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CHEMICAL FERTILIZER COMPLEX FEASIBILITY STUDY FOR NICARAGUA [1]

by

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Managua, D.N. May - 1971

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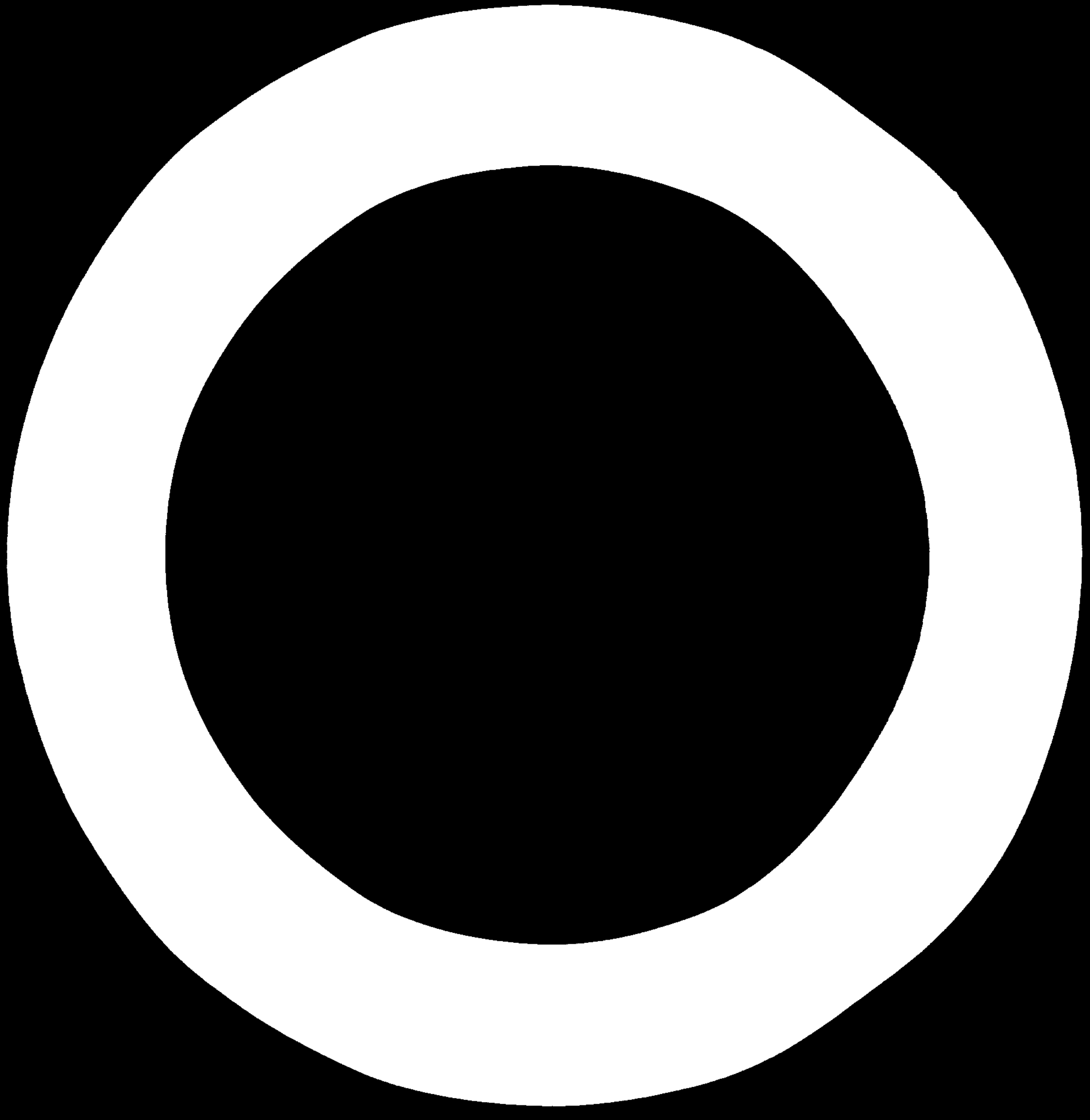

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SECTION I. SUMMARY

A. GENERAL

1. The format and documentation of this report is so that it may be easily kept current. It is recommended that this be done in a minimum of six months intervals until all consideration of the project is abandoned.

2. The statements in the Chemico[3] report; Government Role Part II-E, recommendation in Part III-3 & 4 and Central American Market for Fertilizers, and the pertinent statements in part IV should be considered as a supplement to this report.

3. The project must meet a real need and have valid reasons for its creation. It should satisfy enough of the following to justify it recommendation:

   a) Increase domestic food supplies.
   b) Make savings in foreign exchange.
   c) Produce foreign exchange by exporting fertilizer materials made from indigenous raw materials.
   d) Secure sources of raw materials or new market by private investment.
   e) Increase local employment.
   f) Increase local skills.
   g) Increase local purchasing power.
   h) Increase tax revenues both local and national.

i) Ensure adequate financial return on investment.

It is evident, therefore, that the project evaluation should not be limited to technical superiority or maximum financial return.

B. CONCLUSIONS

1. The present need for fertilizers in Nicaragua is at least three time the usage in 1968, the year of highest fertilizer consumption in Nicaraguan history.

2. The Agro-industry, the main support of the Nicaraguan economy appears to be in a depression that started in 1969 and is predicted to last at least through 1971.

3. For the majority of the farmers their training and attitude toward farm and land management, the use of chemical fertilizers, and credit responsibility, leaves very much to be desired.

4. Farm credit is insufficient, both in quantity and availability to develop the full potential of the fertilizer market.

5. Under existing conditions, there is no assurance that if a fertilizer industry is started that it could capture enough of the Nicaraguan market or export enough fertilizer at a sufficient profit to make the operation economically feasible, even considering the fact that the operation would not start until 1975.

6. There is no legislation against the temporary "dumping" of fertilizer to cause serious financial implications on the project.

7. The most desirable plant location is in the Corinto-Chinandega area in the heart of the fertilizer consuming area; near Nicaragua's main port, Corinto, which is also approximately in the center of the CACM countries and Panama, and fulfils all of the requirements for an ideal plant location for this type plant.

8. The plant is basically a nitrogen producing unit with the nitrogen plant facilities comprising 63.4% of the total plant investment. The price for nitrogen fertilizer is definitely expected to increase due to the world wide increase in petroleum raw materials. The price of the other two plant nutrients, phosphorus and potash are expected to increase also.

9. The total capital requirements for project will be about $24,300,000.00.

The plant can have the following financial potential, based on present day prices and conditions:

	Per cent Plant Capacity	
	55	100
	1,000 Dollars	
CASE I-Selling to Dealers	1975	1980
Earning on Sales	465	3,313
Payroll	537	537
Savings in foreign exchange	3,533	6,716
CASE II-Selling Direct to Farmer		
Earning on Sales	1,044	4,836
Payroll	700	700
Savings in Foreign Exchange	3,533	6,716

10. The inclusion of a sulfuric acid plant to produce ammonium sulfate at an addition capital investment for battery limit plants of $2,000,000.00 is not warranted.

11. The addition of battery limit plant facilities to produce phosphoric acid at an additional investment of $4,800,000 may be necessary.

12. The development of a FERTILIZER INDUSTRY in Nicaragua will require for Nicaragua an extremely large scale investment and a prodigious human effort. If not done properly under the right economic climate and large scale government assistance, both financial and regulatory, it will result in one great financial fiasco.

13. Nicaragua is capable of affording, financing, and profitably operating, a decent fertilizer operation.

C. <u>RECOMMENDATIONS</u>

1. That positive and aggressive action be taken to develop the full potential for the use of chemical fertilizer needed to meet Nicaragua's estimated present requirements.

2. That the credit situation, both the availability of credit to enable all farmers to use adequate amounts of fertilizers and financial responsibility on the part of the farmers be highly upgraded.

3. That all possible be done on a farmer educational program to include all phases in good farming practices.

4. That steps be taken to insure the [illegible] capture a large majority of Nicaraguan market. [illegible] arrangement between the [illegible] fertilizer purchase [illegible]. This should also include provision to prevent "dumping" of fertilizer.

5. That the next phase in establishing the industry— [illegible] ing bid tender specifications, submitting them to selected contractors, bid proposal evaluation and investigation of the relocating of plants that have been retired—be started. This can be done at a very [illegible] expense. The bid tender specification should include as an alternate all battery limit plants, raw material storage, and offsites required to produce phosphoric acid.

6. That two consultants be put on a retainer to advise and protect the interest of Nicaragua on the project. One consultant should have overall experience from the client view point in starting a "grass roots" fertilizer operation. The other should be an expert in Ammonia and Urea plant design, construction and operation.

7. Under present conditions and unless market development is expedited (there are four and one-half years i.e. estimated project realisation) to accomplish this and market protection devised, the project cannot be recommended.

SECTION II. PROFITABILITY

A. [illegible]

1. [illegible]

The break-even point of the fertilizer complex is when the plant operates at 65.[illegible] of capacity, with the C.I.F. average price of bagged fertilizer at a low of $60.7[illegible] as shown in Figure 1-A, page II-[illegible]. The average C.I.F. price as published in Dirección General de Aduanas for 1969 is $74.[illegible]7. The average C.I.F. price used for calculating profitability is 69.57. To this C.I.F. price was added 13.65 for port, broker, tariff and freight and handling charges to arrive at the average price to the distributor of $83.22. The average sales price of $95.14 to the farmer was calculated from a price list F.O.B. Corinto furnished by Servicio Agrícola Gurdian, S.A.[2]

2. Return on Investment

The profitability of the plant, with the present cost of raw materials and utilities depends on two factors.

a) The sales price.

b) The per cent capacity at which the plant will have to operate (see cost of production vs plant capacity Figure 1-A) to supply the market. The market projections for the minimum requirements for Nicaragua only for 1975 will require the plant to operate at 55.5% of capacity and with exports of 15% (70.5% of capacity). The calculated return on investment selling to dealers on this basis is 2.8% at 55.5% capacity and 7.6% at 70.5% capacity. The return on investment selling direct to the farmer on the same basis is 5.3% and 12.7%, respectively. In 1975, using the expected maximum market, the return on investment on the dealer basis is [illegible] and [illegible] respectively and selling direct to the farmer is 15.2% and [illegible] respectively.

For 1980, selling to the dealers in the same basis as above, the return on investment for the minimum market situation is 7.0% and 1[illegible].2% respectively and for the expected market 1[illegible].7% and 18.3% respectively, and for direct sales to the farmer, the return is 1[illegible] and 26.7% respectively.

The return on the investment will be very marginal with the start of the plant in 1975 even including 15% exports, whether sales are through dealers or direct to the consumer. The plant may even show a loss due to unforeseen mechanical failures, overestimation of the market that the operation can capture, etc.

As the market and exports grow the plant will become more profitable each year until it reaches 100% capacity where the return on investment will be between 19 and 27%. This should happen by 1980 or a few years thereafter.

It must be realized that the project is a long term venture that will see lean years in the beginning, but will be very profitable in the future. Tabulated below is an analysis of the profitability of the project for the years 1975 and 1980. The one factor missing, due to lack of information, is the profit that can be realized on exports, the assumption being made that they will equal the profits on material sold locally. However, increasing the plant production by exports will lower the cost of production and increase the profit on the fertilizer sold in Nicaragua.

With the plant located near the port of Corinto it will be in a favorable position for exports as Corinto is located almost in the center of all the C.CM countries plus Panama.

CASE I - Minimum Market-1975	Nicaragua only	Exports [illegible]	[illegible]	[illegible]
Percent of Plant Capacity	[illegible]	[illegible]	[illegible]	[illegible]
Production in 1,000 metric tons per year	[illegible]	[illegible]	[illegible]	[illegible]
Value of Sales to dealers-$1,000	[illegible]	[illegible]	[illegible]	[illegible]
Cost of Production-$1,000	[illegible]	[illegible]	[illegible]	[illegible]
Profit on Operations-$1,000	465	736	[illegible]	[illegible]
Return on Investment, percent	[illegible]	4.1	[illegible]	7.6
Pay Out time in years	[illegible]	9.4	[illegible]	7.1
Value of Direct Sales to User-$1,000	[illegible]	[illegible]	[illegible]	[illegible]
Cost of Production and Sales -$1,000	[illegible]	[illegible]	[illegible]	[illegible]
Profit on Sales-$1,000	[illegible]	[illegible]	[illegible]	[illegible]
Return on Investment-percent	[illegible]	8.1	[illegible]	[illegible]
Pay out time in years	8.1	6.8	5.8	[illegible]

CASE II - Expected Market-1975				
Percent of Plant Capacity	71.5	[illegible]	[illegible]	[illegible]
Production in 1,000 metric tons per year	[illegible]	129	[illegible]	[illegible]
Value of Sales to dealers-$1,000	9,986	[illegible]	[illegible]	[illegible]
Cost of Production-$1,000	8,550	8,966	[illegible]	[illegible]
Profit on Operations-$1,000	1,456	1,770	[illegible]	[illegible]
Return on Investment, Percent	8.0	9.5	11.5	[illegible]
Pay Out Time in years	6.8	6.1	5.6	[illegible]
Value of Direct Sales to User-$1,000	11,417	12,273	13,034	[illegible]
Cost of Production and Sales-$1,000	9,030	9,446	[illegible]	[illegible]
Profit on Sales-$1,000	2,387	2,827	[illegible]	[illegible]
Return on Investment	13.2	15.6	17.9	[illegible]
Pay Out time in year	5.0	4.5	4.1	[illegible]

CASE III - Minimum Market-1980				
Percent of Plant Capacity	68.5	73.5	78.5	[illegible]
Production in 1,000 metric tons per year	115	[illegible]	132	[illegible]
Value of Sales to dealers-$1,000	9,570	10,236	10,985	11,651
Cost of Production - $1,000	8,309	8,672	9,108	9,450
Profit on Operations - $1,000	1,261	1,564	1,877	2,201
Return on Investment, Per cent	7.0	8.6	[illegible]	[illegible]
Pay Out Time in years	7.4	6.6	5.9	5.3
Value of Direct Sales to User-$1,000	10,941	11,702	12,558	13,320
Cost of Production and Sales-$1,000	8,789	9,152	9,588	[illegible]
Profit on Sales - $1,000	2,152	2,550	2,970	[illegible]
Return on Investment, Per cent	11.9	14.1	16.4	18.7
Pay Out Time in years	5.4	4.8	4.4	4.0

CASE IV - Expected Market-1980				
Per cent of Plant Capacity	84.5	89.5	94.5	100.0
Production in 1,000 metric tons per year	142	150	159	168
Value of Sales to dealers-$1,000	11,817	12,483	13,232	[illegible]
Cost of Production - $1,000	9,514	9,863	10,295	10,668
Profit on Operations	2,303	2,620	2,937	3,313
Return on Investment, Per cent	12.7	14.4	16.2	18.3
Pay out Time in years	5.2	4.8	4.4	4.0
Value of Direct Sales to User-$1,000	13,510	14,271	15,127	[illegible]
Cost of Production and Sales-$1,000	9,994	10,343	10,775	[illegible]
Profit on Sales - $1,000	3,516	3,928	4,352	4,836
Return on Investment, Per cent	19.3	21.6	24.0	26.7
Pay Out Time in years	3.9	3.5	3.3	3.0

BAGGED FERTILIZER COST IMPORTED OR PRODUCED
CORINTO-CHINANDEGA AREA

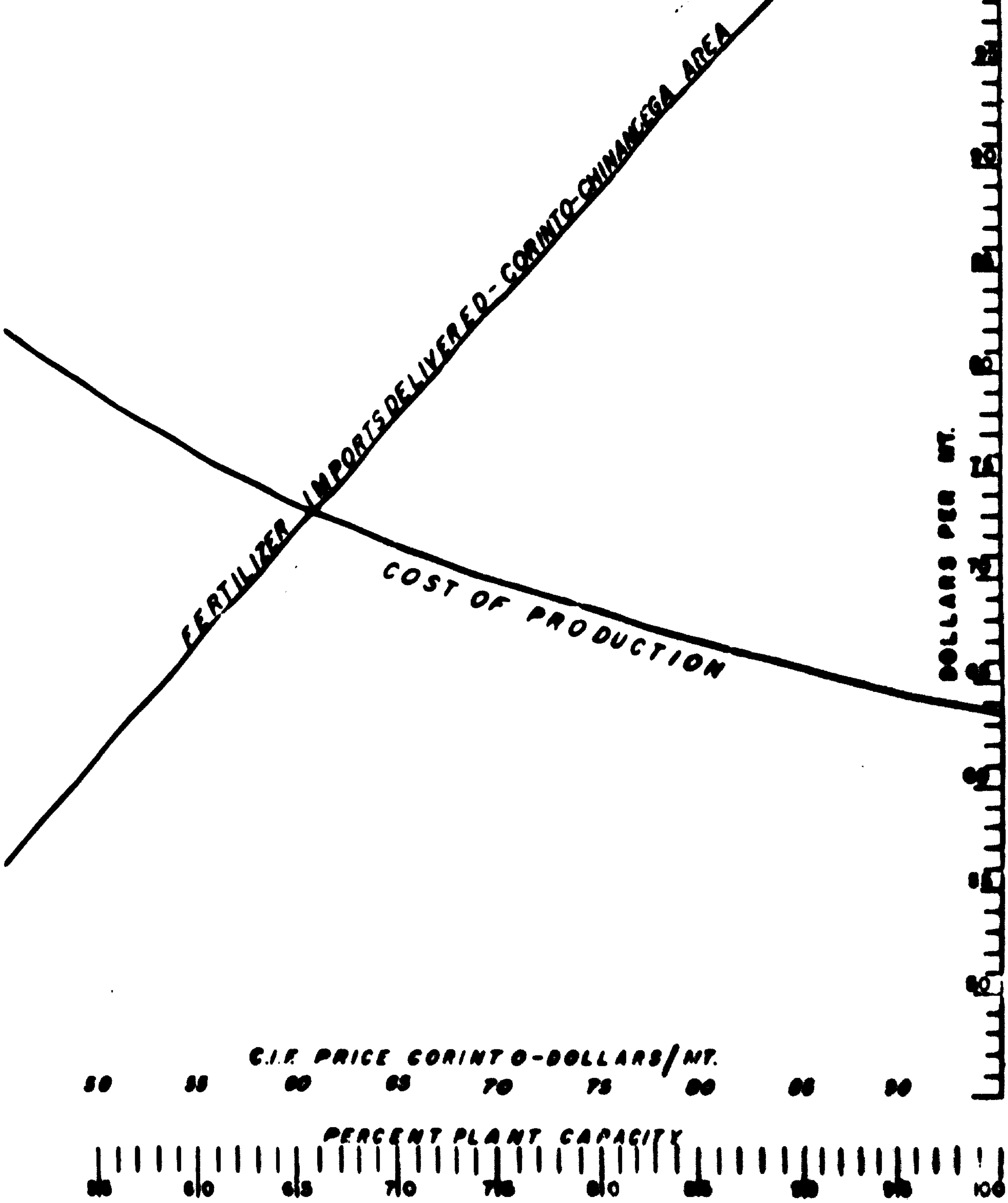


FIGURE 1-A

SECTION III. MARKET AND PRICING

A. MARKET

1. General

The fertilizer complex is basically a nitrogen producing plant as the other two plant nutrients, phosphorus and potash will be imported.

