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UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

Vienna

FEDERAL REPUBLIC OF NIGERIA

Project SI/NIR/85/801

contract 85/126

Assistance in the Evaluation of Tenders for Factories to be Established in

Bendel State of Nigeria

T E C H N I C A L R E P O R T

Polytechna Prague

Research Institute for Ceramics, Refractories and Non-metallic Raw Materials, Pilsen

Czechoslovakia

April 1986

1. EXPLANATORY NOTES

1 N (Naira)	= 100 kobo = 1.084 US $ (26. Nov. 1985)
FOB	= Free on board
CIF	= Cost - Freight-insurance
SQ. M.	= Square meter
CU. M.	= Cubic meter
SCM	= Standard cubic meter
SCF	= Standard cubic foot
MT	= Metric tonne
TPD	= Tonne per day
TPA	= Tonne per Annum
MWH	= Megawatt hour
LPP	= Low pour point
PSA	= Pressure-swing- adsorption
N.N.P.C.	= Nigerian National Petroleum Company
NPK	= Nitrogen-phosphorus-potassium complex fertilizer
CN	= Calcium nitrate
CAN	= Calcium ammonium nitrate
AN	= Ammonium nitrate

2. ABSTRACT

On basis of a contract between UNIDO Vienna and Polytechna, Foreign Trade Company, Technical Cooperation Agency Prague, Czechoslovakia, three consultants, Mr. P. Duchek, ceramic technologist, Mr. J. Mueller, industrial economist and Mr. J. Novotný, chemical engineer were appointed to evaluate and pre-select tenders to set up a ceramic plant producing glazed ceramic tiles and sanitarywares. The other project tendered was a small scale ammonia/urea plant. The well prepared pre-investment phase in case of ceramic project substantiates consideration to establish a financing corporation. Criteria were set up which would enable to select unambiguously the most suitable offer meeting the technical and economic considerations. In case of fertilizer project the conditions on local markets have changed since 1982 when a feasibility study was elaborated. Consequently, a comprehensive feasibility study on different production programme should be elaborated. The new prospective products required in Nigeria are complex fertilizers. Based on the evaluation of local conditions and presented tenders relevant activities were recommended to be carried out.

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4. INTRODUCTION

There are favourable conditions in Bendel State for establishing ceramic industries; cheap energy and manpower, non-metallic raw materials and large market of Nigeria which is supplied from abroad. On this basis, considerations to establish and subsequently diversify ceramic industries are substantiated. The Ministry of Commerce and Industry had feasibility studies elaborated which proved economic viability of a small-scale production capacity to produce glazed ceramic tiles and sanitary wares. The pre-investment phase was accomplished and tenderers were invited to offer. The invitation for tender was well prepared by the Ministry and 7 bids did not differ essentially in the quoted prices, some minor differences can be ascribed to monetary affects rather than to the differences in quantity and quality of equipment. All the bids were evaluated quantitatively whether they correspond to the projected capacity and production programme.

During preselection the stress was given to the sensitivity of offered technology and equipment to different changes which could set in and which could affect the production costs. For example, a part of unprocessed raw materials is more probable to be imported to feed the demanding single-firing technology with adverse impact on profitability. This risk is smaller in case of double-firing technology. Other criteria were suitability of equipment to the recommended low pour point oil and appropriate proportion between mechanized and manual operations. On this base 4 offers could be eliminated, The three left ones can be easily and unambiguously compared according to economic criteria; direct production costs, price of supply and/or financial terms and scope of offered shareholding.

The other tenders to be evaluated concerned ammonia and urea project on basis of cheap locally available associated natural gas. The pre-investment phase has been very long, feasibility study was elaborated in 1982. The conditions,

especially domestic supply of urea, has changed considerably since. The market is going to be supplied by new Port Harcourt plant which has excess capacity to supply domestic and foreign markets. The considerations of large scale ammonia production for export are not supported by reliable marketing data. Latest information reveals that a production plant supplying complex fertilizers for domestic Nigerian markets could have good prospects.

The bids on urea production were evaluated technically, however it is recommended not to take the venture before a comprehensive feasiblity study has been elaborated.

During the evaluation work technical discussions were held with the staff of the Ministry of Commerce and Industry which led to conclusion that technical assistance in establishing and contigent diversification of ceramic and fertilizer industries roofed up by UNIDO would be of considerable use. The assistance would involve training, elaboration of raw material inventories and the feasibility study on fertilizers.

The consultants had counterparts from the Ministry who very actively collaborated during the work and provided much information on local conditions. On the other hand, the technical and economic information given them could help in their future work. The objectives of the mission were fulfilled.

The consultants are much obliged to:

Mr. L. Oghene-Omoru, Honourable Commissioner for Commerce and Industry of Bendel State.
Mr. T. Owolabi, Permanent Secretary, Ministry of Commerce and Industry of Bendel State
Mr. O. U. Onuwaje, Cheif Industrial Officer, Ministry of Commerce and Industry of Bendel State
for all the attention and assistance extended during their work.

5. RECOMMENDATIONS

(1) Owing to the well prepared pre-investment phases by the Ministry of Commerce and Industry of Bendel State, it is possible to proceed to establishing a ceramic corporation, which will produce 600 000 sq. m. of ceramic glazed tiles and 3 000 tpa of sanitary ware.

(2) To carry out a final selection of a technical partner and supplier of equipment and technology of the turnkey project.

(3) To select a most suitable location for the ceramic enterprise considering technical and economic viewpoints and infrastructure. In view of employing the external economies, the most suitable location is probably Benin City as having grid system, road and telecommunication, University, schools, homes, governmental establishments and available manpower, among others.

(4) To procure all access to the unprocessed raw materials necessary for optimal body compositions throughout Nigeria. To procure all access to the utilities in the selected location and verify the available reserves of selected raw materials.

(5) To open clay deposits in Ozzara - Igbanke area for excavating and homogenizing several tons of samples for semi-industrial verification of both the ceramic technologies - glazed tiles and sanitary ware. To procure several tons of samples of kaolin and non-plastic components, such as feldspar, dolomite and/or limestone and quartz for pilot tests by the supplier of technology and equipment.

(6) To evaluate economy of setting-up a refractory workshop to produce refractory auxiliary materials on the spot; if economical, to extend the projected ceramic plant.

(7) There is not a sound information basis on which a decision could be accepted to establish the fertilizer industry in Bendel State

(8) To elaborate a market study on domestic demand for complex industrial fertilizers, especially NPK type, in Bendel State of Nigeria as a basis of subsequent decisions.

(9) Pursuant to the conclusions of market survey to elaborate a comprehensive feasibility study on establishing the fertilizer industry oriented on domestic and/or foreign markets, if need be.

(10) To apply to UNIDO through the UNDP Office, Lagos, for technical assistance in establishing ceramic and fertilizer industries and their contigent subsequent diversification. It is desirable to organize study tours, individual training, inventories of non-metallic minerals and rocks, pre-investment studies. Other technical assistance provided by UNIDO to the infant industries could also be needed.

6. EVALUATION OF TENDERS

A. Activities and Outputs

Federal Ministry of National Planning in Nigeria, advised UNDP Lagos to request UNIDO assistance in the evaluation of bids on establishment of the ceramic and fertilizer industries the Bendel State Government does not have necessary in-house expertise to make clear technical and economical evaluation of tenders. POLYTECHNA, Foreign Trade Corporation, Technical Co-operation Agency, Prague, Czechoslovakia having contracted the job appointed the team of three consultants (ceramic technologist, fertilizer technologist, industrial economist) to provide the government with the economic and technological expertise relating to the selection of contractors.

The experts during their assignment studied carefully all the tenders, feasibility studies and other relevant documantation as well as made themselves acquainted with local conditions and related problems. Durig the stay, the team also visited deposits of clays in Bendel State and location Ozarra - Igbanke which are supposed to be used in ceramic production, the natural gas and crude oil deposits and the port in Warri.

The nominated personnel of the Ministry of Commerce and Industry took part all the time throughout tender evaluation. The progress and results of the work were discussed.

The report itself is divided into the ceramic and fertilizer parts according to different problems evaluated. Each part has been elaborated as the complex unit covering both technological and economic aspects of bids. However, problems linked with establishments of ceramic and fertilizer plants differ. In case of ceramic factory, the local raw materials quality, homogenety and supply is of great importance. On the other hand, there exists an insufficient feasibility study on the fertilizer project and tenders were left to be evaluated only according to the status given and up-to-date information accessible. Especially the market for different fertilizer products was not evaluated. Therefore, further pre-investment steps are to be taken prior to any selection of bids.

1. EVALUATION OF CERAMIC TENDERS

1.1. Analysis of Background Information

1.1.1. Feasibility Studies Elaborated

Two feasiblity reports were elaborated in the course of 1983 by two consulting agencies.

- Oghene Omavuezi and Company, Consulting division, Benin City, February 1983.
- SITTI, Marano Ticino, Italy, May 1983.

While the Oghene Omavuezi elaborated a feasibility study on the production of ceramic glazed tiles and sanitary wares, the Italian consultant regarded only the production of glazed wall and floor tiles.

(a) Market, demand, prices, production programme

Import of Sanitary Ware to Nigeria

Year	Total quantity including fittings (MT)	Value (000N)
1973	8,766	3,593
1974	9,189	5,027
1975	12,201	10,656
1976	10,142	9,613
1977	12,966	13,392
1978	15,834	23,046
1979	6,412	11,358

(Source: Oghene Omavuezi)

Import of Ceramic Tiles and other Ceramic Wares

Year	Quantity (MT)	Value (000N)
1975	21,735	6,007
1976	20,047	6,369
1977	29,047	10,351
1978	28,257	13,966
1979	4,293	2,286

(Source: Oghene Omavuezi)

ESTIMATE OF FUTURE DEMAND

From the above import figures, the effective demand was forcast as groving by 24% annually in the case of sanitary wares and by 40% in the case of other ceramic products. It means that annual consumption in 1989 should be 168,745 MT in case of sanitary wares and 1 144 282 MT in case of other ceramic products. According to these figures, the share of proposed capacity would be almost negligible.

Pricing:

According to Oghene Omavuezi

1 kg of sanitary Ware - N4.3
1 sq. m. of floor tiles - N21.00
1 sq. m. of wall tiles - N13.50

According to SITTI:

1 sq. m. of glazed undecorated wall tiles - N10
1 sq. m. of glazed decorated wall tiles - N12
1 sq. m. of glazed decorated floor tiles - N14

Proposed production capacity

Oghene Omavuezi - 400 000 sq. m. of wall tiles
200 000 sq. m. of floor tiles
3 000 MT of sanitary ware

SITTI - 200 000 sq. m. of undecorated wall tiles
140 000 sq. m. of decorated wall tiles
260 000 sq. m. of decorated floor tiles

Taking into consideration the market figures from 1970's, the proposed capacities are reasonable. In the case of sanitary ware, the share of demand is about 25% - 50%. In the case of ceramic tiles, the share ranges between 30% - 100%. As for prices, it should be born in mind that those represent about 300% of average world ex-factory prices which are 3 - 5 US $ for 1 sq. m. of ceramic tiles and 1 - 1,5 US $ for 1 kg. of sanitary ware. There is a possibility for the importers to compete by cutting prices and therefore, it is advisable to protect the starting industries against low priced imports.

(b) Supplies of Inputs:

Both the feasibility studies failed to give sufficient data on raw materials and other inputs. No preliminary laboratory research in the body compositions based on local raw materials was carried out. As body composition on raw materials clays from the deposit Ozarra-Igbanke were recommended. Other non-plastic components were not considered. As for processed raw materials such as frits, stains, plaster of Paris and auxilliary materials, the studies suppose importing. For firing, low pour point oil is considered which is recommendable because of its availability throughout Bendel State.

(c) Location:

The feasibility study elaborated by Oghene Omavuezi recommends to set up the plant in the vicinity of the clay deposit. However, the feasibility study failed to describe availability of utility supplies and manpower and other infrastructures.

(d) Technological Processing:

Both the feasibility studies consider double firing of tiles pressed from spray-dried powder. In case of sanitary ware, manual casting is considered. With regard to the production capacities, unknown quality of raw materials and unskilness of manpower, these technologies should be optimal.

(e) Commercial Evaluation:

Providing the initial conditions of using local raw materials and of contemporary prices on Nigeria markets are valid, the economic viability of the project is ensured. Therefore, the industrial venture of establishing ceramic industries was recommended. Based on the recommendations and conclusions of the Oghene Omavuezi study, bidders were invited to tender.

(f) Cost - Benefit Analysis:

Both the feasibility studies evaluate the venture form the commercial point of view only. No national economic objectives are considered.

1.1.2. Other Background Information:

To select a bid that would be most suitable to the local conditions, some more data not provided by feasibility studies are vital. For example, the application of single firing technology is more sensitive to the quality of raw materials and, consequently, there is a higher risk of deterioration of profitability if large quantities of unprocessed raw materials were to be imported. The research of body compositions cannot start before the raw materials are available, so that tentative body compositions based on available data were suggested that the Bendel Authorities could start relevant negotiations.

(a) Tentative Input Balance for Ceramic Tiles Uprocessed Materials:

- ball clays approx	7 300 Tpa
- kaolin (white firing) approx	1 500 Tpa
- quartz approx	4 800 Tpa
- dolomite (limestone) approx	2 400 Tpa

Semi-processed and processed materials:

- Glazes and stains	1 000 Tpa
- Liquefying agents	10 Tpa

Auxiliary materials:

Kiln car furniture, lubricants and others.

Utilities per annum:

- Water	30 000 cum
- Electricity	2 500 MWh
- Natural gas	3 200 000 s.c.m.
- or fuel oil	2 500 MT

(b) Tentative input balance for sanitary wares

Unprocessed materials:

- ball clay	approx	1 100 Tpa
- kaolin	approx	1 100 Tpa
- feldspar	approx	1 100 Tpa
- quartz	approx	1 100 Tpa

Semi-processed materials:

- glazes and stains	approx	500 Tpa
- plaster of Paris	approx	500 Tpa
- deflocculants	approx	30 Tpa

Auxiliary Materials:

Kiln car furnitures, lubricants etc.

Utilities per annum:

- water	15 000 cum
- electric power	2 500 MWh
- natural gas	2 200 000 scm
- or fuel oil	1 300 Mt

(c) Availability of Inputs:

According to the PRODA's (Project Development Institute) report on the survey of clay deposits in Bendel State, there exist a large variety of raw materials suitable for ceramics. However, neither data on deposits as for their magnitude nor analyses of these raw materials are given. Concerning sanitary ware and tile production, the following raw materials could be obtained from local sources in Nigeria.

Unprocessed Raw Materials:

Ball clays: Deposits OZARRA/IGBANKE (Bendel State) that were recommended by the feasibility studies, reserves are estimated for 50 to several hundreds of years. They have higher silica and alumina contents, more clay substance and comparatively lower contents of feldspar and quartz. With respect to kaolinite and hallyosite components, the clay exhibits high plasticity. The clay can be used in body composition with other components like low-plasticity kaolin (white firing), feldspar, quartz, dolomite.

