (iv) in table V.3.1 and adding these to the new items listed above; the costs of new off-site facilities for a green field site and for new infra structure are included. On this basis the total capital for a new project is estimated at

Rs 450 million , (foreign exchange $60 million)

5.3.2 Capital Costs - continued

thus the local currency advantage in siting such a project at W.P.I.D.C's plant is about Rs 35 million, and benefit in foreign exchange is $21 million. The total saving is therefore about Rs 137 million.

The estimated 1973 value of existing facilities included in the project is Rs 70 million as running plant. As discussed for scheme A in section 5.2.2, the realistic valuation should be taken at a rather lower figure. Again on the same basis as in section 5.2.2, a realistic valuation of Rs 55 million is estimated.

Table V.5.3. Capital cost breakdown - Scheme B (Nitrophosphate)

	Foreign Exchange (Rs millions)	Local (Rs millions)
Equipment, spares, freight & insurance, escalation	119.8	
Engineering & fees, supervision of construction or commissioning	32.6	
Construction, civils, local equipment, services, freight, escalation		48.7
Import duty		45.7
	152.4	94.4
Start-up & consultancy costs	12.8	5.7
Interest on Foreign Exchange loan during construction and start-up	18.0	
Written down value of existing facilities (1973)		30.0
	183.2	130.1
Overall total		313.3
Working capital		30.6

5.3.3 Operating Costs and Sales Revenue

Operating costs for the scheme are listed in table V.5.4. Also included in the table are estimated Sales Revenue and anuual net cash flow. Rupee investment is shown as a single payment. Again, all figures are on a 1970 basis.

Ex-works selling prices for ANL and Urea are quoted in section 5.2.3 based on information supplied by W.P.I.D.C. NP fertiliser is not currently produced in Pakistan. Imported product is sold at about Rs 400/MT. If, however, the price of NP fertiliser (22:22:0) is calculated on the basis of its nutrient content in relation to the prices of Urea and TSP, a price to farmer of Rs 500/MT is obtained. Again assuming transport and commission of Rs 55/MT, an ex-works price of Rs 465/MT is obtained. Calculated sales revenue per year is therefore:

Urea	92,400 MTPA	Rs 510/MT	Rs 47.1 million
ANL	290,400 MTPA	Rs 288/MT	Rs 83.6 million
NP (22:22:0)	320,100 MTPA	Rs 465/MT	Rs 148.7 million
			Rs 279.4 million

This project shows an attractive cash flow performance. The DCF return, although lower than for the scheme A, still exceeds 40%. Again the project could tolerate a lower selling price structure or, alternatively, absorb for some years the increased costs associated with rising feedstock, utility and labour costs.

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CAPITAL REPAYMENT (F.E.)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-10.3
INTEREST (F.E.)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	- [illegible]	- 7.3	- [illegible]	- 4.3	- 2.9
CAPITAL INVESTMENT (LOCAL)		[illegible]	-	-	-	-	-	-	-	-
RAW MATERIALS (F.E.)										
Catalysts		- [illegible]	- [illegible]	- [illegible]	- [illegible]	- [illegible]	- [illegible]	- [illegible]	- [illegible]	- 4.1
Phosphate Rock		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-10.9
RAW MATERIALS (LOCAL)										
Natural Gas		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-81.2
Water Treatment Chemicals		- 0.5	- [illegible]	- [illegible]	- [illegible]	- [illegible]	- [illegible]	- [illegible]	- [illegible]	- 0.6
Catalysts (Duties, Bump Vouchers)		- [illegible]	- 4.7	- 4.7	- 4.7	- 4.7	- 4.7	- 4.7	- 4.7	- 4.7
Phosphate rock (Duties, Bonus Vouchers)		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-65.5
UTILITIES										
Power		- [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-11.3
Make-up water		- [illegible]	- [illegible]	- [illegible]	- [illegible]	- [illegible]	- [illegible]	- [illegible]	- [illegible]	- 2.6
Maintenance (F.E.)		- 4.5	- 4.5	- 4.5	- 4.5	- 4.5	- 4.5	- 4.5	- 4.5	- 4.5
Maintenance (Local)		- [illegible]	- [illegible]	- [illegible]	- [illegible]	- [illegible]	- [illegible]	- [illegible]	- [illegible]	- 5.0
Administration & Insurance (Local)		- [illegible]	- [illegible]	- [illegible]	- [illegible]	- [illegible]	- [illegible]	- [illegible]	- 6.3	- 6.3
Operating & Day Labour (Local)		- [illegible]	- [illegible]	- [illegible]	- [illegible]	- [illegible]	- [illegible]	- [illegible]	- 2.5	- 2.5
Raw Material Product Bagging & Handling (Local)		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-70.0	-70.0
Working Capital		[illegible]	-	-	-	-	-	-	-	-
[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-479.4
[illegible]		[illegible]	+ [illegible]	+ [illegible]	+ [illegible]	+ [illegible]	+ [illegible]	+ [illegible]	+ [illegible]	+ 81.0

