OCCASION

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

DISCLAIMER

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

FAIR USE POLICY

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

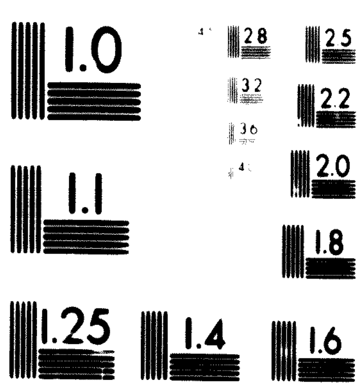
CONTACT

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

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

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

1 OF 1



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS
STANDARD REFERENCE MATERIAL 1010a
(ANSI and ISO TEST CHART No. 2)

24x
F

UNIDO/TCD.40

01249-E

Distribution
CONFIDENTIAL

1? July 1969
ORIGINAL: ENGLISH

ALGERIA

INDUSTRIAL AND MARKETING SURVEYS

ON

PETROLEUM DERIVATIVES AND NATURAL GAS

Draft

Report on Project Results
Conclusions and Recommendations

by

THE UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION ACTING AS PARTICIPATING AND EXECUTING AGENCY FOR THE UNITED NATIONS DEVELOPMENT PROGRAMME (SPECIAL FUND)

FS/gem

id.69-3786

TABLE OF CONTENTS

1. Introduction.

1.1 The United Nations was designated Executing Agency for the project in January 1965 by the Governing Council of the United Nations Development Programme (Special Fund), for carrying out a detailed survey designed to explore and assess:

a) the feasibility of petrochemical and related fertilizer facilities based on derivatives of petroleum and natural gas; and

b) the export markets for Algerian natural gas and the technology and economy of transporting the gas from the Algerian coast to prospective users.

1.2 The United Nations Industrial Development Organization became a Participating and Executing Agency of the United Nations Development Programme on 1 January 1967, and it assumed full responsibility for this project on 1 July 1967. The portion of the project relating to the studies on natural gas remained the responsibility of, and was completed by, the United Nations (Natural Resources Division).

1.3 The Plan of Operation was signed on 8 December 1965 and the project was officially authorised to commence operations on 15 April 1966. The field operations of the project were closed out on 15 February 1968.
The final total Special Fund allocation amounted to US$834,792 with the Government contributing US$320,000.

1.4 Under Contract No. 60/66, the United Nations designated Scandia-Consult AB of Sweden and the Bureau Central d'Etudes pour les Equipements d'Outre-Mer (BCEOM) of France jointly as consulting engineers to carry out that phase of the project which relates to the study of the export markets for Algerian natural gas and the technology of its transport.

1.5 Studies on petrochemicals and fertilizers, covering market research, feasibility studies and launching and marketing operations, were carried out under contract by Japan Gasoline Co. Ltd. of Tokyo, Japan, under contracts 132/66 and 73/67, respectively.

1.6 The conclusions and recommendations arrived at under this project are mainly based on findings prior to late 1967 when the fact-finding for the draft final reports was concluded. The only exception was in connection with the marketing study for petrochemicals and fertilizers which was carried on until April 1968.

1.7 In accordance with the explicit request by the Algerian Government, the findings and recommendations of this project are being treated as confidential.

2. Summary, Conclusions and Recommendations.

2.1 General.

2.1.1 The scope of the study of the export markets for Algerian natural gas and the technology of its transport included forecasts of the potential markets and the calculation of quantities and costs in relation to the different transport methods studied. Various sales policies have been worked out and were backed by a study of the institutional and legal aspects connected herewith.

The combination of transport by submarine pipeline and LNG tankers was found to be the most profitable from a strictly commercial angle. Transport by LNG tanker, however, provides the Algerian economy with roughly double the added value of what would be the case for the pipeline transport.

2.1.2 For petrochemicals and fertilizers, the project culminated in a detailed pre-investment study for one petrochemical and one fertilizer complex, backed by studies of export markets and Algerian needs which were supplemented by a launching and marketing operation for the purpose of confirming the feasibility of the recommended facilities.

The capital required for the recommended petrochemical complex including off-sites, based on an ethylene capacity of 150,000 tpy, producing polyvinyl chloride, low-density and high-density polyethylene, detergent raw material dodecylbenzenes and aromatics, as well as some intermediates, was calculated to be US$90.25 million, the foreign exchange component of which is 62.4%. The rate of return based on Discounted Cash Flow (DCF) calculations assuming 100% operating efficiency, no corporate tax for three years and 50% for the remaining seven years of the project life, came to 17.6%. The recommended fertilizer complex for the production of 110,000 tpy diammonium phosphate (DAP) and 90,000 tpy triple superphosphate (TSP), requires an investment of US$ 26.74 million, with 61.6% foreign exchange component. The rate of return is practically the same as the one for the petrochemical complex.

2.1.3 The only substantial aspect linking the studies on the petrochemicals and the gas study is the raw material chosen for the production of petrochemicals, i.e., the condensate recovered from the produced gas at the rate of approximately 200,000 tons per billion cubic metres of gas. The choice of the raw material for petrochemicals, which was made after a thorough technical and economic evaluation of alternative sources, has the built-in tactical advantage of making the petrochemical planning independent of any decisions which may later be taken on the export of natural gas, such as type and location of liquefaction plants and the decision to sell the LNG with or without C_2 and heavier hydrocarbons.

2.1.4 It should be recorded here that by definition the project was not to deal with the natural gas-based ammonia production, seeing that the 1,000 tpd plant at Arzew had already been decided by the Government when project operations started. Consequently only the utilization of part of the anticipated ammonia production was studied and will be discussed under the chapter "Fertilizers".

2.2 The Preliminary Petrochemical Study.

2.2.1 The determination of priorities was effected through a global approach, considering the world market situation, Algerian needs and requirements and the preliminary calculation of hypothetical production costs in Algeria for the most relevant basic, intermediate and finished petrochemical products, with due regard to various raw material sources and different process routes.

2.2.2 A statistical analysis of the world market situation accompanied by spot checks in the EEC, EFTA and COMECON regions confirm that there are good chances for the export of a wide range of basic and intermediate petrochemical products provided there are competitive pricewise.

2.2.3 A study of Algerian needs and requirements revealed that within the next decade an increasing demand for basic and intermediate petrochemical products will be forthcoming.

2.2.4 It can safely be concluded that future domestic consumption and export of intermediate petrochemicals and base products for the various finishing industries put together will well justify a petrochemical complex at or above the critical level of minimum economic size.

2.2.5 As for finished products, the world market situation for plastomers, elastomers, synthetic fibres, detergents and insecticides has been investigated. Elastomers and synthetic fibres have been eliminated at this stage from the production programme for a number of reasons which are expected to vanish once the basic petrochemical industry is well established in Algeria. As for the insecticides, BHC was investigated, which could have provided a good captive utilization of benzene, but market investigations showed there was no outlet for this product.

2.2.6 The plastomers considered to be of interest for the first development phase of a petrochemical industry were Polyvinyl Chloride (PVC), Low-density Polyethylene (LDPE), High-density Polyethylene (HDPE) and Polypropylene (PP), bearing in mind that these products are partly interchangeable as far as final utilization is concerned. As for the export of these products, it is believed that, at least [illegible] recent date. [illegible] will [illegible] the efforts made for introducing [illegible] future [illegible]

[illegible]

...7 [illegible] rapid- [illegible] sophisticated [illegible] not normally [illegible] term [illegible] in general [illegible] number of years. It was [illegible] for the initial planning [illegible] products of the [illegible]

... [illegible] the petrochemical building blocks which [illegible] and acetylene, [illegible] both [illegible] to be resolved in [illegible] which the petrochemical [illegible] would [illegible].

As indicated under [illegible] the condensate recovered at the gas fields and valued at 13.[illegible]/t at the Mediterranean coast, was chosen as starting material.

[illegible] calculations have confirmed the advisability of basing the petrochemical complex on ethylene rather than acetylene or both. The calculated production cost of ethylene at the level of 150,000 tpy was close to 30 [illegible]/t or 1.4 US cts/lb. The cost of shipping liquefied ethylene to Spain (Barcelona) has been calculated at 0.32 to 0.33 US cts/lb and to a harbour in northern Italy at 0.45 to 0.47 cts/lb. The lower figure applies to shipment in tankers with integrated containers, while the higher one refers to the self-supporting type.

- -

The forward integration of the basic building stone ethylene in the creation of a domestic industry for the production of intermediate and finished products is thus further enhanced by the fact that it will be possible to export more than half of the ethylene production under competitive conditions and in this way to benefit from the economy of scale in both investment and production costs.

2.2.9 Following the determination of the main parameters three alternatives for a petrochemical complex have been worked out. The common denominator for all three cases is the starting material (condensate), with ethylene as the main petrochemical building block. Also the ethylene capacity is the same in all three cases, i.e., 1[illegible] tpy. In each of the three cases it was proposed to produce plastomers, detergent base material (dodecylbenzene) and aromatics.

For all processes under consideration it was possible to confirm that know-how and licences were available for Algeria. For a realistic evaluation of the situation the know-how fees were worked into the production costs.

2.2.10 The process units foreseen in each case were:

1. Fractionation of condensate for preparing a naphtha cut
2. Steam pyrolysis of naphtha for ethylene production
3. Production of plastomers
4. Aromatics recovery
5. Sodium chloride electrolysis

The main difference among the three cases is to be found in the types of plastomers to be produced. Case A produces PVC, LDPE and HDPE, case B produces LDPE and HDPE and case C LDPE and PP.

The estimated total investment costs for cases A, B and C, expressed in US$ have been calculated at:

65,400,000 72,200,000 and 70,100,000 respectively.

A detailed breakdown by process units and offsite facilities is given in tables 1, 2, 3 and 4.

2.2.11 Table 5 shows the calculated production costs for the main products for each of the three alternatives.

As a preliminary step for the economic evaluation, the sales volumes and sales values have been calculated for all three cases, considering main products and by-products as well as their anticipated share in export and domestic markets. The relevant data are presented in tables 6, 7 and 8.

The rate of return on investment which was subsequently calculated by using the discounted cash flow (DCF) technique resulted as follows:

	Case A	Case B	Case C
50% corporate tax	[illegible].5%	[illegible].1	[illegible].5%
No corporate tax for three years, 50% for the rest	13.2%	12.5%	13.1%

The results of the detailed calculations are reported in table 9. Ten years have been assumed throughout for the economic life of the project.

Financially speaking, case A had a slight advantage over the two others. The factor deciding definitely in favour of case A however is its product distribution which is best suited to satisfy the specifications for a wide range of plastics utilizations. Case A was consequently chosen for a more detailed study of its economic, technical and marketing aspects.

2.3 The recommended Petrochemical Complex.

2.3.1 Seeing that plant location and site conditions can have a considerable effect on the investment cost and thus on the production costs, a thorough survey of the following prospective industrial areas was undertaken:

Arzew
Bedjaia
Skikda
Annaba

For each of these areas all pertinent aspects have been investigated and the findings and evaluation tabled as indicated below:

Soil conditions	Table	10
Site conditions	"	11
Meteorological and Oceanographic conditions	"	12
Harbours	"	13
Raw material transport	"	14
Transport of products	"	15
Power and industrial water	"	16
Misc. reference data	"	17

The overall evaluation of the above information, compiled in table 18, has led to Bedjaia being recommended as the most suitable site for the petrochemical complex.

Next in classification came Arzew evaluated as suitable, followed by Skikda and Annaba described as possible sites.

A key map for the region of Bedjaia showing the proposed plant location and the general plot plan for the petrochemical facilities are attached (figures 1 and 2).

2.3.2 Other factors affecting investment and operating costs are design specifications and type and unit cost of the utilities. This information has been worked out in detail but space does not allow inclusion of the bulk of the material here, nor does the material lend itself to condensation into a general abstract. For inspection of these data reference is made to pages 54-67 of the "Study of Petrochemical and Fertilizer Industries" Part II Petrochemical Complex.

2.3.3 Also, the backfeed of the information collected in the course of the sales promotion for the anticipated products necessitated certain

re[illegible] t[illegible] the originally foreseen production capacities reflect-
in[illegible] investment and [illegible] cost. [illegible] flow chart
Fig. 3 represents the final version of the recommended complex.

2.5.4 With the information [illegible] it was possible to proceed with the firming up of the preliminary figures arrived at under [illegible]. The [illegible] investment figures are:

	Foreign Currency	Local Currency	Total
	$1,000	DA1,000	$1,000
Process Units	44,2[illegible]7	10,[illegible]	6[illegible],5[illegible]7
Offsite Facilities	13,[illegible]03	15,7[illegible]	2[illegible],723
	5[illegible],2[illegible]	1[illegible]	[illegible],[illegible]50

It will be noted that [illegible]7.7 [illegible] of the investment for the process units and 4[illegible] of the investment for the offsites will have to be raised in foreign currency. The [illegible] currency component for the total investment amounts to [illegible].

For the breakdown of these costs by classes of equipment into materials, freight, erection cost, engineering, procurement, royalties, know-how, licence fees and start-up expenses, reference is made to tables 1[illegible] through 22.