While the total tonnage of fertilizer to be produced is of relative importance, this tonnage can and will vary considerably due to yearly changes in the ratio of Urea to Granular Fertilizers used and also variations in both the different amounts and grades of granular Fertilizers used. As the average analysis of the granular fertilizer used goes down the tonnage goes up, and the price per ton goes down. Also the capacity of the granulating plant goes up. The reverse of these factors is true as the average analysis of the fertilizer goes up.

The trend of usage of fertilizer should be toward higher analysis,[13] because this lowers the cost per unit of plant food to the consumer. Also, the continued usage of high ratios of nitrogen to the other two nutrients will force higher usage of the other nutrients due to the fact that a greater amount of these elements will be removed from the soil whether present naturally or added as fertilizer.

If an optimum balance is not maintained between nitrogen, phosphorus, and potash the grower will not get the response that he should from fertilization and his return on his investment in fertilizers will drop to a very disappointing level. The additional required usage of phosphorus and potash will add to the trend to higher analysis fertiliser. This fact should be emphasized in all grower educational programs.

The problem of the market for the proposed fertilizer complex is basically one of how much nitrogen can be sold with the other two elements falling in line with the agronomic needs. It is primarily on this basis that the market surveys, studies and forecast of the future market were made.

Since it will be about the middle of 1971 by the time this report is completed and evaluated, the market predictions for the future have been made starting with 1975 and continuing through 1980. This allows for a leg time of 4.5 years to reach the decision to proceed, write bid specifications, submit bid tenders to the selected contractors, time for the contractor to submit their proposals, the evaluetion of the bid proposals, the final negotiations and eward of the contract(s), the engineering, purchasing and shipment of equipment to Nicaragua, erection of the plents and off sites and start up of the plant. This is not en unduly long time, because from completion of the feasibility studies to actuel operations is usually a minimum of 3 years and in most cases longer in the United States.

2. Need for Fertilizers

The economy of Nicaragua is primarily based on its agro-industry. The country has no indigenous mineral resource to the extent thet they could support its economy.

The need for fertilizer is based on present acreage in agricultural use which is estimated[1,2] at 1,600,000 acres, for the crops grown[1,2] including range grass for cattle, it is estimated that a minimum of between 57,000 to 65,000 MT of Nitrogen, 46,000 MT of P_2O_5 and 24,000 to 35,000 MT of K_2O is needed. This is 3.[illegible] times the amount of nitrogen, 4.3 times the amount of P_2O_5, and 6.7 times the amount of K_2O used during 1965, the highest fertilizer usage year in Nicaraguan history.

3. Present Market - Figure 1,

Fertilizer consumption by tons of fertilizer and tons of nitrogen are shown in figure 1 for the years 1962 to 1970. Also shown are three year running averages for these figures because in discussions with The Nicaraguan Fertilizer Industry people, yearly figures were said to be unreliable due to inventory carry over. The three year averages are probably the most reliable figures and were used as the minimum market.

The plot of these figures in Figure 1 show a steady increase in both total fertilizer consumption and nitrogen consumption until 1968, when fertilizer consumption dropped during the years 1969 and 1970.

Nitrogen consumption dropped 15.3% to 15,000 MT and the total tonnage dropped 25.4% to 53,000 MT over this two year period. Predictions[2] by those in the Nicaraguan Fertilizer Industry are that the year 1971 will be in the 50,000 MT Range.

From these facts it is evident that the Nicaraguan Agro-industry is now in a state of depression.

4. Future Market 1975 - 1980, Figure 1,

Since the economy of Nicaragua is agricultural it is assumed that vigorous steps will be taken to revive its agriculture and promote its growth in the future.

I concur with the statements made in the Chemico report[3] on the Governmental Role in developing both a fertilizer industry and the country's agriculture. I might also add that price supports coupled with acreage crop allotments may have to be instituted for an orderly program of development.

Since such programs would require very little foreign capital and the development of a Nicaraguan Fertiliger Industry would result in a savings in Foreign Exchange offrom a minimumat the start of $3,500,000 to about $6,700,000 when the operation is at full capacity such programs would appear to be excellent investments. However, this is a very specialized area and should be considered, studied and recommendations made by agricultural economic specialists.

Based on the assumption that between now (1971) and 1975 that fertilizer usage will return to its previous pattern of usage and growth, the average slopes of the curves for yearly and 3 year average were extended to cover the period 1975 - 1980. (See Figure 1, curves A & B). It is interesting to note that if the average slope of the yearly usage curve is extended, omitting the years 1969 and 1970 it almost passes through the nitrogen usage point, predicted in the UNIDO[4] report published in 1966 for the year 1970. The 3 year average plot (B) Figure

1 indicates the usage of nitrogen in Nicaragua should be [illegible],000 MT or 55.5% of the proposed plant capacity in 1975 and [illegible],500 MT or 71.5% of capacity by 19[illegible]. These are considered the minimum usage and growth for the period.

The yearly average plot (A), Figure 1, indicates the usage of nitrogen in Nicaragua can be expected to be 35,000 MT or 68.5% of capacity in 1975 and 45,300 MT or 54.5% in 19[illegible]. The total tonnages of fertilizer used for the period 1975 to 19[illegible] are not shown in Figure 1 but for the year 1975 these figures are a minimum tonnage of 93,000 MT and an expected tonnage of 120,000 MT. These figures for the year 1980 are 115,000 MT (minimum) and 142,000 MT (expected). The above figures are in reasonable agreement with projections by others[3,4] which are also shown on Figure 1.

5. Potential Export Markets

The potential for exporting fertilizer to other CACM countries and the importance of exports to the success of the proposed fertilizer complex are well covered in the Chemico[3] report.

Since El Salvador is one of the major users of ammonium sulfate in the CACM and has returned to its use after trying Urea (it has evidently done so for the sulfur content of the ammonium sulfate. Sulfur deficiencies reportedly exist in the soils of El Salvador). This country is a good prospect for export nitrogen.

Using Chemico[3] C.I.F. prices for Urea and ammonium sulfate, the cost per unit of nitrogen (22 lbs.) is $1.79 for ammonium sulfate and 1.50 for Urea. By the time this material reaches the grower this cost will have increased at least 50% which makes the price per unit $2.69 and $2.25 respectively.

Since the sulfuric acid plant and ammonium sulfate plant, as proposed by Chemico[3], were eliminated from the complex due to the high estimated investment ($2,000,000) for producing a low analysis material, with a history of declining usage, a very uncertain future in the CACM, and an extremely low usage (3,200 MT) in Nicaragua, it is suggested that the production of sulfur coated UREA prills[5] be considered as a replacement for ammonium sulfate.

This product has the advantage of having 1.76 times the nitrogen content of ammonium sulfate; contains sulfur which becomes available to the plants; is a slow release fertilizer, retarding losses of nitrogen from leaching; and does not chemically burn germinating seeds.

An investment of about $100,000 would be required to produce a material containing 37% N and 15% S at a cost of $57.74/MT, bags or $1.56 per unit of N.

In fact since most of the fertilizer application in Nicaragua is during the rainy season this could be a valuable material to use here.

6. Fertilizer Market by Grades

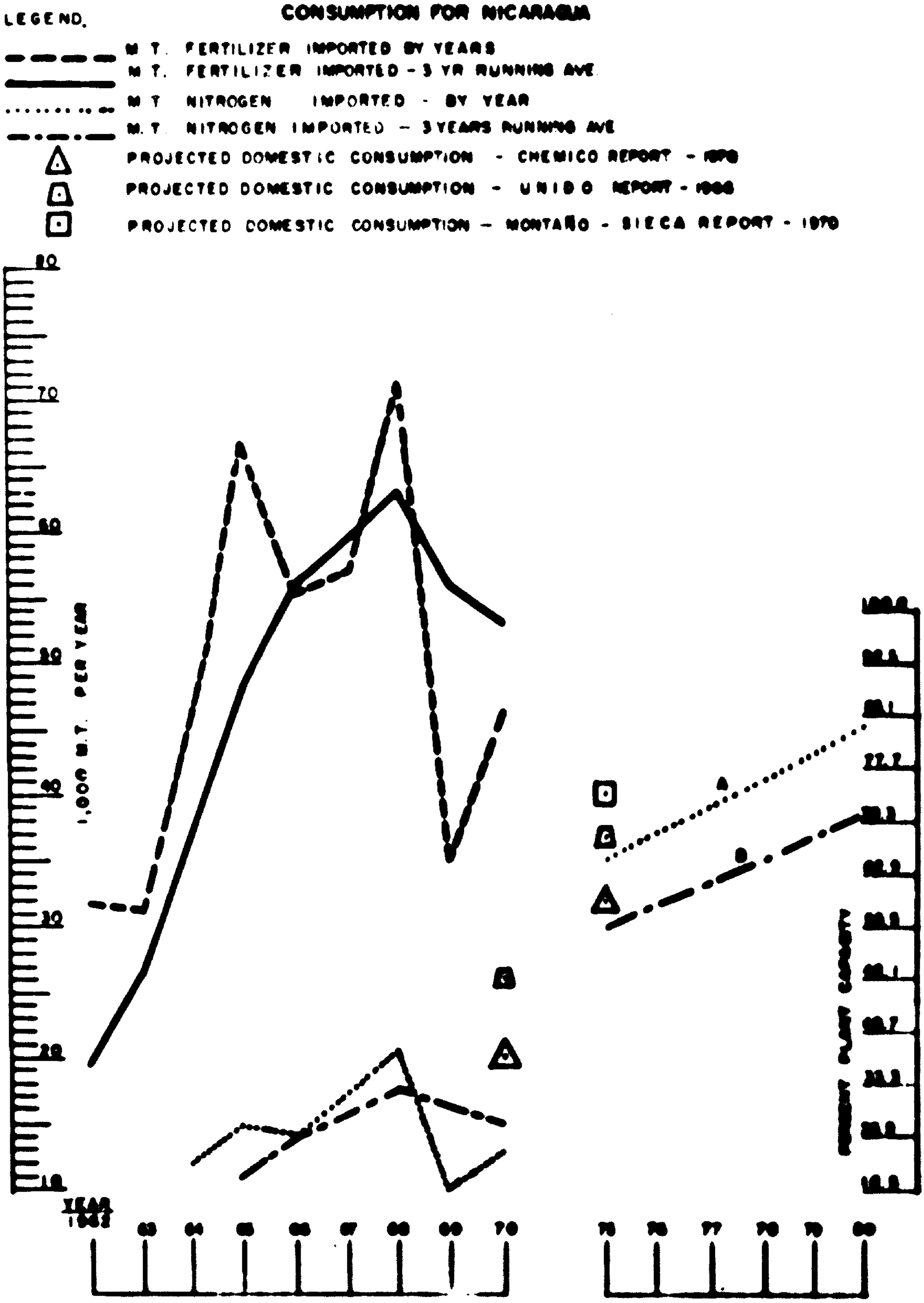
Exhibit A shows the various grades, with tonnage of the fertilizer used in Nicaragua. These figures show that Urea accounted for 72% of the Nitrogen consumed in 1964 and 79% in 1968. The grades, 10-40-10, 10-30-10, 18-46-0, 15-15-15, 12-24-12, 13-13-20 account for 75% of all other fertilizers.

(Note: Similars grade such as 14-14-14, 16-48-0, 12-12-19 etc. have been combined with the nearest analysis to the listed grades). The proposed fertilizer complex production is based on producing Urea and the six grades listed above, with about 80% of the nitrogen production going to produce Urea.

7. Sizing Producing Plants For Market

Exhibits B,C and D tabulate the expected consumption in Nicaragua for the years 1970,1975 and 1980, the calculations for the optimum plant size to meet the market, the nitrogen balance between production of the ammonia plant and the nitrogen consumption in the Urea and Granular Fertilizer plants. The distribution of the tonnage of the various grades to be produced is based on the available records of previous years except for 15-15-15, 12-24-12 and 13-13-20 which were divided equally from the remainder of the requirements after the most popular grades were satisfied.

ACTUAL AND PROJECTED FERTILIZER CONSUMPTION FOR NICARAGUA



FIGURE

B. PRICING

1. Current Prices

Prices at three different levels were obtained.

a) The C.I.F. price, Corinto which reflects the import value or foreign currency requirements.

b) The price at which the fertilizer would be sold in the Corinto-Chinandega or other port, if ad valorem tariff, custom broker, and freight and handling charges were added to the C.I.F. price (Distributor's (General) Price).

c) The price to the consumer F.O.B., Corinto-Chinandega

The results of this survey is shown in exhibit [illegible]. These prices other than the price to consumer were very difficult to obtain due to the reluctance of the fertilizer companies to furnish any concrete price such as the C.I.F. price that would reveal their profits, so some of the prices used had to be calculated using the consumer price, published government port, tariff, brokerage rates and estimated freight and handling costs plus certain factors obtained during contacts with the industry.

Truck freight rates were also confusing, because instead of being quoted on a MT/Km basis, the rates were quoted so that fertilizer prices would be about equalized at any point in the country, i.e. same price for fertilizer F.O.B. warehouse, Corinto as F.O.B. warehouse Managua. It is understood this is an industry practice.

The average C.I.F. price Corinto was calculated to be $69.57/MT based on 1971 prices and the average cost to the dealer in the Corinto-Chinandega area is $83.22/MT, a difference of $13.65 MT, the latter figure compares favorably with information obtained in interviews with people in the fertilizer industry. The average sales price to the consumer is $95.14/MT, a difference of $11.92/MT or 14.3% above the dealer price which also checks favorably.

The average C.I.F. price for 1969 as published by Dirección General de Aduanas was $74.07/MT. This is $4.50 more than the C.I.F. price used in the Section IV-Financial. Exhibits F and G support the above.

2. Future Prices

This is something that it is almost impossible to predict. However, there are some indicators that should be mentioned.

The price of petroleum products are on the increase world wide. Future contracts for natural gas in the United States are expected be in the $0.25 - 0.40/MM BTU range. Due to the shortage of natural gas, plans are being made to import liquified natural gas at a cost of $0.68 - $0.85 MM BTU.

This should preclude any major expansion in nitrogen production until demand and price reach the point where additional capacity would be profitable. The price of nitrogen fertilizer should increase as a result of the above.

The U.S. Department of Agriculture report in "Chemical Engineering" April, 1971, stated that the prices paid by farmers for fertiliser started to move slightly higher in 1970 after reaching near record lows in 1969; and the level for 1971 is likely to be about one tenth higher than 1970.

While fertiliser capacity is still greater than demand, prices seem to have bottomed out and are on the increase, except in isolated cases.

Also on a world wide basis there will be years where in certain countries, their agriculture will be depressed for various reasons, such as adverse climate, etc. and these countries may dump certain amounts of fertiliser on the world market at depressed prices. These will be temporary conditions which cannot be expected to affect a long-term operation.

There is one thing that I predict will happen if Nicaragua decides to establish a fertiliser industry, I have personally been connected with new plants where this happened several times. When it becomes known that plans are being developed for a fertiliser project, fertilisers may be dumped in Nicaragua at ridiculously low prices to kill the project.

While the market of each individual country that borders on the Gulf of Mexico and the Caribbean Sea is not large, the total market of all the countries is very sizeable and lucrative. If one country should successfully start its own industry others would follow and this would really upset the proverbial "apple cart".

SECTION IV. FINANCIAL

A. PROFIT AND LOSS STATEMENT

The profit and loss analysis, capital investment, etc. have been assembled on the basic premise that the plant will be in operation at the beginning of the year 1975 and will reach 100% of capacity by 1980 with 15% of plant production being exported. The difference between the 1975 requirements and full capacity in 1980 is the anticipated market growth over the five years.

The sales prices used are based on current C.I.F. prices, Corinto plus port, custom broker, ad valorem tariff and freight charges are shown in Exhibit E.

The statement is based on the assumption that the fertiliser will be sold to existing distributors F.O.B. the Corinto - Chinandega area.

If the decision is made for the plant to have its own sales and distribution organization and sell direct to the farmer the return on investment will increase 55-65%, less the cost of sales and distribution.

Highlights of the financial aspects of the operation of the fertiliser complex are given in the table below.

Four cases are shown: Cases I and II are for the year 1975 and cover supplying the whole Nicaraguan market, the Nicaraguan market plus exports of 5,10, and 15% of production at the minimum and expected market requirements for the year.

Cases III and IV cover the same as Cases I and II but are for the year 1980 when the local market plus 15% exports should be equal to the plant production at 100% capacity.

