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PETROVIETNAM
PRE-INVESTMENT STUDY

VOLUME 1

SUMMARY

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S/F FERTILIZERS, PETROCHEMICALS
PETROLEUM

C/F VIETNAM

p 35

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1. GENERAL

i. The Vietnamese Government intends to create an oil-based industrial zone in THANH HOA province.

This zone will contain :

- an oil refinery
- a nitrogeneous - and possibly phosphate - fertilizer plant
- a petrochemical plant.

Other, smaller-scale industries will gradually establish themselves in the zone, construction material factories in particular. As the surrounding area is undeveloped, the infrastructure required for the industrial zone and for operating personnel will have to be set up ; this includes :

- an electricity generating station
- a water production and treatment plant
- a harbour
- a residential area with public facilities.

ii. All VIETNAM's refined product, nitrogeneous fertilizer and plastics needs are at present met by imports. The importance of this project is therefore tremendous, as it will provide the reliable source of supplies vital to the country's development.

iii. A number of barriers have to be overcome in implementing such a project. The most important of these is :

- The high investment required, which means seeking finance from international sources.

Others include :

- Uncertainty as to product market growth
- Uncertainty as to quantities and grades of crude oil to be processed
- The problem of transfer of technology : some processes among these likely to be implemented could not be easily available due to US embargo. This concerns specifically catalytic cracking and ammonia production process.

There are, however, two factors favouring this development :

- The prospect that oil may be substantially produced in VIETNAM
- The existence of a large potential market.

iv. On account of the uncertainties regarding markets and raw material grades coupled with the complete lack of infrastructure in the area, several alternatives have been studied in relation to :

- the general layout of the complex
- the production scheme
- processes
- auxiliary facilities, e.g. harbour and power station.

In the study, the various alternatives are analysed, the advantages and disadvantages of each weighed up, and a number of solutions identified. There are still too many unknowns, however, for any one solution to be adopted henceforth on technical and economic grounds.

In addition possible integration which could be envisaged between the various plants such as for utilities and hydrogen production, have not been studied at this stage.

v. Table 1 gives some technical and economic characteristics of the overall project. Figures can of course at this stage be no more than orders of magnitude.

They are, however, sufficient to show that developing the different parts of the project will mean that :

- Implementation of the various units will have to be co-ordinated in order to keep time schedules as short as possible and thus minimise costs
- Skilled manpower and material requirements will probably exceed VIETNAM's present resources
- Investment will be extremely high, part of it in foreign currency.

vi. For these reasons construction must be spread over several stages, and thus it is vital to draw up as soon as possible an implementation schedule based on a realistic assessment of VIETNAM's technical, human and financial resources.

Such a schedule, the first stages of which are studies connected with the site and with setting up basic infrastructure (a temporary camp, unloading facilities, power) can be drawn up only if a precise, realistic objective has been defined, for instance "The first priority is construction of the refinery, which must start-up by (date) at the latest".

In fact, in order for one of the planned units to go into industrial operation in THANH HOA province where no infrastructure whatsoever exists at the moment, all the facilities required for its operation such as a power station, harbour, residential area, etc.. would have to be constructed beforehand.

vii Material and above all human resources could to some extent be minimised by means of a well-planned schedule. For example, civil works for the fertilizer plant do not commence until those for the refinery are completed, as a result of which field material can be amortized under better conditions, the workforce benefits from the experience gained and there is less need to call in foreign specialists.

Training of workmen, technicians and management must form an internal part of the implementation schedule. It can begin at once with the help of one or several local civil engineering and construction firms, but the bulk of it will have to be provided by foreign contractors.

viii Investment remains the fundamental difficulty. For the purpose of the study investments have been assessed on a European cost basis, taking implementation conditions and schedules in VIETNAM to be rather similar to those in fast developing countries. Amounts are expressed in US dollars, but a fair proportion of the total will in fact be paid in dongs. To take account of the implementation conditions assumed, ratios have been preliminary estimated making total amounts considerably higher in VIETNAM than in EUROPE, mainly because of the need for large numbers of foreign specialists and management, which increases foreign currency expenditure. These estimates are only orders of magnitude and are likely to be subsequently modified by a better appraisal of the Vietnamese context. Implementation schedules are one of the main factors determining investment levels. Greatly extending time schedules might cut down the foreign currency part but would on the other hand lead to an increase in total investment through the combined effect of inflation and interest on loans.

ix. The major part of the foreign currency expenditure should be met by loans under bilateral or multilateral agreements. This will be studied in fuller detail in phase two of the study. However, in view of the total amount involved, a start should be made now to seek various sources of finance. Foreign firms supplying know-how and technology under licence, could participate financially in the project to the amount of their fees, thus providing part, though a fairly small one.

VIETNAM's means of paying back loans will be the critical point in discussions with finance organisations. The output of the proposed units is to be sold on the domestic market, so that sales of surpluses cannot be looked to provide foreign currency earnings. The discovery of oil in VIETNAM would make it much easier to obtain credit as reimbursement would thus be guaranteed.

x. Financial contributions from foreign firms involved in the project would ease the transfer of technology (up-to-date improvements in processes, product end uses, etc..). At present technology is not entirely available, particularly from the UNITED STATES. Although a number of barriers may be overcome in this respect, note that it may prove difficult to acquire some processes, such as catalytic cracking and partial oxidation for ammonia production, for VIETNAM on this account alone. This problem will have to be borne in mind when making the final choice of processes.

xi. The creation of an industrial zone in THANH HOA province means that downstream industries will have to be set up to consume, transform or package the products manufactured. In the case of the refinery particular needs would be :

- an LPG bottling plant
- an asphalt plant

and for the petrochemical side :

- a resin to end product converting plant
- a plastic bag plant for fertilizer packaging.

Most of these industries, and the asphalt and plastic bag plants in particular (the latter using imported polyethylene or polypropylene initially) can be set up on the site. On the other hand, it would be more economical to bottle LPG near consumer markets.

244 The harmful effects on the environment of this concentration of industry must be kept to a minimum, particularly water pollution. Atmospheric pollution can be avoided to a great extent by discharging as little solid and volatile matter as possible, and no noxious gases, to the atmosphere.

TABLE 1

TECHNO-ECONOMIC FIGURES OF OVERALL IMPLEMENTATION*

(BASIC CASE)

TECHNICAL

• Earth work	(m^3)	4 800 000	(excluding harbour)
• Dredging	(m^3)	4 800 000	
• Concrete	(m^3)	175 000	
• Buildings	(m^2)	27 000	
• Total equipment	(t)	114 000	
• Piping (battery limit)	(t)	14 300	
• Piping (interconnecting)	(t)	12 400	
• Product Pipeline	(t)	9 000	
• Work hours (European basis without contingencies)		18 400 000	

INVESTMENT (in VIETNAM) $ (10^3)

• Complex and auxiliaries	
Refinery	438 000
Fertilizer	338 700
Petrochemical	56 600
Power unit	41 600
Water treatment	6 100
Product pipeline	16 100
TOTAL	823 100
• Site equipment and connections	72 550
• Harbour	89 800
Sub-total	162 350
T O T A L	1 085 450

* *Complex scattered over site North and South ; harbour in site North*

2. REFINING

i. Petroleum product requirements are currently around 2.2 MM tons, about 50 % of this being middle distillates (kerosene and diesel oils). Estimating future requirements on the basis of a similar pattern to that found in neighbouring countries, allowing for an initial phase of rapid development, figures of 3.5 MM tons in 1980 and 5.6 MM tons by 1985 emerge.

The proportion of middle distillates and particularly diesel oils can be expected to increase slightly, with a corresponding drop in the motor gasoline share (see table 2).

ii. Refining capacity required to meet domestic requirements should form part of a long term development plan. In the initial stage, taking into account normal implementation schedules, the refinery planned for THANH HOA province will have a nominal capacity of 5 MM tons. Growing demand will mean a second refinery of the same size being started up three to four years later.

iii. The chances of finding oil in VIETNAM are sufficiently good to boost the refining industry. However, the future refinery must not be designed for local crude alone as neither quantities nor quality are certain. It must be planned to use imported crude, during the first few years of operation at least.

iv. The refinery must therefore be able to process both local and imported crude. Early assessments of Vietnamese crude oil quality show it to be unsuited to the Vietnamese market, less well suited than one of the common, readily available crudes that could be imported (see fig.1). However new discoveries may change this picture.

v. First information on Vietnamese crude oil supplied by PETROVIETNAM shows that it could be similar in kind to other crude oils now produced in the Far East, the commonest of these being MINAS (INDONESIA). The latter has been selected as design local crude oil.