The production costs for intermediate and final products have also been firmed up for both 80 and 100% operating efficiency and are given below for both cases:

Total Production Cost ($/t)

	Operating Efficiency	
	100%	80%
Naphtha	7.33	7.63
Ethylene	30.52	3[illegible].73
Vinyl chloride	89.[illegible]2	114.21
Polyvinyl chloride	14[illegible].1[illegible]	186.97
Low-density polyethylene	20[illegible].[illegible]2	253.[illegible]5
High-density polyethylene	33[illegible].5[illegible]	412.27
Dodecylbenzene	13[illegible].18	155.90
Benzene	45.26	50.52
Toluene	37.34	41.68
Xylenes	36.21	40.42
Chlorine	53.30	71.47

After compiling the annual sales values in table 23 for both 80% and 100% operating efficiency, the figures for the rate of return on investment [illegible] for the project resulted as follows:

a) 100% operating efficiency, 50% corporate tax, rate of return 14.5%

b) 100% operating efficiency, no corporate tax for the first three years and 50% for the rest, rate of return .... 17.[illegible]

c) 80% operating efficiency for the first two years, 100% for the rest, 50% corporate tax rate of return 13.3%

d) 80% operating efficiency for the first two years, 100% for the rest, no corporate tax for the first three years, 50% for the rest, rate of return 14.7%

2.3.5 It is encouraging to note that the detailed study of the recommended complex reveals a higher rate of return on investment than did the preliminary studies.

Further confirmation of the feasibility of the proposed facilities was obtained in the course of a marketing and launching study conducted simultaneously with the firming up stage of the technical study.

2.3.6 As a result of the marketing study, outlets have been found for all main products as well as byproducts. Detailed information per products and countries has been collected in volumes 2 and 3 of the "Study of Launching and Marketing of Petrochemicals and Related Fertilizers".

The programme for the "launching" of the anticipated products provided also for the finding of specific foreign buyers. The most promising and immediate possibilities grouped by products are:

Ethylene:	Spanish Government, Ministry of Industry. A possibility exists for barter trade in exchange for sulphuric acid.
	Solvay and Cie., through Solvic S.A., for their Spanish and Italian affiliates.
	Portuguese Government for SACOR, Lisbon.
	Polish Government, CIECH. Possibility

	for barter trade in exchange for sulphur.
Vinyl chloride:	UAR Government, Egyptian General Industrialization Organization. Interest has been expressed for barter trade in exchange for chlorine.
	Companhia de Resinas Sintéticas, Estarreja, Portugal.
	Hungarian Government, Chemimpex.
Pyrolysis Gasoline (intermediate for aromatics and dodecylbenzene):	Mobil Chemicals USA, through Mobil Chemicals International (Geneva, Switzerland), for Mobil Chemicals Italiana (Naples, Italy).
Byproduct kerosene:	Albacc (Geneva, Switzerland), for surplus kerosene not sold on the domestic market.

As for the balance of the products mainly intended for domestic outlets and neighbouring markets, reference is made to 2.2.6 and 2.2.7 for the summary of the situation, and for the details to volumes 2 and 3 of the "Study of Launching and Marketing of Petrochemicals and Related Fertilizers".

On the subject of plastomers, a separate study has been carried out concerning the possibilities of developing a plastics finishing industry in Algeria based on locally produced intermediates. It was prepared in co-operation with various Government agencies and edited by courtesy of the Algerian Ministry of Industry and Energy, which has also arranged for the appropriate distribution. The findings of this study have been built into the comments under 2.2.6.

2.3.7 To conclude on the subject of petrochemicals, a recommendation should be made here concerning the schedule for the erection of the processing units composing the proposed facilities. It is believed that in view of the foregoing studies priority should be given to the plants for the fractionation of condensate, the production of ethylene, vinyl chloride, polyvinyl chloride (PVC) and high-density polyethylene (HDPE). The production of low-density polyethylene (LDPE), aromatics and dodecylbenzene should be deferred for one to two years.

2.4 The preliminary study of the Fertilizer Complex.

2.4.1 Following the same tactical approach as used in the preliminary petrochemical study an investigation of the world market situation and the Algerian requirements has been carried out and raw material sources, processing routes and related know-how have been reviewed.

To start with, the following four products have been chosen for closer consideration:

Triple superphosphate (TSP)
Diammonium phosphate (DAP)
NP (20:20) fertilizer
Calcium ammonium nitrate (CAN)

Process alternatives have been worked out and production costs calculated accordingly.

With investment and the rate of return on investment for the possible alternatives being of the same order of magnitude, the determination of priorities was made in consideration of potential exports.

The production of NP fertilizer and CAN being linked processwise, the marketing aspects for both of these products had to be considered together. Detailed market studies indicate that NP fertilizers are produced in considerable quantities in Europe for domestic consumption. Demand and supply are well balanced in this area and the use of NP fertilizers is not in demand in the rice paddy fields of South East Asia. Moreover, as compared to DAP, the transport costs of NP fertilizer per unit of nutrient are high and the range of its application is narrow. The result of this is that the international markets are limited. Another argument against the production of the NP fertilizer/CAN tandem is that CAN would inevitably compete with the ammonium nitrate scheduled to be produced at the Arzew complex.

The demand for TSP and DAP in Algeria and in a number of countries believed to be interesting for Algeria's export has therefore received another close look, with particular emphasis on the potential Algerian share of supply, and the following figures expressed as 1,000 tpy P_2O_5 have been arrived at:

Country	Total Demand		Algerian share			
	TSP	DAP	TSP		DAP	
			min.	max.	min.	max.
Turkey	100	100	5	10	5	10
U.A.R.(Egypt) experimental quantities			-	-	5	10
India	-	350	-	-	18	35
Pakistan	35	40	2	4	2	4
Africa	15	-	1	2	-	-
Algeria	10	-	10	15	5	10
Oceania	-	25	-	-	2	3
East Europe	77	-	15	25	-	-
Mainland China) Cuba)			n.a.			
Total	237	515	33	56	37	72
Average			44		54.5	

The contacts made in the course of export sales promotion indicate in the first place India, UAR and Turkey for DAP and East European countries for TSP.

Reverting to the subject of domestic market forecasts it can safely be stated that there is plenty of scope for the development of nutrient application before this will reach even a minimum desirable value.

Since the public sector accounts for about 90% of the fertilizer used, it is evident that the Central Administration already controls to a very large extent the purchase and application of fertilizer in Algeria. The actual nutrient "demands" will therefore depend very largely on the degree to which the Government elects, as a matter of policy, to control the future development of the market. The encouragement towards increased fertilizer use is obtained by means of Extension Service, farmer education, credit availability and others, which will be dealt with in more detail under the follow-up implications of the project.

In conclusion of the above considerations it is recommended to base the fertilizer complex on the production of TSP and DAP and to exclude NP fertilizers and CAN from the present considerations.

2.5 The recommended Fertilizer Complex.

2.5.1 The overall evaluation of the site information compiled in Table 18 led to Annaba being recommended as the most suitable site for the fertilizer complex, with Arzew, Bedjaia and Skikda considered as possible sites.

A key map for Annaba (Fig. 4) is attached, showing the location of the proposed facilities, while Fig. 5 represents the general plot plan for the industrial complex.

2.5.2 The project design data on which the calculations for the fertilizer complex have been based are spelt out in the attached report on the "Study of Petrochemical and Fertilizer Industries", Part III, Phosphatic Fertilizer Complex, pages 15 through 29.

2.5.3 The fertilizer complex is anticipated to use the calcined phosphate rock from Djebel Onkh as starting material. The phosphoric acid produced by the wet process is used for the production of triple superphosphate (TSP), and diammonium phosphate (DAP) by blocked operation, as outlined below:

Product	Capacity	Annual Production	Calculation basis 300 SD/year
Phosphoric acid	P_2O_5 300 t/d	86,000 t/y	Run at 100% capacity for 60% of the year, and at 90% for 40% of the year
DAP (Grades 18-46-0)	180,000 t/y	110,000 t/y (P_2O_5 50,000 t/y)	Run at 100% capacity for 60% of the year
TSP (Grades 0-46-0)	220,000 t/y	90,000 t/y (P_2O_5 41,000 t/y)	Run at 100% capacity for 40% of the year

The determining factors in making this choice were the following:

i) In most countries of the world, the fertilizer market is subject to seasonal variations, so that fertilizer factories are required to be capable of producing large quantities in short periods of time. Therefore, for a factory with a given production capacity for phosphoric acid, blocked operation is more advantageous in that it enables it to concentrate production in a short period. Parallel production does not offer flexibility in this respect. Moreover, should one of the proposed two plants be shut down for some reason, the phosphoric acid plant would have to be run at 50% capacity, which would be most uneconomical.

ii) DAP and TSP are both typical phosphatic fertilizers which can switch markets. As for demand for them, it sometimes leans toward TSP and at others toward DAP, so that demand forecasts must be made in terms of total P_2O_5 content. A blocked operation system is obviously the better choice because it allows exclusive production of one or the other for different periods.

iii) Admittedly, blocked operation requires larger equipment than parallel operation and consequently entails larger total investment. But this disadvantage is more than offset by the fewer operators required (about half those needed for parallel production), the smaller proportion of fixed cost in total production cost, and the merits in marketing and sales.

2.5.4 The recommended complex includes facilities for the recovery of sulphur from byproduct gypsum which can produce up to 200,000 t of cement clinker per year.

The alternative for producing sulphuric acid from imported sulphur is also presented.

2.5.5 The block flow diagram Fig. 6 shows the material flow for the single process units as well as the overall production of the complex.

2.5.6 The total investment for the process units and the offsite facilities was calculated to be:

	Foreign Exchange $1,000	Local Currency DA1,000	Total $1,000
Process Units	12,527	27,693	18,178.6
Offsite Facilities	3,[illegible]56	22,572	8,562.5
	16,483	50,265	26,741.1

Detailed estimates have allowed the foreign exchange component of the investment to be kept to 61.6%.

2.5.7 The profitability calculations are based on the following costs for raw materials, intermediates for captive use, and final products (all in $/t):

Raw Material	
Calcined Phosphate Rock (BPL 75)	10.00
Ammonia	35.00
Elemental Sulphur	39.00
Coke	15.00
Clay	2.00
Pyrite Cinder	1.00
Diatomaceous Earth	10.00
Intermediates	
Pulverized Phosphate Rock	11.82
Crude Phosphoric Acid (P_2O_5 30%) (as P_2O_5)	91.43
Sulphuric Acid (as H_2SO_4 100%)	13.92
Concentrated Phosphoric Acid (P_2O_5 54%) (as P_2O_5)	102.78
Final Products	
Diammonium Phosphate (18-46-0)	64.96
Triple Superphosphate (0-46-0)	48.45
Cement Clinker	10.50

2.5.8 The annual sales value has accordingly been compiled in Table 24. The rate of return on investment calculated by the DCF method, assuming ten years' economic life of the project, is:

a) For 300 days blocked operation, 50% corporate tax for 10 years' economic life of project 14.9%

b) For 300 days blocked operation, no corporate tax for the first three years, 50% for the rest of the life of the project 17.6%

It is interesting to note that the profitability for the recommended fertilizer complex is practically the same as for the recommended petrochemical complex.

2.6 Summary of the "Study of Markets for Algerian Natural Gas and the Technology of its Transport".

2.6.1 The objectives of the study were to define the possible markets for Algerian natural gas, to discuss the possible means of transporting this gas to potential markets, and to prepare estimates of the probable delivered cost of Algerian natural gas and of the quantities which might be expected to be sold at these prices.

2.6.2 The study commenced with a discussion of possible markets for Algerian natural gas in the light of present-day intense competition in the international energy market due to the very large supplies of cheap petroleum available, principally from the geographical region known as the Middle East. An attempt was made to forecast probable future energy demand in Western Europe, which was regarded by the authors as the most likely outlet for Algerian natural gas. Any attempt to determine which part of this total market may be supplied by natural gas is dependent on the price at which the gas can be sold, since substitution of different fuels is possible over a wide range. The study recognized that natural gas might enjoy a certain premium for special uses owing to its cleanliness and convenience, but drew attention to the large capital investment required to develop such markets.

2.6.3 The study continued with a survey of the means by which Algerian natural gas might be transported to the possible markets. Due to the geographical location of the Algerian gas fields, long overland pipelines are necessary to bring the gas to the coast. From the Algerian coast the gas must cross the Mediterranean in order to reach potential markets in Western Europe. Two methods of transport are feasible under present-day conditions.

a. Liquefaction of the gas by freezing, so that it can be transported across the sea in specially designed tankers.

b. Construction of underwater gas pipelines.

Both the above methods require heavy capital investment both in Algeria and in the consuming countries. The liquefaction process has been proven in practice and Algerian liquefied natural gas (LNG) is being shipped from Arzew to England under long-term contract. Underwater gas pipelines strong enough to withstand the water pressures which would be encountered at the bottom of the Mediterranean have never yet been built and operated, although experiments indicate that it would be technically feasible to build such a pipeline.

The study discussed the probable cost and the technical factors involved in transporting Algerian natural gas to European markets.

Three possible systems were considered.

a. Overland pipelines with the trans-Mediterranean link provided by sea transport of LNG.
b. Overland pipelines linked by a high-pressure submarine pipeline laid on the bed of the Mediterranean.
c. Parallel operation of systems 'a' and 'b'.