FINANCIAL HIGHLIGHT[illegible] OF [illegible] [illegible] OPERATION

PLANT INVESTMENT - $1[illegible],[illegible],000

1975	Nicaragua only	5%	10%	[illegible]
CASE I Minimum Exports				
Per cent of Plant Capacity	55.5	60.5	65.5	7[illegible].5
1,000 MT of Fertilizer	93	102	11[illegible]	118
Cost Per MT of Production $	78.75	76.00	73.25	71.5[illegible]
Cost in Corinto - Chinandega area-1000$:				
Imported Fertilizers	7,7[illegible]	8,4[illegible]	9,154	9,820
Produced Fertilizers	7,324	7,752	8,057	8,437
Profit on Operation	465	736	1,097	1,[illegible]
Depreciation & Start Up	1,191	1,191	1,191	1,191
Cash Flow	1,656	1,927	2,2[illegible]	2,57[illegible]
Return on Investment in Per cent	2.8	4.1	6.0	7.6
Pay Out Time in years	11.0	9.4	7.9	7.1
C. I. F. Price - 1,000 $				
Imported Fertilizers	6,470	7,096	7,653	8,209
Raw Material for Production	2,937	3,166	3,304	3,623
Savings in Foreign Exchange	3,533	3,930	4,249	4,586
CA[illegible] II Expected Exports				
Per cent of Plant Capacity	71.5	76.5	81.5	86.5
1,000 MT of Fertilizer	120	129	137	145
Cost Per MT of Production - $	71.25	69.50	68.00	66.50
Cost in [illegible]rinto-Chinandega area-1000$:				
Imported Fertilizers	9,986	10,736	11,401	12,067
Produced Fertilizers	8,550	8,966	9,316	9,643
Profit on Operation	1,456	1,770	2,085	2,424
Depreciation & Start Up	1,191	1,191	1,191	1,191
Cash Flow	2,627	2,961	3,216	3,615
Return on Investment in Per cent	8.0	9.8	11.5	13.4
Pay Out Time in years	6.8	6.1	5.6	5.0
C. I. F. Prices - 1,000$				
Imported Fertilizers	8,348	8,975	9,531	10,088
Raw Material For Production	3,674	3,903	4,132	4,360
Savings in Foreign Exchange	4,674	5,072	5,399	5,728

FINANCIAL HIGHLIGHTS OF THE PLANT OPERATION

PLANT INVESTMENT - $18,137,000

1980	Nicaragua only	5%	10%	15%
CASE III Minimum Exports				
Per cent of Plant Capacity	68.5	73.5	78.5	83.5
1,000 MT of Fertilizer	115	123	132	140
Cost Per MT of Production -$	72.25	70.50	69.00	67.50
Cost in Corinto-Chinandega area-1,000$:				
Imported Fertilizers	9,570	10,236	10,985	11,651
Produced Fertilizers	8,309	8,672	9,108	9,450
Profit On Operation	1,261	1,564	1,877	2,201
Depreciation & Start Up	1,191	1,191	1,191	1,191
Cash Flow	2,452	2,755	3,068	3,392
Return on Investment in Per cent	7.0	8.6	10.3	12.2
Pay Out Time in years	7.4	6.6	5.9	5.3
C. I. F. Prices - 1,000$				
Imported Fertilizers	8,001	8,557	9,183	9,740
Raw Materials For Production	3,535	3,764	3,922	4,221
Savings in Foreign Exchange	4,466	4,793	5,261	5,519
CASE IV Expected Exports				
Per cent of Plant Capacity	84.5	89.5	94.5	100.00
1,000 MT of Fertilizer	142	150	159	168
Cost Per MT of Production - $	67.00	65.75	64.75	63.50
Cost in Corinto-Chinandega Area-1,000$				
Imported Fertilizers	11,817	12,483	13,232	13,981
Produced Fertilizers	9,514	9,963	10,295	10,668
Profit on Operation	2,303	2,620	2,937	3,313
Depreciation & Start Up	1,191	1,191	1,191	1,191
Cash Flow	3,494	3,811	4,12[illegible]	4,504
Return on Investmenti in Per cent	12.7	14.4	16.2	18.3
Pay Out Time in years	5.2	4.8	4.4	4.0
C. I. F. Prices - 1,000 $				
Imported Fertilizers	9,879	10,436	11,062	11,687
Raw Materials for Production	4,263	4,492	4,720	4,971
Savings in Foreign Exchange	5,616	5,944	6.342	6,7[illegible]6

B. CAPITAL INVESTMENT & TOTAL CAPITAL REQUIREMENTS

1. Processing Plants and Offsites

The estimated investments for the process plants and offsites are based on prices for similar plants of the capacities indicated delivered and erected (D & E price) on the gulf coast, U.S.A. and increased by 30% for freight, port charges and other condition peculiar to Nicaragua. The 30% factor was furnished by INFONAC as the figure they have for the estimated cost of plants built in Nicaragua over the cost of plants built in the U.S.A. The estimated cost of plants and offsites is $18,042,000.00. Offsites amount to about 35% of the battery limit plants cost which is normal for a grass roots complex.

I believe that the estimated cost for the plant is conservative and in all probability this figure will go down some when final competitive bids are received from contractors.

2. Land

The cost of land for the plant site in the Corinto-Chinandega area was estimated at $3,167.00 per manzana or $1,900.00 per acre for a total investment of $95,000 for 50 acres.

3. Start Up Expenses

Start up expenses are detailed in Exhibit N-1 and amount to $415,000. Start up expenses were amortized over a 10 year period and added to over head expenses.

4. Working Capital

Working capital requirements are detailed in Exhibit H-2 and amount to $3,500,000 which is 25% of the value of sales which is a normal average for this figure.

5. Interest on Loan

Interest on the loan is figured on a capital investment of $18,552,000 which includes the plant investment, automotive and mobile equipment, land, and start up expenses. It has been assumed the loan will carry a 2 year moratorium before payments on the loan begin. It was also assumed a loan of 50% of the capital investment would be required. At a 12% interest rate on the loan this amounts to $2,226,120.00.

6. SUMMARY OF CAPITAL INVESTMENT & REQUIREMENTS

PROCESS PLANTS	MM DOLLARS Battery Limits	Off sites	TOTAL
200 MTD Ammonia Plant	6.7000	2.21790	8.91790
300 MTD Urea Plant	4.9000	1.25615	6.15615
240 MTD Granular Complex fertilizer PLT.	1.4300	0.49635	1.92635
Product Storage, Bagging & Shipping	-	0.94170	0.94170
Total Plants	12.9300	4.48870	17.84200
Automotive and mobile Equipment	-	-	0.20000
Land			0.09500
Total Investment	-	-	18.13700
Other Capital Requirements	-	-	
Start Up Expenses			0.41500

SUMMARY OF CAPITAL INVESTMENT & REQUIREMENTS (CONTINUATION)

PROCESS PLANTS	MM DOLLARS Battery Limits	Off sites	TOTAL
Interest on Loan for 2 years.	-	-	2.22612
Working Capital			3.50000
Total Capital Requirements			24.27812

C. OPERATING EXPENSES - 100% PLANT CAPACITY

1. **Fixed Cost Expenses**

a) Over Head

Exhibit J details the estimated cost of the plant overhead expense. The cost of start up expenses, mobile equipment depreciation, and general labor force wages have been added to the normal overhead expense with the total overhead prorated to the various operations on the basis of direct labor cost. The salaries and wages used are given in Exhibit K.

Overhead expense amount to $424,158 per year.

b) Direct Labor

Exhibit L details the cost of labor and supervision for each producing plant and the bagging and shipping operation. The wages used are given in Exhibit K.

Direct labor expense amount to $284,500 per year.

c) Taxes & Insurance

Taxes and Insurance have been estimated at 1% of plant investment, with the assumption that the plant will have a 10 year tax free status. Taxes and Insurance amount to $178,420 per year.

d) Depreciation & Maintenance

Exhibit N details the calculations for the depreciation and maintenance expense. Depreciation expense is based on the straight line method using an economic life of 20 years for buildings and offsites, 15 years for process equipment, and 5 years for mobile equipment. Depreciation expense amounts to $1,149,751 per year. Maintenance expenses after deducting maintenance labor and supervision amount to $325,948 per year.

e) Interest Expense

Interest expense is based on the plant investment cost using the declining balance method assuming the plant will be financed by 50% invested capital and 50% loan capital. The loan capital will be on a two year moratorium basis and will then be repaid in ten years. This gives an interest rate of 6% on the total plant investment cost and amounts to $908,300 per year. Exhibit O details the interest calculations and distribution to the operating plants.

2. Variable Cost Expenses

a) Raw Material Costs

Exhibit P give the detail cost of imported raw materials delivered to the plant site. Most of these costs have been documented by letters[2] from suppliers and published port handling costs. Raw Material cost amount to $6,995,676 per year.

b) Utilities

(1) Electric Power

Electric power cost are based on the price of power paid by Electroquimica Penn Salt (ELPESA) on a negotiated contract with Empresa Nacional de Luz y Fuerza. This contract has a rate of $0.01 per KWH. Power cost amount to $748,170.

(2) Fuel

Fuel cost are based on using naptha which is the feedstock for the ammonia plant as the source of fuel required for other plant operations. This gives a fuel cost of $0.68 per MM BTU. Fuel cost amount to $24,480 per year.

(3) Steam and Water

These costs are based on the estimated cost for these utilities for similar plant operations in the U.S.A. and amount to $194,660 per yr.

c) Catalyst and Chemicals

Costs are based on experience in the operation of similar plants. The catalyst and chemicals cost amount to $108,900 per year.

D. PRODUCTION COSTS

1. Raw Materials

a) Ammonia Production

Three raw materials were considered as feedstock for the ammonia plant; refinery off-gas, liquified natural gas and naptha.

There is refinery off-gas produced by the ESSO refinery in Managua, but it is not available.

The availability of liquified natural gas is highly questionable and its C.I.F. price, Corinto would be about $0.90-1.00 per MM BTU or more.

Naptha is available and is easy to store and handle (no refrigeration required). While not confirmed in writing a price from a reliable source of $0.095 per gal. F.O.B. Caribbean ports was obtained, which is equivalent to $20.76/MT. To this has been added an estimated freight of $5.86 giving a C.I.F. price of $26.62/MT

This results in a cost of Naptha delivered to the plant site of $30.20/MT or $22.08/MT of ammonia.

A previous price given me, by [illegible] and quoted to be very reliable and was from the [illegible]SC Refinery here was $22.[illegible]/MT, delivered [illegible]. The published estimated increase in Naptha prices is $3.00/MT. Which would make the new price $2[illegible]/MT Managua or $[illegible]. [illegible]4/MT delivered to the plant site by rail, or $21.15/MT of ammonia.

b) Urea Production

The raw materials required for the production of urea are ammonia and carbon dioxide both of which are produced in adequate quantities by the ammonia plant, a part of the fertiliser complex. Ammonia cost for urea production is $32.[illegible]2/MT urea. An carbon dioxide is furnished at no cost, since it is waste by-product.

c) Granular Complex Fertilisers

(1) Ammonia

Produced by the ammonia plant in adequate quantity for the projected granular complex fertiliser and urea production.

Average cost for ammonia per MT of Granular Fertiliser is $7.46.

(2) Phosphoric Acid

Phosphoric acid can be produced in Nicaragua[2] for about $62.51/MT of 74.5% H_3PO_4 (54% P_2O_5) with an additional capital investment of $[illegible] million as compared to purchased acid from the U.S.A. delivered to the plant site for $65.88/MT or Mexican acid at $70.44/MT the largest return on investment this operation could show based on the lowest quoted Mexican price would be about $570,000/year or 12%.

The U.S.A. price was used and amounts to $40.81/MT on an average ton of granular fertiliser.

(3) Potash

There is no indigenous source of potash in Nicaragua. This material must be imported as a refined potash salt, potassium chloride, which contains 60-62% K_2O. The cost of potash is $49.44/MT delivered to the plant site or an average cost of $8.07/MT of granular fertilisers.

(4) Filler

Filler is a raw material required to adjust the mixture of the various fertiliser chemicals used in the manufacture of complex fertilisers to give the desired product the correct chemical analysis. Suitable materials for this are sand, gypsum and purverised limestone all of which are found in Nicaragua. Purity of the material is irrevelant because it does not enter into any of the chemical reactions that take place, but is an inert in the process.

The most desirable of the three mentioned materials is gypsum, because this material usually promotes good granulation and also has valuable agronomic properties.

Nicaragua has a large gypsum deposit[6] in the Santa Rosa area that is now being mined. The lower grade material from this deposit, which contains about 70% gypsum is perfectly satisfactory for use as Filler and this material was selected. The cost of gypsum filler used is $16.00/MT delivered to the plant site or $1.93 for an average ton of granular fertiliser.

(5) Coating agent

This material is used on certain fertilisers that have hydroscopic properties that are such that they absorb moisture from the atmosphere and cake into hard lumps, both in storage piles and after being bagged.

There are three materials indigenous to Nicaragua[6] that can be used for this purpose and are listed in the order of their preference, diatomaceous earth, clays and pulverized limestone. The bulk density of most of these materials, particularly diatomaceous earth is so low that it carries over five times (charges based on 40 cu. ft. - not weight) the normal freight and handling charges, making its importation economically prohibitive. The cost of diatomaceous earth used is $60.00/MT delivered to the plant site or $1.20 per MT of product when used.

(6) Raw material requirements.

Exhibit II-3 is a summary of the tonnages of raw materials required for the plant.

(7) Bags

Close woven polyethylene bags, manufactured in Managua, Nicaragua would be used for the fertiliser bags. These bags are lined with a sheet of polyethylene liner to act as a moisture barrier. The delivered cost of the bags are $0.34/bag for urea and $0.30/bag for granular fertiliser.

E. PLANT PERSONNEL REQUIREMENTS

A suggested organisational chart for the plant operations is shown is Figure 2, page IV-16. Total personnel requirements will be about 214 people with a yearly payroll of about $537,158.

1. <u>Overhead</u>

Exhibit J gives the plant overhead cost in detail showing the number of people required and their tenative job classification. The cost of amortizing the start-up expenses and the depreciation on office, automotive and mobile equipment have been added to the overhead expenses. Total overhead expenses amount to \$2.52/MT of product.

2. <u>Direct Labor and Supervision including Maintenance</u>.

Exhibit L gives the operating and maintenance personnel requirements and their tentative job and/or trade classification. Total expenses in this category amount to \$1.69/MT of product.

3. <u>Salaries and Wages.</u>

The salary and wage scale used in arriving at the cost of over head, plant operating and maintenance labor are shown in schedule K. These rates were furnished by INFONAC.

FERTILIZER PLANT ORGANIZATION CHART

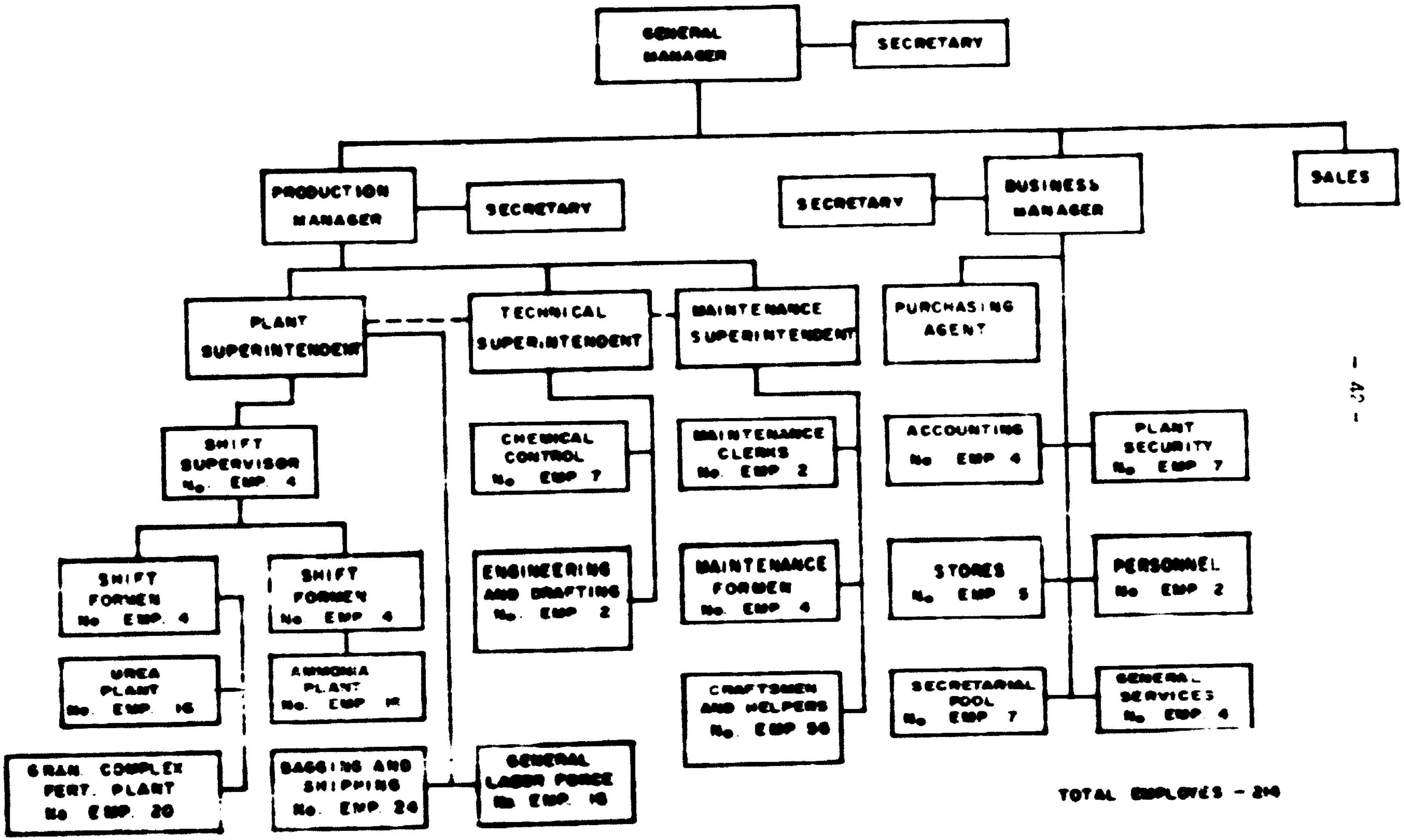


FIGURE 2

V. COST OF PRODUCTS AND INTERMEDIATE PRODUCTS.

1. Cost of Ammonia Production

Exhibit R gives in detail all the elements of the cost of production. The cost of producing liquid anhydrous ammonia is $57.58/MT.

2. Cost of Urea Production

Exhibit S gives in detail all the elements of the cost of production. The cost of producing prilled Urea is $45.36/MT in bulk and $55.30/MT coated and bagged.

3. Cost of Granular Complex Fertilizer Production

Exhibit T gives in detail the average cost of producing the six most popular grades of granular fertilizers; 10-40-10, 10-30-10, 18-46-0, 15-15-15, 12-24-12 and 13-13-20 all elements of cost of production are shown. The average cost of producing granular complex fertilizer is $67.30/MT in bulk and $75.16/MT bagged.

4. Product Storage, Bagging and Shipping

Exhibit U give the cost of storage, bagging, and shipping in detail, with all elements of cost shown. The cost of bagging of granular fertilizers is $7.86/MT and for Urea $8.74/MT. If Urea is coated with 2% coating agent the cost is $9.94/MT

5. Cost of Producing the Various Grades of Granular Fertilizers.

Exhibits V-1, V-2 and V-3 give in detail the cost of producing each of the selected grades of granular fertilizers with all elements of cost shown. While the cost of utilities and fixed costs will vary with the grade being produced due to variations in recycle rates and the conditions required for granulation this difference is practically impossible to calculate at this time, so the average cost of these factors was used. Such variations will be small and not affect the final cost to any great extent. The following are the production costs of the various grades.

Grade	MT/yr	Cost /MT-Bulk	Cost/MT-Bagged
10-40-10	24,500	$ 72.63	$ 80.49
10-30-10	15,400	62.84	70.70
18-46-0	13,300	77.97	85.83
15-15-15	6,270	55.66	63.52
12-24-12	6,270	59.45	67.31
13-13-20	6,260	55.53	63.39
(Ave.)12.6-33.5-9.8	72,000	67.30	75.16

The supporting formulations for these grades of fertilisers are shown in Exhibit W-1.