Quartz:	- deposits in the Kano State
Kaolin:	- deposits in the Plateau and Kaduna States
Feldspar:	- deposits near Okene (Kwara State)
Limestone:	- deposits in the North of Bendel State
Dolomite:	- deposits in Bendel and Kwara States

The acces to above deposits to get the necessary raw materials are to be negotiated with the Nigerian Mining Corporation prior to other decisions.

Semi-processed Raw Materials:

Glazes, chemicals and plaster of Paris are recommendable to be imported, at least in the initial years.

Utilities:

Availability of water and electric power is a question of location selection. The consultants visited the region Ozarra - Igbanke and are of opinion that only two places come into consideration as a location:, either the town Agbor which is a comparatively large one with a solid infrastructire or the capital of the State, Benin City. When in Benin City, the corporation will employ external economics most because there are schools, university, grid systems, banking, telecomunications, manpower, governmental establishments.

As for the fuel, the consultants recommend to use fuel oil because the access to the natural gas is too late to be negotiated unless the start of the industry is postponed considerably. The time necessary to negotiate this access with the Nigerian National Petroleum Corporation is 18 months at least.

Auxiliary Materials:

Lubricants etc. are supposed to be available locally. Kiln furniture (slabs, saggars) is not available within Nigeria according to given information. Both feasibility studies and offers suppose import of refractory auxiliary mateials. Annual output justifies considerations to set up a specialized refractory workshop provided with crushers, mills, presses, casting devices and shuttle kiln to produce them locally. It is recommended to negotiate the economic viability of this consideration with the selected supplier.

1.2. Analysis of Tenders:

1.2.1. Firms invited to bid:

On the basis of recommendations of Oghene Omavuezi report a letter of invitation to tender was prepared by the Ministry of Commerce and Industry of Bendel State (Annex 1). The following companies responded to the invitation:

I. Technipetrol Spa, Roma, Viale Castello della Magliani 68

II. Franz Kirchfeld GMBH and Co., Koenigshalle 17, 4000 Duesseldorf

III. Gillambourne Limited, 3, Doncaster Drive, Merseyside, England

IV. China Liaoning International Corporation of Economic and Technical Co-operation, China

V. Ceric, 18, Rue Royale - 75008 Paris, France

VI. Atlas Enterprise Limited, Baarerstrasse 43, Zug Ch. 6300, Switzerland (together with Agrob Anlagebau GMBH)

VII. Welko - Industriale SPA, 20122 Milano, Piazza Velasca 5, Italy

As far as the conditions of tender are concerned four of the above bidders offer complete turnkey projects of required capacities. They are Technipetrol, Franz Kirchfeld, Ceric and Atlas-Agrob. Welko offers sanitaryware plant of 1000 Tpa capacity only, while Gillambourne offers only production equipment.

China Liaoning's offer failed to describe the equipment and technology in sufficient detail. According to some data a conclusion can be drawn that no world standard ceramic products are scheduled (e.g. input 25 000 MT to produce 600 000 sq. m. of tiles corresponds to industrial paving tiles rather than interior ceramic tiles. Other information regarding the excesive 560 workers enables to deem that a high production cost ceramic plant would be set up.

Experience within Nigeria:

3 of the bidders have experiences in the Federal Republic of Nigeria. They have participated in the following brick/ ceramic ventures.

WELKO (Italy)

Quality Ceramic Products, Limited, in Itu-Chyo, Cross River State and Nigerian Italian Ceramic Products, Limited in Ifon, Ondo State.

These establishments - according to information letter of Messrs Welko have been producing tiles, sanitaryware and dinnerware.

CERIC (France)

Brick Factory at Funta (Kaduna State), and Brick Factory at Mumbi (Gongola State). The factory at Mumbi is operating well, while that at Funta has not started production yet.

KIRCHFELD (West Germany)

Nigergrob in Abeokuta (Ogun State) and Ceramic Manufacturers (Nig) Ltd., in Kano (Kano State).

The first establishment was started up in 1976, production being discontinued nowadays. The second plant was commisioned in 1984, now producing 3 300 tonns/year of sanitaryware and works properly with 90% of raw materials provided form Nigeria deposits.

1.2.2. TECHNOLOGICAL PROCESS APPLIED:

One of the most important standpoints concerns technological process, quality and quantity of production.

The bidders assume following technologies for tiles/sanitaryware production:

S/NO.	Bidder	tiles		sanitaryware (casting)
		floor	wall	
1.	Gillambourne	single-fired	double-fired	manual, battery
2.	Atlas-Agrob	single-fired	single-fired	manual, battery
3.	Kirchfeld	double-fired	double-fired	manual
4.	Ceric	double-fired	double-fired	manual
5.	Technipetrol	double.fired	double-fired	manual
6.	China L.I.C.1)	double-fired	double-fired	manual
7.	Welko	single-fired	single-fired	manual

Note 1: concerning "inner and outer wall bricks" incomparable with world standard tiles demanded.

Selection of the proper firing technology for tiles production has been evaluated from different technical and economic points of view taking into consideration mainly local conditions.

Exploitation of single-firing technology supposes plenty of good quality raw materials with fixed and homogeneous composition. Roller kilns used for single-firing process are highly sophisticated devices demanding skilled staff. To suggest this technology without precise chemical and mineralogical analyses of ceramic behaviour of local raw materials and without detailed geological prospection of deposits could be risky. According to the only accessible clay characteristics (Annexure II) some of the ball clays from Ozarra/Igbanke location contain a greater amount of organic matter. During the firing process, these contaminations are fired out of the raw material and in case of single-firing process, they can react with glazes resulting into colour changes, pin-holes etc. This could be precluded by using bisque firing. From the economic point of view, the risk of single-firing technology is further discussed in the paragraph 1.3. "PRODUCTION COSTS". Save for the above mentioned single-firing risks, there are no other important differences as far as the production process is concerned. The production of tiles is based on the preparation of slurry which then passes through spray drier to prepare for pressing powder, the green body is dried up after pressing to evaporate the remaining moisture (below 1%). In case of single-firing process dried tiles are glazed and decorated, if need be, and then rapidly fired. This technology conserves costs in firing and in direct manpower. Its advantages are best displayed in the production of floor tiles - very low specific heat consumption per selling unit (sq.m.) and in countries with high wages and low cost of electric energy.

In case of double-firing system, the shaped products are loaded on kiln cars to pass the drier and bisque firing kiln. Then they must be unloaded to feed the glazing lines. After

glazing they are again sagged on cars for glost firing. This process consumes more manpower (mainly semi-skilled or women), more energy due to the double-firing. However, in countries with cheap manpower and energy and in case of the production of thin wall tiles which weight about 60% of floor tiles per sq.m., the production costs do not differ considerably from single-firing. The consumption of unprocessed raw materials is also lower if standard 5 - 6 mm thick tiles are produced by double-firing. There is to be mentioned that there can be differences in organization of handling operations during double-firing. Devices were developed to mechanize the loading, unloading and kiln feeding operations. The result is a considerable conservation of manpower, especially that of unskilled. The mechanized or semi-automated handling is case of the offers of Technipetrol and Ceric. In case of Kirchfeld the higher consumption of assistants shows that manual loading is suggested. In case of sanitary ware there are no technological differences among the separate bids. The process is based on separate milling of plastic and non-plastic components. These two batches are then blunged together, sieved and magnetically separated, slip feeds then the cast slip distribution system. The casting is manual which is optimal with regard to the small output and other local conditions. Finishing of cast products, handling moulds, glazing are also manual operations as well as loading kiln cars for firing. The sanitary ware plants are provided with glaze preparation and mould forming shops.

If. L.P.P. fuel oil is used to fire sanitary ware muffled tunnel kilns should be applied to avoid quality problems which could set in with open flame kilns owing to impurities in the fuel.

1.3. PRODUCTION COSTS

a) Production Direct Costs:

There are 4 cost items which correspond directly with the type of equipment, used production method and which dif-

fer according to separate offers. Those costs are:

- cost of unprocessed raw materials
- cost of fuel
- cost of electric energy
- cost of direct manpower

These costs are compared according to separate bids below (Table 1). Other costs are not considered here because they depend on other factors, such as administration and selling cost, or they could not be fixed from the data given by bidders, such as auxiliary materials. There can be zero consumption of kiln furniture in case of single-firing technologies but on the other hand there will be cost in replacement of worn rollers etc. Usually it is not possible to calculate the exact price of auxilliary materials in the pre-investment phase and about 15% of total production cost is a good estimate in the case of ceramic tile production regardless the type of equipment and production technology. Therefore, the cost of auxilliary materials are not going to influence the option of bidders.

Cost of Unprocessed Raw Materials

However, a greater difference can be expected in case of unprocessed raw materials, namely plastic ones for the body compositions. All the bids are based on the presupposition that local mateials will be used save for some smaller correction parts not exeeding 10%. This is probably valid in case of double-firing technology (offered by Ceric, Technipetrol and Kirchfeld). In such a case the total mass of local inputs will be approximately 7 500 tonnes x 1,4 - 10 500 tonnes of inputs valid N20 per 1 tonne (according to presented feasibility studies). Annual cost will be then about N 210 000 or 35 kobo per sqm.

In case of single-firing technology, the risk of unsuitability of local raw materials is higher because the single-firing require well defined and stable plastic raw materials not containing (or only small quantities) organic matters. If about 40% of raw material inputs were to be imported, all the

advantages of single-firing could be thwarted up by high costs of raw materials. The total weight of single-fired output is about 11 000 - 12 000 tonnes (because thicker tiles must be produced of mass between 18 - 20 kg per sq.m.). Therefore costs of inputs will be 11 500 x 14 x 20 N=322 000 annually. If 40% of raw materials is imported for N 250 (low estimate) a tonne, then the annual cost will be N 1 803 000. On the other hand, if 40% of raw materials were imported in case of double -firing technology the cost of unprocessed raw materials would be N 1 176 000, i.e. lower by N 627 000. From this point of view it will be more prudent to select double-firing technology which has other advantages not negligible in case of starting industry e.g. simpler equipment requiring less experienced management and manpower.

Cost of fuel

These costs were calculated from the specific heat consumptions given by the separate bidders and the price of low pour point oil of calorific value of 9 600 kcal/kg. which is available in Bendel for 9 kobo per 1 kg. Natural gas as offered by several bidders cannot be recommended because it is not certain to be accessible cheeply (vide infra). Some sources as the N-ReN feasibility study on the urea project give the price as follows:

- 12 kobo per 1 000 SCF
- daily 300 000 SCM
- N2 200 000 fixed per annum
- the total price per 1 000 SCF is 60 kobo.

It is about 4 times less per a unit of calorific value then in case of oil, however, the consumption is enormous so that the fixed part of price does not affect considerably. In case of ceramic firing when the consumption of natural gas is 26 times lower the price of firing by natural gas would be at least 7 times higher provided the fixed cost of access to the natural gas is the same in case of the urea project. In addition, it was found, that time necessary to negotiate acces to the natural gas with the Nigerian National Petrol Corporation (NNPC) is 18 months. Therefore, it is recommendable to use

fuel oil which is assessible instantly.

Cost of Electric Energy

This item was derived from the installed electric capacity given by separate bidders. Eleven hours operation time of electric devices and 300 days annually were considered for each offer. There are differences among suppliers, they calculated electric power consumption on basis of 10 - 13 hours average operation.

Direct Manpower

This cost item was calculated on basis of break-downs given by separate bidders. Only direct manpower used in the process was taken into consideration because some bidders did not fix any data about service shops etc. Therefore, their costs are icluded into other overheads as given by feasibility studies for the offers to be comparable.

Based on feasibility studies, annual wages according to categories are as follows:

- skilled workers N 3 000
- semi- skilled workers N 2 500
- mechanics N 3 500
- laboratory N 2 500

b) Other Production Costs (Used only for the ceramic tile production)

There are included costs which are affected by other factors and are identical for all the bids. They are:

- auxilliary materials
- salaries

It is to be mentioned that financial costs are not considered here because they cannot be assessed at the moment as depending on the debt service etc.

Glazes and stains

It is estimated according to the feasibility studies that an average cost will be N 870 per tonne of applied glaze. It is estimated that 1 sq.m. of wall tiles requires 1 kg of glazes while this quantity is 1,3 kg in case of floor tiles.

Auxilliary Materials

The feasibility studies estimate them at about 28% of direct production costs.

Salaries

According to feasibility studies, this item will be N 585 000 in case of ceramic tiles.

Maintenance and Other Overhead Costs:

Cost of maintenance: 3% of CIF price of equipment were taken into account for each bid.

Other Overhead Costs: Based on feasibility studies N 200 000 is calculated for the tile factory. Table 2 presents total production costs in case of ceramic tiles. When comparing the production costs calculated on basis of data derived from separate bids there can be seen no considerable differences (Tables 1,2). In case of sanitary-ware the difference between the lowest cost and the highest cost bids is only 8%. In case of tile production there is a high cost offer, Franz Kirchfeld. This can be ascribed both to the high capacity reserves and to the high manpower consumption because of scheduled totally manual handling operations. Other offers differ negligibly since the lower cost in fuel and manpower in single -firing are counter-balanced by higher cost in electric power and unprocessed raw materials. It is to be underlined that Technipetrol offers the lowest cost for both ceramic productions.

Note: The offers will also influence cost of production by depreciation which will differ according to the price of equipment etc. However, this is not compared here.

In some cases these costs cannot be separated for the tile and sanitary-ware productions as some bidders failed to separate the prices of equipment. From the point of view of return on investment the different depreciations cannot affect the selection of bids since they do not influence the cash flow during the years of tax holiday as supposed by feasibility

studies.

1.4. SELECTION CRITERIA

It was necessary to compare the offers as complete units including both the production programmes, ceramic tiles and sanitaryware. If either production programmes were considered separately, a possibility of combining of two offers as most suitable option could set in.

For the comparison the below sequence of criteria was set up that would enable to eliminate the offers step by step until an optimal bid is selected. The offers that do not comply with all the criteria set up should be omitted from further considerations. There can be an objection against this procedure since some adjustments can be negotiated with selected bidders. However, there are bids enough to select a good one which will suit without further major adjustments. Additional negotiations with more than two bidders would prolong the decision making process.

- Completion of offer which is necessary if unproductive delays and extra investment costs are to be reduced
- Suitability of offered processing way to the accessible inputs and other local conditions which will influence the quality of final products and costs of production.
- Suitability of offered equipment to the required production programme and accessible inputs
- Direct production costs in manpower, raw materials, electric energy and firing which depend on the technology and equipment.

a) Completion of tenders (Table 7)

- TECHNIPETROL

The bid is complete within the tender conditions except for the quarring equipment.

As for the equipment offered there are only two presses projected. In case of operational breaks, troubles could set in.

- KIRCHFELD

The bid is complete within the tender conditions

- WELKO

The firm bids the sanitaryware plant of capacity of 1 000 Tpa only. It is insufficient in the terms of tender conditions.