As far as imported crude oils are concerned, ARABIAN LIGHT has been chosen as design crude oil. From the viewpoint of quantity, it is freely available and in quality, it is quite representative of the average quality of imported crude oils (including soviet oils. A comparison with Arabian is made in volume 3 pages 37-38).

vi. The refining scheme must be decided with regard to this basic industry's objectives, namely :

- covering the local market
- possibly processing Vietnamese crude
- keeping foreign currency expenditure to a minimum.

In view of the crude oil characteristics and the demand structure in VIETNAM, a compromise solution will have to be adopted, based in part on the market value of Vietnamese crude on the international market. A domestic and export price scale for finished products has been worked out, with reference to international levels (see table 3).

vii. To meet the objective of the refinery being able to process local and imported crude oils meeting all requirements while minimizing total investments, several refining schemes have been investigated :

- hydroskimming
- hydroskimming + catalytic cracking or hydrocracking
- the previous ones + coking
- hydroskimming + thermal cracking (or coking)

fed by a mixture 50/50 local/imported crude oils.

Basically the various schemes have been established, considering 50/50 % MINAS/ARABIAN LIGHT design basis. This configuration represents a reasonable compromise on which the respective advantages of both design crudes are utilized to reduce investments. Material balances have been established when feeding the same schemes successively by local and imported crude oil alone.

For comparison purpose, similar refining schemes have been set up with 100 % MINAS design basis, fed by local crude oil alone.

viii. The inherent qualities of Vietnamese crude cannot be utilized to advantage on the domestic market but would on the other hand give it considerable added value under present conditions on the export market. Partial processing at least of one of the common Persian GULF quality crudes offers a means of reducing investment generally and above all of substantially increasing the quantities supplied to the domestic market.

ix. Only a complex scheme involving a hydrocracking unit and a coking unit would ensure total domestic demand satisfaction and operational flexibility with regard to uncertain local crude supplies. This solution means very high investment, and in addition could not be economically developed if no local crude oil were available.

- Conversely, a simple scheme cannot satisfy total demand but the corresponding investments are some 200 million dollars less than in the above case. Such a scheme is unsuited to local crude and would be economically feasible only with a high proportion of imported crude.

- The schemes involving hydrocracking alone or coking alone give reasonable market coverage while at the same time investments are not too high. While the first is more flexible, investment for the second is lower.

x. If the refinery were to be implemented on the NGHI SON site using one of the two schemes in *ix* above, budget cost would be in the order of 410-440 million dollars (mid 1978). To this figure must be added :

- the cost of deconcentrating reserve storage capacities
- the cost of sea shipping facilities (excluding basic harbour infrastructure).

This puts total investment at some 480 million US dollars, constant mid 1978, excluding financial charges, such as bank interest and commision and interest during construction, and excluding also the funds needed to create a working capital.

xi. The high investment involved, together with uncertainties as to crude oil supplies, might seem to indicate gradual development of the refinery, starting with a Type 1 scheme (atmospheric distillation and catalytic reforming) based on a high proportion of imported crude. After a short period the scheme could be adapted to actual domestic requirements and to local crude by the addition of secondary process units of appropriate capacity and design. The advantage of this solution is that it does not involve premature - or possibly even needless - investment in the event of local crude being better matched to the market than expected, e.g. of a similar quality to BRUNEI LIGHT SERIA.

The main disadvantage of implementing a simple refining scheme processing at least in first years imported high sulphur crude oil, is the disposal of large excess of fuel oil difficult to sell on export markets, unless the price is low. However extra utilization of such a fuel oil as compared to normal local market requirements -1 400 000 tons- could be eased by

- producing asphalt (and in a further stage lubricant) necessarily carried out from imported materials
- burning fuel oil in the power station supplying the complex
- using residual fuel oil to manufacture ammonia by partial oxidation process.

Finally, in the event of no availability of local crude oil, the previous means could allow to restrict additional secondary processing to a minimum such as visbreaking unit on atmospheric or vacuum residue.

TABLE 2

MARKET PROSPECTS FOR PETROLEUM PRODUCTS IN VIETNAM

BEICIP ESTIMATE

(tons)

PRODUCTS	1977	1980	1985
L P G	20 000	35 000	70 000
GASOLINES	500 000	600 000	870 000
KEROSENE	250 000	345 000	550 000
JET FUEL	70 000	120 000	210 000
DIESEL OIL	710 000	1 300 000	2 100 000
FUEL OIL	520 000	900 000	1 500 000
TOTAL ENERGY PRODUCTS	2 070 000	3 300 000	5 300 000
ASPHALTS	80 000	110 000	180 000
LUBRICANTS	75 000	100 000	150 000
T O T A L	2 225 000	3 510 000	5 630 000

CODE:

REV.:

DATE:

CRUDE OIL CHARACTERISTICS AND DEMANDE STRUCTURE

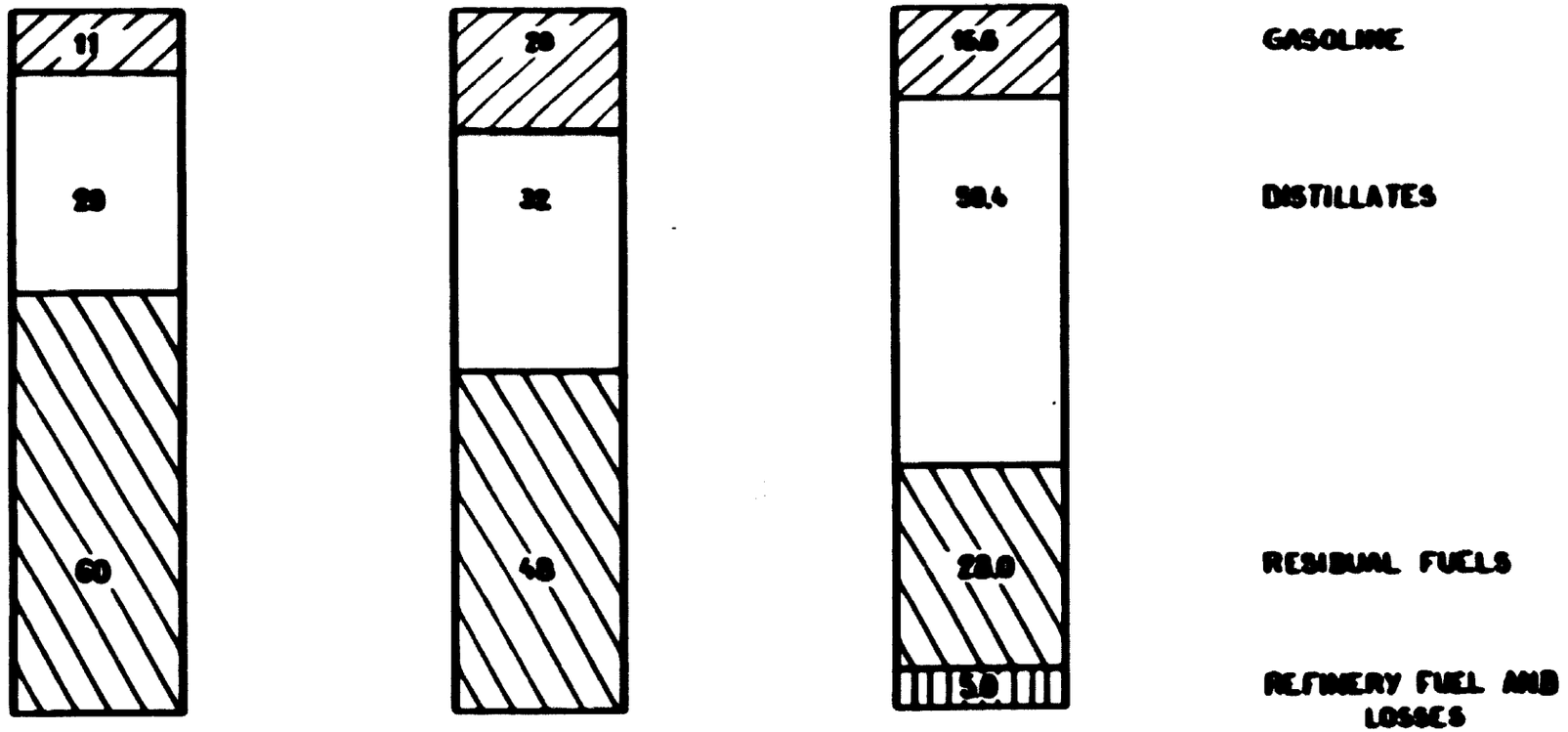

FIGURE 1

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TABLE 3

PRICES FOR CRUDE OILS AND PRODUCTS

	° API	CIF $/ton
LOCAL CRUDE	35.3	102.8
IMPORTED CRUDE	33.7	98.8

	Domestic outlets EX REFINERY PRICES $/ton	EXPORT FOB PRICES $/ton
LPG	141	-
NAPHTHA	158	124
PREMIUM	201	-
REGULAR	188	-
KERO/JET	143	-
DIESEL OIL	135	-
FUEL OIL 3 % S	87	87
FUEL OIL 0.5 % S		90
COKE	-	100

TABLE 4

MAIN ECONOMIC RESULTS

IN THOUSAND $ 1978

CASES / UNITS	1 Hydro-skimming	2 Catalytic cracking	3 Cat.Crack. cok.	4 Hydro-cracking	5 Hydrocra./ cok.	6 Therm.Crack cok.	7 Visb./Th Cnk.
DESIGN 50/50 MINAS/ARABIAN LIGHT							
INVESTMENT (rounded)	350 000	425 000	545 000	484 000	582 000	455 000	
Feed 50/50 local/imported							
PAY OUT (years)	6.4	6.4	6.9	5.9	6.5	5.9	
Δ export - 10 % (1)	+ 1.6	+ 0.7	+ 0.4	+ 0.2	+ 0.1	+ 0.3	
Δ import.crude + 1 % (2)	+ 0.3	+ 0.2	+ 0.2	+ 0.2	+ 0.2	+ 0.2	
Δ investment + 10 % (3)	+ 0.7	+ 0.7	+ 0.7	+ 0.6	+ 0.6	+ 0.6	
local products/crude feed (4)	74	81	87	90	92	87	
. Feed 100 % local PAY OUT (years)	13.4	11.0	9.6	10.6	11.6	10.8	
. Feed 100 % imported PAY OUT (years)	5.6	5.3		5.0			
DESIGN 100 % MINAS							
INVESTMENT (rounded)	300 000	436 000	607 000	528 000	636 000	481 000	391 000
Feed 100 local							
PAY OUT (years)	11.3	9.4	10.0	7.1	8.7	7.7	8.7
Δ export - 10 % (1)	-	+ 4.1	+ 0.7	+ 0.4	+ 0.2	+ 0.7	+ 2.7
Local products/crude feed (4)	42	62	84	84	90	82	76

(1) *Increase of pay out time when excess products are sold on export market 10 % lower than in basic conditions*
(2) *Increase of pay out time when imported crude price is 1 % higher than in basic conditions*
(3) *Increase of pay out time when investments are 10 % higher than in basic conditions*
(4) *Share of refinery production sold on local market*

3 . FERTILIZERS

i. According to "FAO production year book" the fertilizer consumption in VIETNAM was about 42 kg NPK per ha in 1974.

The lack of data on past consumption figures, soil requirements and farming habits makes it very difficult to estimate needs.

Meanwhile considering the consumption figure given by PETROVIETNAM, i.e. 150 kg of urea on average per hectare of rice, present rice crops should require about 870 000 tons of urea. Taking the forecast of rice cultivated land for 1980, the same unit consumption leads to about 1 000 000 tons of urea alone.

The phosphoric, potassic and nitrogen fertilizers required for rice and other crops, considering the 1980 cultivated land and consumption Plan objectives, could reach about 2 000 000 tons or 180 kg of fertilizer per hectare, equivalent to about 72 kg NPK in 1980.

Finally, 1980 objectives do not appear as unrealistic ones but they seem difficult to be met, especially in view of the necessary foreign currency expenditure.

ii. Starting with 1000 tons per day of ammonia, three possible production schemes have been set by PETROVIETNAM to manufacture finished fertilizers usable in VIETNAM.

After further investigation material balances have been slightly modified to cope with the usual yields of the proposed schemes as follows (in tons per year)

	ALTERNATE I	ALTERNATE II	ALTERNATE III
. Urea	200 000	450 000	570 000
. Ammonium nitrate	333 000	150 000	-
. Nitrophosphate	300 000	-	-

- The plant capacity of 1000 tons per day of ammonia - planned in a first step - is far below Vietnamese requirements.

- The first alternative produces both nitrogenous and phosphatic fertilizers from phosphate rock available in VIETNAM. It meets the rice crop needs rather well particularly because of the high nitrogen ammonia content of urea and nitrophosphates. Ammonium nitrate production which is more convenient for dry crops - due to its high nitrogen nitrate content - is to be carefully looked at with a view to hinterland crops requirements.

- Alternatives II and III deal only with ammonia derivatives such as urea and ammonium nitrate. Alternate II which produces large amount of ammonium nitrate seems less suitable for rice than the other two. Alternate III produces only urea. While appropriate for rice crops this alternative does not supply all the fertilizer needs of such crops - no phosphatic fertilizers.

It appears that a better appraisal for the selection of one of these alternatives, whatever the economics are should result from an in-depth analysis of Vietnamese requirements, particularly rice crops.

iii. Two processes may be utilized for ammonia production : steam reforming using gas or naphtha as feedstock and partial oxidation using all feedstock ranges from gas to residual fuel oils.

In terms of raw materials availability, considering that any feed suits partial oxydation process this alternative will offer more flexibility than steam reforming and therefore will be less demanding with regard to the refinery configuration.

iv. Investments required by both processes are much lower for steam reforming than for partial oxidation. Operating costs are also lower for steam reformer but the economic comparison of the two ways is ruled by the respective prices of feedstocks.

From the refinery fuel oil will be more easily available than naphtha. Indeed, only sophisticated and expensive refining scheme will produce naphtha in excess of the gasoline requirements. On the contrary fuel oil will be generally in excess and consequent amounts will have to be sold on export market.

Using the present international product prices for naphtha and residual fuel oil makes profitability of the partial oxidation process slightly higher than those of naphtha steam reforming. Expected prospects for fuel oil and naphtha availability and prices on international oil product market could lead to a definitive advantage in favour of partial oxidation.

Consequently fuel oil partial oxidation seems to be a more suitable solution for ammonia production in VIETNAM. However it should be pointed out that VIETNAM's access to the license for such technology has to be made clear.

v. The main figures of the economic evaluation of the three alternatives are presented in tables 6 and 7.

Alternative III leads to the lowest investment. Alternatives II and I are respectively 13 and 37 % higher.

With the prices retained for each product, Alternative III gives slightly better profitability than the other two alternatives, but the differences are not significant.

vi. Gathering technical and economic advantages of the three alternatives makes difficult a definitive choice but it seems advisable for the first fertilizer complex in VIETNAM to select that alternative meeting the most urgent requirements of the country and leading to the most lowest investment.

vii. On the other hand the various phosphate fertilizer production routes (phosphoric acid, MAP, DAP, nitrophosphate...) should be investigated before the definitive selection of nitrophosphate 20/30 which appears at a first look as rather well suited for rice. In the meantime, provisional solution would be set up to feed the first phosphorous needs such as finely ground rock phosphate applied directly for the growing of wet rice.