G. COST OF PRODUCTION AT CAPACITIES OF FROM 50-100%

Exhibit X summaries the cost of producing ammonia, urea, granular complex fertiliser, and the cost of bagging and shipping at plant capacities of 50, 60, 70, 80, 90 and 100% of capacity. Since the market for fertiliser will range within these figures from the beginning of operations in 1975 to at least 1980.

Summarized below is the cost of producing urea and the average cost of granular fertilizer both as bulk and bagged product.

UREA	PER CENT OF PLANT CAPACITY					
	50	60	70	80	90	100
Cost/MT-Bulk	$68.89	$61.06	$55.44	$51.18	$47.98	$45.36
Cost/MT-Bags	80.80	71.84	65.92	61.44	58.06	55.30
GRANULAR FERTILIZERS						
Cost/MT-Bulk	77.30	74.00	71.54	69.77	68.40	67.30
Cost/MT-Bags	85.16	81.86	79.40	77.63	76.26	75.16

SECTION V. TECHNICAL

A. FERTILIZER PLANT COMPLEX

The Fertilizer Plant Complex consists of the following process units and operations. These are also shown in Figure 3, page V-2 Block Flow Diagram Fertilizer Plant Complex.

200 MT per day ammonia plant

300 MT per day urea plant

240 MT per day granular complex fertiliser plant

Bulk storage for raw materials & products.

Coating agent & bagging facilities

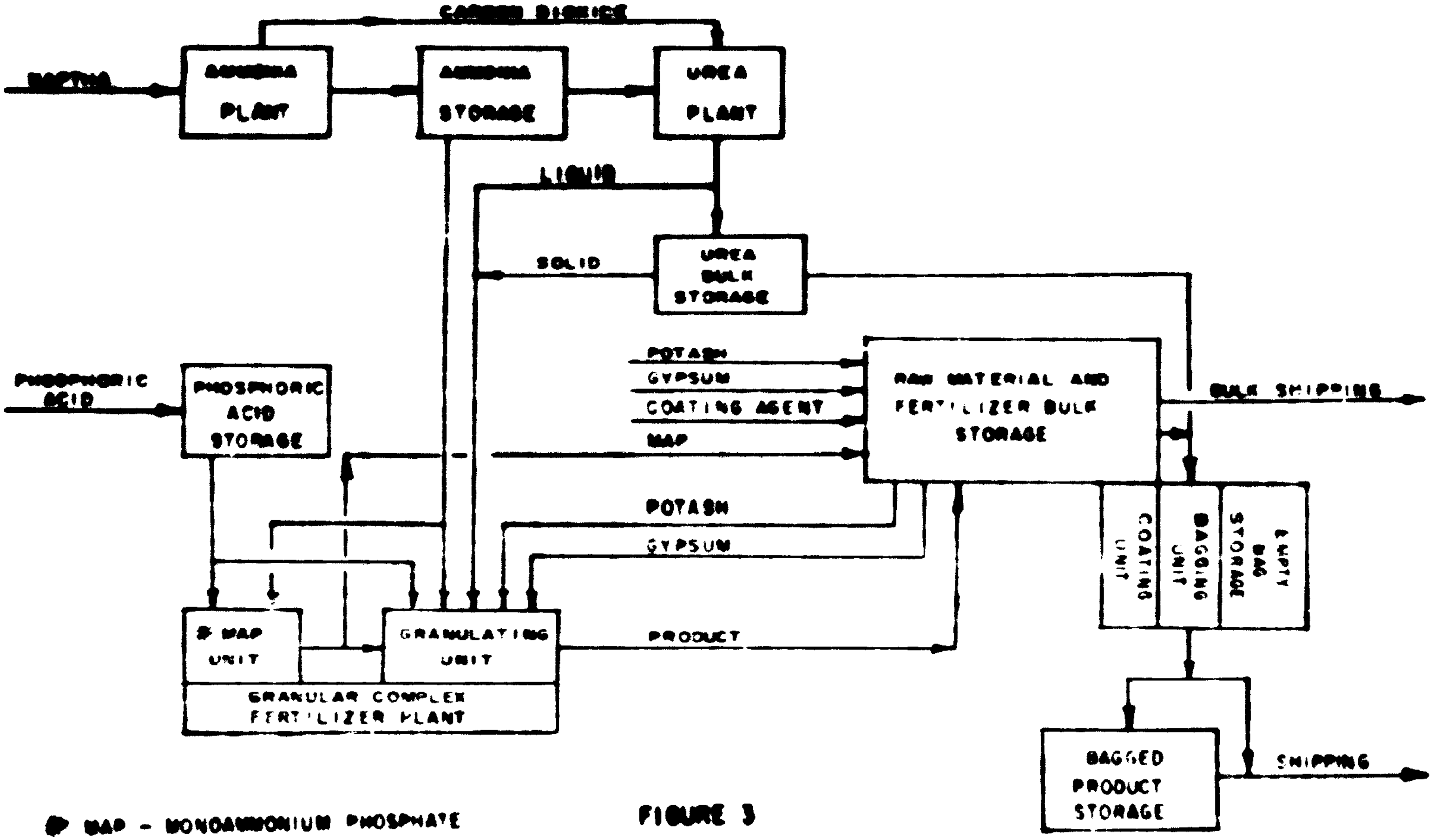
Bagged product storage

It is estimated that the area required for the complex will be about 50 acres (29.4 manzanas) which will allow for future expansion, unless the production of phosphoric acid is contemplated, as waste disposal (gypsum) from this operation requires considerable area.

The economics of producing phosphoric acid in Nicaragua as given in section IV under raw materials shows that the cost of imported raw materials delivered to the plant are so high that the return on the investment is low.

Calculations for sizing the process units are shown in Exhibit C

BLOCK FLOW DIAGRAM - FERTILIZER PLANT COMPLEX



* MAP - MONOAMMONIUM PHOSPHATE

FIGURE 3

B. PLANT SITE

Two sites were studied for the location of the propose fertilizer complex. These sites were Managua in the area adjacent to the existing ESSO refinery and the area between Corinto and Chinandega, between the highway and railroad that connects the two towns. The latter location being in the heart of the fertilizer consuming area and near the port of Corinto.

1. Managua.

The site at Managua was considered for two reasons. First, was the possibility that there may be sufficient off-gas from the refinery plus hydrogen from the near by ELPESA chloro-alkali plant to produce the required amount of ammonia. This would result in a considerable reduction in the capital investment for the ammonia plant and if the off-gas could be obtained at a reasonably low price per MM BTU it is possible that this could have more than off set the cost of the freight to Managua on the phosphoric acid and potash required as raw materials plus the back hauling of an estimated minimum of 50% of the finished product to the market area in the departments of Leon and Chinandega. An estimated saving in depreciation, interest on investment, and feedstock cost of $300,000/year would have to be realized to break even with the second location during the early years and

$480,000/year with operations at 100% of plant capacity.

While the ESSO refinery produces an off-gas it is used within the refinery as a fuel and they are not inclined to offer it for sale. The chloro-alkali plant only produces enough hydrogen to produce about 4 metric tons of ammonia per day. So these facts eliminate the most important reason for considering Managua

The second reason for considering this site was the suggestion of CHEMICO in their report of sharing offsites and possibly other services with the refinery. The ESSO refinery is to a great extent a self contained unit without any excess of facilities to share. Even if there were facilities, the savings would have to be at least equal to the above figures which is an improbability.

Such arrangements are also never satisfactory unless there is a substantial vested interest by the the party furnishing the services.

I was a consultant on a project recently where a fertiliser plant was to be built next to a refinery because of availability of land and industrial zoning regulations. Negotiations were undertaken to share offsite and services with the refinery and it soon became evident that it was cheaper for the fertiliser plant to go it alone.

In view of all of the above factors Managua would not be the most suitable or economical location for the fertilizer complex.

2. CORINTO - CHINANDEGA AREA

A visit to the area revealed that Corinto, the major Nicaraguan port is located on an island which is highly developed and lacks the space required for the proposed fertilizer complex.

In addition, land is expensive and soil conditions are very poor, requiring expensive foundations for the heavy plant equipment.

After leaving Corinto and proceeding along the highway to Chinandega for a distance of 6 to 10 miles there is an area between the railroad, power line, and highway approximately a 1.5 to 2.0 miles wide that provides adequate space for the fertilizer plant. (See figure 4, page V-10).

The advantages and conditions in this area are discussed below.

a) Soil Conditions and land

Visual inspection of the ground shows that the area is level, ground appears to be fairly solid, and small surface boulders are present. Adequate land, 50 acres (29.4 manzanas) the estimated area required for the plant can be selected over a fairly wide area to give the most optimum location. The cost of the land is estimated to be considerably cheaper than in either Corinto or Managua.

A preliminary soils engineering report states that the ground is silty sand and sandy silt overlain by silt and silty clay moderately deep to very deep. Locally there is a weak to strong cemented layer at depths of from 0.5 meters to 1.[illegible] meters and where the soil is cemented, sub-drainage may be required for foundations. Foundation conditions including subgrade vary from poor to good. There are reported deposits of sand and gravel suitable for construction located 10 KM north of Chinandega.

Actual soil bearing tests (minimum) should be conducted before the land for the exact site location is purchased.

b) Roads and Railroads

(1) Roads

The exact location for the plant would be either adjacent to or just off the paved highway between the port of Corinto and Chinandega. From Chinandega there is a good net work of roads servicing the major fertilizer consuming area. There are paved highways going North and East, joining the Carretera Interamericana at about San Isidro and South and East joining this highway at Managua. There is also an all weather road to Potosi, linking to the ferry that goes to El Salvador.

(2) Railroads

The plant site will also be in close proximity to the rail line of the Ferrocarril del Pacifico de Nicaragua. This railroad serves the port of Corinto, runs North to Puerto Morazan, East to Rio Grande, and South to Granada and Diriamba, passing through Leon, Nagarote, Managua and Masaya.

There is presently very little movement of freight by rail due mainly to the reported lack of dependability of the railroad service, although adequate rolling stock is owned by the railroad.

Railroad freight rates are in most cases 50% or more less than truck rates. With proper planning considerable savings can be made by use of the railroad; an example moving product to outlying warehouses ahead of the heavy consuming season.

Figure 4, page V-10 shows the net work of roads and rail lines from the proposed plant site which is at the approximate hub of a half circle 122 km in radius that serves the area where 70% or better of all of the fertilizers consumed in Nicaragua are used.

c) <u>Water Supply</u>

There is adequate ground water in the area[7], with moderate to large quantities (90 to 900 gpm) from wells in sand and gravel, mainly at depths of less than 250 ft., quality of the water is reported to be soft to moderately hard. Fresh surface water is locally plentiful.

d) <u>Power Supply</u>

Chinandega is tied to a delta shaped power grid system (Jinotega, Managua, Leon) having a capacity of about 150,000 KW. There is a 15,000 KW generating station located at Chinandega. A 13,200 KV line runs between Chinandega and Corinto and passes close to the proposed plant site.

Power requirements for the plant will be around 10,000 KW., so adequate power is available.

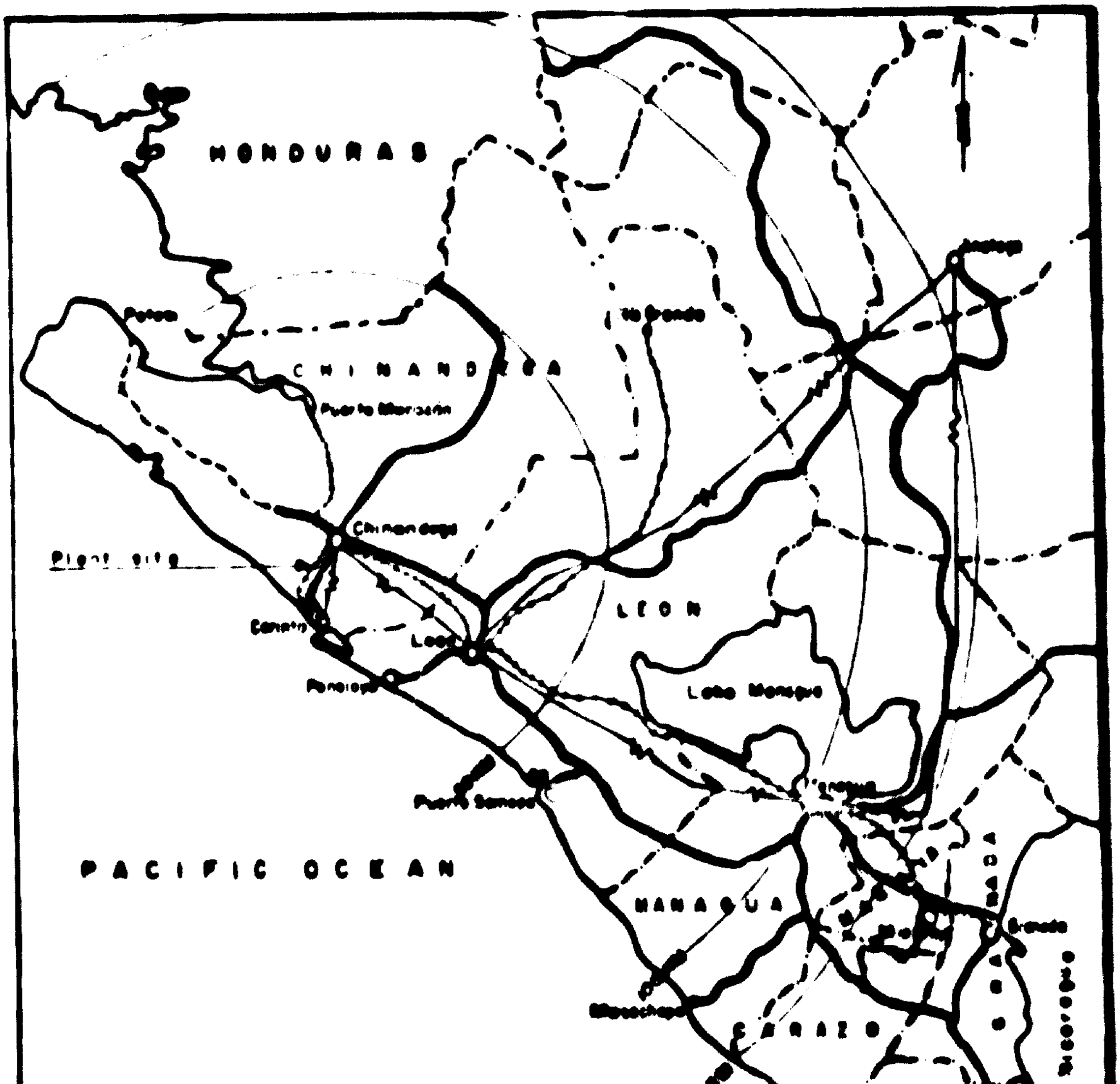
e) <u>Labor Supply</u>

Labor can be drawn from the towns of Corinto, population 8,000; Chinandega, population 28,000; and Leon, population 55,000. Unemployment in the area is reported to be as high as 30-40%.

The following industries are located in this area: a power generating plant; a sugar mill, the largest in the CACM countries; many cotton gins; a distillery; an edible oil plant, several bulk blending fertilizer plants; a wheat flour plant and a glue plant.

There appears to be no shortage of labor capable of being trained for the plant operation.

E-F



MAP OF NICARAGUA SHOWING MAIN ROADS, RAIL ROADS AND ELECTRIC POWER SYSTEMS IN MAJOR FERTILIZER CONSUMPTION IN RELATION TO SELECTED FERTILIZER PLANT SITE

FIGURE 4

C. PROCESSING PLANTS

1. Ammonia Plant

The basic unit operations for the production of synthetic ammonia as a liquid are:

Crude synthesis gas generating unit

CO conversion unit

CO_2 removal system

Final synthesis gas purification unit

Ammonia synthesis unit

Refrigeration

The feed stock for the preparation of the synthesis gas can be any one of the following: coal, coke, charcoal, lignite, crude petroleum, fuel oil, natural gas, refinery off-gas, by product hydrogen from chlorine cells, and naptha.

Due to factors such as availability, cost of raw materials and production, capital investment, and ease and stability of operations only refinery off-gas plus hydrogen, liquified natural gas and naptha were evaluated with naptha proving to be the most available and economical.

There are many processes for the manufacture of synthetic ammonia. Each process comprises the necessary component parts for the various functions in the manufacture of ammonia.

There is a choice of variations for each component part but the functions are the same for all processes. There are the following well known processes for synthetic ammonia production; Casale, Claude, Kellog, SBA, Fauser and Chemico.

Each of these processes has its own characteristics and each is made up of components which are interchangable with those adopted by other processes.

The modern ammonia plant is not a monolithic process in operation. It is rather a composite assembly of interchangeable component parts, among which the ammonia converter where the synthesis proper takes place that gives the plant its proprietary designation. Other components also have their trade-marks.

Any synthetic ammonia plant may not only be an overall trade name process but may also be a selected choice of the various component parts.

Any of the above processes will satisfactory produce ammonia. The process which should be selected is the one offered by a reputable design and construction firm with a proven performance record in ammonia plants that give the lowest capital investment and product cost.

Since there are many ammonia processes, process descriptions and flow diagrams are not included in this report, but may be found along with considerable technical data in references 8 & 9.

a) Bid Specifications Suggestions

There are certain items which should be definitely covered in the Bid Specifications for the ammonia plant. They are:

(1) All operating pumps to have installed spares. Large pump services to have three (3) 50% pumps (50% spare)

(2) All reciprocating compressor service is to consist of two (2) 50% compressors

(3) Exchanger tubing to be of standard diameters and lengths.

(4) Furnace coils to be designed for a minimum of 100,000 hours stress to rupture.

(5) Emergency electrical power systems are to be provided.

(6) All electrical switch gear and instruments to be tropicalise for at least moisture and fungus protection.

2. Urea Plant

The urea plant is based on the total recycle principle for complete conversion of liquid anhydrous ammonia and carbon dioxide to urea.

There are numerous processes for the manufacture of Urea, some of the best known one are: Inventa, Stamicarbon, Pechiney, DuPont, Montecatini, Toyokoatsu, and Chemico.

Flow sheets and other technical data on Urea and Urea Processes may be found in references 9, 10 & 11.