- GILLAMBOURNE

Only production equipment is included without service shops and civil engineering works. The bid is not complete.

- CERIC

The bid is complete in the terms of tender conditions. Similarly to the Technipetrol tenders, only two presses are projected.

- ATLAS - AGROB

The bid is complete, however, the technical assistance and training are not included in the offer price.

- CHINA L.I.O.C.

The bid is not complete in the terms of tender conditions. In addition the offered production programme does not comply with world standard glazed wall and floor tiles.

b) Suitability of Technology

With regard to the unknown quality and quantity of unprocessed raw materials, it is strongly recommended to apply double-firing technology of ceramic tiles as it is less sensitive to the quality of raw material inputs. In addition to it, less quantity of raw materials will be consumed which influences positively the cost of production. The risk of using the expensive imported raw materials thus will be reduced. The following bidders offer single-firing technology; WELKO, GILLAMBOURNE, ATLAS-AGROB.

c) Suitability of equipment

With regard to the accessibility of fuels in Bendel State it is recommended to use equipment heated with fuel oil.

In comparison with natural gas this fuel oil (L.P.P) is accessible instantly at low price while the use of natural gas is to be negotiated with N.N.P.C. 18 months before at least. In addition, the fixed costs of this fuel are probably to be very high in case of small consumption units so that the total price could exceed the price of the fuel oil.

Concerning sanitaryware production, the use of L.P.P. fuel oil could be detrimental to the quality of final products in case of firing in open flame tunnel kilns. Therefore it is recommended to install muffled kilns in the plant producing sanitaryware.

The following bidders offer open flame kilns: GILLAM-BOURNE, ATLAS-AGROB, CERIC. The adjustment of the firing for fuel oil is not costly.

From the points of view of tenders completeness, suitability of proposed technology and equipment to local conditions, two bids comply best. They are Technipetrol and Kirchfeld. Technipetrol offer is based on SITTI technology and equipment which is the world known reliable supplier of ceramic technologies.

FRANZ KIRCHFELD offer is based on NETZSCH technology and equipment being also acknowledged throughout the world.
Note: It is worth mentioning that both above bidders were involved in elaborations of relevant feasibility studies. The first one recommended Franz Kirchfeld while the other one was elaborated by SITTI itself.

d) Production costs

There are presented data in Table 6 on physical consumption by separate bids which will influence the manufacturing costs. Built up area will ensue into the costs of

civil works, prices of equipment and technology will influence depreciation. Further there are data, on physical specific consumptions etc. In tables 1,2 there are presented direct production costs ensuing from the above data and contemporary prices of inputs in Bendel State. (The China L.I.O.C. offer is not presented because of the lack of information on physical inputs). As for the production direct costs, the lowest cost offer is that of Technipetrol.

The production costs ensuing from the data given by the bidders require some considerations paid to the contingent changes of prices of factors. As for the unprocessed raw materials their price N20/MT (datum from feasibility studies) is based on a presupposition of using locally available raw materials. There can be expected that in case of necessary imports or long distance domestic transports the loco factory price will go up considerably (as it was analysed above no location can be found in the vicinity of all necessary raw material, clays, kaolin, quartz, feldspar, limestome and dolomite). In this case the lower consumption of raw materials when the double-firing system is applied will influence the production costs and profit very distinctly. Therefore it is recommended strongly to apply double-firing technology for the tile production. On the other hand the prices of fuel can be looked upon as comparatively stable in view of the world oversupply of fuels experienced in recent years.

In case of manpower a growth of wages can be expected. In addition it is possible that the want of workers will be proportionally higher with regard to their unskillness. From this point of view a reasonable mechanization and semiautomation of operations is preferable to conserve the cost in unskilled manpower. It is also an experience within the ceramic industries that manual handling of glazed unfired products by unskilled manpower is usually detrimental to the final quality.

2. PRE-SELECTION OF OFFERS

It is recommended:

a) To exclude the China Liaoning offer from further considerations. It can be derived from the insufficient data presented that an industry without standard output (quoted from the offer: "inner and outer bricks" of mass about 40 kg/sq.m.) and with very high production costs would be set-up.

b) To exclude from further considerations the bids offering single firing ceramic tile technology. It consumes more unprocessed raw materials, and is very sensitive to the quality of inputs. Therefore, there is a danger of high production costs spent in a contingent unprocessed raw material import. The following firms offer single firing ceramic tile technology: Gillambourne, Welko, Atlas-Agrob. In addition, Welko offers only 1 000 Tpa capacity for sanitaryware.

c) To use equipment burning fuel oil because of questionable accessibility to the natural gas. Natural gas of quality as in Nigeria is perfectly suitable for firing sanitarywares in open flame kilns, however, it is not a case of L.P.P. fuel oil recommended to be used which could spoil the colour, especially that white, of sanitarywares. Therefore muffled kilns are recommendable even th ough the specific heat consumption is higher. Only Technipetrol and Kirehfeld offer muffled kilns for sanitaryware heated with fuel oil. However, this requirement does not exclude the offer of Ceric from further considerations because the company also delivers muffled kilns. The change can be easily negotiated including the adjustment of burners in case of tile production equipment.

d) To consider with the selected technical partner setting up a factory workshop to produce auxilliary refractory materials provided it is economical.

e) To use the economic performance to select further

- Table 1 presents direct production costs in the production of both ceramic tiles and sanitaryware which were derived from the data given by bidders and calculated on basis of contemporary prices.
- Table 2 presents total production costs in the ceramic tile production collected from the data given by bidders and SITTI feasibility study.
- Table 3 presents prices of components of supplies quoted by separate bidders. The quotations given for FOB supplies of equipment correspond to the completeness of supply and different technologies applied (for instance, the low price of the Gillambourne offer is a result of offering only production hardware without ancillary and service shops, therefore, the price of the complete supply can be expected to be higher). The quotations of civil works differ more distinctly. Therefore, the Ministry of Commerce and Industry had an estimate calculated of price of factory buildings per sq. m. The price for light factory hall with concrete floor, roofs without air controll and any machinery foundations is approximately N50 per sq. m. For rough estimate the built-up areas are presented in Table 6 together with other indicators.
- Tables 4, 5, 6 and 7 present different technological data which can be used for some special considerations during the final selection process.

3.0 EVALUATION OF FERTILIZER TENDERS

3.1 Analysis of Background Information

Feasibility study elaborated

A feasibility study presented as a preliminary draft was elaborated by N-Ren International, Vijhoeckstraat, 40-1801 Chateau du Pettite, Belgium in September, 1982. This study evaluated the possibility of production of urea for domestic Nigerian markets.

Nitrogen Potential Demand - Nigeria

(MT)

	1979/80	1982/83	1985/86
Nitrogen	83 000	156 000	400 000
Urea Equivalent	180 000	339 000	870 000

(N-ReN International)

Regional Demand for Nitrogen

(N-ReN International)

(%)

Regions	Campaign	
	1976/77	1977/78
Bendel State	5,8	5,4
Anambra State	8,6	7,9
Ogun, Ondo, Oyo States	14,0	13,0
Kwara State	14,2	13,0
Benue, Plateau States	18,6	15,8
Total % of Nigerian consumption	61,2	55,1

A conclusion is drawn from above figures that the regional need for urea will be 252 000 MT in agricultural camparing 1985/86. The demand estimate is supported by the discussion with Federal Ministry of Agriculture that assumes the consumption as follows:

- "All the 50 000 MT consumed during 1979/80 campaign was imported. It was predicted that in another 3 - 5 years about 1,5 - 2,0 million MT would be consumed in Nigeria annually".
- "Notwithstanding the projected capacity to be established in Rivers State there would be still an ample room for a plant producing 90 000 MT of urea annually. In fact the new Port Harcourt plant will deliver only 35% of the need in 1985".

Proposed Capacity

From the above forecasts the study proposed to set up a plant producing 90 000 MT ammonia/urea annually. This capacity would meet most of demand for urea in South-West Nigeria. There would be available markets for more urea and/or other types of fertilizers which may be produced by an extension to the plant by other facilities.

Raw Material Inputs

The plant was supposed to use as feedstock natural gas available in the Southern part of Bendel State (quantities and quality of natural gas are presented in Annex III). Already gas being produced in the course of oil production amounts to 57.10^6 cum/day and all but one-tenth is flared off.

Location

The feasibility study selected the Oleh-Ozoro area within the Isoko Local Goverment as the best suited site for the establishment of the urea project based on geological, technical and economic considerations.

Proposed Technology

In the feasibility study, conventional technology for ammonia production has been proposed. Natural gas feeds the desulphurization unit and after mixing with the steam passes through the primary reformer. After air input, the mixture is led to the secondary reformer with following two stage shift conversion of the gas originated and washing-out of carbon dioxide by

amine solutions. Being methanized and compressed, syngas originated enters the synthesis loop. In this process, the synthesis reaction at the pressure of 33,5 MPa proceeds. Liquid ammonia is separated from the loop after cooling. Suggestions for cooling of some main flows throughout the process by means of steam or condensate quenching are not common. These methods seem to be energetically less advantageous in comparison with processes exploiting indirect heat exchange.

The urea production process has been proposed with the total masses recirculation and with double decomposition of ammonia carbonate. Further on, evaporation of urea solution and pan granulation of the product has been formulated. Equipment for ammonia recovery from the waste condensate (originating by urea evaporation) containing more than 2 percent of ammonia has been proposed.

This process is less economical compared with stripping processes which are very spread all over the world. The process of granulation is not very common as well, dominating methods are prilling and cold spherodizing. However, pan granulation can be also used.

The draft feasibility study available to the consultants failed in giving any other important information concerning economic performance and impacts of the chemical production on environment. Other inputs and necessary infrastructures as far as their availability were not considered, either.

Other Information Available

During the introductory discussion with officers of Ministry of Commerce and Industry, there was revealed an objective to set up a medium size ammonia plant producing 1 000 tpd of ammonia of which 700 tpd should be exported and the remaining 300 tpd used for production of urea for export. Latin America was considered for ammonia and India, China, Far East for urea exports. Since the preliminary draft feasibility study was elaborated some presuppositions have changed. The Ministry of Agriculture (Annex IV) assesses the need for urea to be covered by Port Harcourt plant with excess to be exported; the

production of complex fertilizers of NPK type were recommended as desirable as for the need of the agriculture. It is assumed that Nigerian nitrogen fertilizers market will be supplied fully by domestic production, after 1990. No other reliable and up-to-date information about both domestic and foreign markets were available on the need for ammonia, urea, nitrates and complex fertilizers. Based on the above insufficient information no industrial venture can be recommended. Prior to further decisions a comprehensive feasibility study considering both domestic and foreign markets should be elaborated.
The supplement to the Feasibility study (App. III) deals only with availability of natural gas as the main input raw material. Other infrastructural requirements are not mentioned in the study.

The largest gas fields which may be considered are located to the north of the Warri Port and near the Sapele area. There is a suitable gas pipeline connected with Sapelle Ughelli and Aladja places. The quality of the natural gas is very high - the percentage of methane content reach more than 95 volume percent. However, closer data on pipeline capacities are not obvious from the feasibility study.

During their mission the consultants visited the area proposed for errection of fertilizer factory (Ozorro/Oleh) having recommended to find out the optimal place for this purpose. The area proposed should fulfil following provisions:

- proximity of a sea port
- sufficient road network
- possibility of joining the electricity network/Ughelli - line 132 kV, Warri - 33 kV /
- Sufficient capacity of the near water source and its type
- proximity of other industrial enterprises mainly those with close production programme (e.a. petrochemistry) and machineries.
- possibility of providing sufficient quantity of manpower with all infrastructural connections (schools, telecommunications, housing, banking facilities etc.)

Taking nito consideration these presuppositions, in the feasibility study proposed location (Ozorro/Oleh - district Isoko) seemed to be less advantageous compared with the area of Wari-Aladja near Wari-river which was visited by experts. This place should meet the requirements for area selection mentioned above. Nevertheless, the detailed evaluation should be done by a new feasibility study.

3.2 Analysis of Tenders

Following three companies answered the invitation to tender :

1) China National Chemical Construction Corporation, P.O. Box 1407, Beijing, China
2) Foster Wheeler, 31, Rue des Burdonais, Paris, France
3) Technipetrol, S.P.A, 00148 Roma, Viale Castello della Magliana 68, Italy.

Bid of China National Chemical Construction Corporation

(For the capacity of 220 MT of ammonia and 340 MT of urea per day). Tender does not proclaim name of the process of ammonia and urea production. Regarding the technology suggested, the usual process of ammonia production using natural gas and the total recirculation urea production are described. From the economic point of view the total recirculation urea production is less profitable than stripping processes. Stamicarbon and Snam Progetti stripping processes are preferred in the world (Table 8). Investment prices and production costs of stripping processes are lower than those of total recirculation processes without stripping (e.g. 15% lower production costs).

As for the tender itself, it was offered in a very brief and incomplete version. There are missing generally:

- declaration of processes for ammonia/urea production
- waste steam characteristics
- characteristics of catalysts; chemical and other materials
- detailed specification of main process equipment

- specification of piping, electrical, measuring and regulation devices
- civil works execution
- list of references

Bid of Foster Wheeler

Tender does not consider urea production. All the technology is divided into four parts:

(i) Reforming of natural gas - Foster Wheeler process
(ii) P.S.A. purification and nitrogen blending - Union carbide process
(iii) Air separation unit - Society L'Air Liquid process
(iv) Ammonia synthesis - Casale process

Data on earlier run of this technology are missing. The offer supposes considerable reduction of natural gas and utility consumptions. However, values of overall fuel and power consumption offered by Technipetrol and those of this technology are approximately the same taking different capacity into account. It is to note that common technologies as Haldor-Topsøe and Kellog processes with carbon dioxide removal and methanation operations which were put into force many years ago, have been verified and accomplished.
Most of the projects use these technologies of ammonia production form natural gas (Table 8).

The bid proper does not involve specifications of piping, devices, civil works as well as terms of delivery. CO_2 for urea production is not available from Foster Wheeler technology.

Bid of Technipetrol (Assuming capacity of 260 MT of ammonia and 460 MT of urea per day).

Technipetrol offered the most complete tender of the three bidders missing only ammonia and urea storage, handling, bagging, personnel requirements and terms of delivery.
As the natural gas inlet pressure given (4.3 MPa) differs from the actual one (2.5 - 2.8 MPa), the natural gas compressor should be used. The firm bids Snam Progetti stripping technology of urea production. Using titanium protection of exposed

parts of apparatusses and titanium tubes in the stripper is less advantageous in comparison with the Stamicarbon process using carbon dioxide stripping. Ammonia stripping runs approximately within 10°C higher temperature range than carbon dioxide stripping which could have impact on service life.

Snam Progetti process is recommended for its high energy efficiency and other advantages in comparison with other processes.