System 'a' requires the construction of a gas liquefaction plant at an Algerian port, together with storage and loading facilities. It also requires unloading facilities at a port in the consuming country, together with storage facilities and regasification plant. The receiving terminal must be connected by high-pressure overland pipeline with the centres of gas consumption because overland transport of LNG in bulk was not considered feasible or economic.

System 'b' requires the laying of a long submarine pipeline of an experimental nature. Such a system would be less flexible than system '●' but would be more economic at higher volume throughput. Various different routes for such a submarine pipeline were discussed.

It was considered that, because of the experimental nature of the submarine pipeline required, it would be quicker to construct an LNG system since the technology has been proven. Both methods of transport would be uneconomic unless a certain minimum throughput could be maintained.

2.7 Conclusions.

The study concluded that Algerian gas was at a serious geographical disadvantage with regard to potential markets. It would encounter fierce competition from cheap petroleum and from natural gas from other sources. Promising prospects for the sale of Algerian gas would be in south-west Europe, principally Spain and southern France.

The study was unable to make accurate forecasts of future energy price levels in the European market because of various unpredictable factors, such as individual Government policies in consuming countries, and uncertainty regarding future petroleum price levels on the world market. It was concluded, however, that on a qualitative basis energy prices would remain at present low levels for the foreseeable future.

Due to high transport costs Algerian gas had only a slight competitive margin over alternative sources of supply even in south-western Europe. Libyan gas in particular would remain a strong competitor. The competitive position of Algerian gas had worsened in recent years due to the discovery of alternative, more accessible, sources of supply. Possible markets were being pre-empted very rapidly by competitors and for technological reasons these markets would tend to remain captive to the original supplier. Prompt action was required by the Algerian Government if any of the potential gas markets were to be reserved to Algeria. In this connexion the agreement-in-principle of 1965 between Algeria and France for the delivery of 3 Gm^3 per annum for 15 years was of great significance.

Of the possible alternative systems for transporting Algerian gas to markets in south-west Europe, the LNG system could be placed in operation more rapidly due to its technology having been proved. The submarine pipeline system would take longer to install due to its experimental nature but it should provide cheaper gas in the consuming centres than the LNG transport system, especially at higher volumes.

Nevertheless it was concluded that an LNG system would give a higher value added to the Algerian economy per unit of gas sold because of increased processing within Algeria. The LNG system would require 10 % less capital expenditure than a submarine pipeline handling the same volume throughput, but the delivered price would be sensitive to inflationary increases in operating costs whereas the operating cost of the pipeline should be relatively stable throughout its economic life.

The study concludes that the optimum transport system would be a combination of both methods. LNG should be shipped to southern France and a submarine pipeline laid from Mostaganem to Cartagena to supply the Spanish market. Since it would be relatively easy to expand the capacity of the submarine pipeline once the initial crossing had been made, the possibility of extending the Spanish pipeline into France should be kept in view. In this case the LNG system could be used later to supply other markets such as northern Italy or Yugoslavia/Austria.

Initially, in the case of 'c' the LNG system should be designed to handle 3.5 Gm^3 per annum of natural gas, and the submarine pipeline for 2 Gm^3 per annum. It is probable that the system would be under-utilized in the early years of operation while the market for Algerian gas was being built up, but this should be recoverable in later years.

The gas liquefaction plant should be located at a point on the Algerian coast such that a single pipeline from the gas fields in the interior could serve both the liquefaction plant and the submarine pipeline to Spain. The location indicated by the study was Arzew where an existing liquefaction plant is already in operation. The best crossing point for the submarine gas line was Mostaganem-Cartagena. The LNG terminal in France should be at Fos.

The report submitted by the contractor in July 1968 consisted of the following:

Part 1. Summary, Conclusions and Recommendations
Part 2. Export Markets
Part 2. Appendix
Part 3. Transport
Part 4 Export Policy
Part 5. Institutional and Legal Aspects

2.8 Recommendations for the Transport and Marketing of Natural Gas.

The recommendations made by the study were as follows:

2.8.1 It is in Algeria's interest to conclude, without delay, the agreement-in-principle with France for delivery of liquid natural gas at a rate of 3.7 Gm^3 per annum by about 1975. Output from the liquefaction plant should reach a production of at least 3 Gm^3 per annum to keep the unit cost price within limits consistent with the negotiated sales price. Capacity should, at the same time, be limited to that necessary to supply the amounts agreed to in firm sales contracts. If the Algerian Government wishes to reduce the risk of incurring a loss on the export of liquefied natural gas and to ensure its chances of capturing a market in Spain, it is suggested that the liquefaction plant be located at Arzew. The same feeder main could supply both a submarine pipeline to Spain across the Mediterranean and the liquefaction plant.

2.8.2 Algerian gas can be offered at a competitive price on the Spanish market if the supply is transmitted by submarine pipeline between Mostaganem and Cartagena, laid in accordance with the method developed by Gaz de France-Electricité de France, and if the amounts purchased by Spain reach some 1.3 Gm^3 per annum. Negotiations with Spain should thus be conducted on the basis of the cost made possible by this particular mode of transport. The supply contract should contain a clause to provide for revision or cancellation which could be invoked should there be delay or failure in laying of the pipeline.
Once the contract with Spain is concluded construction of the supply system should be carried out in two stages: first, laying of the initial pipe in the submarine system which, if successful, would be followed by the installation of the necessary land pipelines.

2.8.3 It is in Algeria's interest to start preliminary negotiations with France as soon as possible on the submarine pipeline transportation system. These negotiations should include, from the outset, an offer which would be backed up by the type of competitive prices that this system would make possible once its throughput from Algeria to Spain, France and points beyond reached 6 Gm^3 per annum.

2.8.4 The legal and institutional problems which arise from the establishment of a system to undersea and overland pipelines to Spain and France need to be solved by Algeria and the other countries concerned at the same time as the problems on investment and sales policy.

2.8.5 Once the preliminary negotiations with France and Spain have made sufficient progress, and perhaps even prior to conclusion, it would be in Algeria's interest to attempt to secure with the help of the two countries, the financial resources required for laying the submarine pipeline between Mostaganem and Cartagena (about US$30 million). Work should be started as soon as funds are made available. Speed at this stage would gain time which would subsequently be very valuable.

2.8.6 In spite of the difficulties imposed by strong competition, Algeria should persist in its efforts to make contacts with countries other than France and Spain. With Italy and Yugoslavia, the tenor of the discussions should be to offer liquefied natural gas from the liquefaction plant to be shipped in methane tankers for delivery during 1970-75. Such deliveries could start as soon as the pipeline system reaches the Rhone Valley in France.
Such a policy would allow Algeria to offer prices that would be more competitive than if it has to finance new installations. Moreover, it would increase the possibility of developing sales in France, as it would take full advantage of the economies of scale that would result from a high throughput system across the Mediterranean and Spain.

2.8.7 Should it not be possible to finalize, before the end of 1968, the agreement-in-principle between Algeria and France on deliveries of liquid natural gas, or should the agreement be limited to a quantity less than 3 Gm^3 per annum, the Algerian Government would be well advised to abandon any kind of liquefaction scheme and to concentrate its efforts on export by pipeline.

3. Follow-up Implications of the Project.

3.1 The implementation of the petrochemical complex.

3.1.1 The following considerations concern both the implementation of the industrial complex as well as the marketing of the anticipated products.

3.1.2 Once the requirements for the establishment of a petrochemical industry have been satisfied by appropriate pre-investment studies and market research, the problems connected with financing have to be solved.
UNIDO's programme includes assistance in the course of this phase and the relevant specialized services may be mobilized on request.

3.1.3 Also, the Special Fund Project, Algeria 1 , Centre of Industrial Studies and Technology, provides for assistance on various technical and economical aspects of the implementation of the petrochemical projects. It is recommended that the services provided are extensively utilized, for example, in the preparation of tender specifications, evaluation of proposals and in the operational phases following the award of contracts.

3.2 The sales promotion services connected with the petrochemical complex.

Among the products of the recommended petrochemical complex plastics and detergents will need sales promotion services over and above those required for the other bulk chemicals. It should be emphasized here that a thorough understanding of the modern concepts and methods of marketing is essential for the successful development of the respective industries, seeing that the relevant marketing methods have undergone great changes in recent years. The recommendations elaborated in the course of the project reflect the most advanced practices used in these industries. The information on this subject is presented in the report on the "Study of Launching and Marketing of Petrochemicals and Fertilizers" volume 2, pages [illegible] through 236, which should be consulted for closer study. The main implications are highlighted in the following.

3.2.1 For plastics a technical service organization is recommended which will fulfil the following functions:

1. Research on physical properties of intermediate and finished products
2. Research on processing methods and processing machines
3. Development of new kinds of plastics products
4. Technical service accompanying sales activities.

These operations should be carried out in close co-operation with the marketing department, the technical department of the petrochemical complex, the research and development organization and directly with the customers.

The technical service includes training of the marketing staff and of the personnel in the finishing industries, consultations to the finishing industries and general services, including publications of manuals, organization of lectures, exhibitions and similar activities. A fully-fledged technical service organization will require laboratory equipment as well as processing equipment including extruders, injectors, blow moulders, cable coating extruders, mixers and a calender, at a total estimated cost of US$2,000,000.

3.2.2 The equipment required for the sales promotion of detergents is considerably simpler than that described for plastics, with the required equipment cost estimated at US$28,000. The relevant equipment is intended to serve laboratory purposes only, particularly for the analysis of electrosing materials, auxiliary materials and water, as well as for the solving of miscellaneous customers' problems.

3.3 The implementation of the fertilizer complex.

3.3.1 The general considerations under paragraphs 3.1.2 and 3.1.3 concerning the implementation of the petrochemical complex and the related marketing also apply here.

3.4 The sales promotion services connected with the fertilizer complex.

3.4.1 The future development of fertilizer application depends on a number of factors, among the most important of which are:

1. Extension Service,
2. Sophistication of farmers,
3. Price of products
4. Availability of credit,
5. Availability of products,
6. Appropriate crop price/fertilizer price ratio.

1. Extension Service:

By Extension Service is implied expert technical advice, supplied, without charge to the farmer, either by the Government or by the Sales Service of the fertilizer manufacturers. The range of advice would include selection of crops, desirable rotation procedure, optimum fertilizer application based on cropping, rotation, soil analysis (for which there might be a per test charge), pesticide use, etc... The individuals supplying this advice have to be expert agronomists, familiar with their region and its particular problems and above all trusted by the individual farmers. The service would also sponsor experimental applications test/demonstration plots etc... to drive home its policies to the local farmers.

2. Sophistication of Farmers:

It would be ideal for the farmer to be brought to regard his land as an instrument or tool required for the production of his output. It represents a considerable investment, and like any other piece of equipment it needs proper raw materials and maintenance if it is to render profitable service. Proper raw materials implies the most favourable selection of seeds, etc...; the optimum use of fertilizer can be viewed partly as raw material, partly as maintenance; while appropriate crop rotation, pesticide application, and soil working, etc..., is needed to maintain the soil itself in top condition to resist disease, insects, erosion and other detrimental agents that could reduce profits.

Much of the current crop rotation, for instance, includes fallow every second year. If this were modified to every third year - with appropriate extra use of fertilizer - both productivity and profit would be improved, while at the same time the land [illegible] itself would [illegible].

[illegible] important that farmers should [illegible] fertilizer.

3. [illegible]

[illegible] fixed amount of fertilizer [illegible] naturally represent [illegible] nutrients [illegible] appreciate that increased fertilizer rates – up to the optimum – returns increased profits [illegible], their consumption is certain to rise. The variation of prices with time of year and with bulk or bagged shipment, although important to the convenience of operation of the individual, probably does not greatly affect the total consumption. On the other hand when the new fertilizer producing plants start up in Algeria it might be possible to move to rapid growth of domestic consumption by some sales technique, such as "Apply one ton, get another ton free" which would take advantage of low cost incremental production.

4. Availability of Credit:

The extension of credit to the farmer by the fertilizer suppliers has become standard practice in many areas. The rates of interest charged vary very considerably (in France rates are said to vary from 6% or more per annum to very favourable terms such as interest-free payment [illegible] months after the delivery of the fertilizer). This service is expensive for the fertilizer suppliers but certainly contributes very materially to their sales volumes, and is used as a powerful competitive tool. In a directed economy with virtually all the fertilizer materials passing through a single supply service the situation will inevitably be somewhat different, and much will depend on the sums made available by the Administration for fertilizer purchase; it is to be hoped that the funds made available will at least permit supply of all requests for fertilizer up to optimum application levels. In all events, at the farmer level, some form of credit availability is essential if fertilizer sale and use is to grow.

5. Availability of Products:

At present the plant nutrients applied in Algeria are supplied in a relatively limited number of forms. This is a very desirable situation, representing a great improvement on the enormous numbers of simple and especially compound fertilizers that significantly increase the complications and cost of fertilizer supply in other areas. It is currently being hoped that the central direction will continue to restrict the number of grades available, while at the same time ensuring that adequate quantities of all nutrients are always on hand when required to meet demand up to the optimum application levels.

c. <u>Crop price/fertilizer price ratio</u>

The "optimum" level of fertilizer application, as described above, is obviously a function of the relative prices of fertilizer applied and crop produced. If crop prices are maintained artificially at a low level while at the same time fertilizer prices are artificially high (due perhaps to import controls), the "optimum" level may be vanishingly low and all incentive to increased fertilizer use may disappear. It is therefore of fundamental importance that the ratio between crop prices and fertilizer prices is such that there should always exist a real monetary advantage in the use of fertilizer.