The same criterion used in selecting the ammonia plant process should also be used to select the Urea Plant process and that is the one offered by a reputable design and construction firm with a proven record in urea plants that will give the lowest capital investment and product cost.

a) General Process Description

The production of urea from carbon dioxide and ammonia is performed in three stages, which are:

Synthesis

Ammonia and carbon dioxide recovery and recycle

Concentration and prilling

Ammonia and carbon dioxide are combined in an exothermic reaction to form ammonium carbamate and in a subsequent reaction, which is endothermic, the ammonium carbamate is dehydrated to form urea and water as illustrated by the following equations:

$$2\ NH_3 + CO_2 \rightleftharpoons NH_4\ CO_2\ NH_2$$

$$NH_4\ CO_2\ NH_2 \rightleftharpoons (NH_2)_2\ CO + H_2O$$

Unreacted ammonia and carbon dioxide are recovered and recycled to the reactor and the urea melt is concentrated and prilled in subsequent operations.

(1) **Synthesis**

Ammonia and carbon dioxide in a selected ratio, together with recycle carbamate solution, are fed to the reactor. The proper selection of feed ratios and reactor temperatures and pressures permit the synthesis reaction under optimum conditions of conversion. Under these selected conditions, approximately 7[illegible]% of the carbon dioxide is reacted. Operating experience has shown that under normal operating conditions this conversion rate can be obtained in stainless equipment without incurring excessive corrosion and operating difficulties.

The urea synthesis operation is carried out in a minimum size high-pressure vessel. Construction is with a commercially available alloy liner rather than the costly silver or lead linings sometimes used.

The effluent from the reactor containing urea, ammonium carbamate and water, is reduced to an intermediate pressure and heated to complete the decomposition of carbamate in the primary decomposer. The ammonia and carbon dioxide in the overhead gases from this decomposition operation are absorbed in an atmospheric absorption tower (primary absorber) and the aqueous solution from this tower is recycled to the system through the urea synthesis reactor. In partial recycle systems these gases are not absorbed and recycled, but sent to another unit for processing into such products as ammonium sulfate, ammonium nitrate, etc. The urea solution in the secondary decomposer is stripped to remove practically all the ammonia and carbon dioxide dissolved in the solution. The recovered aqueous solution from the secondary absorber is sent to the atmospheric absorption tower by way of the primary decomposer. This stripper permits the maximum recovery of the ammonia and carbon dioxide as any amount of the residual gases left in the urea solution will be lost in the evaporating system concentrating the urea solution.

(2) Ammonia and Carbon Dioxide Recovery and Recycle
The high-pressure gases from the first stage of the decomposition are recovered in the absorption tower in an aqueous solution. This tower further concentrates most of the ammonia so that it can be condensed and recycled to the reactor along with the fresh ammonia feed. The carbamate solution containing all the carbon dioxide and a portion of the ammonia fed to the absorption tower is recycled back to the reactor. The recovery and recycle system permits the conver-

sion of over 99% of both the ammonia and carbon dioxide feed. The use of a water solution of carbamate provides a recycle stream completely free of any contaminating material which is not formed or originally fed to the system. Carbon dioxide compression costs are reduced since the carbon dioxide is recycled as a liquid rather than as a gas. The ammonia to be recycled is condensed separately from the carbon dioxide, thus eliminating an operating problem caused by condensing carbamate.

(3). Concentration and Prilling

The urea solution prior to prilling is concentrated by evaporation. A urea concentration of over 99% is obtained with a minimum increase of biuret content. The concentrated molten urea is distributed into a prill tower through a spinner arrangement which forms and distributes liquid urea droplets into the tower. These drops of liquid urea are cooled and solidified into prills by air drawn into the tower by fans.

After the prill tower, the urea prills are cooled, screened, and coated with diatomaceous earth. Normal arrangements are for the production of the single screen size product designed primarily for fertilizer usage; however, several types of prilled product can be produced. Although the plant may be operated to produce 100% of the prilled material as fertiliser grade, screening operations can be conducted so that 10 to 25% of the production rate is obtained as a special size industrial or feed grade material. This type of operation would eliminate any redissolving of solids except for a very small amount of oversized material.

b) Bid Specification Suggestions

Items that should be definitely covered in bid specifications are:

(1) All critical process pumps should have installed spares.

(2) All electrical switch gear and instruments should be tropicalised against moisture and fungus.

(3) Exchanger tubes should be of standard diameter and lengths.

3. Granular Complex Fertiliser Plant

The proposed method for the manufacture of granular complex fertilizers is one designed to produce homogeneous fertiliser granules, each granule containing each of the three plant nutrients, nitrogen, phosphorus, and potash.

The process is extremely flexible in that it can produce any of the NP or NPK fertiliser grades listed in Exhibit A, which are now used in Nicaragua, however it is usually not considered economical to produce lots of less than 500 MT in this size plant.

The Plant is also capable of producing other grades[12,13] such as 17-17-24, 20-20-20, 25-15-15, 17-22-17, [illegible], 25-37-0, [illegible], [illegible], [illegible], [illegible].

The production of the high analysis fertilizer grades will lower the cost per unit of plant food delivered to the grower, by reducing the freight and handling costs per unit.

The process is a proven one with commercial scale plants operating in the United States, England, Scotland, Holland and Spain.

The process consists of a monoammonium phosphate (MAP) powder unit (microprillers) added to a Tennessee Valley Authority (TVA) granulating unit. The addition of the MAP powder unit has three distinct advantages. They are:

(1) Maximum advantage is taken of the heat of reaction between ammonia and phosphoric acid to evaporate the water content of the phosphoric acid and produce a dry powder that is of high analysis, has good storage and handling properties, can be granulated to form granular MAP, further ammoniated and granulated to form diammonium phosphate (DAP) or mixed with urea, ammonia and potash and granulated to form granular

complex NP and NPK fertilizer.

(2) [illegible] dry MAP powder to the NPK granulating unit reduces the amount of recycle required, thereby reducing the size of the equipment for the unit. Fuel requirements are also reduced due to the reduction in the water content of the material entering the dryer.

(3) The MAP powder may be exported to other granulating plants, replacing the superphosphate now being used as source of phosphorus. The higher plant food content of the MAP reduces the cost of transportation per unit of plant food.

There are four process for the production of MAP powder, they are: (1) Fisons Fertiliser Ltd. England, (2) Scottish Agricultural Industries, Ltd., Scotland; (3) Swift and Co., United States and (4) Nissan Chemical Co., Japan. All four process are available.

a) Process Description (Process Flow sheets-figures 5 & 6)

(1) MAP unit

Liquid anhydrous ammonia is reacted with from 42% to 54% P_2O_5 phosphoric acid to a pH of about 4.0 in a special type reactor.

The heat of reaction drives off most of the water content of the phosphoric acid as steam, which can be used in the ammoniator-granulator of the granulating unit if required or vented to the atmosphere.

The ammonium phosphate slurry from the [illegible] containing 10-12% moisture is sprayed into a tower where the water content is reduced to 6 - 8% by flashing and the MAP powder, which is now dry in appearance and handles easily, is withdrawn from the bottom of the tower and conveyed either to storage or to the surge hopper in the granulating unit.

(2) Granulating, Drying, Cooling and Sizing Unit.

The dry bulk raw materials which are; MAP powder, potash, urea, and filler along with the recycle fines are metered by weigh feeders to a collecting conveyor which transports the mix to a surge hopper. From the surge hopper the mix is metered to the TVA type ammoniator-granulator where ammonia, phosphoric acid, steam, and water are metered to this unit to give the optimum conditions for granulation and proper analysis.

From the granulator the material is fed by gravity to a co-current hot air rotary dryer where the moisture content is reduced to 0.5% or less. From the dryer, the dried granules pass to a counter-current rotary cooler. From the cooler the material is elevated to a set of vibrating screens where it is separated into an oversize fraction, a product size fraction and a fines fraction.

The product size fraction is conveyed to the bulk storage building.

The oversize fraction is crushed to below product size material and with the fines fraction is returned to the recycle surge bin to be reprocessed into product size material.

(3) Bid Specifications Suggestions

Items of special interest that should be covered in the bid specifications are:

a) Aluminum fans on TEFC motors are not acceptable. Cast iron fans should be specified.

b) The electrical grounding system must be of stainless steel. Copper and Aluminium are not acceptable.

c) Building siding must be corrugated transite. Aluminium, galvanized iron, galbestos, etc. siding is unacceptalbe.

d) Dryer is to be sized to have sufficient retention time to dry granular fertilizers with a high urea content to 0.50% moisture or less.

e) Galvanized iron conduit is not acceptable, conduit may be plastic conduit, but armored plastic covered cable is preferred. All junction boxes, pot heads, etc. are to be dust and water tight.

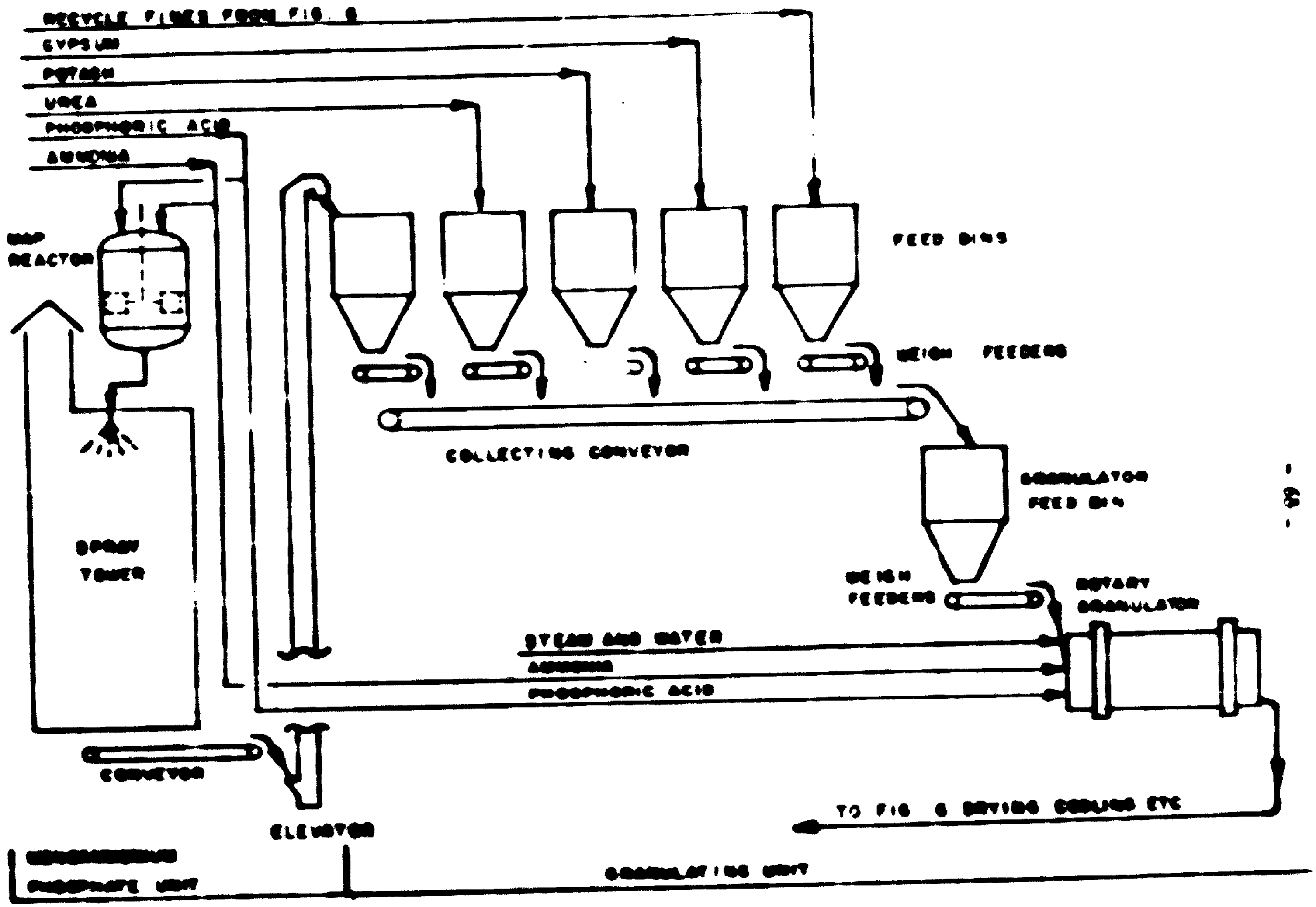
f) The motor controll center is to be pressurized with filtered air.

g) Control room is to be pressurised and air conditioned.

h) All equipment subject to excessive vibration such as fans and grinding mills are to be set on curbed, drained, concrete pads and isolated from the building structure.

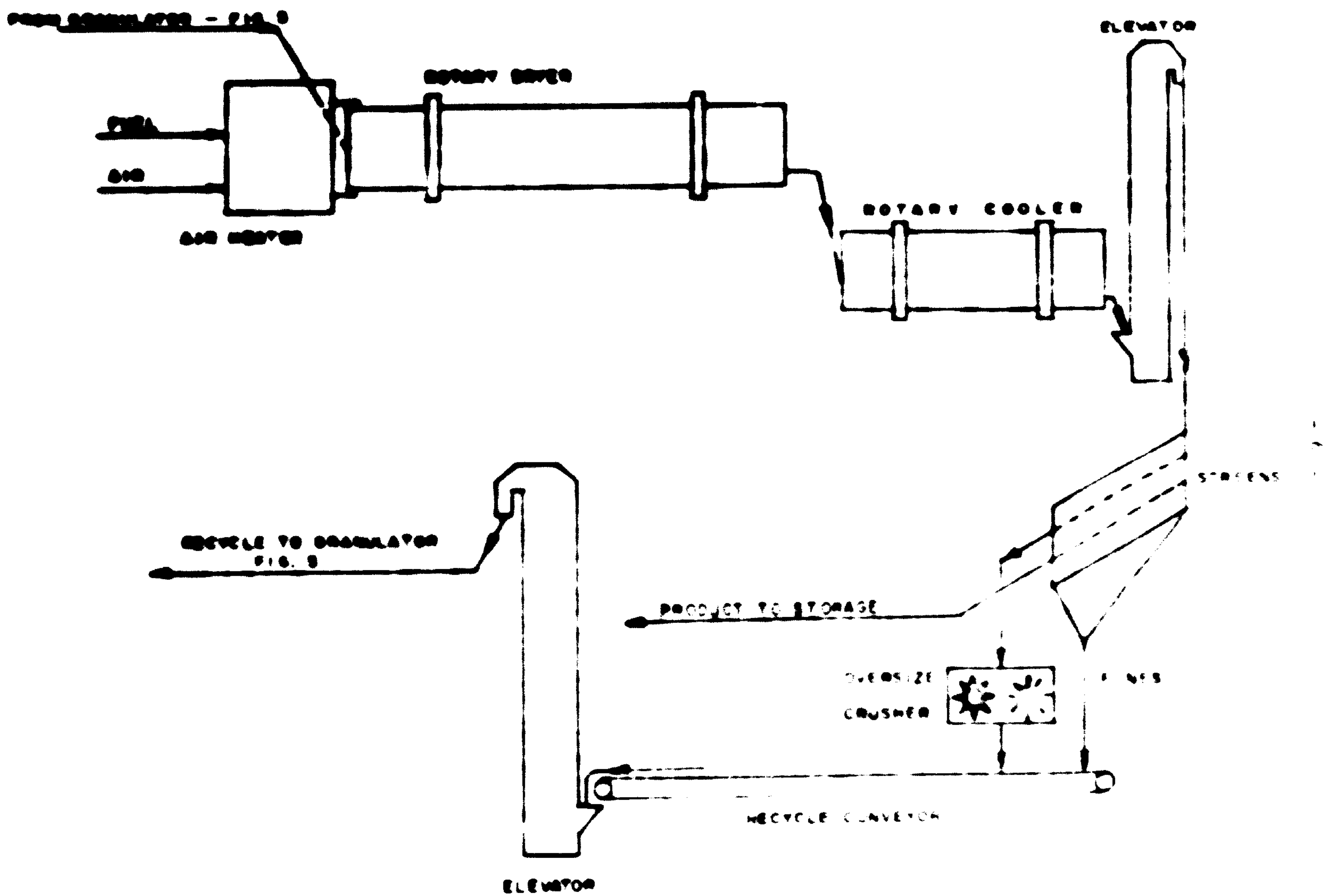
i) All electrical equipment and instruments and to be tropicalised against moisture and fungus.

V..



GRANULAR COMPLEX FERTILIZER FLOW SHEET MONOAMMONIUM PHOSPHATE GRANULATING UNITS

FIGURE 5



GRANULAR COMPLEX FERTILIZER FLOW SHEET DRYING COOLING, SIZING AND CRUSHING UNITS

FIGURE 6

D. PRODUCT STORAGE, BAGGING, AND SHIPPING

1. Product Storage

The money allocated for the investment for bagged storage may appear to be high, however a recent study for a similiar type fertilizer complex where a large amount of Urea was to be stored indicated that a bulk storage building with humidity control is more costly. To store Urea in a hot humid climate requires that for bulk storage of Urea humidity control is a neccessity to keep the material from forming a hard cake which would require reprilling or wasting considerable product. However Bid Tender Specifications should specify that the contractor will make an independent analysis and quote on the cheapest method of storaging the products, furnishing his analysis of both methods with his quotation. Sufficient bagged storage is provided for four (4) months production, due to the highly seasonal nature of fertilizer usage. The building(s) are of low cost galvanized steel, pre-engineered construction, having a 5" reinforced concrete floor, an overhead bag conveyor down the center line, over head lighting, electric power outlets for conveyers in modules and space is provided for the movement of portable conveyors and palletising equipment for shipments.

Due to the high investment for pallets for storage, the filled bags will be placed in a solid storage pile with the bottom layer of bags placed on polyethylene sheets laid on the floor as protection against moisture absorption.

2. Bulk Storage

a. Granular Complex Fertilizers

One weeks storage of bulk granular fertilizers is provided, to permit time to analyze and control production to on specification product before it is bagged.

b. Urea

A 900 MT, (approximately 3 days production) humidity controlled bulk storage silo is provided ahead of the bagging operation. This gives a surge capacity sufficient to keep the Urea plant operating while bagging granular complex fertilizer, over Sundays and short Holidays, and in case of a break down in the bagging operation.

3. Coating Agent Facilities

Coating facilities are provided just ahead of the bagging operation. The coating agent facilities consist of a coating agent feed hopper, weight feeder, and a rotary drum coater where the granular or prilled product is mixed and coated with either diatomaceous earth or finely ground clay to prevent the caking of the fertilizer after bagging, while in storage.

Unless urea and high potash grades of fertilizer are used soon after bagging there is a good posibility that much of the material will form large, hard lumps in the bags before use. Some contractors claim that coating of urea is not neccessary when using their process. This is open to question from field experience particularly in the climatic conditions that exist in Nicaragua.