The comparison of natural gas and utilities consumptions is obvious from Table 15. As the Foster Wheeler tender did not offer urea technology, consumption values of Snam Progetti process (Technipetrol bid) were used in connection with Foster Wheeler ammonia consumption values and the table gives the best fuel and power consumption value level for Technipetrol with higher value level for the Chinese and Foster Wheeler offer. Economic evaluation could not be done owing to lack of economic data in tenders and feasibility study and estimate of consumptions for CO_2 producted by firing the natural gas utilizing the heat originated for electric energy production.

From the three bids submitted that of Technipetrol was of the highest completeness having offered ammonia/urea technology which has been very wide spread throughout the world and checked by many years praxis. In case of unchanged requirements for ammonia/urea plant, this offer could be submitted to following negotiations. Owing to the fact that the letter of Ministry of Agriculture (Annex IV) informs about the impending saturation of Nigerian market with urea and expresses demand on complex fertilizer production on the other side, the ammonia/urea production field of interest becomes to be irrelevant.

3.3. Production flow sheets of selected fertilizers

In order to provide some orientation for market investigation several flow sheets of selected possible technologies for other types of fertilizers including those com-

plex were elaborated. All the technologies are exploiting natural gas as the main input raw material.

The production flow sheets of different types of fertilizers are given in figures 1 to 7 according to separate varieties of products. The first step to nitrogen fertilizers production is an ammonia plant, following with either urea plant (Fig. 1) as the final step or nitric acid plant (Fig. 2 - 7). Ammonia nitrate resulting from reaction of ammonia with nitric acid plays an important role among nitrogen fertilizers (Fig. 2) being also mixed with limestone and/or dolomite (Fig. 3). By the similar process calcium nitrate can be produced (Fig. 4). Figure 5 presents the flow sheet of both NPK-complex fertilizer and calcium nitrate production. The most complex flow sheet (Fig. 7) assumes production of eight commodities including ammonium nitrate-urea liquid fertilizer which is of wide use namely in developed countries.

Figure 6 presents flow sheet for both NPK and ammonium nitrate production. Analysis of inputs and outputs together with their quality parameters is given in Table 16.

It can be estimated that for 200 000 Tpa of NPK fertilizer some 121 200 Tpa of phosphates and about 66 000 Tpa of potasium salt should be imported possibly from Togo (phosphates) and Republic of Congo (potasium salt).

About 17 500 SCM of natural gas/hour and 2 500 cum/hour of technological water will be required for the production of complex fertilizer, calcium ammonium nitrate, nitric acid and ammonia.

Utilization of outputs

Products resulting from processes given by flow sheets will also find other exploitation in different industrial branches, e. g. in chemical industry, food industry (CO_2), textile fibre industry (NH_3), production of explosives (ammonium nitrate), building industry.

Renown World Suppliers:

The following list presents information on possible suppliers of technology and/or know-how.

LIST OF KNOWN SUPPLIERS OF TECHNOLOGY FOR FERTILIZER INDUSTRY

NO	COMPANY	COUNTRY
1.	Friedrich Uhde GMBH	Federal Republic of Germany, Dortmund
2.	The M. V. Kellog Company	U.S.A. Houston, Texas
3.	Haldor Topsøe	Denmark, Soborg
4.	BASF AG	Federal Republic of Germany, Ludwigshafen
5.	Chemoprojekt	Czechoslovakia, Prague
6.	C.F. Brown Company	U.S.A. Alhambra, California
7.	Imperial Chemical Industries Limited	United Kingdom Billingham
8.	Stamicarbon BV	Netherlands, Geleen
9.	Snam Progetti SpA	Italy, Milano
10.	Humphreys and Glasgour Limited	United Kingdom, London
11.	Societe Chimique de La Grand Paroise	France, Paris
12.	Norsk - Hydro A.S.	Norway, Oslo
13.	Krebs et cie, S.A.	France, Paris
14.	Bamag Verfahrenstechnik GmBH	Federal Republic of Germany, Butzbaum
15.	Davy Power Gas Ltd.	United Kingdom, London
16.	Kaltenbach et Cie, S.A.	France, Sevres
17.	Foster Wheeler Corporation	U.S.A., New Yersey, Livingstone
18.	Technipetrol, SpA	Italy, Rome

B. Utilization of Results:

The analyses of tenders and local conditions carried out during the mission led to the elaboration of criteria to select the best suitable ceramic offers with the view to local conditions.

During the work the consultants closely collaborated with three officers of the Ministry of Commerce and Industry who were given information on ceramic and fertilizer technologies, raw material quality requirements, economic consequences of different types of technology and equipment and methodology of evaluation of tenders. This information could give some guidelines for their further work.

Annual needs for raw materials feeding the ceramic plant were calculated based on tentatively composed ceramic bodies which will be utilized immediately for provision of necessary unprocessed inputs in order to avoid delays in planning and research during the set-up period after the ceramic corporation has been established.

The analyses of tenders and local conditions and preselection guidelines will be utilized for the necessary decisions and final selection of equipment suppliers who are also to participate in the venture financially. With the view to insufficient data base, it is recommended to elaborate market survey and the feasibility study on fertilizer industry in Bendel State prior to further decisions. In order to provide a guidelines for the investigation several types of possible combined production technologies were described including information on input and commercial use of main outputs (complex fertilizers) and by-products. A review of world renown suppliers of fertilizer technologies and equipment was also set-up for contingent informative contacts or invitation to tender by the Ministry of Commerce and Industry . Some actions to be taken after establishing the ceramic company or during that process were recommended which, if omitted could lead to lower production economy or idle delays in setting-up of the plant.

There is a seriesof activities recommendable to be conducted in order to facilitate the establishment, untroubled operation and possible diversification of ceramic and fertilizer industries. It was recommended to apply to UNIDO for assistance in the following:

(a) to train one engineer of Ministry of Commerce and Industry specialized in ceramics (short-term training) in research, testing and utilization of raw-materials, projecting of ceramic and non-metallic industries and their management.

(b) to train one manager in projecting and other aspects of fertilizer industries from the Ministry of Commerce and Industry.

(c) to conduct an inventory of non-metallics in Bendel State as a basis of their utilization for diversification of ceramics into refractories, stoneware, whiteware and other as this market is not supplied by Nigerian industries.

(d) to elaborate a comprehensive feasibility study on the production of complex fertilizers in Bendel State based on local natural gas and some imported feedstocks such as phosphate and potassium salts.

(e) to organize a study-tour on ceramic and fertilizer industries for high-level governmental experts delegation.

C. Conclusions

1. The Ceramic Project

a) With regard to very well prepared tender by the Ministry of Commerce and Industry, which 7 firms took part in the offers do not differ essentially.

b) The feasibility studies were elaborated in the course of 1983 which proved economic viability of a ceramic project on the production of 600 000 sqm of glazed wall and floor tiles and 3 000 MT of sanitary ware annually. There is a high effective demand for the above products in Nigeria.

c) Both the feasibility studies elaborated failed in solving the questions of raw materials accessibility and their technological verification for the suggested production programme. The suggested location Ozara-Igbank is questionable because of lack of infrastructure. In view of the above failures the establishment of the ceramic plant is accompanied with some risks, e. g. import of unprocessed raw materials, especially those of plastic type which could be indespensable to reach a standard quality of ceramic products. This fact strongly affects the selection of suitable technology of the production of glazed ceramic tiles. Applying the single-firing technology which requires larger input of homogeneous, good unprocessed raw materials, the production costs could growth considerably if a correction part were to be imported.

d) As fuel, natural gas and fuel oil is available in Bendel State. It is on the fact that the location of the ceramic plant was not solved that it is not possible to fix the costs in access to natural gas. The relevant negotiations would take 18 months, at least. Therefore, it is not possible to compare direct cost in firing by the two different fuels. It can be derived from the other available information that a small-scale purchase of natural gas would be more expensive, owing to high fixed costs than purchasing fuel oil. Consequently, fuel oil used for firing is a less risky option.

e) Impurities in oil (chemical composition was not available) can cause quality damages if sanitary ware is fired in open flame kilns. In order to avoid this risk, it is recommendable to apply muffled kilns.

f) These above mentioned factors of quality of raw materials and used fuel were principal criteria of evaluation of bids from the technical point of view.

g) The presented tenders were almost identical as far as the production of sanitary ware is concerned (manual casting and handling which is approp riate to the projected small ...ity). The differences regarded only muffled kilns or

open-flame type of kilns. Welko offered lower capacity 1000 Tpa.

h) Among the 7 presented offers on ceramic tile production three considered single-firing technology (Welko, Atlas-Agrob, Gillambourne).

i) The best suited offers as far as technological criteria are concerned are those of Kirchfeld and Technipetrol (double firing of ceramic tiles, muffled kilns for sanitary ware, all heating devices consuming fuel oil). As far as Messrs Ceric are concerned they offer double-firing technology and open flame kilns for sanitary ware consuming natural gas. It is to be mentioned that a contingent adjustment of Ceric offer to use a muffled kiln and burners for fuel oil is easy to be done without an essential price growth or prolongation of set-up period.

j) As another selection view points production costs and price of supply of hardware FOB can be used. The evaluation from the point of view of investment cost should not consider the quoted civil works because they will be affected mainly by selection of locality and local prices. As far as the production costs are concerned the data for their calculation were collected from physical consumptions of raw materials, electric power, manpower and specific heat consumption presented by separate bidders.

k) Direct production costs calculated are lowest in case of Technipetrol offer which corresponds to the technology which is appropriate to local conditions.

l) There are no essential differences in quotations of offered know-how, engineering, training and technical assistance. Essentially lower prices in case of Gillambourne and Atlas-Agrob correspond to excluding some components which would be paid extra. As for the hardware (FOB) all the tenders include sufficient equipment to guarantee the full operation of the ceramic plant. An exclusion is Messrs Gillambourne who offer only production equipment without ancillary shops.

All the tenders can guarantee full required capacity with reserve for the enhancement of production provided there are appropriate technological conditions and skilled manpower.

2. <u>The fertilizer project:</u>

a) There are not sufficient data based on a feasibility study necessary to decision on the production of fertilizers. Especially, discrepancies occur in assesment of demand. The latest information reveals saturation of Nigerian market as for nitrogen fertilizers and need for complex N.P.K. fertilizers.

b) Three offers were presented which differ considerably as for the capacity and production programme. The offers presented do not provide sufficient information necessary to compare them from the technical and economic point of view and their suitability to local conditions. From the technical point of view the equipment offered by Technipetrol is of high quality. However, it is not possible to recommend to take the venture before elaborating necessary market and feasibility studies.

c) In order to provide some orientation for market investigation several flow sheets of selected possible technologies for complex fertilizers were elaborated accompanied with concise descriptions of inputs and their availability, of products and by-products including their commercial use. World suppliers were listed.

d) It was also considered to produce ammonia for export. However, the outlook for the venture is not tempting. The world market is going to be supplied more and more as shown in Table 8 of new projects on ammonia and urea in the world.

6. APPENDICES

TABLE 1

COMPARISON OF BIDS FOR THE CERAMIC PROJECT IN BENDEL STATE
SELECTED PRODUCTION COSTS (₦)

	TECHNIPETROL	KIRCHFELD	WELKO	GILLAMBOURNE	CERIC	ATLAS-AGROB
A TILE PRODUCTION						
-1Unprocessed materials	210 000	210 000	320 000	210 000	210 000	320 000
- 2 Fuel	149 000	248 000	102 000	144 000	155 000	85 000
- 3 Electric power	155 000	256 000	240 000	139 000	147 000	118 000
- 4 Direct manpower	181 000	469 000	117 000	144 000	213 000	180 000
- 5 Sub-total	695 000	1 183 000	779 000	637 000	725 000	763 000
B SANITARY WARES						
- 1 Unprocessed materials	90 000	90 000	2)	90 000	90 000	90 000
- 2 Fuel	75 000	120 000	2)	165 000	56 000	94 000
- 3 Electric power	88 000	226 000	2)	159 000	143 000	72 000
- 4 Direct manpower	318 000	284 000	2)	290 000	329 000	421 000
- 5 Sub-total	571 000	720 000	2)	704 000	618 000	671 000
TOTAL	1 266 000	1 903 000	2)	1 441 000	1 343 000	1 440 000

Note 1) Single-firing technology: therefore a higher input of raw materials

Note 2) WELKO offer regards only 1000 M.T. of Sanitary wares

TABLE 2

COMPARISON OF BIDS FOR THE CERAMIC PROJECT IN BENDEL STATE

Total Production Costs - Ceramic Tile Production

(000 ₦)

	TECHNIPETROL	KIRCHFELD	WELKO	GILLAMBOURNE	CERIC	ATLAS-AGROB
1 - Unprocessed raw materials	210	210	320	210	210	320
2 - Glaze and stains	650	650	700	700	650	700
3 - Fuel	149	248	102	144	147	85
4 - Electric power	155	256	240	139	213	178
5 - Direct manpower	181	469	117	144	213	180
Direct costs (Subtotal 1-5)	1,345	1,833	1,479	1,337	1,375	1,463
6 - Auxilliary materials	376	513	414	405	385	410
7 - Salaries	585	585	585	585	585	585
8 - Other overheads	200	200	200	200	200	200
9 - Maintenance	184	335	216	133	182	138
Production costs	2,690	3,466	2,894	2,660	2,727	2,796
Production costs per sq. m. (₦)	4,48	5,78	4,82	4,43	4,55	4,66
Percent of costs supposed by the feasibility study (2 708 000 ₦)	99,3	128,0	106,9	98,2	100,7	103,2

TABLE 3

COMPARISON OF BIDS FOR THE CERAMIC PROJECT IN BENDEL STATE

Quotation of Components (without equipment for quarrying)

(000₦)

	TECHNIPETROL	KIRCHFELD	WELKO	GILLAMBOURNE	CERIC	ATLAS-AGROB
1. Know-How (Including training assistance	2,410	2,368	2,043	1,254	2,091	828
2. Supplies (FOB)	11,355	18,536	12,751	7,361	10,644	16,964
3. Insurance, transport	895	3,779	1,644	N.I.	1,109	2,407
4. Erection, start-up	5,370	4,348	1,832	N.I.	947	518
Sub - total	20,030	29,031	18,290	8,615	14,791	20,717
5. Civil works	5,840	23,619	13,755	N.I.	7,626	9,160
TOTAL	25,870	52,650	32,045	8,615	22,417	29,877

TABLE 4

COMPARISON OF BIDS FOR THE CERAMIC PROJECT IN BENDEL STATE

Selected Techology Data for Tile Production

	TECHNIPETROL	KIRCHFELD	WELKO
Storage capacity for raw materials (months)	2) 3 (6)	N.A.	1
Production programme for floor tiles (in mm)	200x200x10	100x200	200x200x9
Production programme for wall tiles (in mm)	110x200x6	150x150 100x200	—
Spray drying (Capacity of evaporated water per 1 hour)	1500 kg	1250 l	2000 l
Presses (cycles per minute)	2 hydraulic 800t 20	3 hydraulic 500t 28	4 friction 500t 29
Drying (type, length, drying cycle)	tunnel drier 65m 48 hours	channel drier 60m hours	fast roller drier
Glazing (number of lines)	2	2	2
Bisque firing (length of the kiln, firing cycle, max. temperatures)	semi-muffled kiln 65 m, 48 hrs. 1100°C	60m, 45 hrs, 1150°C	single-firing roller kiln 65 + g m
Glost firing	muffled kiln 89m, 16,5 hrs, 1050°C	60m, 15 hrs 1050°C	1300°C

TABLE 4 CONTINUED

	GILLAMBOURNE	CERIC	ATLAS-AGROB
Storage capacity for raw materials (months)	6	6	3
Production programme for floor tiles (in mm)	thickness 10 mm nonspecified	100x200, 200x200 250x250	100x200 200x200
Production programme for wall tiles (in mm)	thickness 6 mm nonspecified	150x150, 125x200 200x300	150x150
Spray drying (capacity of evaporated water per 1 hour)	1680 l	1760 kg	1750 kg
Presses (cycles per minute)	3 hydraulic 500t	2 friction 500t, 20	3 hydraulic 600t 25
Drying (type, length, drying cycle	fast roller drier	tunnel drier 68 m 48 hours	2 basket drier 175 minutes
Glazing (No. of lines)	2	2	2

Note: 1) According to the bid, the clay material must have a moisture content not superior 15→ 18%.