3.4.2 Detailed recommendations as to how to proceed with the implementation of the recommendations under 3.4.1 are presented in the "Study of Launching and Marketing of Petrochemicals and Related Fertilizers", volume 2, Part II, pages 23[illegible] through [illegible]47. Following a review of the present system of technical service, marketing and supply, a model for a new functional scheme has been worked out which, it is believed, will further enhance the factors contributing to fertilizer promotion. The organogram representing the proposed set up is to be found in Fig. 7 of the attachments.

3.5 General Statement on possible United Nations assistance in connection with follow-up operations.

3.5.1 The nature of the study which deals with problems of marketing of Algerian natural gas and the technology of its transport does not implicitly call for any follow-up action that can be supported by United Nations programmes.
However, if any specific problems arise within this general area and the Algerian Government wishes to avail itself of United Nations co-operation, such a request will receive sympathetic consideration.

4. Background information.

4.1 The data required for establishing technical and economic parameters for the project were compiled by the project team prior to the commencement of the subcontractors' work. This documentation was furnished by courtesy of the Algerian Ministry of Industry and Energy which also arranged for the proper private distribution.

4.2 The subjects of these studies were :-

The inventory of natural resources
The inventory of industrial installations
Structural and demographic perspectives of Algeria
Study of the past and present economic growth of Algeria
Domestic market studies for petrochemicals
and auxiliary products
Site conditions
Analytical data on raw materials
Wages, fiscal charges, insurance fees

The information contained in the above-quoted documentation has been used as a basic reference throughout the studies.

5. Attachments

The relevant documentation has been arranged in two sections, one attached to this report and the other presented under separate cover.

5.1 List of tables and figures attached. Page

TABLE 1

ESTIMATED INVESTMENT COST
PETROCHEMICAL COMPLEX
CASE A

Process Units	$	
1) Fractionator	1,600,000	
2) Ethylene Unit	15,700,000	
3) VC Monomer Unit	3,900,000	
4) PVC Unit	1,800,000	
5) LD Polyethylene Unit	18,000,000	
6) HD Polyethylene Unit	6,900,000	
7) Detergent Alkylate Unit	5,100 000	
8) Aromatics Recovery Unit	2,800,000	
9) NaCl Electrolysis Unit	4,100,000	
	59,900,000	(DA293,000,000)
Offsite Facilities	25,500,000	(DA125,000,000)
Total Investment Cost	85,400,000	(DA418,000,000)

TABLE 2

ESTIMATED INVESTMENT COST
[illegible] CHEMICAL COMPLEX
CASE B

Process Units		$
1)	Fractionator	1,600,000
2)	Ethylene Unit	15,700,000
3)	HD Polyethylene Unit	18,000,000
4)	LD Polyethylene Unit	11,600,000
5)	Detergent Alkylate Unit	5,100,000
6)	Aromatics Recovery Unit	2,800,000
		54,800,000 (DA268,000,000)
Offsite Facilities		24,400,000 (DA120,000,000)
Total Investment Cost		79,200,000 (DA388,000,000)

TABLE 3

ESTIMATED INVESTMENT COST
PETROCHEMICAL COMPLEX
CASE C

Process Units		$
1)	Fractionator	1,600,000
2)	Ethylene Unit	15,900,000
3)	LD Polyethylene Unit	18,000,000
4)	Polypropylene Unit	10,300,000
5)	Detergent Alkylate Unit	5,100,000
6)	Aromatics Recovery Unit	2,800,000
		53,700,000 (DA263,000,000)
Offsite Facilities		24,400,000 (DA120,000,000)
Total Investment Cost		78,100,000 (DA383,000,000)

TABLE 4

PETROCHEMICAL COMPLEX
ESTIMATED INVESTMENT COSTS FOR OFFSITE FACILITIES
BREAKDOWN

	Case A	Cases B, C
Utility Facilities	6,800,000	6,500,000
Storage Facilities	5,100,000	5,000,000
Transfer Facilities	400,000	400,000
Loading and Unloading Facilities	400,000	400,000
Fire Prevention Facilities	300,000	300,000
Civil Works	1,200,000	1,200,000
Pier	2,400,000	2,200,000
Waste Disposal Facilities	500,000	500,000
Buildings and Structures	2,200,000	2,000,000
Laboratory and Shop Works	800,000	800,000
Company Employee Housing	2,700,000	2,500,000
Yard Piping	2,000,000	1,900,000
Temporary Works	700,000	700,000
Total	25,500,000	24,400,000

TABLE 5

PETROCHEMICAL COMPLEX

MAIN PRODUCTS AND ESTIMATED PRODUCTION COST FOR THREE CASES

	CASE A		CASE B		CASE C	
	Quantity (t/y)	Cost (¢/kg)	Quantity (t/y)	Cost (¢/kg)	Quantity (t/y)	Cost (¢/kg)
Ethylene	150,000	3.1	150,000	3.2	150,000	3.0
LD Polyethylene	40,000	25.8	40,000	26.2	40,000	26.1
HD Polyethylene	10,000	34.3	20,000	30.7	-	-
Polypropylene	-	-	-	-	17,000	37.4
VC Monomer	45,000	12.1	-	-	-	-
PVC	20,000	18.8	-	-	-	-
Detergent Alkylate	30,000	13.7	30,000	13.8	30,000	13.8
Benzene	29,600	4.5	29,600	4.6	29,600	4.6
Toluene	21,000	3.7	21,000	3.8	21,000	3.8
Xylenes	13,500	3.6	13,500	3.6	13,500	3.7

TABLE 6

PETROCHEMICAL COMPLEX

FUTURE DOMESTIC AND EXPORT SALES (CASE A)

Products	Quantity (t/y)	Estimated Delivery Price (¢/kg)	For Domestic: Sales Amount (t/y)	Estimated Sales Price * (¢/kg)	Sales Value (10^3 $)	For Export: Sales Amount (t/y)	Estimated FOB Price (¢/kg)	Sales Value (10^3 $)	Total Sales Value (10^3 $)
Ethylene	150,000	7.20	-	-	-	76,400	4.70	3,591	3,591
LDPE	40,000	37.50	7,000	45.00	3,150	33,000	36.00	11,880	15,030
HDPE	10,000	43.90	4,000	52.68	2,107	6,000	42.40	2,544	4,651
VC Monomer	45,000	16.70	-	-	-	24,000	15.50	3,720	3,720
PVC	20,000	23.60	11,000	28.32	3,115	9,000	22.10	1,989	5,104
Detergent Alkylate	30,000	16.70	4,000	17.54	702	26,000	15.50	4,030	4,732
Benzene	29,600	7.80	-	-	-	16,600	6.60	1,095	1,095
Toluene	21,000	6.40	-	-	-	21,000	5.20	1,092	1,092
Xylenes	13,500	6.40	-	-	-	13,500	5.20	702	702
Caustic Soda	32,000	6.70	4,000	7.04	281	28,000	4.90	1,372	1,653
P-P	63,000	2.20	21,000	2.20	462	-	-	-	462
B-B	38,000	1.70	38,000	1.70	646	-	-	-	646
Kerosene	120,000	3.50	120,000	3.50	4,200	-	-	-	4,200
Gas Oil	142,000	3.14	142,000	3.14	4,459	-	-	-	4,459
Raffinate, etc.	29,600	3.00	29,600	3.00	888	-	-	-	888
Liquid Fuels	43,600	1.70	43,600	1.70	741	-	-	-	741
Total					20,751			32,015	52,766

*For domestic sales, we have assumed sales prices 20% up for estimated delivery prices of plastomers, 5% up for those of other chemicals except fuels

TABLE 7

PETROCHEMICAL COMPLEX

FUTURE DOMESTIC AND EXPORT SALES (CASE B)

Products	Quantity (t/y)	Estimated Delivery Price (¢/kg)	For Domestic: Sales Amount (t/y)	For Domestic: Estimated Sales Price* (¢/kg)	For Domestic: Sales Value (10^3 $)	For Export: Sales Amount (t/y)	For Export: Estimated FOB Price (¢/kg)	For Export: Sales Value (10^3 $)	Total Sales Value (10^3 $)
Ethylene	150,000	7.20	-	-	-	86,800	4.70	4,079	4,079
LDPE	40,000	37.50	7,000	45.00	3,150	33,000	36.00	11,880	15,030
HDPE	20,000	43.90	4,000	52.68	2,107	16,000	42.40	6,784	8,891
Detergent Alkylate	30,000	16.70	4,000	17.54	702	26,000	15.50	4,030	4,732
Benzene	29,600	7.80	-	-	-	16,600	6.60	1,095	1,095
Toluene	21,000	6.40	-	-	-	21,000	5.20	1,092	1,092
Xylenes	13,500	6.40	-	-	-	13,500	5.20	702	702
P-P	63,000	2.20	21,000	2.20	462	-	-	-	462
B-B	38,000	1.70	38,000	1.70	646	-	-	-	646
Kerosene	120,000	3.50	120,000	3.50	4,200	-	-	-	4,200
Gas Oil	142,000	3.14	142,000	3.14	4,459	-	-	-	4,459
Raffinate, etc.	29,600	3.00	29,600	3.00	888	-	-	-	888
Liquid Fuels	43,600	1.70	43,600	1.70	741	-	-	-	741
Total					17,355			29,662	47,017

*For domestic sales, we have assumed sales prices 20% up for estimated delivery prices of plastomers, 5% up for those of other chemicals except fuels

TABLE 8

PETROCHEMICAL COMPLEX

FUTURE DOMESTIC AND EXPORT SALES (CASE C)

Products	Quantity (t/y)	Estimated Delivery Price (¢/kg)	For Domestic: Sales Amount (t/y)	For Domestic: Estimated Sales Price* (¢/kg)	For Domestic: Sales Value (10^3 $)	For Export: Sales Amount (t/y)	For Export: Estimated FOB Price (¢/kg)	For Export: Sales Value (10^3 $)	Total Sales Value (10^3 $)
Ethylene	150,000	7.20	-	-	-	108,000	4.70	5,076	5,076
LDPE	40,000	37.50	7,000	45.00	3,150	33,000	36.00	11,880	15,030
Polypropylene	17,000	50.60	5,000	60.72	3,036	12,000	49.10	5,892	8,928
Detergent Alkylate	30,000	16.70	4,000	17.54	702	26,000	15.50	4,030	4,732
Benzene	29,600	7.80	-	-	-	16,600	6.60	1,095	1,095
Toluene	21,000	6.40	-	-	-	21,000	5.20	1,092	1,092
Xylenes	13,500	6.40	-	-	-	13,500	5.20	702	702
P-P	63,000	2.20	-	-	-	-	-	-	-
B-B	38,000	1.70	38,000	1.70	646	-	-	-	646
Kerosene	120,000	3.50	120,000	3.50	4,200	-	-	-	4,200
Gas Oil	142,000	3.14	142,000	3.14	4,459	-	-	-	4,459
Raffinate, etc.	29,600	3.00	29,600	3.00	888	-	-	-	888
Liquid Fuels	43,600	1.70	43,600	1.70	741	-	-	-	741
Total					17,822			29,767	47,589

*For domestic sales, we have assumed sales prices 20% up for estimated delivery prices of plastomers, 5% up for those of other chemicals except fuels

TABLE 9

DCF CALCULATION FOR PETROCHEMICAL COMPLEX

10^3 $			CASE A	CASE B	CASE C
1)	Total Annual Sales		52,766	47,[illegible]17	47,58[illegible]
2)	Annual Production Cost		41,2[illegible]7	36,[illegible]75	37,1[illegible]1
3)	Profit (pre-tax),	1)-2)	11,[illegible]	10,0[illegible]	10,40[illegible]
4)	Corporate Tax,	3)x50%	[illegible],735	5,0[illegible]1	5,20[illegible]
5)	Net Profit,	3)-4)	5,73[illegible]	5,021	5,20[illegible]
6)	Total Investment		[illegible]5,[illegible]	7[illegible],200	78,100
7)	Annual Amortization	6)x1/10	8,5[illegible]0	7,[illegible]20	7,810
8)	Cash Flow	5)+7)	1[illegible],275	12,941	13,01[illegible]
9)	Working Capital	2)x2/12	6,883	6,1[illegible]3	6,197
10)	Salvaged Capital	=9)	6,883	6,163	6,197
11)	Rate of Return on Investment (50% corporate tax on profit)		9.5%	9.1%	9.5%
12)	Rate of Return on Investment (No corporate tax for the first 3 years)		13.[illegible]%	12.5	13.1%