4. Bagging and Shipping Facilities

One bagging line is provided that will bag (18) eighteen 100 pound bags per minute. Since this rate cannot be sustained over long periods of time, using an efficiency of 72% this line will then be able to bag at an average rate of 35.4MT per hour or 283MT per 8 hour shift. Operating 2 shifts per day, the capacity will be 566 MT vs a required 560 MT per day based on 300 operating days per year.

The bagging unit consist of two 25 MT feed hoppers, charge weighing scales, liner heat sealer, bag sewing unit, bag conveyors and dust collecting system.

The bagging unit will be over a grating floor, with [illegible] hopper and conveyor to return spillage to the bagging feed hopper.

Bagged material may be shipped directly from the bagging line or be sent to bagged storage.

If the cost of bagged storage as compared to bulk storage in the final analysis turns out to be very nearly equal, bagged storage is preferred, because with bagged storage you have a steady year round smooth operation as opposed to a 3 shift a day - 2 bagging line operation, generally operated with a considerable number of untrained temporary laborers to meet the heavy demand over the relatively short shipping season. In many cases this result in a mad house operation, with a high percentage of incorrect weights and bag counts, much spillage of material and a high waste of bags due to damage.

8. Possible Investment Reductions

Before the amount of bagged storage required at the plant site is finalized, the use of existing warehouse facilities in the outlying consuming areas should be throughly investigated to determine the optimum storage required at the plant. There is reported[3] to be some 100,000 tons of warehouse storage available in Nicaragua.

This investigation should also include evaluating the use of rail shipments to these warehouses in advance of the shipping season which will result in substantial savings in freight.

SECTION VI. ALTERNATIVES TO NEW CONSTRUCTION

1. <u>Ammonia Plant</u>

Due to the construction of large ammonia plants (1,000-1,500 STPD) throughout the world, many of the small ammonia plants (150-300 STPD) are being retired from service due to the fact that most of these small plants have become uneconomical. Only where local conditions such as a captive supply of natural gas, freight rates, etc. favor the operation are they still in use.

Many of these plants are only about ten years old and are in good condition and still can give good service over many years ([illegible] is just retiring a plant 40 years old which they claim was still in good operating condition.)

Preliminary investigation has revealed that they can be bought as is - where is for a very low price. A price of $250,000 was quoted for a 300 STD plant. If it is not desired to purchase a complete plant, portions such as the synthesis loop with compressors may be purchased and the rest of the plant be new construction. See the discussion under ammonia plants in section V, Technical.

2. Urea Plant

During the course of investigating ammonia plants, a 250 STD urea plant was also offered for $400,000. This plant is located in the Caribean and was built in 1962.

The plant was built by C & I Girdler who I understand are licensees for the Toyo Koatsu process.

While this plant has less than the desired capacity, usually the capacity can be increased with modification when the market exceeds the rated capacity. Further investigation of this plant is warranted.

3. Granular Fertilizer Plant

The equipment and design for the granulation section of a 13 MTD plant is also for sale. The equipment is new and has never been erected or used as the project was cancelled very recently before the plant was built. I understand most of the equipment has already been shipped to Port Au France, Martinique. This could also be purchased at a considerable savings and should also be investigated.

4. Estimated Savings from Other Than New Construction

Estimates of the cost of relocating an existing operating plant run from 60 to 70% of the original cost of the plant depending on the purchase price of the plant. Based on the prices used for the capital imvestment for new construction [illegible] in [illegible] part the saving would be in the order of:

	MM $
1. Ammonia Plant	2.[illegible]
2. Urea Plant [illegible]	[illegible]
3. Granular Fertilizer Plant	0.36
Total Savings	3.6[illegible]

This is a savings of about [illegible]% of the estimated capital investment for the [illegible] for the complex.

5. Disadvantages of [illegible]

Probably the most difficult part of buying [illegible] a plant is in the financing. [illegible] financial institutions are extremely reluctant to make [illegible] than new construction. It will take considerable convincing these institutions that this can be done with a minimum of risk.

The second problem is the loss of the contractors guarantees on plant performance and the equipment manufacturers mechanical guarantees.

The third problem is to disassemble, code mark and crate, the plant so that it may be erected easily and will work properly when placed in operation. Care must be taken to insure the equipment is not damaged during dismantling and shipping. Code marking must be complete and accurate, and noted on purchase requisitions, listed on an equipment list and indi[illegible]ate [illegible] ar[illegible]range.

It may be possible to find a reliable construction company to [illegible] and guarantee that it will be dismantled [illegible] reerected satisfactorily, but this is doubtful.

The [illegible] would in all probability have to take this [illegible] and should therefore carefully select and [illegible] the contractor and obtain a guarantee that contractors supervisory personnel assigned to the job will remain with the project until it is in operation again.

Equipment should be inspected during disassembly and needed repairs noted.

Chemical plants, including ammonia plants have been successfully relocated.

- -

[illegible]

1. Report on the Feasibility [illegible] Fertilizer [illegible] Central America, Japan Consulting Institute, [illegible].

2. Feasibility Report - [illegible] Fer[illegible].

3. A Pre-Feasibility [illegible] Fertilizer Industry in Nicaragua, [illegible] June, 197[illegible].

4. El Uso de Fertiliz[illegible] [illegible], 1966 p. [illegible].

5. Sulfur Coating on Nitrogen Fertilizer [illegible] Release Rate. Agricultural and Food Chemistry, [illegible] 1968 p. 773 - 778.

6. Boletin del Servicio Geologico Nacional de Nicaragua. No. 4, 1960 p. 14[illegible] - 157.

7. Nicaragua - National Inventory of Physical Resources, AID/AIC, GIPR No. 6, November 1966.

8. Synthetic Ammonia - Chemico.

9. Heat Engineering - Foster Wheeler Corp., Sept - Oct. 1969 p. 57 - 61

10. Nitrogen Fertilizers - Chemico.

11. Urea - Stamicarbon - Foster Wheeler, June 1969.

12. Developments in Production of Granular Urea - Ammonium Phosphate Fertilizers. I & E. C. Process Design and Development, Vol. 7, June 1968, p. 124 - 133.

13. The use of Urea in Compound Fertiliser, Conference of the International Superphosphate Manufacturers Association; Stresa, Italy, Sept. 1967, p. 500 - 509.

SECTION VII. EXHIBITS

EXHIBIT A

[illegible]

[illegible]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]		[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	27	27
[illegible]	[illegible]	[illegible]	[illegible]	-
[illegible]	[illegible]	-	-	-
[illegible]	[illegible]	[illegible]	[illegible]	-
[illegible]	[illegible]	-	-	-
[illegible]	[illegible]	[illegible]	[illegible]	-
[illegible]	[illegible]	[illegible]	40	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	275
[illegible]	[illegible]	65	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	606	[illegible]
[illegible]	[illegible]	[illegible]	72	102
[illegible]	[illegible]	[illegible]	[illegible]	-
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	526	[illegible]	526
[illegible]	[illegible]	92	186	186
[illegible]	[illegible]	-	-	-
[illegible]	[illegible]	[illegible]	-	-
[illegible]	[illegible]	[illegible]	-	-
[illegible]	[illegible]	[illegible]	-	-
[illegible]	[illegible]	[illegible]	-	-
[illegible]	[illegible]	44	-	-
[illegible]	[illegible]	-	-	[illegible]
[illegible]	[illegible]	-	200	-
[illegible]	[illegible]	-	-	25
[illegible]	[illegible]	-	[illegible]	-
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]		[illegible]	[illegible]	[illegible]
[illegible]		1.0	0.64	0.24

[illegible]				
[illegible]	[illegible]	[illegible]	-	-
[illegible]	[illegible]	670	-	-
[illegible]	[illegible]	1,150	3,010	-
[illegible]	[illegible]	1,180	4,720	1,180
[illegible]	[illegible]	740	2,200	740

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
All Other	[illegible]	[illegible]	[illegible]	[illegible]
TOTAL	72,[illegible]	[illegible]	[illegible]	[illegible]
Average Analysis		[illegible]	[illegible]	[illegible]
Nutrient Ratio-N:P:K		1,[illegible]	[illegible]	[illegible]

C. OTHER D[illegible]

[illegible]	[illegible]	[illegible]	[illegible]
Granular Complex Fertilizers-1964	[illegible]	[illegible]	[illegible]
Granular Complex Fertilizers-1968	[illegible]	[illegible]	[illegible]

ESTIMATED NUTRI[illegible]

1. Japan Consulting Institute

Metric Ton	5[illegible]	45,0[illegible]	45,100
Ratio-N:P:K	[illegible]	[illegible]	[illegible]

2. FENIC (3)

Metric Tons	64,9[illegible]	[illegible]	3[illegible]
Ratio - N:P:K	1.00	[illegible]	0.50

(1)- J.P.N CONSULTING INSTITUTE report for [illegible] superior

(2)- Pre-Feasibility report on Establishing [illegible] Fertilizer Industry [illegible] Nicaragua- By Chemico

(3)- FENIC'S Estimated Tonnage converted by using data in (2) above.

E X H I B I T B

[illegible]

[illegible] YEARS 1970, 1975 [illegible]

	[illegible] - MT PER YR. 1970	1975	1980
[illegible]	[illegible]	40,000	-
[illegible]	-	45,[illegible]	-
[illegible] Report Item	20,[illegible]	[illegible]2,000	43,[illegible]
[illegible]			
. [illegible]	14,[illegible]		
. [illegible]	24,[illegible]	[illegible],000	45,[illegible]
3. [illegible]	14,5[illegible]0	[illegible],000	[illegible],500
4. [illegible]	[illegible]	[illegible]	41,7[illegible]

E X H I B I T C

[illegible]

1. [illegible] the average Nitrogen [illegible] the Chemico Report and Item No. 4 [illegible] this report [illegible]

$$\frac{4[illegible]}{.85 \times [illegible]} = 1[illegible] \text{ MT of Ammonia Per Day}$$

Since this is very tight [illegible] - [illegible]

2. Ammonia Nitrogen to Urea Production

-99,000 Tons [illegible] / Yr. = 99,[illegible]0 x 0.57 x .8[illegible] = 46,385 Mt/Yr.

3. Ammonia Nitrogen to Granular Complex Fertilizers

54,250 - 46,385 = 7865 MT/Yr.

4. Metric Tons of Granular Complex Fertilizer

- In average of 13.0% Nitrogen $\frac{9270}{.13}$ = 71,500 MT/Yr.

Use 72,000 MT

72,000 MT/Yr./300 Day = 240 MT/D = 10 MT/Hr.

[illegible]

[illegible]

[illegible]

[illegible]

GRADE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
10-40-[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
10-[illegible]-10	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
18-46-0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-
15-15-15 *			[illegible]	[illegible]	[illegible]	[illegible]
12-24-12 *	[illegible]	[illegible]	[illegible]	[illegible]	1,535 (uncertain)	[illegible]
13-13-0 *			[illegible]	[illegible]	[illegible]	[illegible]
SUB TOTAL	[illegible]	[illegible]	72,[illegible]	[illegible]	[illegible]	[illegible]
Urea	35,[illegible]	-	[illegible]	[illegible]	-	-
Ammonium Sulfate	[illegible]	-	-	-	-	-
SUB TOTAL	72,[illegible]		[illegible]	[illegible]	[illegible]	[illegible]
Minus Urea to Complex Fertilizers			[illegible]	[illegible]	-	-
TOTAL			16[illegible],[illegible]	5[illegible],[illegible]	2[illegible],[illegible]	[illegible]

Ammonia Plant Production- MT of Nitrogen/Yr. = [illegible],250

Usage of Nitrogen per above = 54,[illegible]4

Difference + [illegible]236

*These three are the grades with the highest imports other than those listed per Japan Consulting Institute Report and should therefore constitute the biggest portion of other fertilizers not listed by grade in the CHEMICO Report.

EXHIBIT [illegible]

[illegible] P [illegible] R [illegible] RIAL S [illegible]

N [illegible]	[illegible] M.T. x $2[illegible]	=	1,[illegible]5,[illegible]04
[illegible] A[illegible]	[illegible] x $ [illegible]	=	[illegible]
P[illegible]	[illegible],757 [illegible] M.T. x $12.5[illegible]	=	499,711
M[illegible] S[illegible]y		=	[illegible]00,000
[illegible]		=	[illegible]

[illegible]MPAR[illegible] [illegible]ZER PRODUCTI[illegible]N COST AND COST [illegible] IMPORTED FERTILIZERS

	METRIC TONS PER YEAR	DOLLARS PER METRIC TON: PRODUCTION COST	DOLLARS PER METRIC TON: CIF PRICE CORINTO	DOLLARS PER METRIC TON: COST AT CORINTO-CHINANDEGA	DOLLARS PER METRIC TON: SALES PRICE CORINTO CHINANDEGA
[illegible]	24,[illegible]	$ [illegible]	$ [illegible].27	$ [illegible].08	$ 108.13
[illegible]-30-[illegible]	15,[illegible]	[illegible]	68.91	82.66	94.29
1[illegible]-36-0	13,300	[illegible]	83.33	98.54	111.57
15-15-15	6,27[illegible]	[illegible]	68.91	82.63	94.29
[illegible]-24-12	6,2[illegible]	[illegible]	70.11	83.95	95.80
13-13-20	6,26[illegible]	6[illegible]	69.91	83.73	95.80
Sub-Total *	72,[illegible]	7[illegible]	75.30	89.40	102.56
UREA	96,[illegible]00	[illegible]	65.27	78.58	89.57
TOTAL *	168,[illegible]00	$ [illegible]	$ 69.57	$ 83.22	95.14

* PRICES SHOWN ARE WEIGHTED AVERAGES

GRADE	METRIC TONS PER YEAR	TOTAL PRODUCTION COST	TOTAL IMPORT VALUE	TOTAL COST CORINTO - CHINANDEGA	TOTAL SALES VALUE-CORINTO CHINANDEGA
1[illegible]-40-10	24,500	$ [illegible]	$ 1,942,115	$ 2,30[illegible],960	$ 2,656,535
10-30-10	15,400	[illegible]	1,061,676	1,272,964	1,452,066
18-36-0	13,300	[illegible]	1,108,289	1,290,582	1,483,[illegible]
15-15-15	6,270	[illegible]	432,066	518,090	591,198
12-24-12	6,270	[illegible]	439,550	526,367	600,666
13-13-20	6,260	396,[illegible]21	437,637	524,150	599,708
Sub-Total	72,000	[illegible]	5,421,375	6,137,113	7,384,054
UREA	96,000	[illegible]	6,265,920	7,543,680	8,598,720
TOTAL	168,000	[illegible]	$11,687,292	13,980,793	$15,982,774

ANALYSIS [illegible]

COMPANY	UREA	AMMONIA SULFATE	P R I C E S [illegible] 18-46-0	[illegible]	10-[illegible]	[illegible]	[illegible]	[illegible]
1. SERVICIO AGRICOLA [illegible]								
Sales price, Corin[illegible]	89.57	53.43	111.57	108.[illegible]	90.[illegible]	94.[illegible]	[illegible]	94.[illegible]
Port charges & Comm.	4.34	4.34	4.34	4.34	4.34	4.34	4.34	4.34
Freight & Handling	1.05	1.09	1.05	1.[illegible]	1.[illegible]	1.[illegible]	1.0[illegible]	1.[illegible]
Advalorem Tax 10%	6.50	3.70	7.00	8.00	6.9[illegible]	6.[illegible]	[illegible]	7.[illegible]
Profit, Interes, Ecc. -	12.43	7.33	15.87	15.39	13.[illegible]	13.[illegible]	[illegible]	[illegible]
TOTAL ADDED TO CIF	24.30	16.20	28.24	28.66	25.[illegible]	[illegible]	[illegible]	2[illegible]
Estimated CIF Price	65.27	37.23	83.33	[illegible]	68.[illegible]	68.0[illegible]	[illegible]	6[illegible]
2. FERTICA								
Sales price, Managua in bags	90.51	63.80	-	[illegible]	[illegible]	[illegible]	10[illegible]	-
Less amount added to CIF	24.30	16.20	-	[illegible]	[illegible].35	25.[illegible]	[illegible]	-
Less price diff. in 1 & 2	0.94	10.37	-	([illegible])	[illegible]	6.[illegible]	[illegible]	-
ESTIMATED CIF PRICE	65.27	37.23	-	7[illegible]	6[illegible]	[illegible]	[illegible]	-
3. GRACE CHEMICAL CO.								
Price, CIF Corinto - Bulk	65.00*	-	[illegible]	6[illegible]	63.90	[illegible]	[illegible]	[illegible]
Price for Bags (Est.)	-	-	[illegible]	8.00	8.00	[illegible]	[illegible]	[illegible]
CIF price in bags	65.00	-	[illegible]	7[illegible]	7[illegible]	[illegible]		[illegible]
4. COMMERCIAL INTERNATIONAL & CORINTO CUSTOM OFFICE	58.40**	[illegible]**	[illegible]	-	[illegible]	-	[illegible]	[illegible]
5. CHEMICO REPORT, CIF CORINTO IN BAGS-1968	69.13	45.[illegible]8	-	83.[illegible]	96.[illegible]	[illegible]	[illegible]	-
6. OTHER SALES PRICES								
a) Commercial International, Managua in Bags	94.29	5[illegible].86	[illegible]	113.[illegible]	9[illegible]	[illegible]	10[illegible]	
b) FERTICA, Managua in Bags, on Credit	95.85	57.57	-	11[illegible]	107.[illegible]	[illegible]	[illegible]	
c) Diaz & Cruz Cia. Ltd PTO. Somoza, in Bond Bags	78.41	48.55	101.[illegible]	[illegible]	9[illegible].59	[illegible]	[illegible]	

Source of Prices: Letters to I[illegible]NAC requesting prices of fertilizer [illegible] 1970.