2) At additional cost.

TABLE 4 CONTINUED

	GILLAMBOURNE	CERIC	ATLAS-AGROB
Bisque firing (length of the kiln, firing cycle, maximum temperature	Once-fired floor tiles twice-fired wall tiles	Open-flame kiln, 64 m 48 hrs, 1100°C	single-firing roller kiln
Glost firing	2 roller kilns	68m, 17 hrs, 10 1050°C	70 + 8 m 1150°C

TABLE 5

COMPARISON OF BIDS FOR THE CERAMIC PROJECT IN BENDEL STATE

Selected technology data for sanitary ware production

	TECHNIPETROL	KIRCHFELD	WELKO	GILLAMBOURNE	CERIC	ATLAS-AGROB
Storage capacity for raw materials (months)	3	N.A.	6	6	3	3
Production programme	Basins 40% W.C. 40% Other 20%	Basins 40% W.C. 40% Other 20%	Basins 25% Pedestals 15% W.C. 30% Tanks 15%	Basins 40% W.C. 40% Other 20%	very diverse	Basins 40% W.C. 40% Other 20%
Capacity (t/year)	2,940	3,000	1,000	3,000	3,360	3,000
Kiln parameters (type, max. temperature,	tunnel muffled kiln 1280°C	tunnel muffled kiln 1280°C	tunnel muffled kiln 1280°C	tunnel open flame kiln 1250°C	tunnel open fl. kiln 1250°C	tunnel open flame kiln 1250°C
length, firing cycle)	70m, 20hrs	75m, 22,7 hrs	65 m 22,3 hrs	72 m 24,3 hrs	68 m 18 hrs	72 m 24,3 hrs

TABLE 6

COMPARISON OF BIDS FOR THE CERAMIC PROJECT IN BENDEL STATE

Selected indicators (according to bidder's date)

Indicator	Unit	TECHNIPETROL	KIRCHFELD	WELKO	GILLAMBOURNE	CERIC	ATLAS-AGROB
Know-how	000 ₦	2,410	2,368	2,043	1,254	2,091	828
Supplies (FOB)	000 ₦	11,355	18,536	12,751	7,361	10,644	16,964
Factory area	sq.m.	21,000	30,800	N.A.	N.A.	15,000	9,000
Specific heat consumption - tile production	kJ/kg	9,950	16,740	4,720	9,610	10,370	4,810
Specific heat consumption - sanitary ware	kJ/kg	12,540	20,060	14,630	27,670	9,400	15,590
Installed el. power tile production	kW	446	1,140	N.A.	805	720	700
Total amount of workers	man	232	339	139	169	226	275
Type of fuel		gas oil	heavy oil	natural gas	natural gas	natural gas	natural gas
Equity participation	per cent	25	10	minority share	N.A.	51	20

TABLE 7

COMPARISON OF BIDS FOR THE CERAMIC PROJECT IN BENDEL STATE

Completion of Tenders

	TECHNIPETROL	KIRCHFELD	WELKO	GILLIAMBOURNE	CERIC	ATLAS-AGROB	CHINA L.I.O.C.
Know - how	1	1	1	1	1	1	3
Engineering	1	1	1	1	1	1	3
Training	2	1	1	1	1	2	3
Technical assistance	1	1	1	1	1	2	3
Production equipment for sanitary ware of capacity (MT)	3,000	3,000	1,000	3,000	3,360	3,000	3,000
Production eq. for tiles of capacity sq. m.	600,000	600,000	600,000	600,000	600,000	600,000	600,000
Set up period (months)	26	26	36	N.A.	18	24	N.A.
Quarrying equipment	3	1	3	3	1	3	3
Civil eng. works	1	1	1	3	1	1	3

Note: (1) Included in the price
(2) Included in the offer but paid extra
(3) Not included

TABLE 8

COMPARISON OF BIDS FOR THE FERTILIZER INDUSTRY

List of Ammonia and Urea Projects

LOCATION	COUNTRY	CAPACITY (tpa) A-Ammonia U-urea	TECHNOLOGY	PRICE (mil. US $)	REMARK
NSM, Sluiskil	Netherlands	A: 500 000	C.F. Braun	160	
Quimigal Lavradio	Portugal	A: 330 000	Haldor Topsøe/Lurgi	-	
As Mersin	Turkey	A: 660 000	-	-	Oil feedstock
		U: 330 000	-	-	
Police	Poland	A: 2x247 500	Haldor Topsøe	100	Price includes NPK and MAP Prod unit prices
		U: 396 000	Stamicarbon	"	
Kemerovo	the U.S.S.R	A: 2x450 000	Kellog	-	Engineering Toyo, Chemoprojekt Czechoslovakia
		U: 330 000	Stamicarbon	-	
Grodno	the U.S.S.R	U: 330 000	Stamicarbon	-	Eng. Chemoprojekt
Dneprodzerzinsk	the U.S.S.R	U: 330 000	Stamicarbon	-	Eng. Chemoprojekt
Gozlovka	the U.S.S.R	U: 330 000	Stamicarbon	-	Eng. Chemoprojekt

TABLE 8 CONTINUED

LOCATION	COUNTRY	CAPACITY (tpa) A- Ammonia U- Urea	TECHNOLOGY	PRICE (mil. US $)	REMARK
Pantschevo	Yugoslavia	A: 462 000	Kellog	-	Eng. Tecnicas Raunidas
		U: 365 000	Stamicarbon	-	Chemoprojekt
INA, Kutina	Yugoslavia	A: 460 000	Kellog	-	Project: Creusot -Loire
		U: 500 000	Stamicarbon	-	Kellog Continental
Sonatrach Anaba	Algeria	A: 300 000	Kellog	-	Project: Creusot -Loire
Sirte	Libya	A: 2x450 000 U: 574 000	- -	1 000	
Nafcon, Port Harcourt	Nigeria	A: 330 000 U: 500 000	Kellog Stamicarbon	500	
	Somalia	A: 30 000 U: 50 000	Haldor Topsøe Snam Progetti	67	
KAC Kilwa Masako	Tanzania	A: 400 000 U: 550 000	Haldor Topsøe Snam Progetti	640	

TABLE 8 CONTINUED

LOCATION	COUNTRY	CAPACITY (tpa) A - ammonia U - urea	TECHNOLOGY	PRICE (mil. US $)	REMARK
Ruwais	Abu Dhabi	A: 330 000 U: 500 000	Haldor Topsøe Stamicarbon		
Shiraz	Iran	A: 326 000 U: 228 000	ICI Stamicarbon	460	Price includes nitric acid and AN prod. unit prices
ANIC, Bahia Blanca	Argentina	A: 335 000 U: 575 000	- -	300	
Rio de Janeiro	Brazil	A: 300 000	Kellog	-	
CEPE, Pasorja	Ecuador	A: 330 000 U: 330 000	-	300	Price includes NPK Production unit price
Salina Cruz	Mexico	A: 495 000	Kellog	-	
Camargo	Mexico	A: 495 000 U: 500 000	Kellog Snam Progetti	- -	
NEC, Port Lisas	Trinidad and Tobago	A: 450 000 U: 530 000	C.F. Braun Snam Progetti /NSM	250 120	

TABLE 8 CONTINUED

LOCATION	COUNTRY	CAPACITY (tpa) A- ammonia U- urea	TECHNOLOGY	PRICE (mil. US $)	REMARK
IFFCO, Uttarpradesh	India	A: 450 000 U: 726 000	Haldor Topsøe Snam Progetti	500 500	
IGRCC, Yagdishpur	India	A: 450 000 U: 726 000	Haldor Topsøe Snam Progetti	500 500	
KBE, Harizai	India	A: 2x 445 000 U: 4x 365 000	Kellog Snam Progetti	 600	
NF Guna	India	A: 445 000 U: 740 000	Haldor Topsøe Snam Progetti	500 500	
Vidjaipur	India	A: 335 000 U: 660 000	Haldor Topsøe Snam Progetti	500 500	
Hupei	China	A: 330 000 U: 570 000	Kellog Stamicarbon	- -	
Chenkai	China	A: 2x 330 000	Haldor Topsøe	-	
Urumchi	China	A: 330 000	Haldor Topsøe	-	
Ning Sha	China	A: 330 000	Haldor Topsøe	-	
Sanai	China	A: 330 000	Haldor Topsøe	-	
Narying	China	A: 340 000	Haldor Topsøe	-	

(SOURCE: EUROCOEP 1985)

TABLE 9

COMPARISON OF BIDS FOR THE FERTILIZER PROJECT IN BENDEL STATE

Ammonia: Selected technological data on Syngas generation

S/NO.	INDICATOR	UNIT	TECHNIPETROL	FOSTER WHEELER	CHINA N.C.C.C.
1.	Process Owner	-	Haldor Topsøe	Foster Wheeler	N.A.
2.	Primary Reformer	-	Radiant Duplex Single Row	Terrace Wall	N.A.
3.	Primary Reformer Outlet pressure	MPa	3.1 - 3.6	2.24	1.9
4.	Dtto, outlet temperature	^{o}C	1030	842	760
5.	H2O/C ratio	-	3.3	2.8	N.A.
6.	CH4 Content (outlet 1. reformer)	%	N.A.	4.6	<10
7.	Secondary reformer	-	Ni-Catalyst reactor	-	N.A.
8.	CH4 Content (reforming outlet)	%	0.3	4.6	0.3
9.	CO-convertor NO. of stages	-	2	1	2
10.	CO content (Shift conversion outlet)	%	0.24	4.7	0.3

TABLE 10

COMPARISON OF BIDS FOR THE FERTILIZER PROJECT IN THE BENDEL STATE

Ammonia - Selected technological data on final purification (mixing) of syngas and compression

NO.	INDICATOR	UNIT	TECHNIPETROL	FOSTER-WHEELER	CHINA N.C.C.C.
1.	Type of syngas preparation	-	CO_2 removal and methanation	Purification unit, air separation unit (prod. N_2)	CO_2 removal and methanation
2.	Process owner		Benfield, Union Carbide Haldor Topsøe	Union Carbide/L Air Liquid	N.A.
3.	Content of inert gases (synthesis loop inlet)	%	0.3Ar, 0.73 CH_4 <10ppm $CO \neq CO_2$	N.A.	<20 ppm $CO+CO_2$ only
4.	Air compressor power input	KW	2 x 1155	3320 (air for separation), 2x360 (nitrogen)	N.A.
5.	Syngas compressor power input	KW	2 x 2242	2 x 2210	N.A.
6.	Gas recycling compressor power input	KW	2 x 335	180	N.A.
7.	Ammonia compressor power input	KW	2 x 420	2 x 520	N.A.

TABLE 11

COMPARISON OF BIDS FOR THE FERTILIZER PROJECT IN BENDEL STATE

Ammonia-selected technological data on ammonia synthetic proper

NO.	ITEMS	UNIT	TECHNIPETROL	FOSTER-WHEELER	CHINA N.C.C.C.
1.	Process owner	-	Haldor-Topsøe	Casale	N.A.
2.	Synthesis pressure	MPa	34.0	16.2	30.0
3.	Synthesis temp.	^{o}C	480	460	500
4.	Catalyst volume	M^3	7.4	19.6	N.A.
5.	Synthesis loop pressure drop	MPa	1.8	0.83	N.A.
6.	NH_3 content (inlet converter)	%	3.6	4.6	N.A.
7.	NH_3 content (outlet converter)	%	17.0	18.5	N.A.
8.	Ammonia pressure (inlet storage)	MPa	2.5	1.4	N.A.

TABLE 12

COMPARISON OF BIDS FOR THE FERTILIZER PROJECT IN BENDEL STATE

Amongst-selected Technological Data on Product Quality and Consumptions per 1 Ton of NH3

NO.	INDICATOR	UNIT	TECHNIPETROL	FOSTER-WHEELER	CHINA N.C.C.C.
1.	NH3 content	wt.%	99.5	99.5	99.8
2.	H2O content	wt.%	0.5	0,5	0.2
3.	Consumptions				
1.	natural gas	NM3	901	840	930
2.	Inferior heat value of natural gas	GJ	32.4	30.2	33.4
3.	Electric power	KWh	718.1	468.2	875.0
4.	Cooling water	m^3	186.5	132.[illegible]	324.0
5.	High-pressure steam export	t	-2.35	-1.2	-1.8
6.	Low pressure steam	t	0.3	-	-
7.	Hot water (108°C) export	t	-	-1.85	-
8.	Boiler feed water	t	4.3	1.2	4.5
9.	Instrument air	NM^3	36.9	36.0	N.A.

TABLE 13

[illegible]

[illegible]

NO.	INDICATOR	UNIT	TECHNIPETROL	CHIM. M.C.C.C.
1.	Process owner	-	Snam Progetti	N.A.
2.	NH3: CO2 ratio	-	3.3	N.A.
3.	Synthesis pressure	MPa	15.9	20.0
4.	Synthesis temp.	°C	188	185-188
5.	Method of melt manufacture	-	Evaporating	Evaporating
6.	Method of granule manufacture	-	Prilling	Prilling
7.	Product handling	-	N.A.	50 kg bags

Note: No data from Foster-Wheeler available.