[illegible]
[illegible] Ammonia
[illegible] Urea [illegible]
[illegible] Nitric Acid
[illegible] (NH4NO3)
[illegible]
[illegible] (Existing)

Advantage has been taken of the [illegible]
of the existing [illegible] plant.

FE = Foreign Exchange

SECTION 1

SECTION 2

SECTION 6

CONCLUSIONS

1. Plans for the development of the W.P.I.D.C. Multan site must be related to the future fertiliser needs of West Pakistan. The production costs of ammonia are high and the nitrogen fertiliser produced on the site is not competitive with fertiliser produced in modern, large-scale units. For this reason, W.P.I.D.C. would like to undertake redevelopment of the site as soon as possible.

2. Two already-sanctioned projects (Punjab Fertilisers and Hyesons) will ensure that West Pakistan's nitrogen requirements are satisfied until about 1975/76. The Government can only sanction a new independent nitrogen fertiliser project by W.P.I.D.C. at present if one of these two projects does not go ahead.

3. If both the Hyesons and Punjab Fertilisers projects proceed, unsatisfied demand will not reach a level high enough to justify start-up of a new plant at W.P.I.D.C.'s Multan site until 1977/78.

4. The study concludes that the existing ammonia plant should be shut down in any development scheme, since the present ammonia plant is most uneconomic. Even writing off the value of the ammonia plant has too small an effect to make the urea price low enough to sell without a subsidy. It might be possible, however, to purchase ammonia and CO_2 from a large new plant in the locality and this would be attractive until a new ammonia plant is built on W.P.I.D.C.'s Multan site. If the urea plant is intended to continue operation beyond a period of about 3 years, it should be modified to produce prilled product at somewhat increased capacity, provided that a sufficient supply of ammonia and carbon dioxide needed for the higher capacity can be assured.

5. The only satisfactory major development of the site would be based on the construction of a new ammonia plant with a minimum capacity of 600 MTPD. Two alternative schemes incorporating a new ammonia plant and starting up about 1973 have been analysed in detail and preliminary plot plans have been prepared. Since short-term development of the site will only be feasible if either the Hyesons project or Punjab Fertilisers projects does not proceed, the two alternative schemes have been generally related to these two projects. The schemes incorporate the new ammonia plant with either a 1000 MTPD urea plant or with a nitrophosphate plant.

6. The existing facilities at Multan have been examined and their economic status assessed. So far as possible, they are included in the new developments proposed. In the case of the nitrophosphate scheme, the existing urea plant would continue to operate (modified to produce prills). In the scheme for 1000 MTPD urea, the nitric acid and ammonium nitrate limestone plants are kept in operation. Operating costs have been estimated; there is considerable economic advantage in siting such a project at W.P.I.D.C.'s Multan factory, since the existing infrastructure, off-site facilities, etc. would continue to be utilised. Foreign exchange expenditure would be about $ 15-20 million less than the cost of the same schemes on a greenfield site. In addition Rupee saving s are estimated at about 120 million.

7. The nitrophosphate scheme would require fewer of the existing plant units to be shut down and both foreign exchange and Rupee savings would be somewhat higher than in the case of the urea scheme. On the other hand, the nitrophosphate scheme requires a higher foreign exchange expenditure.