SITE EVALUATION

TABLE 1[illegible] Soil Condition

	Advantages	Disadvantages	R*
Arzew	1. Shallow substratum 2. Relative consistency are very dense. 3. No compressible strata.	None in particular.	A
Bedjaia	1 Near the surface there are sand layers of comparatively high density.	1. Deep substratum. 2. Thick compressible layer. 3. Consists partly of filled land on river beds.	C
Skikda	Same as above	1. Deep substratum. 2. Thick layer of soft alluvial soil. 3. Lower density in deep stratum. 4. Consists partly of filled land on former riverbeds.	C
Annaba	Same as above.	1,2,3 above apply. 4. Depending on plotting, may consist partly of filled land on former riverbeds.	C

* Ratings; A—Excellent; B—Good; C—Fair

SITE EVALUATION

TABLE 11 Site Condition

	Advantages	Disadvantages	E
Arzew	1. Generally flat. 2. Can be plotted on National Route.	1. Site area is limited by coastline, National Route and existing industrial facilities. 2. Site assumes narrow strip.	A
Bedjaia	1. Sufficient site area available. 2. Can be plotted on National Route. 3. Generally flat.	1. Close to airport.	A
Skikda	1. Generally flat. 2. National Route runs close to site.	1. Relatively small area. 2. Close to airport.	B
Annaba	1. Generally flat. 2. National Route runs near site.	1. Site along coast is rather small for petrochemical complex.	B

TABLE 12 Meteorological and Oceanographic Conditions

	Advantages	Disadvantages	R[illegible]
Arzew	1. Small tidal amplitude. 2. Mild climate, calm water.	None.	A
Bejaia	1. Small tidal amplitude. 2. Extremely mild climate, calm water.	None.	A
Skikda	1. Small tidal amplitude. 2. Mild climate, calm water.	None.	A
Annaba	Same as above.	None.	A

SITE EVALUATION

TABLE 13 Harbour

	Advantages	Disadvantages	R
Arzew		1. Wharf required for petrochemical complex cannot be built within existing harbour.	C
Bedjaia	1. Wharf facility for petrochemical complex can be built within existing harbour. 2. Good condition of harbour	1. Water depth in harbour is shallow; dredging required. 2. Wharf and other port facilities must be newly built.	A
Skikda		1. Wharf required for petrochemical complex cannot be built within existing harbour. 2. Inconvenient access to harbour.	C
Annaba	1. Expansion of existing harbour is planned.	1. Difficult to build wharf for petrochemical complex within existing harbour.	B

SITE EVALUATION

TABLE 14 Raw Material Transport

	Advantages	Disadvantages	R
Arzew	1. Natural gas can be received directly via pipeline. 2. Offers possibility of receiving supply of condensate via pipeline. 3. Ammonia and nitric acid available from adjacent plants.	1. Phosphate rock must be transported over long distance.	Pet. A Fert. B
Bedjaia	1. Condensate can be received via pipeline.	1. Difficult to receive supply of natural gas. 2. Ammonia, nitric acid and phosphate rock must be brought in.	Pet. A Fert. C
Skikda	1. In future, natural gas can be received directly via pipeline.	1. Condensates must be reshipped. 2. Ammonia, nitric acid and phosphate rock must be brought in.	Pet. B Fert. C
Annaba	1. Direct railroad link available to phosphate mines.	1. Difficult to receive supply of natural gas. 2. Condensates must be reshipped. 3. Ammonia, nitric acid must be brought in.	Pet. C Fert. A

SITE EVALUATION

TABLE 15 Transport of Products

	Advantages	Disadvantages	R
Arzew	1. Extremely convenient road transport.	1. Inconvenient marine transport.	[illegible]
Bedjaia	1. Can be shipped by sea.	1. Road and railroad transport rather inconvenient.	A
Skikda	1. Convenient road and railroad transport (particularly for shipments to southern Algeria).	1. Inconvenient marine transport.	B
Annaba	1. Marine transport possible. 2. Extremely convenient road and railroad transport.		A

SITE EVALUATION

TABLE 16 Power and Industrial Water

	Advantages	Disadvantages	R
Arzew		1. Problems involving industrial water. 2. Anxiety over power supply.	B
Bedjaia	1. Abundant supply of industrial water available. 2. Steady power supply available.		A
Skikda		1. Difficult to obtain industrial water. 2. Anxiety over power supply.	B
Annaba	1. Abundant supply of industrial water available. 2. Steady power supply available.		A

SITE EVALUATION

TABLE 17 Miscellaneous Data

	Hinterland	Others
Arzew	1. Populous large cities in the background. 2. Industrialized to a considerable extent. 3. Leading grape production centre.	
Bedjaia	1. Urbanization delayed. 2. Industrialization not very much advanced. 3. Fruit production centre.	1. Closer to Algiers than any other of four possible sites.
Skikda	1. Major cities in the background. 2. Industrialization not very much advanced. 3. Important granary.	1. Plans afoot to lay pipeline for natural gas and build gas liquefying plant. Offers possibility as site for ammonia plant.
Annaba	1. Located in large city. 2. Industrialization making progress. 3. Located near grain production centre.	

TABLE 18

RECOMMENDATIONS

Overall Evaluation

In accordance with the following Overall Evaluation, we would like to recommend Bedjaia for petrochemical complex and Annaba for fertilizer complex.

	As Site for Petrochemical Complex	As Site for Fertilizer Complex
Arzew	<u>Suitable</u> Raw material conveniently available. Soil condition better than for any other site. Inconvenient for shipment of products by sea. Some difficulty in supply of power and industrial water.	<u>Possible</u> Phosphate rock must be transported over long distance; but offers possibility of integrated fertilizer complex, by combining with ammonia plant.
Bedjaia	<u>Most suitable</u> Raw material conveniently available. Convenient for shipment of products by sea. Site conditions good. No problem about supply of industrial water and power. Natural gas availability difficult.	<u>Possible</u> Both ammonia and phosphate rock must be transported.
Skikda	<u>Possible</u> Inconvenient for obtaining raw material. Some difficulty in supply of power and industrial water. Site area is rather small. Inconvenient access to harbour.	<u>Possible</u> Both ammonia and phosphate rock must be transported. Offers possibility of integrated fertilizer complex, if ammonia plant is built in future.
Annaba	<u>Possible</u> Inconvenient for obtaining raw material. Site area is small.	<u>Most suitable</u> Phosphate rock conveniently available. Ammonia must be transported. Products can be shipped conveniently by land and sea.

TABLE 19
The Recommended Petrochemical Complex
Estimated Material Cost for Process Units

UNIT / ITEM	CONDENSATE FRACTIONATOR $1,000	CONDENSATE FRACTIONATOR DA1,000	ETHYLENE $1,000	ETHYLENE DA1,000	VC MONOMER $1,000	VC MONOMER DA1,000	PVC $1,000	PVC DA1,000	LDPE $1,000	LDPE DA1,000	HDPE $1,000	HDPE DA1,000
Towers	100	-	400	-	170	-	-	-	200	-	100	-
Vessels and Tanks	9	30	240	400	100	330	52	170	300	980	200	630
Reactors	-	-	-	-	120	-	194	-	400	-	120	-
Heat Exchangers	180	-	1,200	-	270	-	-	-	500	-	240	-
Furnaces	180	-	1,700	-	250	-	-	-	-	-	-	-
Pumps, Compressors and Drivers	50	-	1,200	-	240	-	40	-	1,440	-	140	-
Other Equipment	-	-	40	96	-	-	140	340	990	1,100	800	900
Piping	77	-	1,700	-	460	-	150	-	1,500	-	930	-
Electrical	40	-	180	-	100	-	62	-	150	-	100	-
Instruments	50	-	480	-	300	-	100	-	880	-	500	-
Insulation and Paint	40	25	320	70	60	33	11	6	108	60	40	30
Buildings	3*	32*	22	270	20	220	50	570	400	4,700	50	570
Steel Structures, Platforms and Structural Steels	17	160	70	710	50	470	30	280	37	340	50	400
Site Preparation, Foundation and Concrete Structures	0.8	80	7	680	4	330	3	270	5	470	3	260
Temporary Works	4	5	30	40	9	10	10	15	40	50	10	15
Fire and Safety Equipment	2.5	-	50	-	15	-	3	-	30	-	15	-
Spare Parts	19	-	130	-	50	-	23	-	130	-	100	-
Total Material	772.3	332	7,769	2,266	2,218	1,393	868	1,651	7,110	7,700	3,398	2,805
Total Material ($1,000)	840		8,231		2,502		1,205		8,681		3,970	

(cont'd.)

* Buildings of condensate fractionation unit are jointly constructed with ethylene unit.

TABLE 19 (cont'd.)

	DETERGENT ALKYLATE		AROMATICS RECOVERY		NaCl ELECTROLYSIS		TOTAL	
	$1,000	DA1,000	$1,000	DA1,000	$1,000	DA1,000	$1,000	DA1,000
Towers	150	-	140	-	-	-	1,260	-
Vessels and Tanks	60	190	45	145	155	500	1,161	3,375
Reactors	70	-	46	-	-	-	950	-
Heat Exchangers	170	-	170	-	200	-	2,930	-
Furnaces	70	-	36	-	60	-	2,296	-
Pumps, Compressors and Drivers	90	-	125	-	100	-	3,425	-
Other Equipment	40	90	50	120	950	535	3,010	3,181
Piping	150	-	250	-	120	-	5,337	-
Electrical	50	-	70	-	450	-	1,202	-
Instruments	250	-	235	-	11	-	2,806	-
Insulation and Paint	50	30	40	25	10	5	679	284
Buildings	11	130	13	145	75	860	644	7,497
Steel Structures, Platforms and Structural Steels	20	180	30	290	9	80	313	2,910
Site Preparation, Foundation and Concrete Structures	2	200	3	260	3	230	30.8	2,780
Temporary Works	6	7	6	7	8	9	123	158
Fire and Safety Equipment	7	-	7	-	9	-	138.5	-
Spare Parts	40	-	23	-	70	-	585	-
Total Material	1,236	827	1,289	992	2,230	2,219	26,890.3	20,185
Total Material ($1,000)	1,405		1,491		2,683		31,008	

TABLE 20

The Recommended Petrochemical Complex

Estimated Project Cost for Process Units

UNIT / ITEM	CONDENSATE FRACTIONATOR $1,000	DA1,000	ETHYLENE $1,000	DA1,000	VC MONOMER $1,000	DA1,000	PVC $1,000	DA1,000	LDPE $1,000	DA1,000
Total Material	772.3	332	7,769.0	2,266	2,218.0	1,393	868.0	1,651	7,11[illegible]	7,700
Freight	54.0	38	540.0	380	160.0	110	60.0	43	500.0	350
Total Material and Freight	826.3	370	8,309.0	2,646	2,378.0	1,503	928.0	1,694	7,610.0	8,050
Field Labour	-	1,300	-	16,000	-	2,200	-	2,300	-	16,500
Construction Tools	-	300	-	4,000	-	350	-	400	-	4,000
Construction Supervision	130.0	130	500.0	870	200.0	280	270.0	220	600.0	1,000
Engineering	170.0	-	400.0	-	550.0	-	340.0	-	640.0	-
Procurement	34.0	-	90.0	-	70.0	-	60.0	-	110.0	-
Insurance	17.0	-	170.0	-	50.0	-	23.0	-	200.0	-
Process Investment	1,177.3	2,100	9,469.0	23,516	3,248.0	4,333	1,621.0	4,614	9,160.0	29,550
Process Investment ($1,000)	1,605.9		14,268.2		4,132.3		2,562.6		15,190.6	
Start-up Expenses	30.0	360	82.0	3,000	54.0	880	54.0	470	82.0	2,300
Royalty, Know-how Fee, License Fee	-	-	700.0	-	800.0	-	100.0	-	750.0	-
Catalyst and Chemicals Inventory	-	-	12.2	-	58.7	-	-	-	-	-
Total Investment	1,207.3	2,460	10,243.2	26,516	4,160.7	5,213	1,775.0	5,084	9,992.0	31,850
Total Investment ($1,000)	1,709.3		15,674.6		5,224.6		2,812.6		16,492.0	

cont'd.

TABLE 20 (cont'd.)