NO.	INDICATOR	UNIT	CONVENTIONAL	CHINA P.C.C.C.
	Product Quality			
1.	Nitrogen content	wt.%	46.4 min.	46.0 min.
2.	Biuret content	wt.%	0.8 max.	1.0 max.
3.	Moisture content	wt.%	0.05 max.	0.5 max.
	Consumptions			
1.	Ammonia	t	0.571	0.59
2.	Carbon dioxide	t	0.750	0.735
3.	Electric power	KWh	121.8	160.0
4.	Cooling water	m^3	93.9	200.0
5.	High-pressure steam	t	0.035	-
6.	Middle-pressure steam	t	0.9	1.7
7.	Passivation air	Nm^3	4.2	12.0
8.	Steam condensate export	t	0.62	-

TABLE 15

[illegible] FOR
PROPOSED PLANT

Raw Materials and Utilities Consumptions per 1 T of Urea

ITEM	UNIT	ISOTHERMAL	POWER-THERMAL	CBIP I.C.C.C.
Ammonia	kg	570	570	590
Carbon dioxide	kg	743	743	735
Natural gas	Nm^3	514.9	512.1	548.7
Latent heat of input gas	GJ	18.5	18.4	19.7
High-pressure steam (by product)	kg	-225	-	-59
Electricity	KWh	532.2	388.6	676.3
Water	m^3	203	170	343.8
Industrial process water	m^3	2.5	0.7	2.7
Overall fuel and power	GJ	23.0	22.3	26.3

COMPARISON OF BIDS FOR THE FERTILIZER PROJECT IN ENUGU STATE

Inputs and Outputs Production of NPK and Calcium Ammonium Nitrate (CAN) - 27,5% N

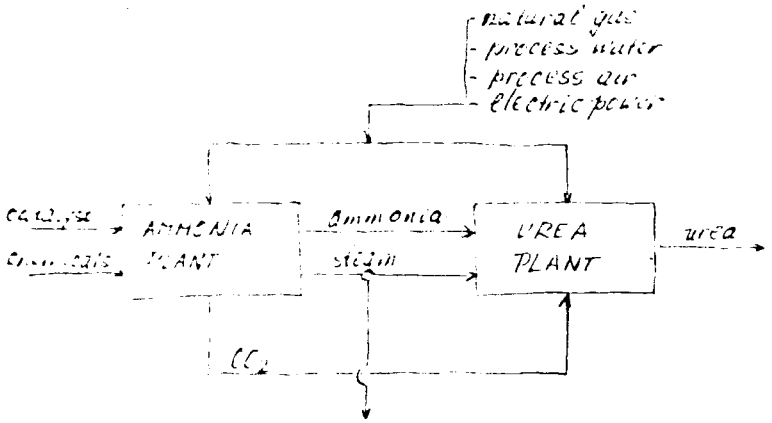
INPUTS	OUTPUTS	BY-PRODUCTS	UNIT	QUANTITY per 1 MT of NPK	QUANTITY per 100 000 MT of NPK	QUANTITY per 200 000 MT of NPK
[illegible]			SCM	682	68,200,000	136,400,000
[illegible] (GJ)			GJ	24.5	2,450,000	4,900,000
[illegible] (P_2O_5)			MT	0.606	60,600	121,200
[illegible] (K_2O)			MT	0.33	33,000	66,000
	Ammonia (intermediate)		MT	0.46	46,000	92,000
	Nitric acid (intermediate)		MT	0.74	74,000	140,000
	NPK - 1 (18-13-18)		MT	1.00	100,000	200,000
	CAN (27,5%N)		MT	0.83	83,000	166,000
	CO_2 (intermediate)		MT	0.214	21,400	42,800
		CO_2	MT	0.346	34,600	69,200
		Fine limestone	MT	0.22	22,000	44,000

[illegible] OF OUTPUTS	UNIT	QUANTITY per 1 MT of NPK	QUANTITY per 100000MT of NPK	QUANTITY per 200000MT of NPK
[illegible] - [illegible] 27,5% N	MT	0.36	36 000	72 000
[illegible]	MT	0,18	18 000	36 000
[illegible]	MT	0.18	18 000	36 000

[illegible] flow sheet - figure 6

Annex 1

Flow Diagram - Production of Urea



INPUTS PER 1 MT OF UREA:
- natural gas 515 SCM
- water 2.5 cu.m.
- electric power 53 C KWH

CHEMICAL REACTIONS:

$CH_4 + H_2O = CO + 3H_2$

$C_nH_{2n+2} + nH_2O = nCO + (2n+1)H_2$

$2CH_4 + O_2 = 2CO + 4H_2$

$CO + H_2O = H_2 + CO_2$

(CO_2 absorption)

$CO + 3H_2 = CH_4 + H_2O$

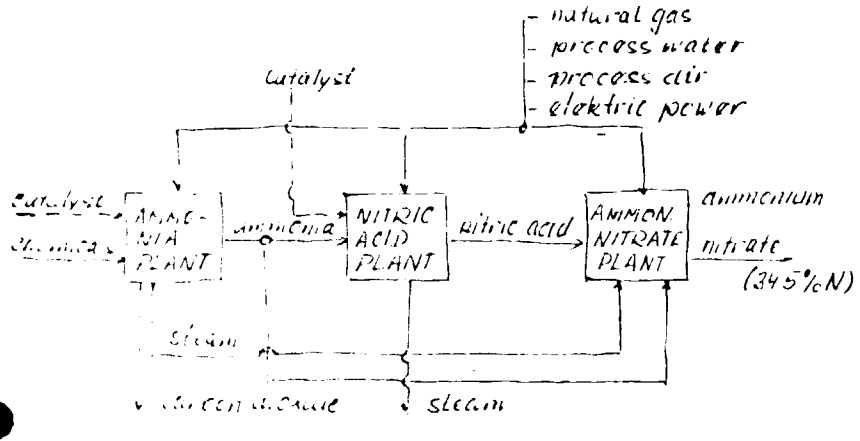
$N_2 + 3H_2 = 2NH_3$ (ammonia)

$2NH_3 + CO_2 = NH_2 \cdot COONH_4$

$NH_2COONH_4 = NH_2CONH_2$ (urea) $+ H_2O$

Figure 2

Flow Diagram - Production of Ammonia Nitrate



INPUTS PER UNIT OF AMMONIUM NITRATE:

- natural gas 962 SCM
- ammonia (intermediate) 450 kg
- nitric acid (intermediate) 800 kg
- carbon dioxide (by-product) 547 kg

CHEMICAL REACTIONS

$4NH_3 + 5O_2 = 4NO + 6H_2O$

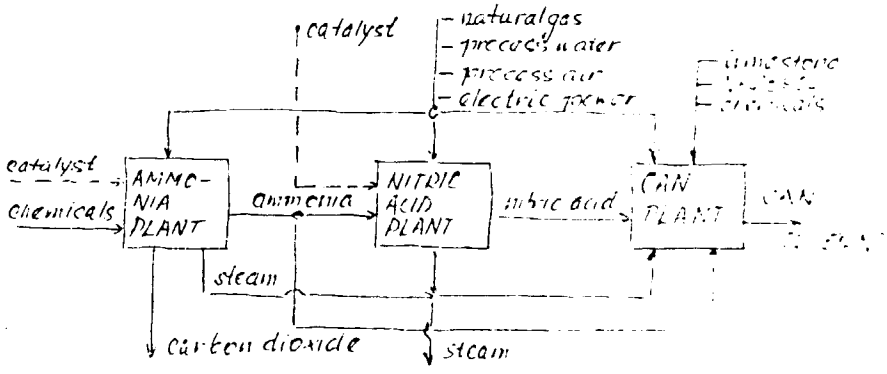
$2NO + O_2 = 2NO_2$

$3NO_2 + H_2O = 2HNO_3$ (nitric acid) $+ NO$

NH_3 (gas) $+ HNO_3$ (liquid) $= NH_4NO_3$ (solid)

Figure 3

Flow Diagram - Production of Calcium Ammonium Nitrate (CAN)



INPUTS PER 1MT OF CAN

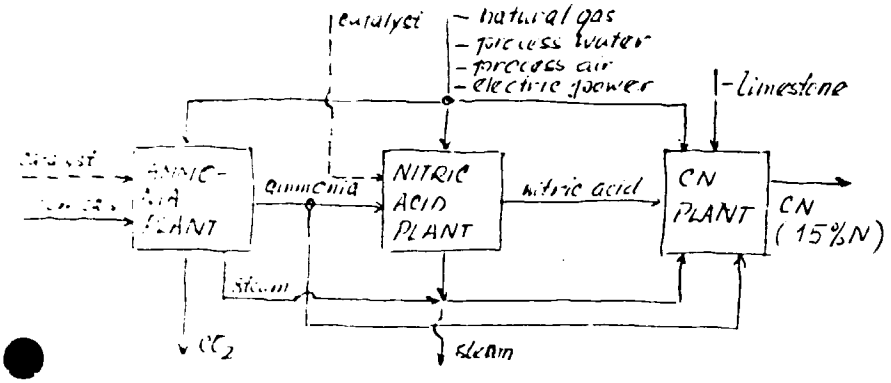
- natural gas 400 SCM
- limestone 220 kg
- ammonium sulphate 10 kg
- ammonia (intermediate) 357 kg
- nitric acid (intermediate 637 kg
- carbon dioxide (byproduct) 436 kg

NOTE

Ammonia process with CO_2 removal and methanation is suggested in all flow diagrams

Figure 4

Flow Diagram - Production of Calcium Nitrate (CN)



INPUTS PER 1 MT OF CN.

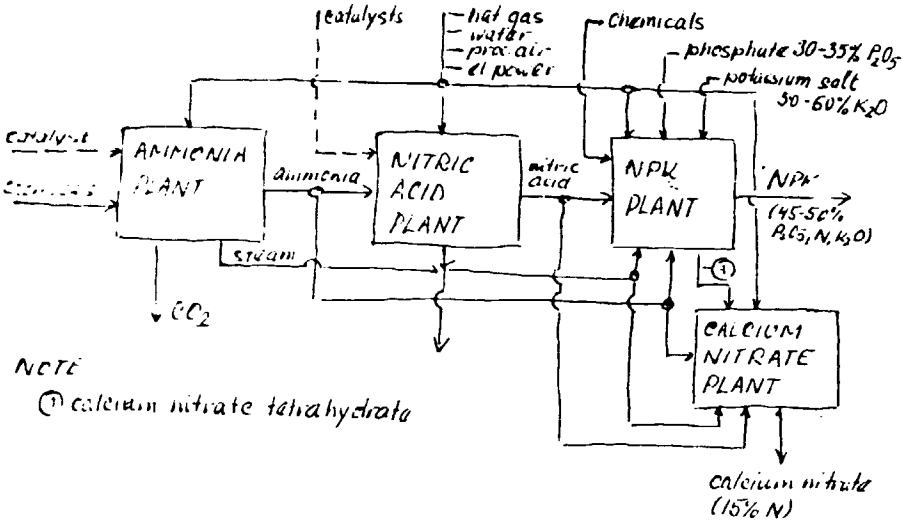
- natural gas 235 SCM
- limestone 525 kg
- ammonia (intermediate) 204 kg
- nitric acid (intermediate) 660 kg
- carbon dioxide (byproduct) 250 kg

CHEMICAL REACTIONS.

$CaCO_3 + 2HNO_3 = Ca(NO_3)_2$ (calcium nitrate) $+ H_2O + CO_2$

Form 5

Flow Diagram - Production of complex NPK



NOTE

① calcium nitrate tetrahydrate

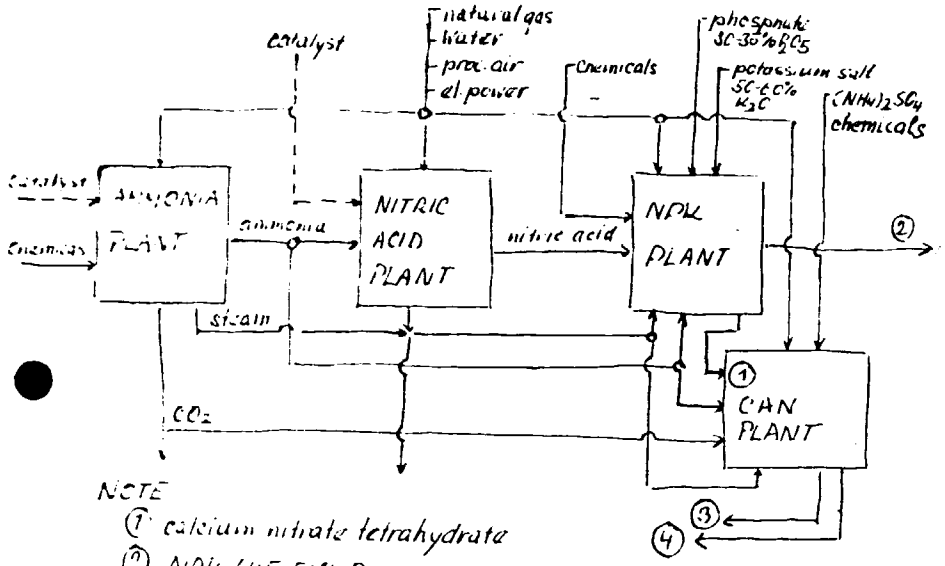
INPUTS AND OUTPUTS

per 1MT of NPK

- natural gas 395 SCM
- phosphate 606 kg
- potassium salt 330kg
- ammonia 330 kg (intermediate)
- nitric acid (intermediate) 755 kg
- NPK-1 1000 kg (16-13-18)
- calcium nitrate (15% N) 865 kg
- carbon dioxide (byproduct) 400 kg

Figure 6

Flow Diagram - Production of NPK and CAN



NOTE

① calcium nitrate tetrahydrate
② NPK (45-50% P_2O_5, N, K_2O)
③ calcium ammonium nitrate (25-28%N)
④ fine limestone

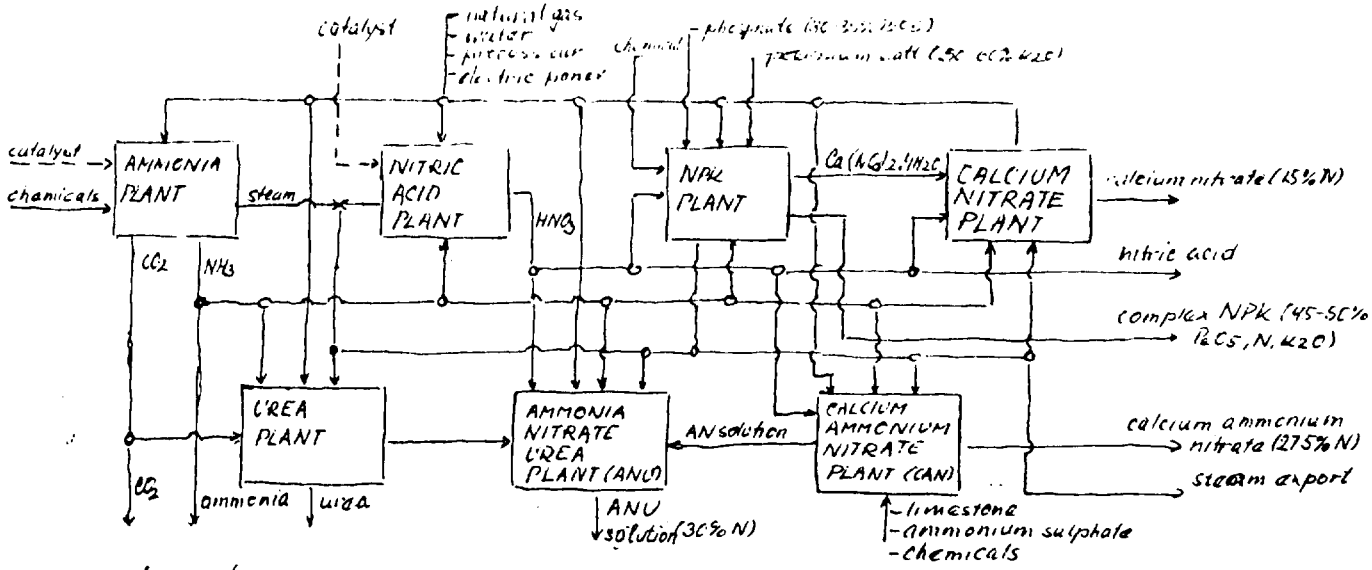
INPUTS AND OUTPUTS - TABLE 16

CHEMICAL REACTION

$$Ca(NO_3)_2 + 2NH_3 + CO_2 + H_2O \rightarrow 2NH_4NO_3 + CaCO_3$$

Figure 7

Flow diagram - Production of NPK, CN, CAN ANU urea, ammonia NA, CD



Legend:
CN - calcium nitrate
CAN - calcium ammonium nitrate
ANU - ammonium nitrate urea solution
NA - nitric acid CD - carbon dioxide

ANNEX I

#18

[illegible] OF COMMERCE AND INDUSTRY
(INDUSTRIES DIVISION)
P.M.B. 1135
BENIN CITY
BENDEL STATE OF NIGERIA

Your Ref:

Our Ref: [illegible]/121/T.1.2/114 ..... March ..... 19 85 ...