* Bagged Material

** Prices obtained at customs office, Corinto, 18-46-0 price for [illegible]

[illegible]	[illegible]	6.29	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	-	2.55	2.96	0.86	[illegible]
[illegible]	-	[illegible]	-	[illegible]	-

[illegible]

1. **START UP EXPENSES** | US$

Plant manager, [illegible] and technical [illegible] including travel expenses, etc.	325,[illegible]
Pre start-up hiring and training	45,[illegible]
Contractor start up engineer, [illegible] for 4 months including living expenses	1[illegible],000
Business [illegible] specific [illegible]	75,[illegible]
Total start - up expenses	$6[illegible]

2. **WORKING CAPITAL REQUIREMENTS** | US$

Catalyst and chemical inventory	170,[illegible]
Ammonia inventory - 30 days [illegible]	345,000
Potash inventory - 5,[illegible] MT	14[illegible],000
Naptha inventory - [illegible]	181,000
Phosphoric Acid inventory - 6,[illegible] MT	3[illegible]2,000
Bag inventory - 2 weeks	45,000
Filler & coating agent	30,000
1/Urea inventory - 2 months -15,[illegible] MT	995,000
1/Complex fertilizer inventory - [illegible] months [illegible]	1,[illegible],000
Spare parts and stores	244,000
TOTAL working capital requirements	$3,500,000

1/Includes billings du[illegible]

3. **RAW MATERIAL [illegible] FOR COMPLEX FERTILIZER [illegible]**

ANALYSIS	10-40-10	[illegible]	[illegible]	[illegible]	[illegible]	13-13-2[illegible]
MT/Y	24,2[illegible]	[illegible]	[illegible]	6,2[illegible]	6,2[illegible]	6,270
Phos. Acid	18,326.0	[illegible]	11,571.0	1,[illegible]	2,[illegible]	1,471.1
Ammonia	3,030.0	[illegible],909.6	2,946.0	[illegible]	[illegible].0	212.5
Urea	-	-	-	1,3[illegible]	[illegible].0	1,43[illegible].5
Potash	4,165.0	2,61[illegible].0	-	1,58[illegible]	1,27[illegible].9	2,1[illegible].6
Gypsum	1,3[illegible].0	3,264.8	319.2	1,200.7	1,45[illegible].6	1,126.[illegible]
Coating Agent	-	-	-	125.[illegible]	-	125.2

ANALYSIS MT/Y	Total 72,[illegible]0	MT/MT Product	ANALYSIS MT/Y	Total 72,[illegible]0	MT/MT Product
Phos. Acid	44,603.4	0.6195	Potash	11,757.9	0.1633
Ammonia	9,329.1	0.1295	Gypsum	8,689.1	0.1207
Urea	2,969.6	0.0412	Coating agent	250.6	0.0035

1/ AVERAGE WEIGHTED ANALYSIS - ALL GRADES -12.6N-33.5P205-9.8K20

[illegible]

[illegible]	[illegible]	[illegible]	[illegible]	Fringe [illegible] Benefits [illegible]	Cost [illegible] Year	Cost per Year U.S.[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible],600	28,[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	19,[illegible]	[illegible]	16,[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
			[illegible]	[illegible]	[illegible]	120,[illegible]

[illegible] 40%

[illegible]

[illegible]						
[illegible]	1	2,[illegible]	24,[illegible]	9,6[illegible]	33,600	4,800
[illegible]	[illegible]	1,[illegible]	[illegible]	15,360	53,76[illegible]	7,680
[illegible]	[illegible]	1,2[illegible]	[illegible]	47,616	162,816	23,[illegible]
Cl[illegible]	4	1,5[illegible]	72,[illegible]	28,[illegible]	100,800	14,400
C[illegible]rks	4	1,[illegible]	48,[illegible]	19,200	67,200	9,6[illegible]
Chi[illegible]ntant	1	3,000	36,[illegible]	14,400	50,[illegible]	7,[illegible]
Accoun[illegible]	3	1,2[illegible]	43,200	17,280	6[illegible],4[illegible]0	8,640
Chemist	2	4,000	96,000	3[illegible],400	134,400	19,200
L[illegible]tory Techni-cians	5	1,000	60,000	24,000	84,000	12,[illegible]
Drafts[illegible]en	2	1,200	28,800	11,520	40,320	5,760
Chauffers	3	900	32,400	12,960	45,360	6,4[illegible]
Messeng[illegible]s	1	400	4,800	1,920	6,72[illegible]	960
SUB TOT[illegible]L	36		598,800	241,056	839,856	119,979

EXHIBIT [illegible]

CLASSIFICATION	No.	Salary Month or Day	Salary Year	Fringe Benefits	[illegible] Year	[illegible] Year
3. Plant Security				[illegible]		
Chief Security Officer	1	[illegible]	[illegible]	[illegible]	[illegible]	
Plant Guards	6	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SUB TOTAL	7		[illegible]	[illegible]	[illegible]	[illegible]
4. General Labor [illegible]						
Yard Foreman	1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Laborers	15	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SUB TOTAL	16		[illegible]	[illegible]	[illegible]	[illegible]
(1) TOTAL PLANT OVERHEAD SALARIES & WAGES	66				[illegible]	[illegible]
(2) Plant Overhead Expenses					[illegible]	[illegible]
TOTAL PLANT OVERHEAD					2,9[illegible]	[illegible]

(1) Fringe Benefits - [illegible] vacation [illegible] security.

Factors used - [illegible] - 17[illegible]

(2) Plant Overhead Expenses: Office [illegible], [illegible], telegraph, travel, depreciation office equipment, [illegible], misc. equipment & amortization [illegible], etc.

[illegible]

	Salary Per Month [illegible]
[illegible]	[illegible]
[illegible]	2,[illegible] - [illegible]
[illegible]	1,[illegible] - 3,[illegible]
[illegible]	[illegible] - 1,5[illegible]
[illegible]	800 - 1,[illegible]
[illegible]	[illegible] - [illegible]
[illegible]	2[illegible] - [illegible]
	Wages Per [illegible]
[illegible]	
[illegible]	30 - 50
[illegible]	[illegible] - 30
[illegible]	[illegible] - [illegible]
C. MAINT[illegible]	
M[illegible]	44
[illegible]	28
[illegible]	2[illegible]
Fr[illegible]k[illegible]	[illegible]
Carp[illegible]r	[illegible]
[illegible]	25
[illegible]	
Labor Foreman	10 - 1[illegible]
Laborer	6 - 1[illegible]

[illegible]

[illegible]

[illegible]

[illegible]	No. [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
A. PLANT [illegible]						
1. AMMONIA PLANT						
Shift Foremen	4	46	[illegible]	[illegible]	[illegible]	[illegible]
Operators	16	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SUB TOTAL	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]
2. UREA PLANT						
Shift Foremen	2	46	[illegible]	[illegible]	[illegible]	[illegible]
Operators	16	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SUB TOTAL	18		[illegible]	[illegible]	[illegible]	[illegible]
3. GRANULAR [illegible] FERTILIZER PLANT						
Shift Foremen	2	46	[illegible]	[illegible]	[illegible]	[illegible]
Operators	4	30	[illegible]	[illegible]	[illegible]	[illegible]
Operators	12	25	81,9[illegible]	[illegible]	[illegible]	17,784
Helpers	4	12	[illegible]	[illegible]	[illegible]	[illegible]
SUB TOTAL	22		[illegible]	[illegible]	[illegible]	[illegible]
4. BAGGING & SHIPPING						
Foremen	2	35	19,110	9,9[illegible]	[illegible]	4,[illegible]
Operators	12	20	65,5[illegible]	34,[illegible]	99,[illegible]	14,[illegible]
Laborers	10	8	21,8[illegible]	11,[illegible]	[illegible]	[illegible]
SUB TOTAL	24		106,[illegible]	[illegible]	[illegible]	[illegible]
5. SHIFT SUPERVISOR	4	135	147,42[illegible]	7[illegible]	224,[illegible]	[illegible]
TOTAL PLANT OPERATIONS	88		747,594	388,[illegible]	1,136,[illegible]	[illegible]
B. PLANT MAINTENANCE						
Maintenance Foremen	4	50	54,600	28,392	82,992	11,[illegible]

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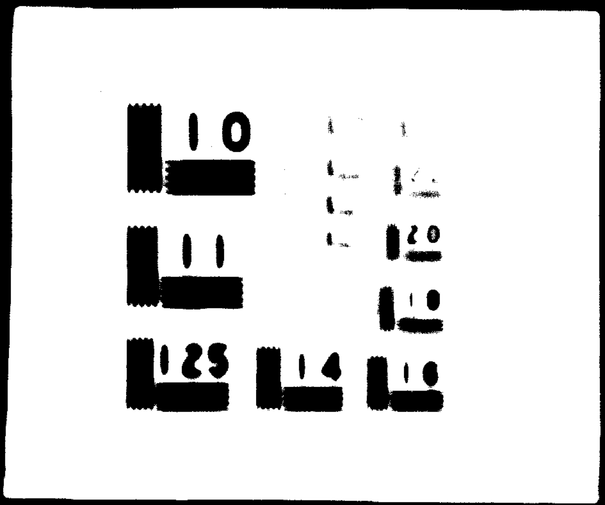

[illegible])

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible] Year	Cost per Year [illegible]
[illegible]			[illegible]	[illegible]4,155	219,099	31,30[illegible]
[illegible]	[illegible]		[illegible]	[illegible]	46,426	6,6[illegible]
[illegible]		[illegible]	[illegible]	[illegible]	[illegible],426	6,6[illegible]
I[illegible]			[illegible]	[illegible]24	[illegible]8,[illegible]94	8,[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible],426	[illegible],649
[illegible]	[illegible]	44	[illegible]	[illegible]45	[illegible]	10,[illegible]
[illegible]		28	[illegible]	[illegible]	46,426	6,6[illegible]
Helper	[illegible]	[illegible]	[illegible]	[illegible]2,5[illegible]	124,[illegible]98	17,[illegible]
SUB TOTAL	[illegible]		48[illegible],[illegible]16	[illegible]54,494	[illegible]3,610	106,26[illegible]
Overtime - [illegible]					111,545	15,93[illegible]
TOTAL [illegible] MAINTENANCE	6[illegible]				855,155	122,16[illegible]
TOTAL DIRECT LABOR					1,991,500	284,50[illegible]

(1) FRINGE [illegible] - Vacations, Holidays, & Social Security - Factors used per [illegible], INFCN.G.

[illegible]

DISTRIBU[illegible]

[illegible]

A. **SHIFT [illegible]**

Basis: Percentage of Total Plant Inv[illegible]

	[illegible]	
Ammonia Plant	[illegible]	[illegible]
Urea Plant	6.[illegible]	[illegible]
Granular Complex, Fertilizer Plant	[illegible]	[illegible]
Product Storage, Bagging & Shipping	[illegible]179	[illegible]
Total	17.[illegible]	[illegible]

Ammonia Plant	$[illegible]	x .[illegible]	$1[illegible]
Urea Plant	" "	x .[illegible]	1[illegible]
Granular Complex Fertilizer Plant	" "	x .[illegible]	[illegible]
Product Storage, Bagging & Shipping	" "	x .0[illegible]	1,69[illegible]
Total			5[illegible]

B. **OVERHEAD**

Basis: Percentage of Direct Operating Labor

	Labor Cost $/Year	%	Overhead Cost-$/Yr
Ammonia Plant	[illegible]	[illegible].1	144,635
Urea Plant	44,77[illegible]	27.6	117,066
Gran. Complex Fert. Plant.	37,37[illegible]	23.0	97,556
Prod. storage, Bagging and Shipping	24,[illegible]	15.3	64,[illegible]
Total	162,335	100.0	[illegible]

C. **START UP EXPENSE**[1]

Basis: Same As "A" above

Ammonia Plant	415,000	x .500	=	$207,500
Urea Plant	" "	x .339	=	140,[illegible]
Gran. Complex Fert. Plant	" "	x .108	=	44,8[illegible]
Prod. Storage, Bagging and Shipping	" "	x .053	=	21,[illegible]
Total				$415,000

[1] Used here only to figure Interest on Investment.

EXHIBIT [illegible]

[illegible]

	Investment in U.S. $	Maintenance Rate	Maintenance cost in U.S. $/yr	Depreciation yrs.	Depreciation rate %	Depreciation U.S. $/yr
PLANT						
1. Ammonia Plant						
A. Foundations	1,5[illegible]	1	15,600	15	6.67	[illegible]
B. Machinery	[illegible]	3	160,800	15	6.67	357,512
C. Off sites & Buildings	[illegible]	1	[illegible]	20	5.00	110,[illegible]
Total Ammonia Plant	[illegible],8[illegible]		196,3[illegible]			557,780
2. Urea Plant						
A. Foundations	960,000	1	9,600	15	6.67	64,032
B. Machinery	3,840,000	3	115,100	15	6.67	[illegible]6,128
C. Off sites & Buildings	1,[illegible]6,150	1	12,561	20	5.00	[illegible]
	6,056,150		137,261			302,968
3. GRANULAR COMPLEX Fertilizer Plant						
A. Foundations	266,000	1	2,660	15	6.67	17,742
B. Machinery	1,064,000	5	53,200	15	6.67	70,969
C. Off sites & Buildings	596,[illegible]0	1	5,964	20	5.00	29,[illegible]
Total Gran Complex. Fert. Plant	1,926,3[illegible]0		61,424			118,529
4. Products Storage, Bagging and Shipping						
A. Foundations	40,400	1	400	15	6.67	2,695
B. Machinery	161,600	3	4,850	15	6.67	10,779
C. Off site & Buildings	739,700	1	7,400	20	5.00	37,000
Total Prod. Stor., Bag. & Ship.	941,700		12,650			50,474
5. Automotive & Mobile Equipment	200,000	20	40,000	5	20.00	40,000
TOTAL MANUFACTURING	18,042,000		448,113		6.37	1,149,7[illegible]

EXHIBIT [illegible]

INTEREST ON INVESTMENT

	M M $
Plant Investment	18.55200
2 year interest on loan	2.22600
	20.77800

INTEREST ON LOAN - 10 YEARS @ 6%

1 st.	year	interest	on	20.7780	M M	1.247
2nd	"	"	"	18.7002	"	1.122
3rd	"	"	"	16.6224	"	0.997
4th	"	"	"	14.5446	"	0.873
5th	"	"	"	12.4668	"	0.748
6th	"	"	"	10.3890	"	0.623
7th	"	"	"	8.3112	"	0.499
8th	"	"	"	6.2334	"	0.374
9th	"	"	"	4.1556	"	0.249
10th	"	"	"	2.0778	"	0.125
Total 10 years interest						6.857
Plus 2 years interest						2.226
Total Interest						9.083

INTEREST DISTRIBUTION TO MANUFACTURING PLANTS

MANUFACTURING PLANT	INVESTMENT MM$	% of TOTAL INVESTMENT	COST IN MM$/YR.
Ammonia	8.91780	50.0	0.45415
Urea	6.05615	33.9	0.30791
Complex Fertilizers	1.92635	10.8	0.09810
Bagging & Shipping	0.94170	5.3	0.04814
TOTALS	17.84200	100.0	0.90830

EXHIBIT P

IMPORTED RAW MATERIAL COST DELIVERED PLANT SIZE

		Cargo		
		Liquids *		Dry **
		Naptha	Phos. Acid	Potash
A.	Port Authority Charges - Corinto			
	1, Wharfage/M.T.	$ 1,430	$ 1,430	$ 2,860
	2. Hauling/M.T.	0.180	0.180	0.715
	Total/M.T.	$ 1.610	$ 1.610	$ 3.575
B.	Custom Broker Charges			
	1. Handling/M.T.	$ 0.600	$ 0.600	$ 0.600
	2. Commission/M.T.	0.094	0.470	0.160
	Total/M.T.	$ 0.694	$ 1.070	$ 0.760
C.	Delivery to Plant			
	1. Freight-Corinto-Chinandega/M.T.	$ 1.080	$ 0.900	$ 1,500
	2. Unloading At Plant/M.T.	0.300	0.300	0.100
	Total/M.T.	1.380	1.200	1.600
D.	Total Handling Cost	$ 3.684	$ 3.880	$ 5.935
E.	CIF PRICE	26.520	62.00	42.500
F.	Cost Raw Materials Delivered - Plant Site	$30.204	$ 65.88	$ 49.435

* On liquid cargos, cost based on main storage located in exisiting tank terminal at Corinto and hauled by rail to small storage tank of plant site of Chinandega.

** Assumes maximum use of rail to transport material to plan site of Chinandega.

EXHIBIT [illegible]

COST OF FERTILIZER BAGS - [illegible]

SOURCE: Plant Manager of SACOS [illegible] Sr. Hugo [illegible]

Urea Bags - 25" W x 36" L	$ 283.00/1,000 bags
" Liners -27" W x 40" L /1½ mils	34.60/1,000 liners
Other Fertilizer Bags 22" W x 36" L	$ 247.00/1,000 bags
" " Liners 24" W x 40" L/1½ mils	[illegible]/1,000 liners
Cost of Printing - 3 colors	$ 10.00/1,000 bags
Cost of Inserting Liners	$ 3.00/1,000 bags
Weight Per bag 22" W	= 124 grs/bag
Weight " " 25" W	136.6grs/bag
1MT of 22" W Bags	= 8,750 bags
1MT of 25" W Bags	= 7,320 bags

UREA BAGS	COST $ / BAG
Cost of Bag	$ 0.2830
Cost of Liner	0.0346
Cost of Printing	0.0100
Cost of Inserting Liners	0.0030
Trucking to Managua (1.86/MT)	0.0003
Freight Managua to Chinandega (R.R.)	0.0004
TOTAL COST	$ 0.3303

Cost per Metric Ton Urea, including bag spoilage, thread, etc.
.34 x 22 $ 7.48

OTHER FERTILIZER BAGS	COST $ / BAG
Cost of Bag	0.2470
" " Liner	0.0323
" " Printing	0.0100
" " Inserting Liner	0.0030
Trucking to Managua	0.0002
R.R. Freight	0.0003
TOTAL COST	0.2933

Cost per MT Fertilizer, Incl. bag spoilage, thread, etc:
.30 x 22 $ 6.60

[illegible] T [illegible]

A [illegible] TI [illegible]

[illegible] 66, [illegible] /Y [illegible] 330 D/Y

[illegible] 6.70 [illegible]
[illegible] 2.[illegible] [illegible]
[illegible] 8.[illegible]128 MM [illegible]

[illegible]

[illegible]:	Units	Units/ [illegible]	$/Unit	$/yr	$/MT
[illegible]	[illegible]	6.[illegible]	[illegible]	1,[illegible]	[illegible]
[illegible]:					
Power	KWH	[illegible]	0.01	599,94[illegible]	9.09
F[illegible]l					
Steam, [illegible]	[illegible]	[illegible]	0.[illegible]	-(21,7[illegible])	-(0.33)
St[illegible]					
[illegible]					
Co[illegible]	[illegible]	2[illegible].3	0.02	12[illegible],[illegible]00	1.85
B[illegible]	[illegible]	6.[illegible]	0.[illegible]	[illegible],300	0.55
Cat[illegible]				108,900	1.65
Total Vari[illegible] Cost				2,302,740	34.89
FIXED [illegible]					
Labor:					
Operator				28,454	0.43
Helper					
Labor[illegible]					
Supervi[illegible]				26,913	0.41
Total Direct Labor				55,367	0.84
Other:					
Overhead				144,638	2.19
Maintenance				196,3[illegible]	2.[illegible]
Taxes & Insurance @ 1%				[illegible]9,17[illegible]	1.35
Depreciation				557,7[illegible]	8.45
Interest on Investment @ 6%				454,153	6.88
Total Fixed Cost				1,497,491	22.69
Total Production Cost/MT				3,800,231	57.58