	HDPE		DETERGENT ALKYLATE		AROMATICS RECOVERY		NaCl ELECTROLYSIS		TOTAL	
	$1,000	DA1,000	$1,000	DA1,000	$1,000	DA1,000	$1,000	DA1,000	$1,000	DA1,000
Total Material	3,398.0	2,805	1,236.0	827	1,289.0	992	2,230.0	2,119	26,[illegible].3	20,1[illegible]5
Freight	240.0	170	90.0	60	90.0	60	160.0	110	1,[illegible].0	1,[illegible]1
Total Material and Freight	3,638.0	2,975	1,326.0	887	1,379.0	1,052	2,390.0	2,[illegible]	2[illegible],784.3	[illegible]1,566
Field Labour	-	5,700	-	2,800	-	3,300	-	2,500	-	52,700
Construction Tools	-	1,400	-	700	-	800	-	400	-	1[illegible],350
Construction Supervision	330.0	470	270.0	260	270.0	260	270.0	140	2,8[illegible].0	3,[illegible]30
Engineering	410.0	-	350.0	-	280.0	-	370.0	-	3,51[illegible]	-
Procurement	90.0	-	80.0	-	80.0	-	70.0	-	68[illegible]	-
Insurance	85.0	-	30.0	-	35.0	-	50.0	-	660.0	-
Process Investment	[illegible],553.0	10,545	2,656.0	4,647	2,0[illegible].0	5,412	3,150.0	5,469	36,[illegible].3	90,186
Process Investment ($1,000)	6,705.0		3,004.4		3,148.5		4,2[illegible].1		[illegible],883.[illegible]	
Start-up Expenses	66.0	1,100	66.0	650	66.0	700	54.0	1,000	55[illegible]	10,[illegible]
Royalty, Know-how Fee, License Fee	1,670.0	-	485.0	-	266.3	-	450.0	-	5,[illegible]1.3	-
Catalyst and Chemicals Inventory	-	-	8.8	-	100.0	-	550.0	-	7[illegible].7	-
Total Investment	6,289.0	11,6[illegible]5	2,615.8	5,297	2,480.3	6,112	4,20[illegible].0	6,[illegible]69	[illegible]2,[illegible]7.3	100,6[illegible]
Total Investment ($1,000)	8,665.5		3,696.8		3,727.6		5,52[illegible].2		63,5[illegible]7.[illegible]	

TABLE 21
The Recommended Petrochemical Complex
Estimated Material Cost for Offsite Facilities

Item	$ 1,000	DA 1,000
Electrical Facilities		
Power Station	550	-
Power Receiving and Distribution	1,430	-
Other Electrical Facilities	220	-
Total	2,200	-
Boiler Unit	490	-
Industrial and Potable Water System	130	-
Water Treater	290	-
Cooling Water System	900	-
Air System	140	-
Fuel System	360	150
Storage Tanks	360	5,200
Unloading Facilities	70	-
Loading Facilities	600	-
Transfer Pumps	90	-
Yard Piping	1,550	-
Ethylene Refrigeration System	220	-
Fire Fighting System	250	-
Sewer and Flare System	190	400
Site Preparation	3	120
Traffic Facilities	160	1,900
Harbour	170	1,900
Fence, Gate and Steel Structures	80	1,700

TABLE [illegible]1 (cont'd.)

Item	1,000	DA 1,000
Buildings		
Laboratory	[illegible]	220
Company Employee Housing, Guest House, etc.	580	6,700
Repair Shop	130	150
Other Buildings	3[illegible]0	4,300
Total	1,280	11,370
General Temporary Works and Misc. Works	30	1,200
Total Material	9,563	23,940
" " ($ 1,000)	[illegible]	

TABLE 22
The Recommended Petrochemical Complex
Estimated Project Cost for Offsite Facilities

	$1,000	DA1,000
Total Material	9,563	23,940
Freight	770	470
Total Material and Freight	10,333	24,410
Field Labour	-	32,000
Construction Tools	-	8,000
Construction Supervision	920	1,150
Engineering	1,570	-
Procurement	180	-
Insurance	200	-
Plant Investment	13,203	65,560
" ($1,000)	26,583	
Start-up Expenses	70	200
Royalty, Know-how Fee, Licence	30	-
Total In[illegible]	13,303	65,760
" ($1,000)	26,723	

TABLE 23
The Recommended Petrochemical Complex
Future Domestic and Export Sales

PRODUCTS	FOR DOMESTIC SALES AMOUNT (10^3t) 1	ESTIMATED SALES PRICE ($/t) 2	SALES VALUE ($10^3$$) 3	FOR EXPORT SALES AMOUNT (10^3t) 4	ESTIMATED FOB PRICE ($/t) 5	SALES VALUE ($10^3$$) 6	TOTAL AMOUNT (10^3t) 7 = 1 + 4	TOTAL SALES VALUE ($10^3$$) 8 = 3 + 6	TOTAL SALES VALUE BY R OF RATIO ($10^3$$) 8 x 0.8
Ethylene	-	-	-	76.0	60	4,560	76.0	4,560	3,648
VC Monomer	-	-	-	24.68	120	2,962	24.68	2,962	2,370
PVC	15.0	250	3,750	5.0	200	1,000	20.0	4,750	3,800
LDPE	12.0	300	3,600	28.0	260	7,280	40.0	10,880	8,704
HDPE	5.0	430	2,150	5.0	395	1,975	10.0	4,125	3,300
Detergent Alkylate	5.0	160	800	10.0	140	1,400	15.0	2,200	1,760
Benzene	-	-	-	23.1	70	1,617	23.1	1,617	1,294
Toluene	-	-	-	21.3	45	959	21.3	959	767
Xylenes	-	-	-	13.5	60	810	13.5	810	648
Kerosene	59.4	30	1,782	59.5	30	1,785	118.9	3,567	2,854
Gas Oil	100.7	27	2,719	-	-	-	100.7	2,719	2,175
Fuel Oil	21.0(1)	18	378	-	-	-	21.0	378	302
P-P Fraction	44.0	30	1,320	-	-	-	44.0	1,320	1,056
Gasoline	18.1	30	543	-	-	-	18.1	543	434
Caustic Soda (100%)	8.0	60	480	-	-	-	8.0	480	384
Caustic Soda (50%)	45.0(2)	25	1,125	-	-	-	45.0	1,125	900
Total			18,647			24,348		42,995	34,396

Note: (1) For sales to fertilizer complex in Annaba
(2) 4000 t/y was reduced for consumption in the complex.

TABLE 23 (cont'd.)

COST

	PRODUCTION COST ($/t) 9	PRODUCTION COST BY 80% OPERATION ($/t) 10	ANNUAL PRODUCTION COST (10^3\$) 9 x 7	ANNUAL PRODUCTION COST BY 80% OPERATION (10^3\$) 10 x 7 x 0.8
Ethylene	30.52	39.73	2,320	2,416
VC Monomer	89.52	114.21	2,209	2,255
PVC	149.19	186.97	2,984	2,392
LDPE	209.92	253.85	8,397	8,123
HDPE	336.59	412.27	3,366	3,298
Detergent Alkylate	134.18	155.90	2,013	1,871
Benzene	45.26	50.52	1,046	934
Toluene	37.34	41.68	795	710
Xylenes	36.21	40.42	489	437
Kerosene	30.00	30.00	3,567	2,854
Gas Oil	27.00	27.00	2,719	2,175
Fuel Oil	18.00	18.00	378	302
P-P Fraction	30.00	30.00	1,320	1,056
Gasoline	30.00	30.00	543	434
Caustic Soda (100%)	60.00	60.00	480	384
Caustic Soda (50%)	25.00	25.00	1,125	900
			33,751	31,141

Figure 1.

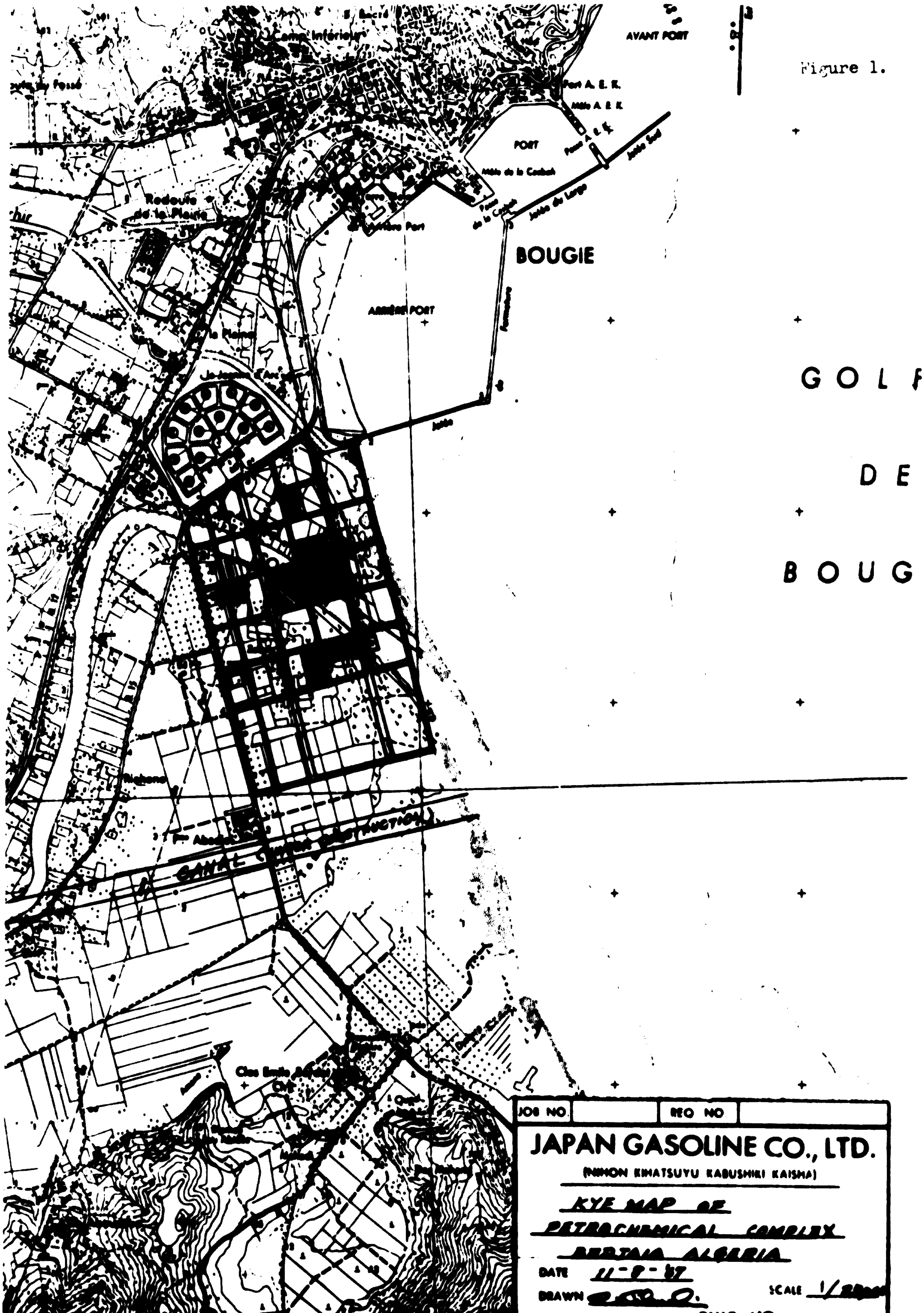
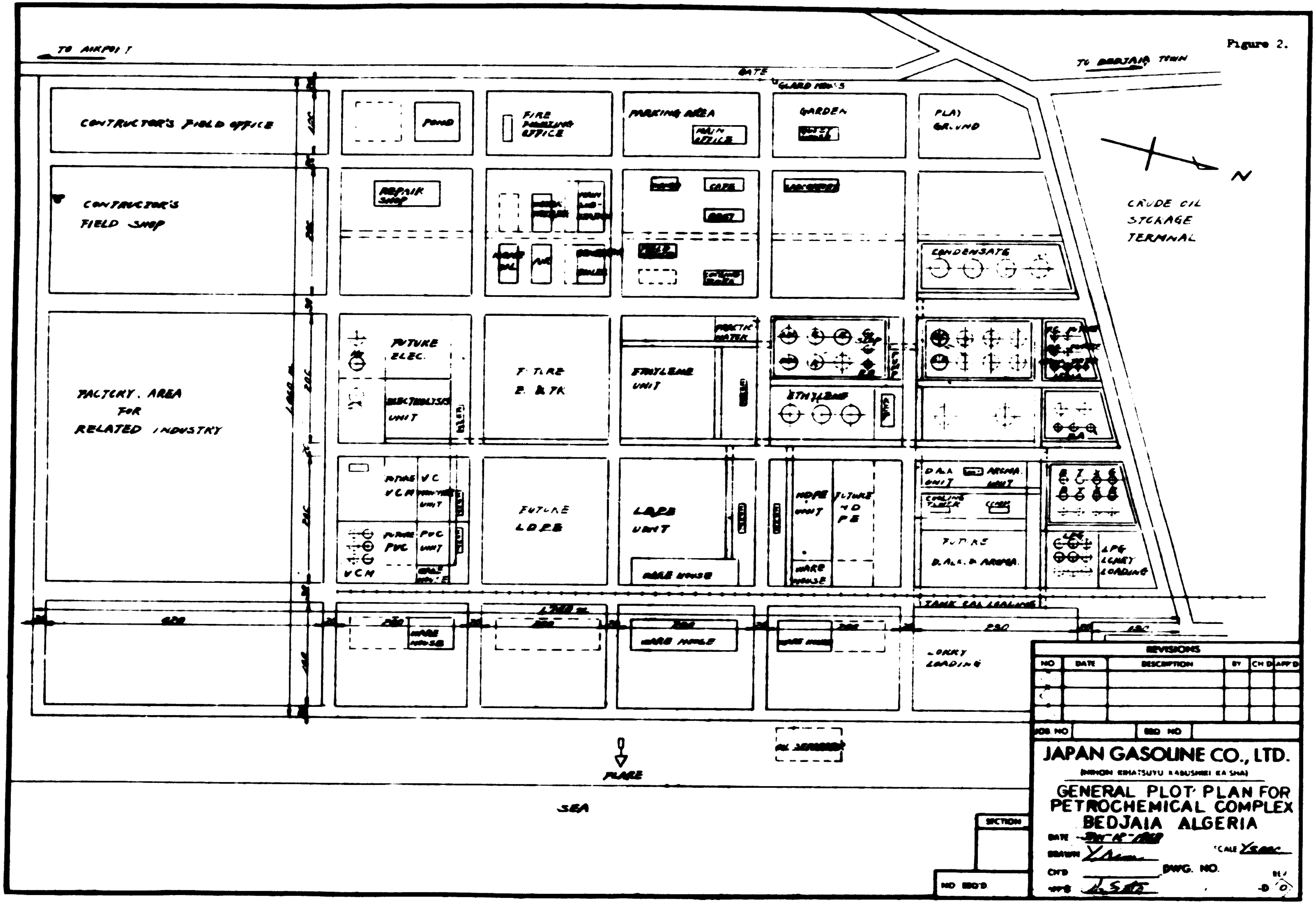
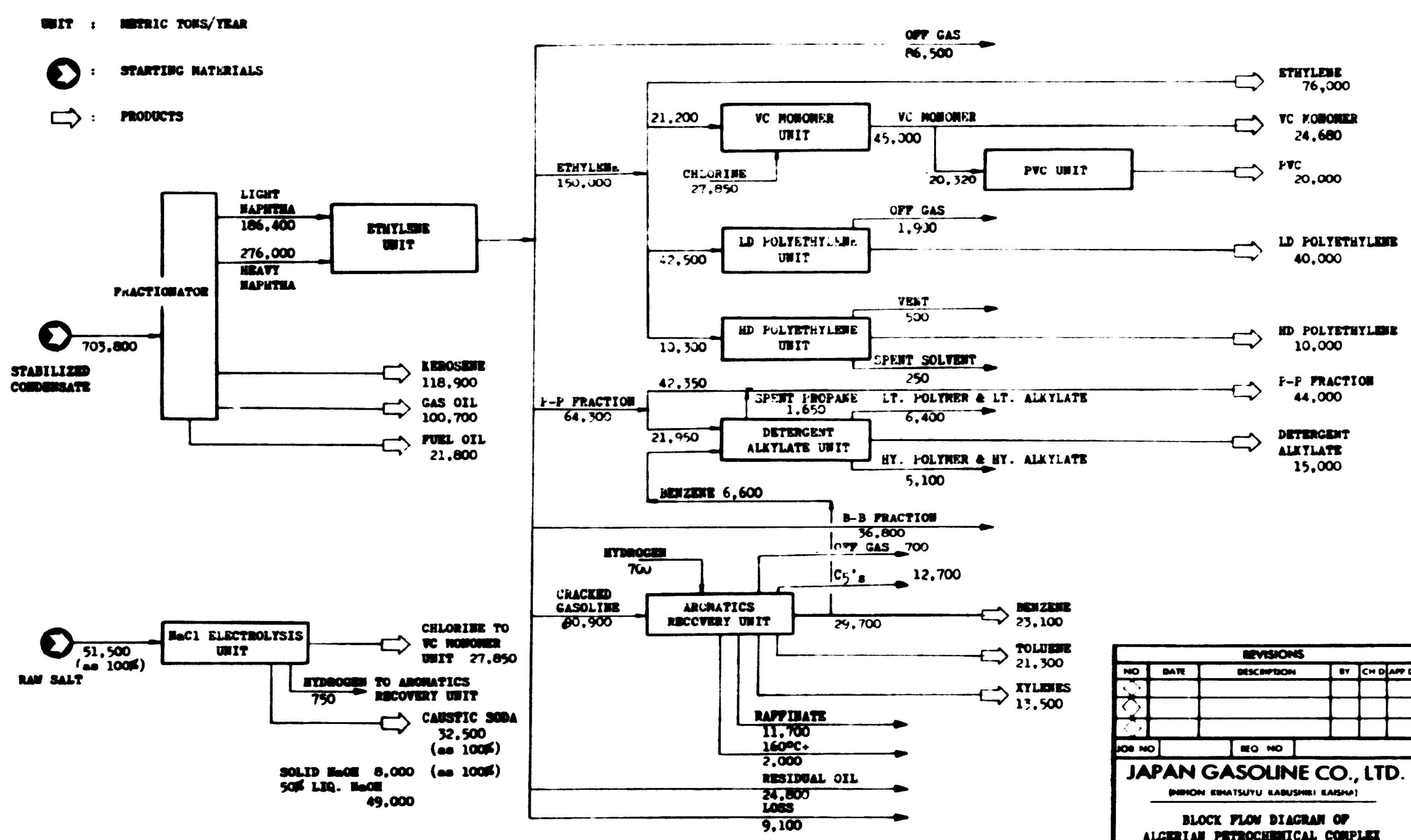