[illegible]

Dear Sir,

Establishment of A Ceramic Factory

As you may well know, the Bendel State Government of Nigeria intends to establish a ceramics factory in Bendel State. You are hereby invited to quote for the establishment of this factory, on a turnkey basis.

2. The factory is expected to produce economically, floor tiles, wall tiles, and sanitary wares. The factory will be located in any one of the following locations:-

(a) Iguoriakhi

(b) Uzalla

(c) Igbanke/Ozarra

(d) Afuze.

3. Your quotation should however be based on the location you think is most suitable.

4. The plant should have a capacity to produce annually the following items, in the quantity stated:-

Wash hand basins (large and small)	- 80,000 units
Water closets	- 80,000 units
Other sanitary wares	- 40,000 units
Wall ceramic tiles	- 400,000 sq. metres
Floor ceramic tiles	- 200,000 sq. metres.

5. The scope of Contractor's work is as follows:-

(i) Selection of a suitable site out of the four sites mentioned above on an economic basis.

(ii) Quantification of the clay deposits in the chosen location.

.../2

(iii) Establishment of design basis of the Plant.

(iv) Supply of know-how, basic, and detailed engineering relating to the Plant and quarry.

(v) Procurement of all equipment and Materials for the plant, workshop, maintenance shops, laboratory facilities, storages, and other facilities at site including administrative office, and procurement of spare-parts.

(vi) Procurement of all equipment and materials necessary for the effective quarrying of clay, and transportation of clay to site.

(vii) Transportation of the equipment from point of despatch FOB to site.

(viii) Taking out all necessary insurance coverages.

(ix) Clearing levelling and the development of the site for the factory, and quarry.

(x) Testing the soil Characteristics of the site.

(xi) Testing the clay properties of the chosen site for the quarry.

(xii) Construction of Roads/ Rail within the factory, and quarry, and between factory and quarry.

(xiii) Installation of all telephone and other similar facilities for communication within the site and from site to quarry.

(xiv) Constuction of all civil works within the factory, and quarry.

(xv) Receipt inspection and storage of equipment at site.

(xvi) Provision of all erection equipment, tools and tackle.

(xvii) Erecting all equipment.

(xviii) Providing training for plant and quarry managers, operators, maintenance administrative personnel.

(xix) Testing all erected equipment individually, by sections, and as a complete plant, and carrying out all necessary commissioning procedures.

(xx) Commissioning and start up of the plant, until products are obtained.

(xxi) Operation of the plant, from start-up until completion of the performance guarantee Tests for the plant.

(xxii) Conducting and completing the performance guarantee test.

.../3

(xxiii) Management of the operations of the plant after Mechanical completion, and until satisfactory completion of the performance guarantee tests.

(xxiv) Management of the operations of the plant for 24 months after provisional acceptance.

(xxv) The location and nomination of a suitable ceramic wares manufacturer to invest in the project.

6. The following information should accompany your quotations:-

6.1 Price:

The price for executing the works as stated above should be stated in lump sum and broken down under the following headings:

	Local Component	Foreign Component
6.1.1. Engineering services including Licences (if any) Design, Works supervision and Start-up.		
6.1.2 Supply of goods F.O.B.		
6.1.3 Transportation and Insurance to site.		
6.1.4 Civil Works.		
6.1.5 Erection.		

6.2.1 The terms of payment for each of the quoted price in 6.1.1 to 6.1.5 above should be stated under each heading.

6.2.2 The lump sum price should further broken down into:

Floor and Wall Tiles

Sanitary Wares

Quarry Equipment.

6.2 Design Basis:

The clay characteristics for each of the suggested locations are attached as Appendices 1 to 4. Other design basis may be supplied on request, if the Ministry is given adequate notice.

.../4

6.3 Plot Plan:

Your quotation should be accompanied by a proposed plot plan of the Quarry and plant.

6.4 Process Description, supply of Equipment and Service Facilities

6.4.1 Process Description:

The process used should be described in details, and accompanied with flow diagrams, showing clearly majoritems of equipment. The method of quarrying should also be stated.

6.4.2 Preliminary Lay-Out:

The preliminary Lay-Out of plant, utility buildings, etc. in relation to the site, should be shown in a drawing. The plants buildings should be clearly identified.

6.4.3 Equipment List:

A list of major equipments to be supplied should be made. Each equipment should be accompanied by the following information:-

Name of Equipment;

List of Probable suppliers

Size and any other technical data.

6.5 Time Table:

A time table for the execution of the contract of the bar-chart type should accompany the quotation.

6.6 Specification of Products:

A detailed technical specification of the products, should be stated.

6.7 Utilities and Raw Materials:

The expected consumption of utilities on an annual basis for gas, electricity, water, and Raw Materials, should be stated. A detailed specification of the necessary utilities, and Raw Materials should be given.

6.8 A schedule of Contractors personnel that will operate the plant for the initial 24 months training period should be given. The schedule should give conditions of their stay in Nigeria.

6.9 Details of local personnel required to operate the plant, and to assist in the construction should be stated.

6.10 The name of the manufacturer of ceramic products as well as the extent of its proposed investment in the project should be stated. The manufacturer should

Give details of its experience and the plants he owns.

6.11 Contractor should give details of similar projects handled in the last 5 years, and their location.

7. The factory should be capable of producing tiles of the following sizes:-

Floor tiles - 8"x8"; 4"x8"; 10"x10"

Wall tiles - 6"x6" 5"x8" 8"x12".

8. Your quotation should reach this Ministry on or before 12 noon on Friday the 31st day of May 1985. This Ministry is not bound to accept the lowest or any quotation.

MINISTRY OF COMMERCE & INDUSTRY
DISPATCHED
BENIN CITY

Yours faithfully,

(O. U. Onuwaje)
for Permanent Secretary
Ministry of Commerce and Industry.

Copy to:

1. Price Roy Yakub
36 Offin Road,
Lagos.

2. Mr. G.I. Oviasu
1 Karo Estate Ave,
150A Mission Road,
P.O. Box 648,
Benin City.

3. Casco Int.,
Castlelock House,
22 Romsey Road,
Eastleigh Hampshire,
England.

4. Ceric Dutru
c/o Metlife Ltd.,
58 - 60 Broad Street,
P.O. Box 9310,
Lagos.

5. Polimex Cekop,
00-950 Warszuwa,
Czackego 7/9,
Poland.

CLAY CHARACTERISTICS

CHEMICAL ANALYSIS

		Silica %	Alumina %	Ferric Oxide %	Titania %	Lime %	Magnesia %	Soda %	Potash %	Sulphur Dioxide %	Ignition Loss %	Total %
Igbanke	- Iyi-Ukwu I	65.258	I8.285	I0.004	-	-	-	0.036	0.0I3	-	6.45	I00.046
	- " II	76.484	I7.I45	4.343	-	-	-	0.020	0.008	-	2.85I	I00.85I
Igbontor	- Iyioma	80.86I	5.759	4.774	-	-	4.I42	0.002	0.009	-	4.603	I00.I5
Ozarra	- Igwuigwugwu	60.728	I3.896	2.I06	2.439	3.2I8	2.I06	I.044	0.622	-	I3.4I2	99\57I
	- Ewebi	60.429	8.89I	4.I46	-	I0.874	-	0.069	0.037	-	I5.I23	99.569
	- Iduleha I	58.485	23.002	0.0I6	-	-	-	0.II2	0.07I	-	I8.302	99.988
	- " II	65.30I	20.592	0.0I0	-	-	-	0.I68	0.029	-	I4.I33	I00.233
Iguoriakhi	- Ovbere Bush	59.080	I6.567	7.375	I.667	I.402	I.008	0.270	I.8I2	-	I0.938	I00.II9
	- Ogbomoba Bush	65.870	I4.63I	0.956	2.220	2.879	0.62I	0.606	0.543	-	II.993	I00.3I9
Uzalla	- Ezeko	67.0I0	I2.447	3.I83	2.890	2.770	Trace	0.I66	0.447	-	II.802	I00.7I5

MINERALOGICAL COMPOSITION

		Ideal felspar %	Clay Substance %	Free Quartz %	Iron Oxide %	Titania - %	Calcium Carbonate %	Magnesium Carbonate %	Organic Matter %
Igbanke	- Iyi-Ukwu I	0.29	46.I3	43.62	I0.00	-	-	-	.2I
	" " II	0.I65	43.30I	56.242	4.343	-	-	-	-
Igbontor	- Iyioma	0.07	I4.54	74.06	4.27	-	-	8.69	-
Ozarra	- Igwuigwugwu	9.83	30.6I	40.I4	2.II	2.44	5.73	4.42	3.82
	- Ewebi	.63	22.2I	49.69	4.I5	-	I9.36	-	I.I8
	- Iduleha I	I.08	57.7I	30.96	0.02	-	-	-	I0.25
	- " II	I.I6	5I.57	40.57	0.0I0	-	-	-	6.94
Iguoriakhi	- Ovbere	I2.28	36.23	34.29	7.38	I.67	2.49	2.I2	3.48
	- Ogbomoba	6.78	33.88	45.73	0.96	2.22	5.I3	I.30	3.77
Uzalla	- Iyioma	3.62	29.82	50.8I	3.I8	2.89	4.93	-	4.88

FIRING SHRINKAGE

		950°C %	I000°C %	I050°C %	II00°C %	II50°C %	I200°C %
Igbanke		6.84	7.40	7.36	8.20	I0.05	I2.50
Igbontor	- Iyioma	I0.09	I4.00	II.50	-	-	-
Ozarra	- Igwuigwugwu	I0.04	I0.32	I0.84	I9.20	20.52	-
	- Ewebi	II.84	II.80	I3.76	II.96	I4.48	23.50
	- Iduleha	II.36	II.30	II.36	I2.04	I3.28	I8.64
Iguoriakhi	- Ovbere	II.36	I2.32	I2.44	I4.80	I6.36	I6.60
	- Ogbomoba	8.64	9.I2	9.92	I0.I6	9.64	I0.52
Uzalla	- Ezeko	I4.28	II.40	I2.70	I2.56	I2.64	I6.40

FIRED COLOURS

		950°C	1000°C	1050°C	1100°C	1150°C	1200°C
Igbanke		Light Pink	Light Pink	Light Pink	Dirty Ivory	Dirty Ivory	Dirty Ivory
Igbontor Ozarra	-Iyioma	Pinky Cream	Cream	Cream	Cream	Cream	Cream
Ozarra	-Igwuigwugwu	Ivory	Ivory	Ivory	Dark Ivory	Dirty Ivory	-
	-Ewebi	Pebble Cream	Pebble Cream	Devon Cream	Not F i r e d		
	-Iduleha	Pale Ivory	Pale Ivory	Ivory	White	Ivory	Ivory
Iguoriakhi	-Ovbere	Dull Pink	Dull Pink	Dull Pink	Dull Pink	Dull Pink	Dull Pink
	-Ogbomoba	Pale Ivory	Pale Ivory	Pale Ivory	Pale Ivory	Pale Ivory	Pale Ivory
Uzalla	-Ezeko	Creamy White	Creamy White	Creamy White	Creamy white	Creamy White	Creamy White

MOISTURE CONTENT, PLASTICITY AND DRY SHRINKAGE

		Moisture Current %	Plasticity Index	Dry Shrinkage %
Igbanke		22.83	5.5:I	6.20
Igbontor	- Iyioma	32.85	3.4:I	8.40
Ozarra	- Igwuigwugwu	32.70	5.2:I	6.50
	- Ewebi	33.30	4.3:I	8.70
	- Iduleha	27.10	6.I:I	8.30
Iguoriakhi	- Ovbere	33.75	2.9:I	10.05
	- Ogbomoba	36.30	3.9:I	7.40
Uzalla	- Ezeko	39.8I	3.3:I	9.53

ANNEX III

Extract of C.I. Maurel's Report

N-Rek INTERNATIONAL

DATE: September 18, 1975

NATURAL GAS AVAILABILITY

BENDEL STATE

Information has been collected in Bendel State from N.N.P.C. and others, where associated and non associated gas is available in the Ughelli and Sapele areas. The direct and official discussions with N.N.P.C. on the subject will only be possible when an official invitation is received from the Bendel State Government.

The two major gas fields in Bendel State, i.e. Ughelli/Warri and Sapele are shown on the attached map (Attachment 1).

Sapele Gas Field

The Sapele area is an important crude oil field with associated and non associated gas and is operated by Shell/N.N.P.C. A gas collecting system has been installed to supply gas to the new NEPA power plant at Sapele (1,020 MW).

A temporary gas station is installed at Sapele-West at a place called Abegborode. This station will soon be

transferred to the North-West of Sapele at Oben. The Sapele NEPA power plant will then be supplied in gas from both fields Oben and Abeghorode. N.N.P.C. are projecting the construction of a new 300 Km 30" gas line from Oben to the Ajaokuta steel plant in the Kwara State near the Niger River. The award of this contract to SEDCO is imminent. We have no precision about the route that this new gas line will follow but it is logical to think that it will follow the right of way of the crude oil line from Warri to the new refinery of Kaduna. The new gas station of Oben is assumed to be located in the exact spot of the passage of the crude oil line (see Attachment 2).