Plant [illegible]

Plant [illegible]
[illegible]
Total [illegible]

VA[illegible]

Raw [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ammonia	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Carbon [illegible]	PT	[illegible]	[illegible]	[illegible]	[illegible]
Utilities:					
Power	KWH	[illegible]	[illegible]	[illegible]	[illegible]
Fuel					
Steam, [illegible] Export	[illegible]	[illegible]	[illegible]	[illegible]	-([illegible])
Steam, [illegible]	PT	[illegible]	[illegible]	[illegible]	[illegible]
Process [illegible]	-	-	-	-	-
Cooling [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Boiler Feed Water Export	[illegible]	[illegible]	[illegible]	25,[illegible]	0.2[illegible]
		[illegible]	([illegible])	-(2,[illegible])	-([illegible])
Catalyst & Chem.	-	-	-	-	-
Total Variable Cost				[illegible]	[illegible]
FIXED COST					
Labor					
Operators				[illegible]	[illegible]
Helpers				-	
Laborers				-	
Supervision				[illegible]	[illegible]
Total Direct Labor				[illegible]	[illegible]
Other:					
Overhead				11[illegible]	[illegible]
Maintenance				[illegible]	[illegible]
Taxes & Insurance				[illegible]	[illegible]
Depreciation				[illegible]	[illegible]
Interest on Investment				[illegible]	[illegible]
Total Fixed Cost				1,[illegible]	[illegible]
Total Production Cost/MT, Bulk				4,[illegible]1	[illegible]
Total Production Cost/MT, Bagged				5,445,250	5[illegible].50

E X [illegible] T

[illegible]

		Units/			
[illegible]	[illegible]	[illegible]	$/Unit	$/Yr	$/MT
[illegible]		[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	"	[illegible]	[illegible]	[illegible]	7.6[illegible]
[illegible]	"	0.[illegible]	55.36	[illegible]	1.87
[illegible]	"	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	"	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	"	[illegible]	[illegible]	[illegible]	[illegible]
UTILITIES:					
Power	KWH	[illegible]	0.[illegible]	43,[illegible]	0.6[illegible]
Fuel	[illegible]	[illegible]	0.[illegible]	24,[illegible]	0.34
[illegible]					
[illegible]	-	-	-	-	-
Process Water	M-Gals	0.1[illegible]	0.1[illegible]	720	0.01
Cooling Water	-	-	-	-	-
Boiler Feed Water	-	-	-	-	-
Catalyst & Chem.	-	-	-	-	-
Total Variable Cost				[illegible],413,[illegible]	61.29
FIXED COST					
Labor:					
Operators				24,893	0.35
Helpers				3,556	0.05
Labores				-	-
Supervision				[illegible]	0.12
Total Direct Labor				37,[illegible]	0.52
Other:					
Overhead				97,[illegible]	1.35
Maintenance				61,[illegible]	0.86
Taxes & Insurance				19,25[illegible]	0.2[illegible]
Depreciation				11[illegible],529	1.6[illegible]
Interest on Investment				[illegible]	[illegible]
Total Fixed Cost				[illegible]	[illegible]
Total Production Cost/ MT-Bulk				[illegible]	[illegible]
Total Production Cost/ MT-Bagged				5,413,527	75.[illegible]5

[illegible]

P R O [illegible]

CAPACITY - 168,000 MT/YR, [illegible]

INVESTMENT - [illegible],9017 [illegible]

VARIABLE [illegible]

	Unit	Unit [illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Bags-Urea	ea.	22	[illegible]	[illegible]	[illegible]	
Bags-Gran Fert.	ea.	22	.40	[illegible]	[illegible]	
Gasoline, Oil etc.				1,[illegible]		[illegible]
Total Variable Cost					7.[illegible]	6.[illegible]

FIXED COSTS

LABOR:

Operators	14,[illegible]	[illegible]	[illegible]
Laborers	4,[illegible]	0.[illegible]	[illegible]
Supervision	[illegible]	[illegible]	[illegible]
Total Direct Labor	24,[illegible]	0.[illegible]	0.[illegible]

Other:

Overhead	[illegible]	0.[illegible]	0.39
Maintenance	12,6[illegible]	0.[illegible]	0.[illegible]
Taxes & Insurance	9,417	0.06	0.06
Depreciation	50,474	0.30	0.30
Interest on Investment	4[illegible],14[illegible]	0.2[illegible]	0.[illegible]
Total Other	18[illegible],577	1.10	1.10
Total Fixed Cost	210,[illegible]	1.2[illegible]	1.25
Total Cost Bagging & Shipping			
Urea	[illegible]	8.[illegible]	
Granular Fertilizers	566,[illegible]		7.[illegible]
Cost of Bagged Urea with 2% Coating agent	954,4[illegible]	[illegible].94	

[illegible] 7-[illegible]

[illegible]

[illegible] /Y

[illegible]

[illegible]	[illegible]	Units/ MT	$/Unit	$/Yr	$/MT
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
ATM[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Total Utilities	[illegible]	[illegible]
Total Variable Cost	[illegible]	[illegible]
Total Fixed Cost	147,245	6.01
Total Production Cost/MT - Bulk	[illegible]	72.63
Total Production Cost/MT - bagged	1,972,105	[illegible]

[illegible]

[illegible] FERTILIZER [illegible] - 30 - [illegible]

Tons Produced [illegible]

VARIABLE COST

Raw Materials:	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Phosphoric acid [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ammonia [illegible] N	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Potash - 60% K_2O	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Others	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
TOTAL UTILITIES				[illegible]	[illegible]
Total Variable Cost				[illegible]	[illegible]
Total Fixed Cost				[illegible]	[illegible]
Total Production Cost/MT - Bulk				[illegible]	[illegible]
Total Production Cost/MT - Bagged				1,0??,??	[illegible]

EXHIBIT V-[illegible]

[illegible]

Tons Production [illegible]

VARIABLE [illegible]

Raw Materials:	Units	Units/ MT	$/unit	$/yr	$/MT
Phosphoric Acid - 54% P_2O_5	MT	0.2515	[illegible]	[illegible]	[illegible]
Ammonia - [illegible]% N	MT	0.0655	[illegible]	[illegible]	[illegible]
Urea - 46.[illegible]% N	MT	[illegible]	[illegible]	[illegible]	[illegible]
Potash - 60% K_2O	MT	0.2535	59.44	[illegible]	[illegible]
Gypsum	MT	[illegible]	[illegible]	[illegible]	[illegible]
Coating Agent	MT	[illegible]	[illegible]	[illegible]	[illegible]

	$/yr	$/MT
Total Utilities	5,957	0.95
Total Variable Cost	[illegible]	[illegible]
Total Fixed Cost	32,681	6.01
Total Production Cost/MT - Bulk	[illegible]	[illegible]
Total Production Cost/MT - Bagged	394,270	[illegible]

[illegible]

[illegible]

T... Production ... [illegible]

Variable ...

Raw Materials	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Total Utilities				[illegible]	[illegible]
Total Variable Cost				[illegible]	[illegible]
Total Fixed Cost				[illegible]	[illegible]
Total Production Cost/... - ...				[illegible]	[illegible]
Total Production Cost/... - Bagged				[illegible]	[illegible]

EXHIBIT [illegible]

[illegible] 13 - 13 - [illegible] PRODUCTION COST

[illegible]

[illegible]

Raw Materials:	Units	Units/ MT	$ Unit	$/Yr	$/MT
[illegible]	[illegible]	.2350	[illegible]	96,105	15.46
[illegible]	[illegible]	.0340	37.53	37,770	3.86
[illegible]	[illegible]	.2200	33.36	65,051	10.39
[illegible]	[illegible]	.3176	33.53	105,892	16.86
[illegible]	[illegible]	.1800	16.00	11,025	2.40
[illegible]	[illegible]	.0200	60.00	7,512	1.20

Total Utilities 5,947 0.95

Total Variable Cost 309,396 49.52

Total Fixed Cost 37,623 6.01

Total Production Cost/MT - Bulk 347,619 55.[illegible]

Total Production Cost/MT - Bagged 396,823 63.39

EXHIBIT V-5A

COMPLETE FERTILIZER 12 - 24 - 12 PRODUCTION [illegible]

Tons Produced 6,270 MT/Y

VARIABLE COST

Raw Materials:	Units	Units/MT	$/Unit	$/YR	$/MT
Phosphoric Acid-54% P_2O_5	MT	[illegible]	[illegible]	[illegible]	[illegible]
Ammonia - 82.% N	MT	[illegible]	[illegible]	46,775	7.46
Urea - [illegible] N	MT	[illegible]	[illegible]	9,530	1.52
Potash - 60% K_2O	MT	[illegible]	59.44	63,076	10.06
Gypsum	MT	[illegible]	[illegible]	[illegible]	[illegible]

Total Utilities	5,952	0.95
Total Variable Cost	[illegible]	23.44
Total Fixed Cost	37,623	6.01
Total Production Cost /MT - Bulk	372,75[illegible]	59.45
Total Production Cost /MT - Bagged	422,034	67.31

EXHIBIT W-1

GRANULAR COMPLETE FERTILIZER FORMULATIONS

RAW MATERIALS:

1. H_3PO_4 — %

	%	
P_2O_5	54.0	(74.5% Phosphoric Acid)
Free SO_4	3.5	
Total Solids	1.5	
Free Water	20.5	
P_2O_5 Anhydrous Basis	68.8	

2. KCL (POTASH)

K_2O	60.0	(Min)

3. AMMONIA

N	82.2

4. FILLER

Gypsum	Inert.

18.2 - 47.0 - 0	Lbs/ST	%	Lbs / S. Ton N	Lbs / S. Ton P_2O_5	Lbs / S. Ton K_2O
Component					
Phosphoric Acid	1,740	87.00	-	940	-
Ammonia	443	22.15	364	-	-
Inerts in H_3PO_4	86	4.30	-	-	-
Filler	48	2.40	-	-	-
H_2O in Product	20	1.00	-	-	-
SUB TOTAL	2,337	116.85	364	940	-
Water Removed	- 337	16.85	-	-	-
TOTAL PRODUCT	2,000	100.00	364	940	-

10.2 - 40.4 - 10.2	Lbs/ST		Lbs / S. Ton N	P_2O_5	K_2O
Phosphoric Acid	1,496	74.80	-	808	-
Ammonia	248	12.40	204	-	-
KCl	340	17.00	-	-	204
Inerts in H_3PO_4	74	3.70	-	-	-
Filler	108	5.40	-	-	-
H_2O in Product	20	1.00	-	-	-
SUB TOTAL	2,286	114.30	204	808	204
Water Removed	- 286	14.30	-	-	-
TOTAL PRODUCT	2,000	100.00	204	808	204

10.2 - 30.3 - 10.2					
Phosphoric Acid	1,122	56.10	-	606	-
Ammonia	248	12.40	204	-	-
KCl	340	17.00	-	-	204
Inerts in H_3PO_4	56	2.80	-	-	-
Filler	424	21.20	-	-	-
H_2O in Product	20	1.00	-	-	-
SUB TOTAL	2,210	110.50	204	606	204
Water Removed	- 210	10.50	-	-	-
TOTAL PRODUCT	2,000	100.00	204	606	204

12.2 - 24.3 - 12.2					
Phosphoric Acid	903	45.15	-	486	-
Ammonia	259	12.95	213	-	-
Urea	67	3.35	31	-	-
KCl	407	20.35	-	-	244
Inerts in H_3PO_4	45	2.25	-	-	-
Filler	464	23.20	-	-	-
H_2O in Product	20	1.00	-	-	-
SUB TOTAL	2,165	108.25	244	486	244
Water Removed	- 165	-8.25	-	-	-
TOTAL PRODUCT	2,000	100.00	244	486	244

15.2 - 15.2 -15.2

COMPONENT	Lbs/ST	%	Lbs / S. Ton N	P_2O_5	K_2O
Phosphoric Acid	563	28.15	-	304	-
Ammonia	131	6.55	108	-	-
Urea	423	21.15	196	-	-
KCl	507	25.35	-	-	304
Inert in H_3PO_4	28	1.40	-	-	-
Filler	383	19.15	-	-	-
Coating Agent	40	2.00	-	-	-
H_2O in Product	20	1.00	-	-	-
SUB TOTAL	2,095	104.75	304	304	304
Water Removed	- 95	4.75	-	-	-
TOTAL PRODUCT	2,000	100.00	304	304	304

13.2 - 13.2 -20.2

COMPONENT	Lbs/ST	%	N	P_2O_5	K_2O
Phosphoric Acid	470	23.50	-	264	-
Ammonia	68	3.40	56	-	-
Urea	458	22.90	208	-	-
KCl	674	33.70	-	-	404
Inert in H_3PO_4	7	0.35	-	-	-
Filler	360	18.00	-	-	-
Coating Agent	40	2.00	-	-	-
H_2O in Product	20	1.00	-	-	-
SUB TOTAL	2,097	104.85	264	264	404
Water Removed	97	4.85	-	-	-
TOTAL PRODUCT	2,000	100.00	264	264	404

EXHIBIT X

COST OF FERTILIZER PRODUCTION AT 50 TO 100 OF PLANT CAPACITY

PLANT	100	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1. AMMONIA						
MT. Ammonia per yr	366,000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Fixed Cost/MT	22.69	[illegible]	28.36	32.41	[illegible]	[illegible]
Variable Cost/MT	34.89	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Total Cost/MT	57.58	[illegible]	[illegible]	[illegible]	72.71	[illegible]
2. UREA						
MT. Urea per yr	99,000	89,100	[illegible]	69,300	59,400	[illegible]
Fixed Cost/MT	10.61	11.79	[illegible]	15.15	17.69	[illegible]
Variable Cost/MT	34.75	36.19	37.98	40.29	43.37	47.67
Total Cost/MT-Bulk	45.36	47.95	51.18	55.44	61.06	[illegible]
Total Cost/MT-Bags	55.30	58.06	61.44	65.92	71.84	[illegible]
3. GRAN COMPLEX FERT.						
MT. Fert. per yr	72,000	64,800	57,600	50,400	43,200	[illegible]
Fixed Cost/MT	6.01	6.68	7.51	8.58	10.10	[illegible]
Variable Cost/MT	61.29	61.72	[illegible]	62.96	[illegible]	[illegible]
Total Cost/MT-Bulk	67.30	[illegible]	69.77	[illegible]	[illegible]	[illegible]
Total Cost/MT-Bags	75.16	76.26	77.63	79.40	[illegible]	[illegible]
4. BAGGING & SHIPPING						
MT. per year	168,000	151,200	134,400	117,600	100,800	84,000
Fixed Cost/MT	1.25	1.39	1.57	1.79	2.09	2.50
Variable Cost:						
a) Urea	8.69	8.69	8.69	8.69	8.69	8.69
Total Cost Urea[1]	9.94	10.08	10.26	10.48	10.78	11.19
b) Gran Fert.	6.61	6.61	6.61	6.61	6.61	6.61
Total Cost Gran Fert.	7.86	8.00	8.18	8.40	8.70	9.11

[1] Contains cost of adding 2% coating agent.

EXHIBIT Y

COST OF IMPORTED BAGGED FERTILIZERS DELIVERED CHINANDEGA, AT CIF-CORINTO OF FROM $45.00 TO 75.00 PER MT.

ITEM OF COST	COST OF BAGGED IMPORTED FERTILIZER-CHINANDEGA						
CIF Price-Corinto	$45.00	$50.00	$55.00	$60.00	$65.00	$70.00	$75.00
Wharfage & Handling	3.58	3.58	3.58	3.58	3.58	3.58	[illegible]
Ad Valorem Tariff	4.50	5.00	5.50	6.00	6.50	7.00	7.50
Custom Broker Fee	0.75	0.80	0.85	0.90	1.00	1.05	1.10
Freight & Handling[1]	2.20	2.20	2.20	2.20	2.20	2.20	[illegible]
Cost-Chinandega	56.03	61.58	67.13	72.68	78.28	[illegible]	[illegible]
Cost Over CIF	11.03	11.58	12.13	12.68	13.28	[illegible]	14.38

[1] Truck Freight Rates

EXHIBIT Z

ESTIM[illegible] INVESTMENT COST OF BATTERY LIMIT PLANTS

	COST IN MM DOLLARS, U. S. A. D & E COST GULF COAST U. S. A.	D & E COST NICARAGUA
1a. Ammonia Plant, [illegible] MT/D Natural Gas Feed Stock	4.60	5.98
b. Ammonia Plant, [illegible] MT/D Naptha Feed Stock	5.15	6.70
2a. Ammonia Plant, [illegible] MT/D Natural Gas Feed Stock	5.50	6.32
b. Ammonia Plant, [illegible] MT/D Naptha Feed Stock	6.15	8.00
3a. Urea Plant, 200 MT/D	3.00	3.90
b. Urea Plant, 300 MT/D	3.70	4.80
4. Granular Complex Fertilizer Plant (*)		
a. 200 MT/D	0.98	1.27
b. 240 MT/D	1.10	1.43

	$ U. S. A NICARAGUA
5. Product Storage, Bulk & Bagged and Bagging Mil[illegible]	
(a) Belt Conveyor Prill Tower to Urea Surger Hopper	3,000
(b) Elevator to surge hopper	6,000
(c) Surge hopper, 900 MT, 30' D x 60' H epoxy painted steel pressurized with refrigerated air	40,000
(d) Conveyor to coating drum	4,000
(e) Coating drum, coating agent hopper and feeder	50,000
(f) Elevator to bagging surge hopper	6,000

EXHIBIT 2 (CONT.)

		$ U. S. A. NICARAGUA
(g)	Bagging surge hopper - 2 a 25 MT	12,000
(h)	Bagging machine, incl extra heat sealing head & sewing machine, slat conveyors etc.	16,000
(i)	Bagging mill building 35'w x 75'H	35,000
(j)	Conveyors from bagging to storage	30,000
	Sub total	202,000
(k)	Bulk storage for granular complex fertilizer and potash - 2,000 MT of fert. & 4,000 MT of potash - 80'W x 200'L x 35'H.(**)	230,000
(l)	Bagged storage - 4 months production of all products, 241,000 Sq. Ft. by 20'H - prefab. building, insulated roof and 5" reinforce concrete floor	480,000
	TOTAL	$ 912,000

(*) Source - Personal Files

(**) Height to top of pile, building of A - frame type.

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