AVANT PORT
Port A. E. K.
Môle A. E. K.
PORT
Môle de la Casbah
Jetée du Large
Jetée Sud
Redoute de la Pleine
BOUGIE
ARRIÈRE PORT
GOLF
DE
BOUG
JOB NO.
REQ NO
JAPAN GASOLINE CO., LTD.
(NIHON KIHATSUYU KABUSHIKI KAISHA)
KYE MAP OF
PETROCHEMICAL COMPLEX
BERTAIA ALGERIA
DATE 11-8-87
DRAWN
SCALE 1/
CH'D
DWG. NO.
APP'D
REV

Figure 2.



TO AIRPORT
TO BEDJAIA TOWN
GATE
GUARD HOUSE
CONTRACTOR'S FIELD OFFICE
CONTRACTOR'S FIELD SHOP
FACTORY AREA FOR RELATED INDUSTRY
POND
FIRE FIGHTING OFFICE
PARKING AREA
MAIN OFFICE
GARDEN
PLAY GROUND
N
CRUDE OIL STORAGE TERMINAL
REPAIR SHOP
CAFE
CONDENSATE
FUTURE ELEC.
ELECTROLYSIS UNIT
FUTURE E. & TK
ETHYLENE UNIT
ETHYLENE
FUTURE V C
V C M
UNIT
FUTURE PVC
PVC UNIT
V C M
FUTURE LDPE
LDPE UNIT
WARE HOUSE
HDPE UNIT
FUTURE HD PE
D.A.A. UNIT
AROMA. UNIT
COOLING TOWER
FUTURE D.A.A. & AROMA.
LPG LORRY LOADING
TANK CAR LOADING
LORRY LOADING
WARE HOUSE
FLARE
SEA
REVISIONS
NO
DATE
DESCRIPTION
BY
CH'D
APP'D
JOB NO
BID NO
JAPAN GASOLINE CO., LTD.
(NIHON KIHATSUYU KABUSHIKI KA SHA)
GENERAL PLOT PLAN FOR PETROCHEMICAL COMPLEX BEDJAIA ALGERIA
DATE
DRAWN
CH'D
APP'D
SCALE
DWG. NO.
SECTION
NO REQ'D

Figure 3.



REVISIONS					
NO	DATE	DESCRIPTION	BY	CH D	APP D

JOB NO | REQ NO

JAPAN GASOLINE CO., LTD.
(NIHON KIHATSUYU KABUSHIKI KAISHA)

BLOCK FLOW DIAGRAM OF ALGERIAN PETROCHEMICAL COMPLEX

DATE DEC-20-1967
DRAWN [signature]
CH'D [signature]
APP'D [signature]
SCALE
DWG NO 3600-A-C-10
REV 0

SECTION
NO REQ'D

TABLE 24
The Recommended Petrochemical Complex
Future Domestic and Export Sales

PRODUCTS	DOMESTIC SALES			EXPORT SALES			TOTAL		COST	
	QUANTITY (10^3t) 1	ESTIMATED UNIT PRICE ($/t) 2	VALUE ($10^3$$) 3	QUANTITY (10^3t) 4	ESTIMATED FOB PRICE ($/t) 5	VALUE ($10^3$$) 6	TOTAL QUANTITY (10^3t) 7=1+4	TOTAL VALUE ($10^3$$) 8=3+6	UNIT PRODUCTION COST($/t) 9	ANNUAL PRODUCTION COST ($10^3$$) 9 x 7
DAP	54	85	4,590	56	66	3,696	110	8,286	64.96	7,146
TSP	33	80	2,640	57	50	2,850	90	5,490	48.45	4,361
Cement Clinker	199	12	2,388	-	-	-	199	2,388	10.50	2,090
			9,618			6,546		16,164		13,597

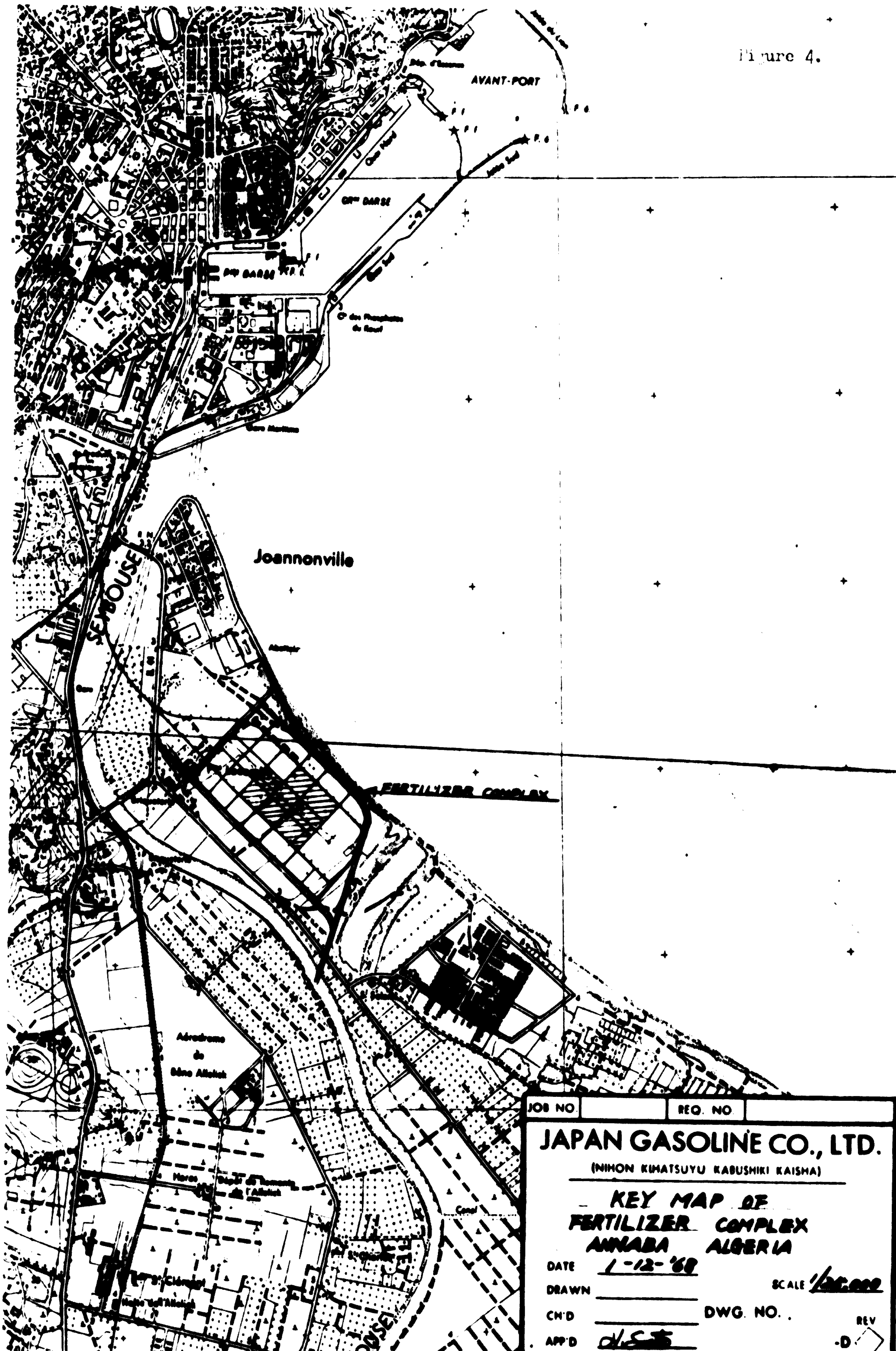

AVANT-PORT
Joannonville
SEYBOUSE
FERTILIZER COMPLEX
JOB NO.
REQ. NO.
JAPAN GASOLINE CO., LTD.
(NIHON KIHATSUYU KABUSHIKI KAISHA)
KEY MAP OF
FERTILIZER COMPLEX
ANNABA ALGERIA
DATE 1-12-'68
SCALE
DRAWN
CH'D
DWG. NO.
REV
APP'D
D

Figure 4.

Figure 5.