TABLE 5

ECONOMIC COMPARISON OF PARTIAL OXIDATION AND STEAM REFORMING

	PARTIAL OXIDATION	STEAM REFORMING
RAW MATERIALS (tons/year)		
• Naphtha		172 920
• L.S. Fuel oil		129 500
• Fuel 3.5 % S	308 550	
ECONOMICS		
• Total investment* 10^3US$	284 200	199 350
• Operating cost 10^3US$	34 380	45 480
Pay out time years	7	7.5

* Including power plant for own use.

TABLE 6

PRICES USED FOR FERTILIZER ECONOMIC EVALUATION

US$/TON

RAW MATERIAL	
• FUEL OIL (3.5 % S)	87
• NAPHTHA	158
• PHOSPHATE ROCK	35
FINISHED PRODUCTS	
• UREA	185
• AMMONIUM NITRATE	140
• NITROPHOSPHATE 20/30	155
• NITRIC ACID	150
• CALCIUM CARBONATE	20

TABLE 7

ECONOMIC COMPARISON OF THE ALTERNATIVES PROPOSED BY PETROVIETNAM

	ALTERNATIVE I	ALTERNATIVE II	ALTERNATIVE III
MATERIAL BALANCE (tons/year)			
Urea	200 000	450 000	570 000
Ammonium nitrate	333 000	150 000	
Nitrophosphate (20/30)	300 000		
Nitric acid	10 000	10 000	
Calcium carbonate	171 000		
RAW MATERIALS UTILITIES			
Feedstock for ammonia	fuel oil	fuel oil	fuel oil
Phosphate rock (tons/year)	225 000	-	-
Fuel (10^6kcal/h)	438	384	381
Power (kWh/h)	14 220	8 045	5 080
Water (m^3/h)	1 510	1 210	880
ECONOMIC ITEMS (including ammonia)			
TOTAL INVESTMENT IN VIETNAM (10^3US$)	563 000	485 000	410 000
OPERATING COST (10^3US$)	55 210	42 610	41 375
PAY OUT TIME (years)	7.4	7.3	6.4

4. PETROCHEMICALS

i. The lack of data on past and present petrochemical products consumption does not allow to develop typical forecasting methods for evaluating future requirements.

Macro-economic approach based on the hypothesis that VIETNAM could follow similar consumption development as neighbouring countries was used to estimate the plastics, fibers, and detergents prospects.

These figures have been compared with Plan objectives.

ii. Total thermoplastics demand could be 80 000 tons by 1980 and 160 000 tons by 1985. The PVC share foreseen in Plan objectives seems very optimistic and a possible consumption structure for 1985 has been estimated by BEICIP as follows :

- Low density polyethylene 15-20 %
- High density polyethylene 20-25 %
- Polyvinyl chloride 30-35 %
- Polypropylene 10-15 %
- Polystyrene 5-10 %.

iii. Total man-made fibre demand can be estimated to some 115 000 tons by 1985, with synthetic fibres accounting for 95 to 100 000 tons in which polyester share should be no more than 65 %.

A possible consumption pattern by 1985 could be as follows :

- Acrylics 10-15 %
- Polyamides 20-25 %
- Polyesters 60-65 %

iv. The Plan objectives for total detergent demand, i.e. 100 000 tons by 1980 and 210 000 tons by 1985 can be kept as far as the soap + synthetic detergents figures are concerned. The breakdown between soaps and detergents might show a progressive shift towards synthetic.

Total active ingredient consumption would be around 20 000 tons by 1985.

v. The present market for petrochemicals in VIETNAM is not very developed but considering the large population and the expected increase of national income mid and long term prospects could be bright enough. A preliminary evaluation of the future consumption of basic petrochemical intermediates has led to the following figures (tons)

	1985	1990
. Ethylene	125 000	245 000
. Propylene	70 000	150 000
. Benzene	55 000	95 000
. Para-xylene	45 000	90 000

These values could not be reached except if means of financing and adequate raw material are made available and if local processing industry is developed accordingly.

vi. Whatever the rate of growth may be, development of the petrochemical industry in VIETNAM has to be planned in several steps.

For the first step, only the PVC market size unables the setting up of a profitable production unit.

Several scenarios, based mainly on raw materials availability have been preliminary investigated for the following steps of development.

As a matter of fact, olefins and aromatics needs are too small to justify "Economic size" units (steam cracker and aromatic reformer) before 1990.

In the meantime, some units producing finished products such as plasticizers, active materials for detergents and polyesters from imported raw materials (phthalic anhydride, benzene, ethylene glycol and DMT..) will have been set up.

vii. As PVC production is concerned, it seems advisable to first import vinylchloride monomer (VCM) instead of producing it because of large investments required by chlorine and VCM units. On the other side, size of VCM plant would be uneconomical as compared to this of PVC alone. Lastly caustic soda outlet has to be investigated before taken any decision.

viii. The polyvinyl chloride production unit is sized in such a way to produce 60 000 tons of PVC resins from imported VCM.

Two main types of processes are available : the suspension process and the bulk process.

Preliminary economic evaluation for the suspension process is presented in table 8.

ix. Raw material cost constitutes 60 % of the total price. The PVC production profitability will mainly depend on the import VCM prices.

x. The total investment for a PVC production is 65 10^6US$. The investment of the total PVC chain,i.e. chlorine production, VCM production and PVC production, would be between 150 and 200 million US dollars for 60 000 tons of PVC produced.

TABLE 8

MAIN DATA ON PVC PRODUCTION
(SUSPENSION PROCESS)

RAW MATERIAL	
VCM quantity tons/year	83 840
price US$/ton	365
UTILITIES	
FUEL 10^6kcal/hour	14.2
ELECTRICITY kWh/h	3 200
INDUSTRIAL WATER m^3/h	220
TOTAL INVESTMENT 10^3US$ (erected in VIETNAM)	85 430
TOTAL OPERATING COST 10^3US$/ton	28 118
Pay out time (in years)	8
PVC SALES PRICE US$/ton	850

5. COMMON FACILITIES AND AREA EQUIPMENT

i. Besides the complex, the industrial zone will include :

- An harbour which should at least serve the needs of the industrial zone, particularly as regards raw material delivery and finished product shipping.
- A residential area in which will be housed the present local inhabitants together with families of personnel working in the complex and in the other units within the industrial zone.
- An electricity generating station and a centralized industrial and drinking water plant supplying the whole industrial zone.
- A series, yet to be defined, of plants and workshops providing construction materials, mechanical services, foodstuffs, ship repairs, etc..
- A network such as roads, railways, power lines, water supplies, product transfer and transport systems, etc..

ii. Two possible harbour locations have been studied, one to the North and the other to the South of NGHI SON Island.

Marine surveys have to be undertaken to ascertain what could be the respective technical advantages of the both site.

The North solution involves a rather long breakwater and other marine facilities could be necessary to face satisfactorily the strongest wind and swell conditions.

The South solution appears at first simpler. However as in the North solution problems involved by sand deposit have to be studied.

From economic viewpoint, the South location at first sight is the cheapest though dredging costs are practically similar for the both solutions. However subsoil quality to the South of NGHI SON Island is to be carefully checked.

iii. The power station is intended to supply solely electricity required by the industrial and urban zone. The range of required power capacity is 32-50 MW according to the actual needs of the complex.

Respective advantages of the three possible types of station have been compared (table 9).

The total condensation steam turbine type is particularly suited to medium and large capacity, the high investment being balanced by high efficiency and reliability. In spite of the possibility of easily using heavy fuel oil available from the refinery, such a type does not appear to be suited to the requirements of the industrial zone at least in the first stage of development.

The gas turbine type is normally suited to small and medium capacity units due to low investment and short construction time and from these viewpoints well adapted to the Vietnamese project. However, its efficiency and also reliability are medium and chiefly fuel required has to be fairly noble and of a much higher quality than residual fuel oils.

Diesel groups could finally be the most acceptable solution in spite of relatively high investment and medium reliability. Their high efficiency combined with the use of low value fuel leads to the lowest unit cost per kWh.