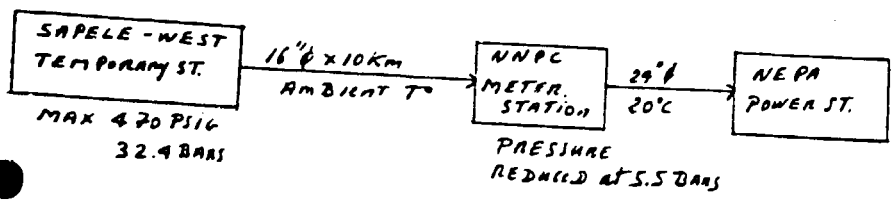
The crude oil line passes through Owa, (on the Benin City/ Onitsha road), located at a distance of 40 km from Benin City. N.N.P.C. further indicated that at a later stage the gas will be supplied to Lagos from Oben. This gas line will necessarily follow the existing Refined Product line coming from the Warri refinery, passing through N.N.P.C. Benin City Depot (Oregbeni - 15 km from Benin City of the Benin/Onitsha). Therefore one could logically think that the project could be located in the Sapele area.

The crude from the Sapele oil field is directed to the Escravos crude oil terminal for export. Non-associated gas is kept in reserve and balances any temporary shortages of associated gas to feed the Sapele Nepa power plant. Both gases have approximately the same analysis but I was given the non-associated gas analysis only.

	Mol %
Nitrogen	1.34
CO_2	0.39
Methane	77.19
Ethane	10.63
Propane	6.58
Iso-Butane	1.04
N-Butane	1.24
Iso-Pentane	0.29
N-Pentane	0.21
Hexane	0.11
Heptanes	0.09
	100 %

Gas Temperature 20°C

Gas is presently collected at the Sapele-West gas station at three different pressures: 47 psig - 150 psig - 485 psig. The low and high pressure gases are boosted to 470 psig for supply to the Sapele Nepa power plant via a 16" line at ambient temperature. The scheme hereunder shows the gas supply to Nepa.



NEPA GAS CONSUMPTION : 1st PHASE : 150.10^6 Sc/t/day for the 6 X 120 MW UNITS

2d PHASE : NOT AVAILABLE

Sapele-West Gas Station
(Ingersoll-Rand Compressors)

Associated gas

- 12 Units (Low temperature extracting units)
Low Pressure : 47 psig
High Pressure : 150 psig
Extra High Pressure : 485 psig

Non-associated gas

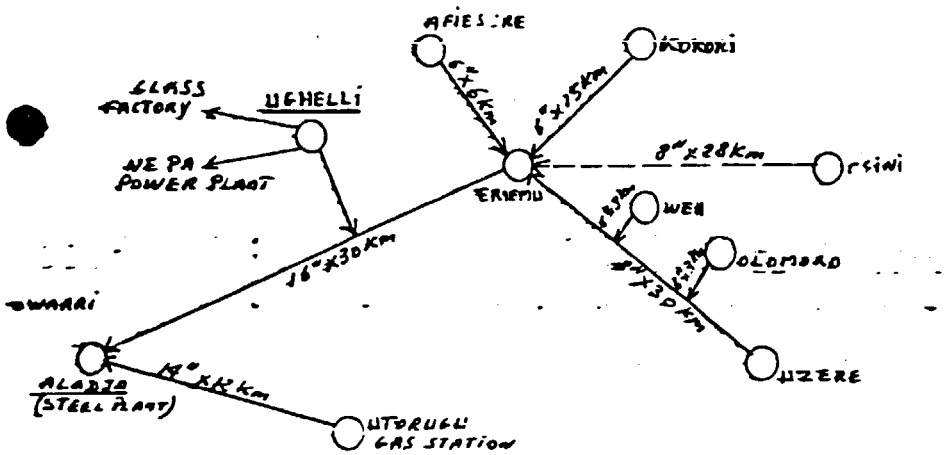
- Capped gas wells. Pressure 2800 psig gas supply to balance availability of associated gas

Crude oil/gas separation takes place at this station and crude is transferred by pipe to the Escravos Crude oil terminal. This station will be transferred to Oben within the next two years. The estimated gas consumption of the Ajaokuta steel plant will be 200.10^6 Scft/day. NNPC indicated that there will be enough gas at least for the next twenty years and our requirement does not present any particular problem compared with the existing reserves.

At the gas station itself NNPC estimated that the quantity of gas presently flared is 16 to 20.10^6 Scft/day, i.e. three times more than our requirements.

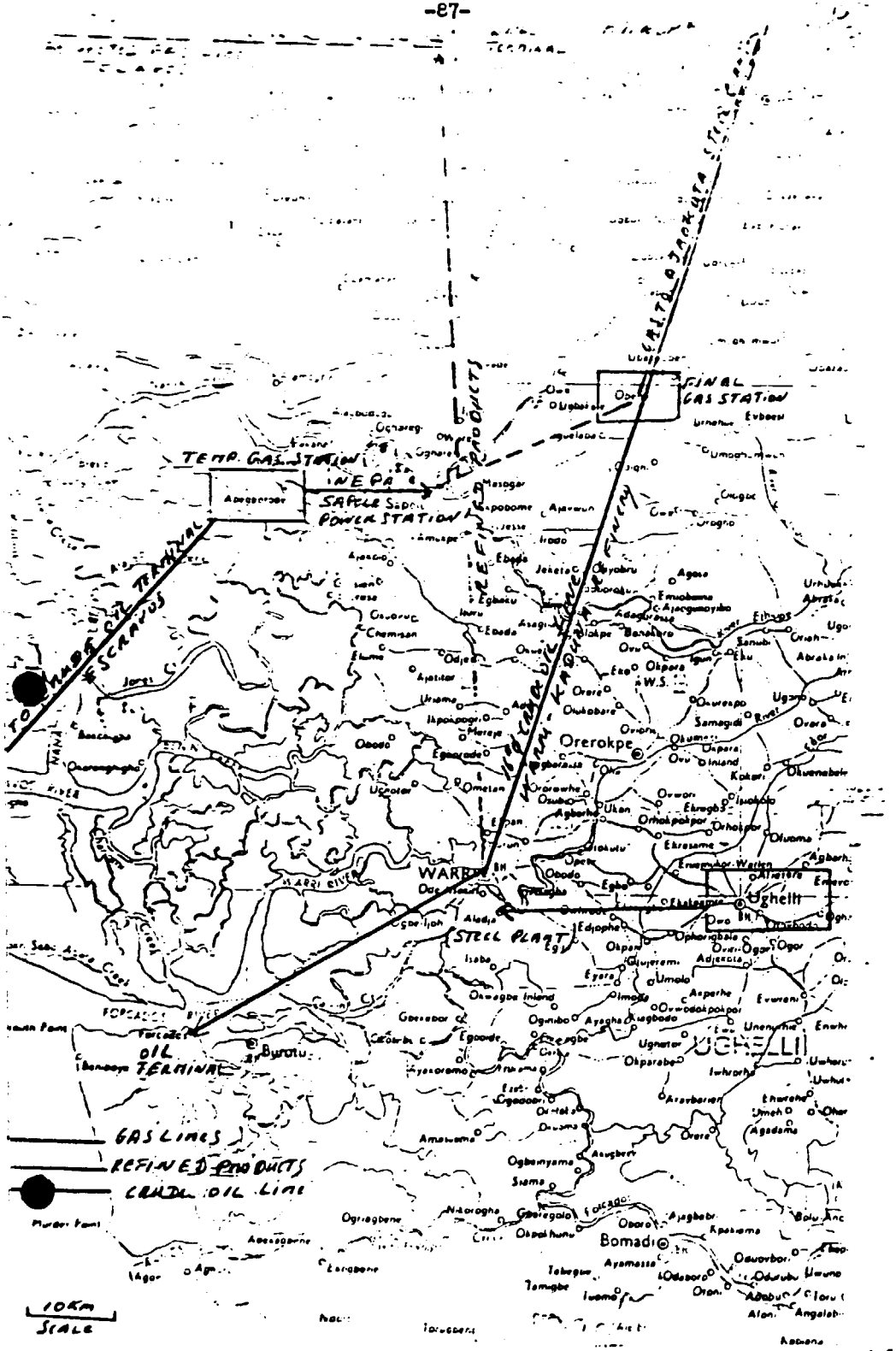
3.11 Ughelli/Warri Oil Fields.

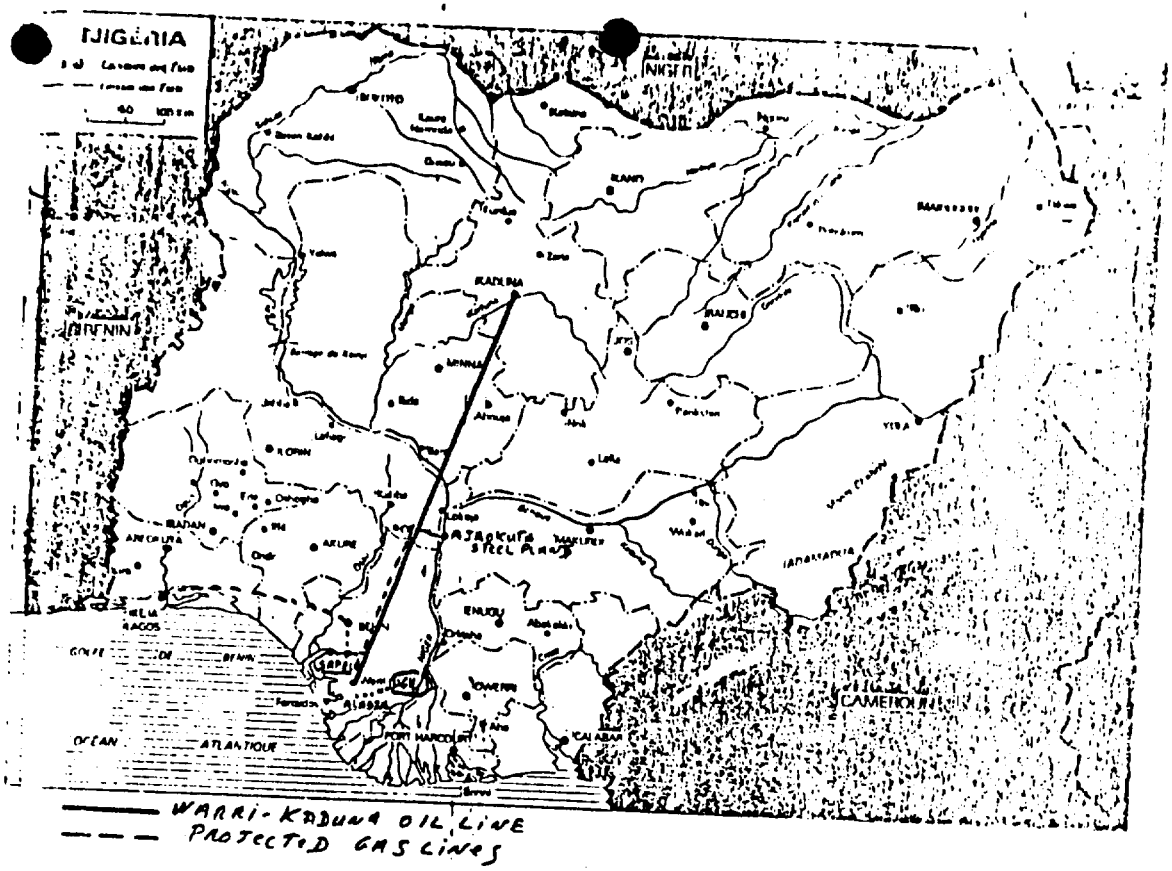
This area is also controled by Shell/N.N.P.C. however, Williams Construction Cy were kind enough to supply data on the gas collecting system in that region since they have just been awarded a contract by NNPC for gas supply to the other new projected steel plant to be located at Aladja near Warri. It is reported that both associated and non-associated gases are available. The gas pipe network in the Ughelli/Warri is shown on the sketch hereunder.



Ughelli/Warri Gas Field

The Ughelli gas field supplies gas to the Ughelli glass factory and to a Nepa power station. As far as gas availability is concerned, location of the plant in this area would not present any other problem than that this area is reported to be very crowded and swampy. The Bendel State Ministry of Industries also indicated that very little land was available in this area.


TEMP. GAS STATION
INEPA
SAPELE Steam
POWER STATION
FINAL
GAS STATION
TO ESCRAVOS
TERMINAL
REFINED PRODUCTS
WARRI-KADUNA
REFINERY
Ororokpe
WARRI
STEEL PLANT
Ughelli
UGHELLI
OIL
TERMINAL
Bomadi
GAS LINES
REFINED PRODUCTS
CRUDE OIL LINE
10Km
SCALE


NIGERIA
BENIN
KADUNA
ZARIA
KANO
MAIDUGURI
YOLA
JOS
MINNA
ILORIN
IBADAN
ABEOKUTA
AKURE
BENIN
WARRI
ENUGU
OWERRI
CALABAR
PORT HARCOURT
LAGOS
GULF OF BENIN
OCEAN ATLANTIQUE
CAMEROUN
WARRI-KADUNA OIL LINE
PROTECTED GAS LINES

ANNEX IV

11

FEDERAL MINISTRY OF AGRICULTURE

FARM PRODUCTS PROCUREMENT AND DISTRIBUTION MANAGEMENT UNIT
171 AHMADU BELLO WAY, VICTORIA ISLAND.

Ref. No FPDU/12/1/183
21st Jan., 19 86

RECEIVED
22 JAN 1986
BENIN CITY

The Permanent Secretary,
Ministry of Commerce & Industry,
(Industries Division),
Benin City.

Attention: C.U. OKUDASO

RE: UREA FERTILIZER MARKET IN NIGERIA

Your letter No. D.113.Vol.VI/158 of 9th October, 1985 refers. Please find the attached details of Urea fertilizer imports by this Ministry from 1980 to 1985 and the total estimated Urea demand from 1986 to 1990 (attachment I). Attachment II, contains the Urea fertilizer requirements for Bendel, Ogun, Oyo, Lagos and Kwara States from 1981 to 1985 and the estimated requirement for these States from 1986 to 1990. Attachment III is the Quality Specification of the Urea presently being imported by this office.

2. As shown in the attachments, the total estimated Urea requirement for the five States from 1986 to 1990 of 109, 610 tonnes is only about 7% of the total projected Urea requirement (1,488,523 tonnes) for the country for the same period.

3. It may be necessary however, to note that the NAFCON fertilizer at Onne in Port Harcourt has capacity of producing all the Urea requirements of this country up till after 1990 and even excess Urea for exports.

4. I hope you will find the information provided useful. It may be advisable for you to explore the possibility of manufacturing popular blend like NPK 15-15-15, NPK 12-12-17 + 2Mgo whose demand the NAFCON Onne Plant cannot satisfy.

L. O. Ologide
for: Director, FPDU.

12

ANNEXURE - I

UREA SALES BY F.C.I. (NEW) 1980-1985

TONNES

0436

TYPE	1980	1981	1982	1983	1984	1985	TOTAL
UREA	50,000	90,000	30,743	56,022	50,000	175,000	496,765

PROJECTED/ESTIMATED UREA DEMAND

1986-1990 - TONNES

TYPE	1986	1987	1988	1989	1990	TOTALS
UREA	186563	238747	294331	349456	419496	1,488,523