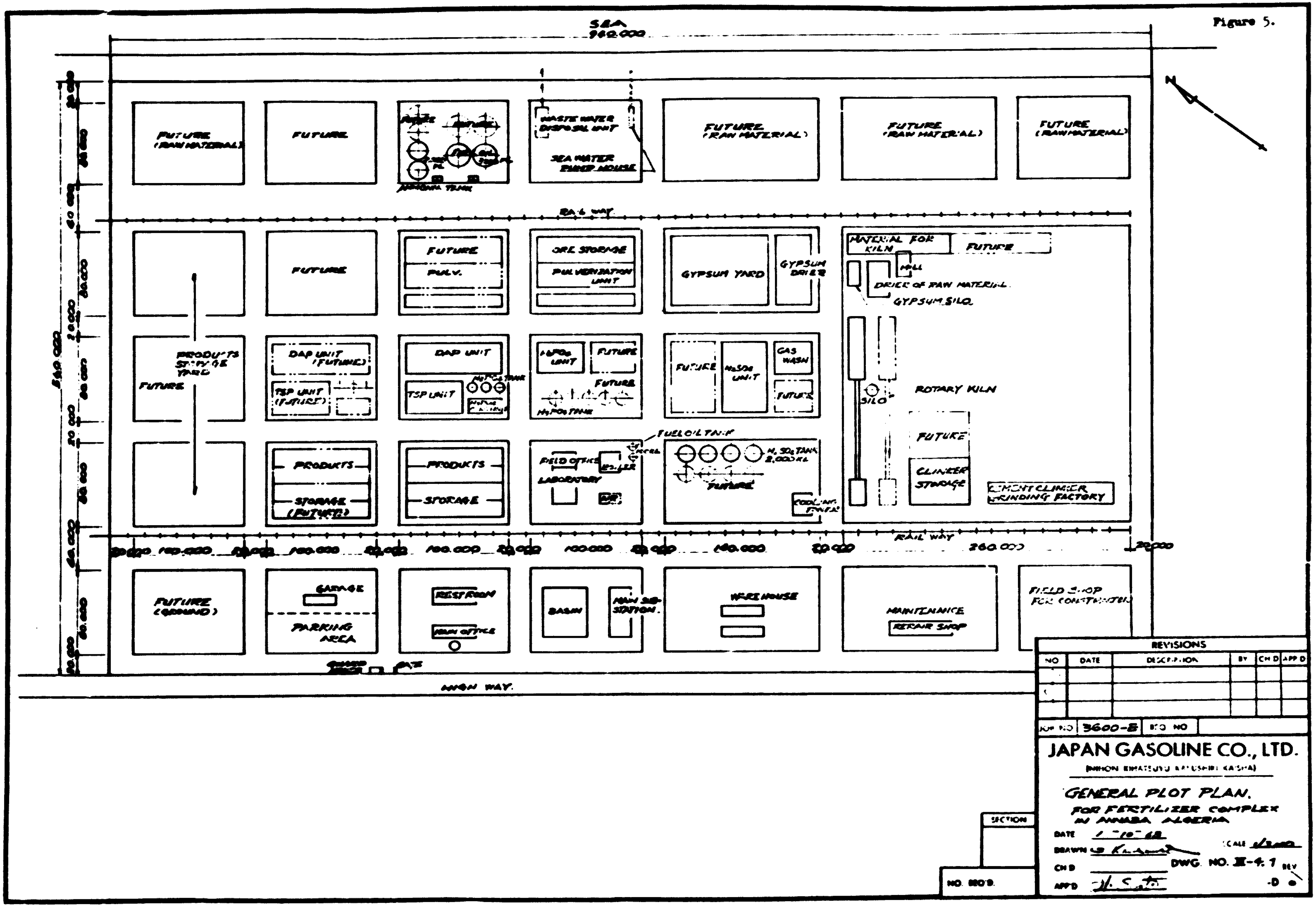
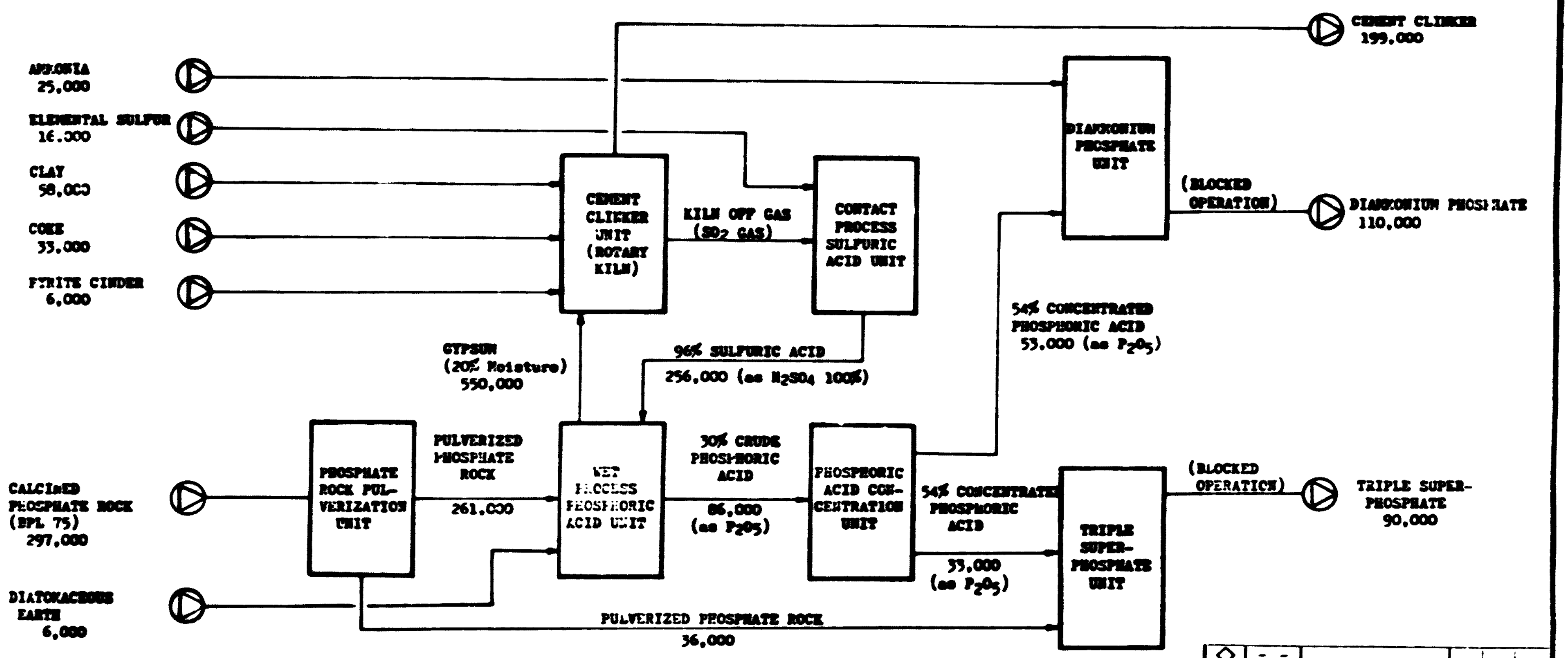

SEA
960.000
FUTURE (RAW MATERIAL)
FUTURE
WASTE WATER DISPOSAL UNIT
SEA WATER PUMP HOUSE
FUTURE (RAW MATERIAL)
RAIL WAY
FUTURE
FUTURE
PULV.
ORE STORAGE
PULVERIZATION UNIT
GYPSUM YARD
GYPSUM DRIER
MATERIAL FOR KILN
MILL
DRIER OF RAW MATERIAL
GYPSUM SILO
PRODUCTS STORAGE YARD
DAP UNIT (FUTURE)
TSP UNIT (FUTURE)
DAP UNIT
TSP UNIT
FUTURE
GAS WASH
SILO
ROTARY KILN
FUEL OIL TANK
PRODUCTS
STORAGE (FUTURE)
STORAGE
FIELD OFFICE
LABORATORY
COOLING TOWER
CLINKER STORAGE
CEMENT CLINKER GRINDING FACTORY
RAIL WAY
260.000
FUTURE (GROUND)
GARAGE
PARKING AREA
REST ROOM
MAIN OFFICE
BASIN
MAIN SUB-STATION.
WAREHOUSE
MAINTENANCE
REPAIR SHOP
FIELD SHOP FOR CONSTRUCTION
GATE
HIGH WAY.
REVISIONS
NO
DATE
DESCRIPTION
BY
CH'D
APP'D
JOB NO 3600-B
JAPAN GASOLINE CO., LTD.
GENERAL PLOT PLAN.
FOR FERTILIZER COMPLEX IN ANNABA ALGERIA
DATE
DRAWN
CH'D
APP'D
SCALE
DWG. NO.
SECTION

Figure 6.



Basis:
1) Unit: Metric Tons/Year
2) 300 Stream Days/Year
3) Blocked Operation:

	Phosphoric Acid Unit	DAP Unit	TSP Unit
i) DAP Production	Run at 100% capacity for 60% of the year	Run at 100% capacity for 60% of the year	-
ii) TSP Production	Run at 90% capacity for 40% of the year	-	Run at 100% capacity for 40% of the year

NO	DATE	DESCRIPTION	ENG	CH D	APP D
◇	- -				
◇	- -				
◇	- -				

REVISIONS

JOB NO. 3600-E REQ. NO.

JAPAN GASOLINE CO., LTD.
(NIHON KIHATSUYU KABUSHIKI KAISHA)

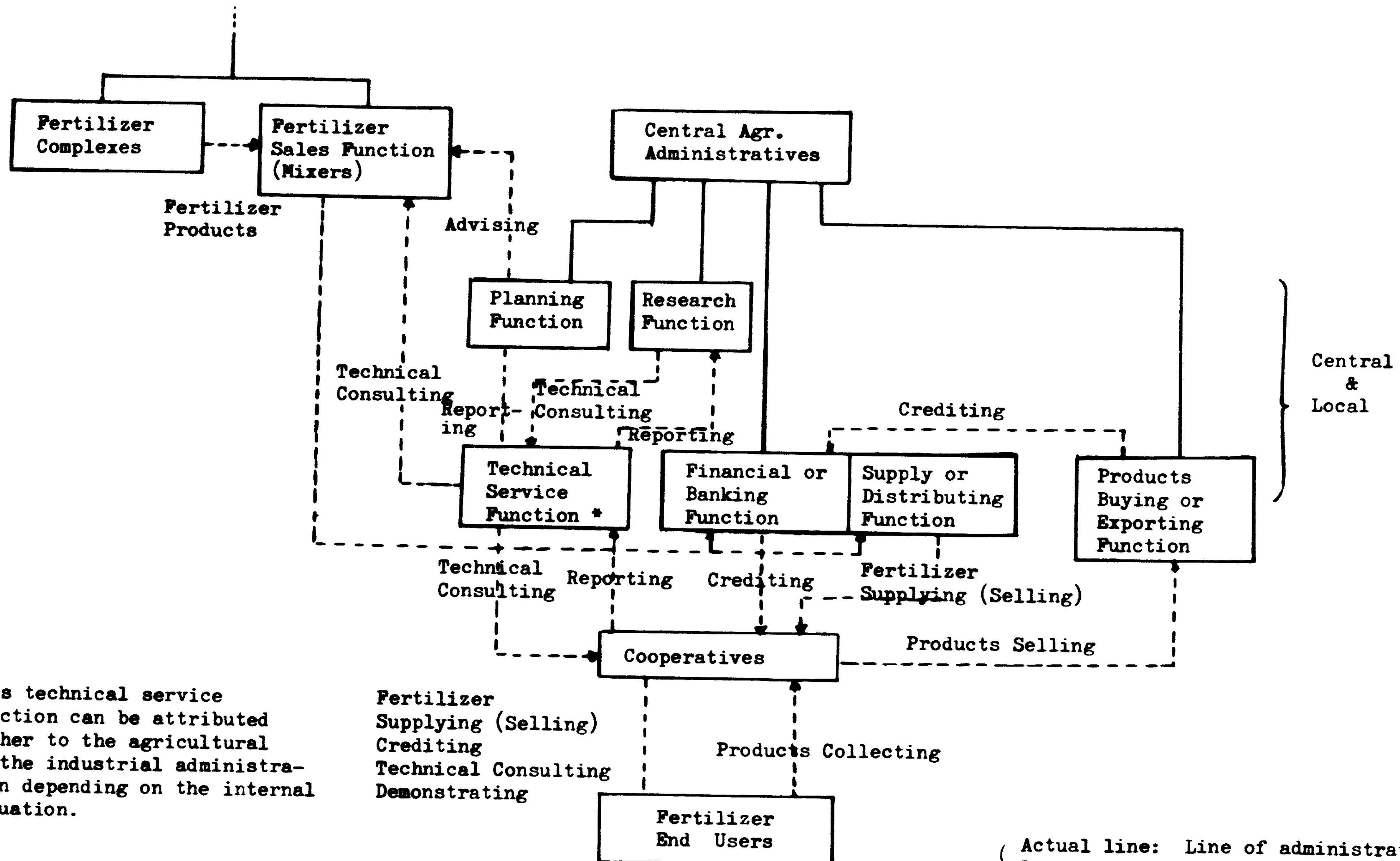
BLOCK FLOW DIAGRAM
OF
ALGERIAN FERTILIZER COMPLEX

DATE 12 - 10 - 1967 SCALE

ENG. CH'D S. Taki APP'D

DWG NO. III-1.1 REV. -D

Figure 7. Proposed Functional Set-up for Technical Services, Marketing and Supply of Fertilizers.



* This technical service function can be attributed either to the agricultural or the industrial administration depending on the internal situation.

(Actual line: Line of administration
Dotted line: Line of functions

Figure 7.

G-932

86.01.10
AD.87.04
ILL 5.5+10