Considering future expansion it seems preferable to site the power station near the harbour. Such a location could be in any case absolutely necessary in the case of a steam turbine for cooling requirements.

iv. Total water requirements for domestic and industrial uses are estimated at about 400/600 litres/sec. for the first stage and double this for a further stage.

A water intake system will be constructed near the reservoir for all needs except drinking water if underground springs could be utilized for this.

Two different types of treatment are planned and separate distribution systems supply the industrial and domestic requirements of the various users in the industrial zone.

* *Including harbour*

v. The inadequacy of inland transport means supplying HANOI area oil needs by pipeline from the refinery.

A 10" pipeline appears the most suitable to face future development of consumption in the North of the country. Storage capacity should be constructed at the terminal outside HANOI.

TABLE 9

ELECTRIC POWER PLANT COMPARISON

CHARACTERISTICS	GAS TURBINES	DIESEL	STEAM TURBINES
Erection and start-up duration	<1.5 years	2 years	> 2 years
Reliability per unit	Average	Average	Average
Residual fuel oil utilization	Very difficult	Possible	Possible
Adequacy to requirements	Good	Good	Difficult
Unit consumption fuel/kWh	High	Low	Average
Operating labour	Low	Low	High
Maintenance cost/kWh	High	High	Average
Operating cost/kWh	High	Average	Average
Investment/kW	Low	Average	High

6. POSSIBLE SITES

Several arrangements of the complex units within the industrial zone have been worked out. They differ each from other mainly in :

- Location of the harbour (North or South of NGHI SON island)
- Location of the refinery/petrochemical plant (North site or South site)
- Distribution of the plants and particularly the crude storage capacity.

Case n°2 with scattered units and storages and sparing cultivated areas involves the highest investments as shown in table 10. The additional cost due to PETROVIETNAM's particular request can be evaluated in the range of 50-60 million dollars. In fact, a major part of this cost would be paid in dongs.

The less expensive arrangement (case n°3) involves the development of the industrial zone in areas B, D and E and particularly the choice of the South site for the harbour. Only submarine and subsoil surveys will give sufficient guarantees as to the actual cost for dredging the harbour and for erecting the industrial plants in area D.

TABLE 10

SITE COMPARISON

	SITE 1	SITE 2	SITE 3	SITE 4	SITE 5
INVESTMENT (10^3 $)					
. Complex	800 100	923 100	800 100	800 100	800 100
. Auxiliary facilities and connections	181 350	182 350	127 700	140 050	134 450
TOTAL	1 081 450	1 085 450	1 027 000	1 040 150	1 034 550
Estimated foreign share	78 %	78 %	78 %	78 %	77 %
MAIN CHARACTERISTICS					
. Earth work (m^3)	4 300 000	4 000 000	2 000 000	800 000	2 000 000
. Dredging (m^3)	4 800 000	4 800 000	4 500 000	4 800 000	4 800 000
. Concrete (m^3)		175 000			
. Piping (outside battery limit)[0](t)	11 800	12 400	11 800	7 800	11 100
. Roads (km)	16.2	22.1	23.2	15.8	18.8
. Railways (km)	10.55	14.7	15.7	8.25	14.7
. Estimated work-hours (European conditions)		19 400 000			

[0] *Excluding product pipeline*

7. PROJECT DEVELOPMENT

The objective of the pre-investment study was to analyse the conditions for developing an oil-based industrial zone in THANH HOA province and to outline possible solutions, taking into account VIETNAM's requirements and potential.

The second phase of the work will comprise a detailed techno-economic study of the alternative selected by PETROVIETNAM. Through technical descriptions of the production schemes and economic analysis of the refinery and petrochemical.fertilizer complex, this second phase must lead to a comprehensive definition of the units to be built and give recommandations as to the successive implementation phases.

Consideration should be given here to the fact that some unknowns will interfere with the selection of an alternative. Some of these have been made the object of assumptions necessary for the definition of the cases to be studied and consequently are of paramount importance with regard to the configuration and the development of the project. Particularly :

- The overall project contemplated in the study corresponds to present and medium term requirements defined by PETROVIETNAM. The development of such a project will imply extremely high capital expenditures, a large part of which will have to be in foreign currency. Such large requirements of foreign currency as well as of local resources may have several implications, for example :

  . such a period of time will be required to build up the financing of the project and the implementation of local structures that some delay will occur in the theoretical schedule based on technical considerations,

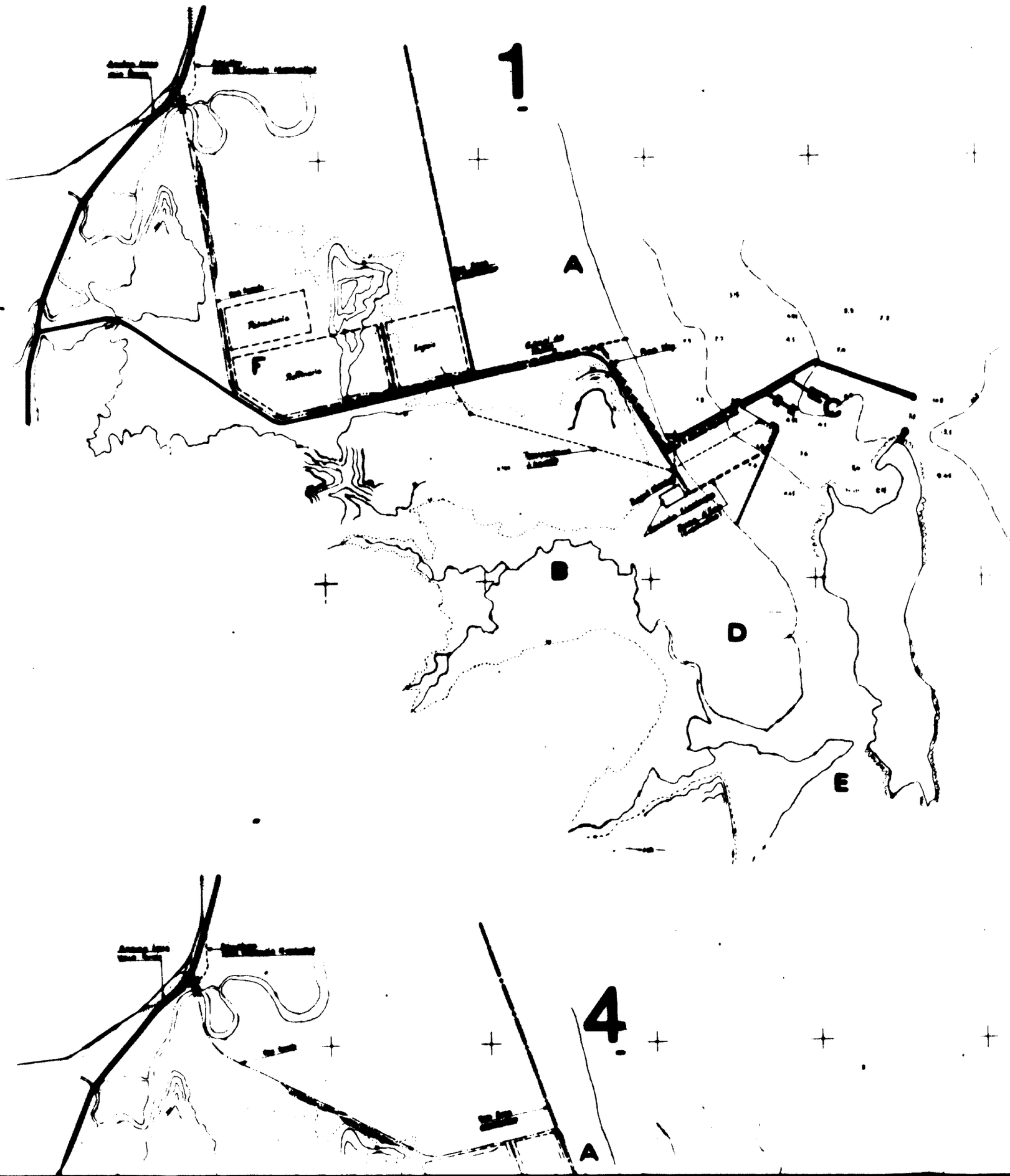
  . the project would have to be adapted to available resources with the possibility that it would differ to a certain extent from a solution selected from a purely technical and economic viewpoint.