8. The urea project shows a higher rate of return to W.P.I.D.C. than the nitrophosphate scheme but both projects are attractive at the sales prices assumed. The higher return in the urea scheme is a result of the known and accepted fact that the current Pakistan prices allow a higher profit on urea than any other fertiliser.

APPENDIX I

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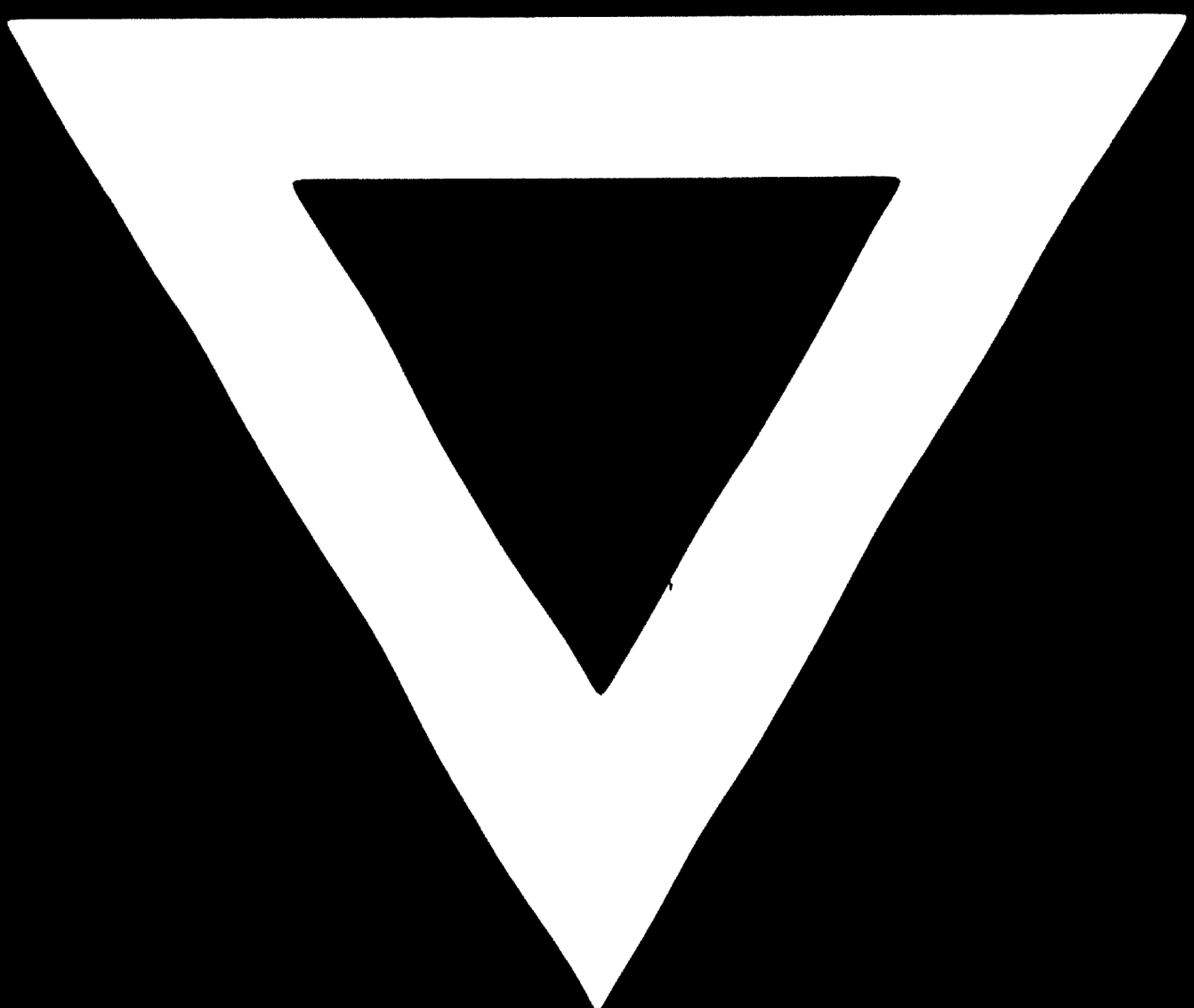

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