- The final selection of site could be largely affected by the possibility of building convenient harbour facilities in the area. Surveys necessary to assess a suitable harbour site -oceanographic and topographical surveys, sea-bottom analyses and harbour studies- could take rather a long time.

- The refinery configuration depends largely on the type of crude oil to be processed. Until VIETNAM's crude oil potential is better assessed, there will be no reliable information for the refinery to be based upon. As much information may not be available for some time, a solution will have to be chosen which limits all capital expenditures that might not prove useful and profitable later on when a Vietnamese crude oil, of a different quality from that assumed, would be processed in the refinery.

These three problems - financing, site selection, crude availability - and to a lesser extent those posed by market evaluation and technology disposal are likely to make the choice of a solution in keeping with the Vietnamese Authority's objectives somewhat difficult in present conditions, particularly because of the complex configuration of the project which implies well ordered successive operations.

If answers can be provided to these various questions, it will be easier to define the case finally adopted. One of the aims of the detailed study constituting Phase Two of this assignment will in any case be to examine the way in which a solution chosen on technical and economic grounds can be progressively implemented and successfully adapted to actual conditions.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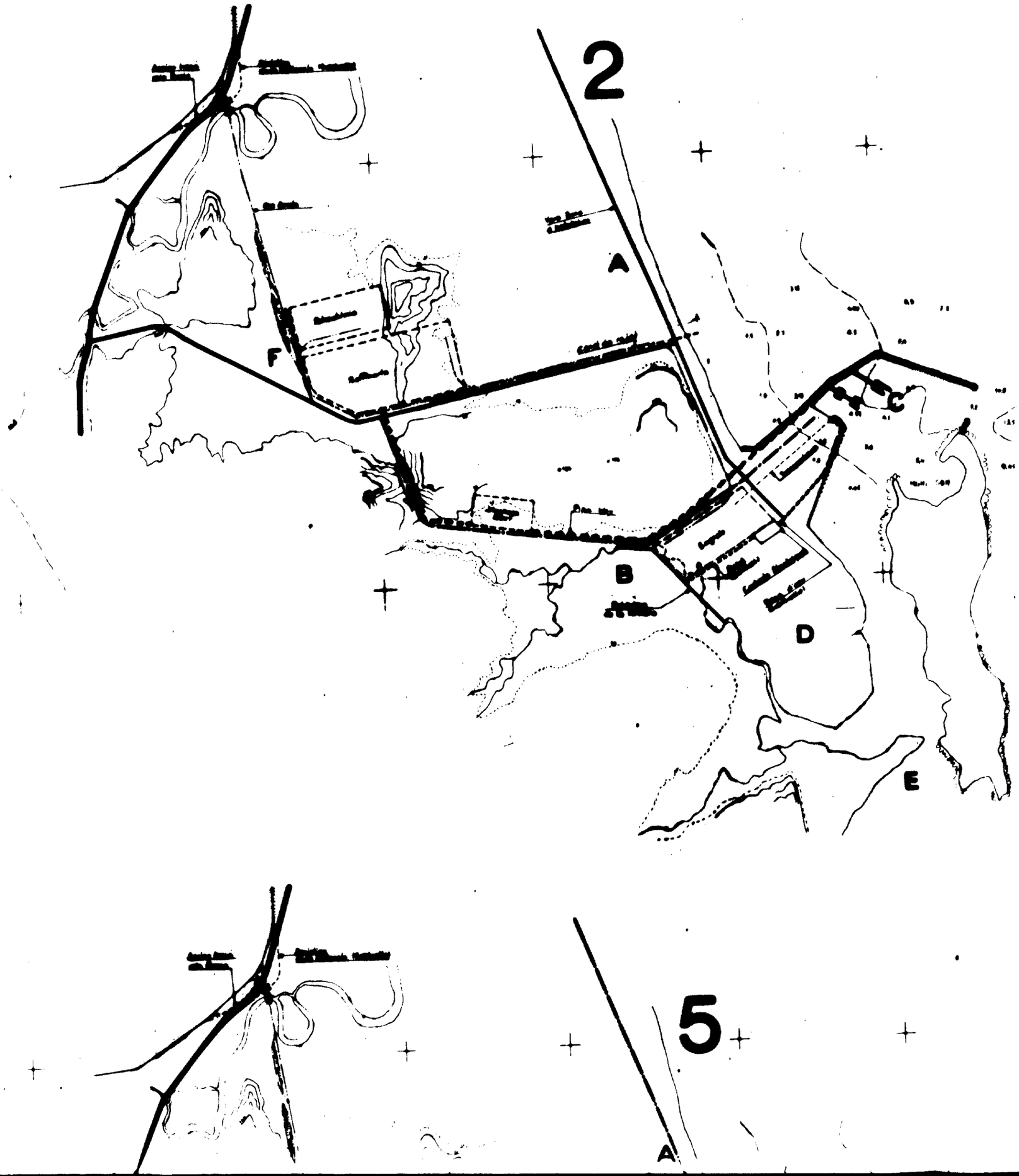
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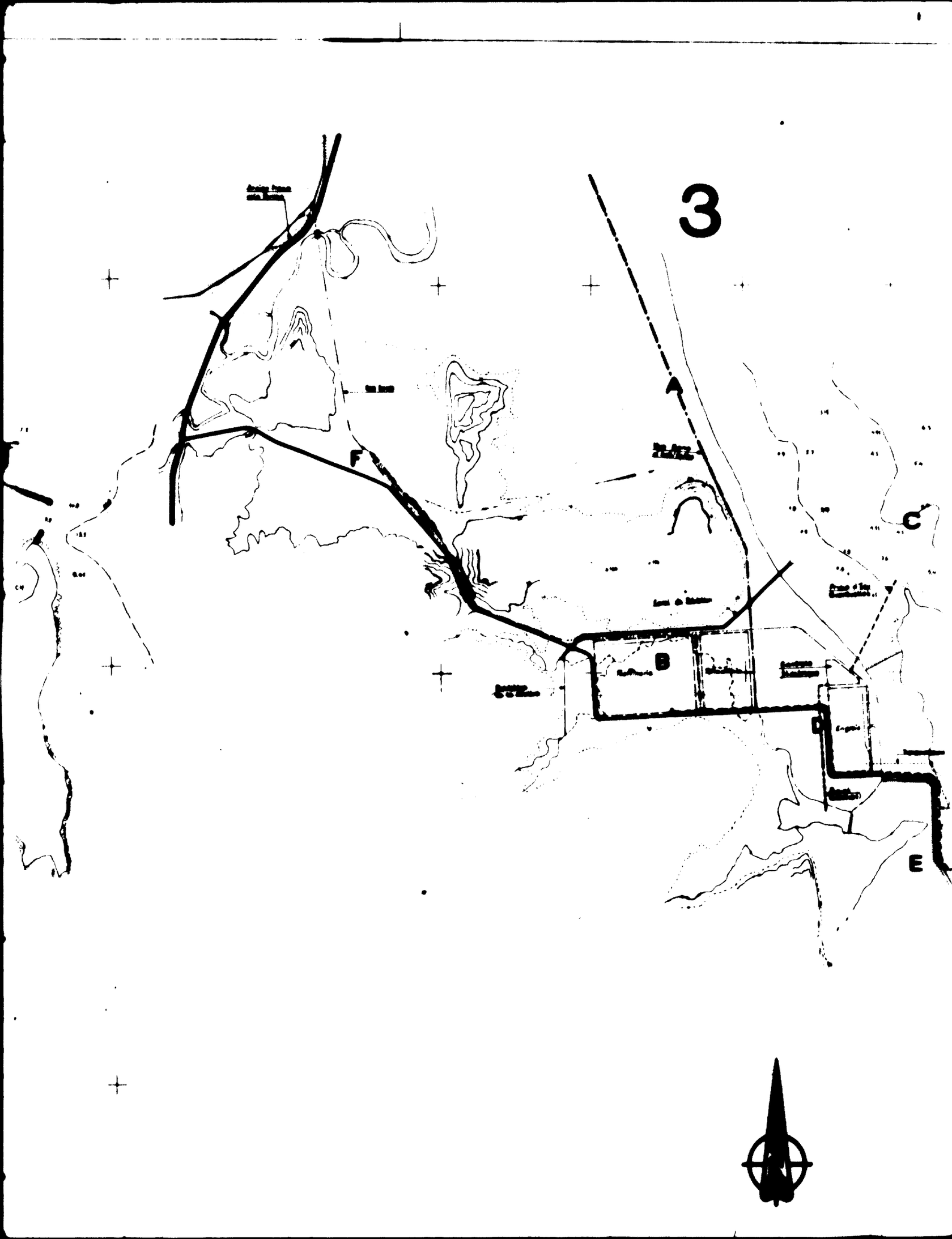
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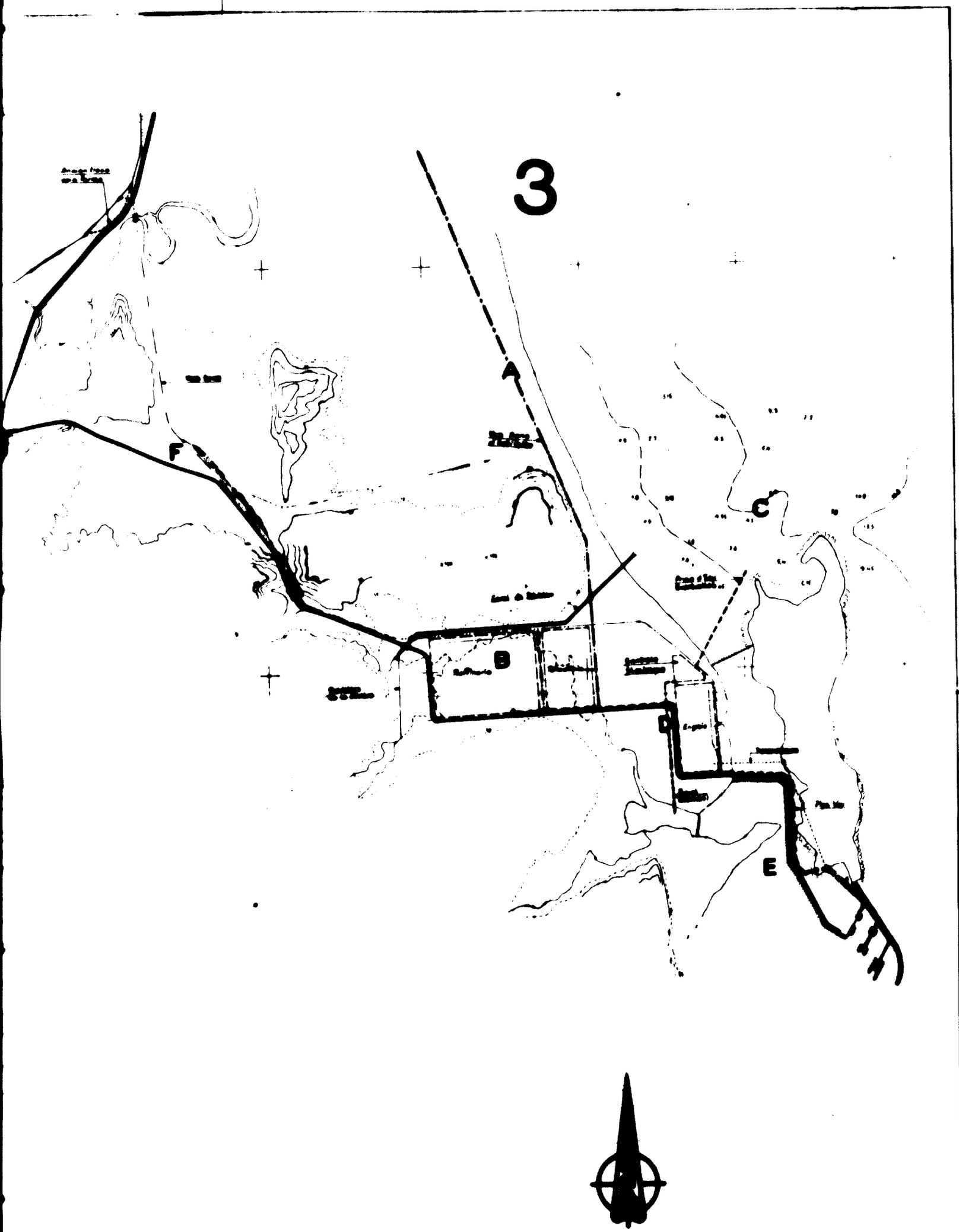
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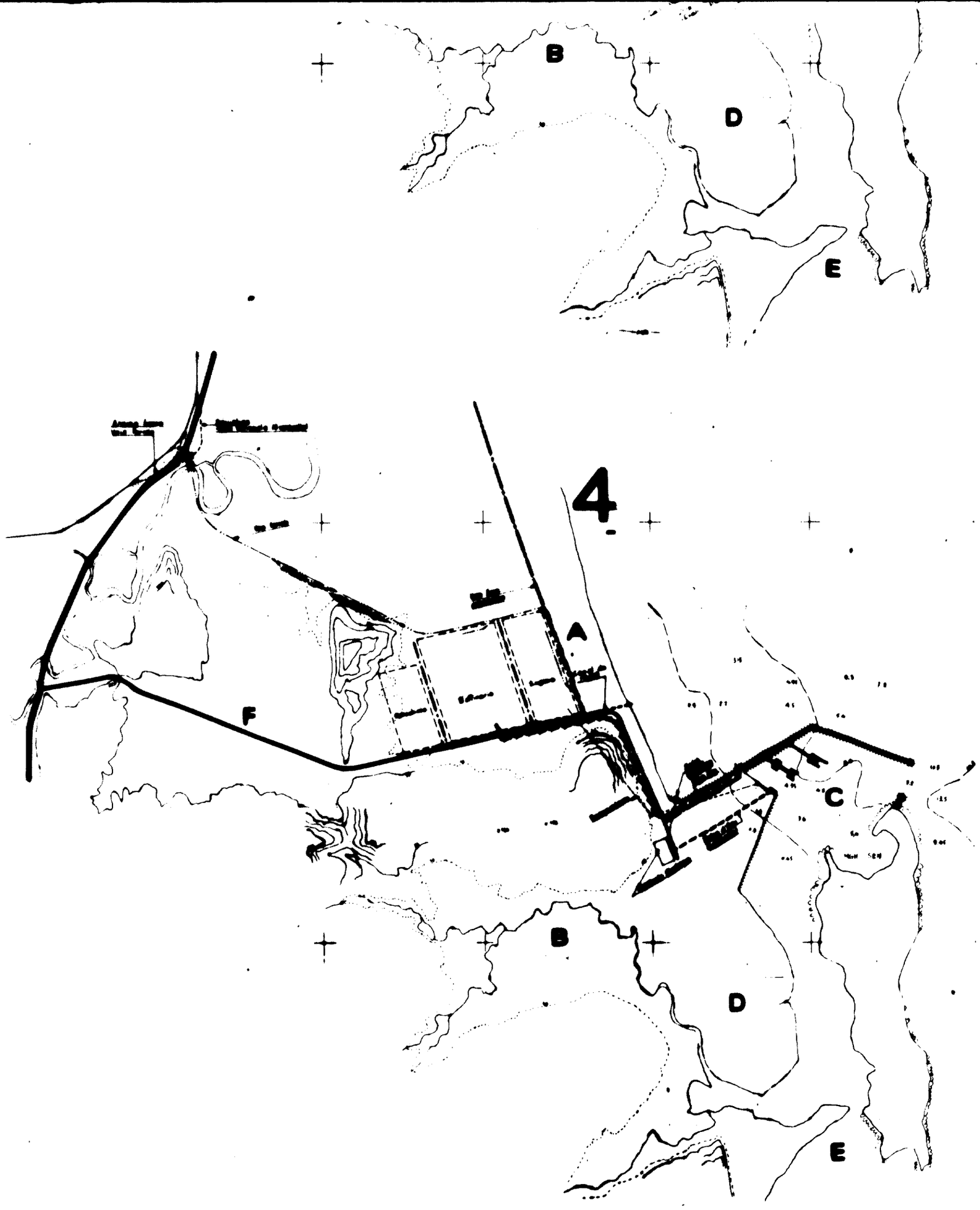
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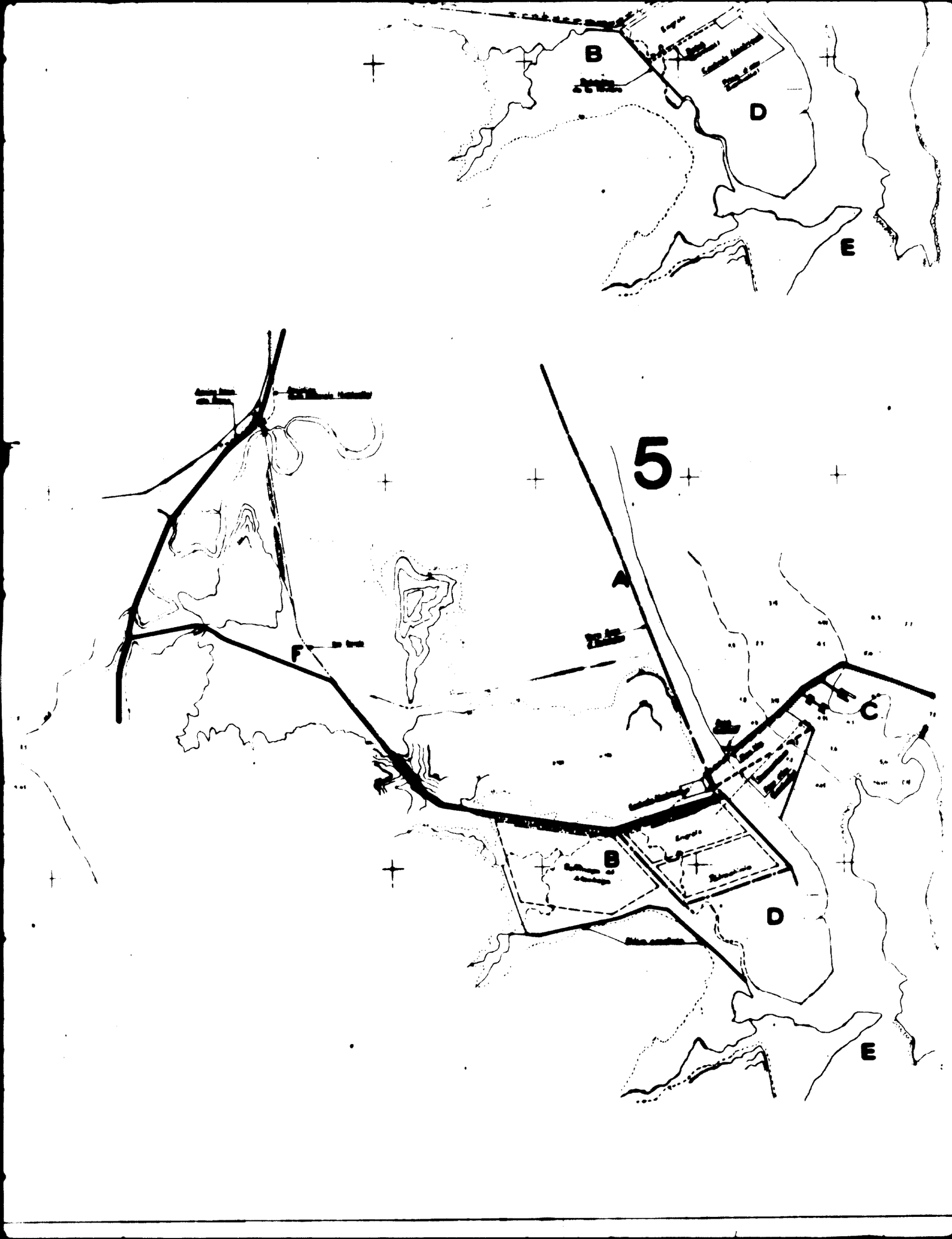
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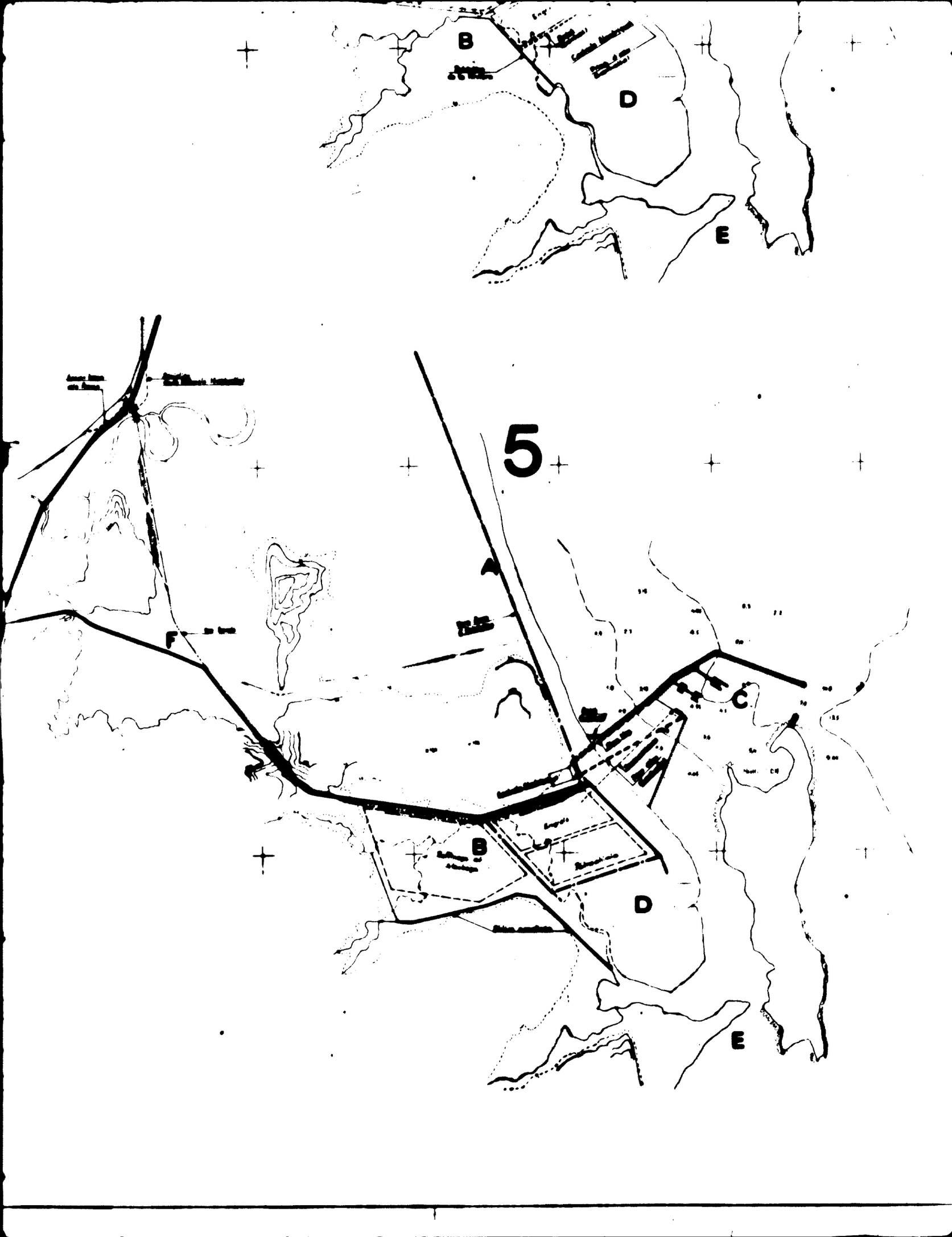
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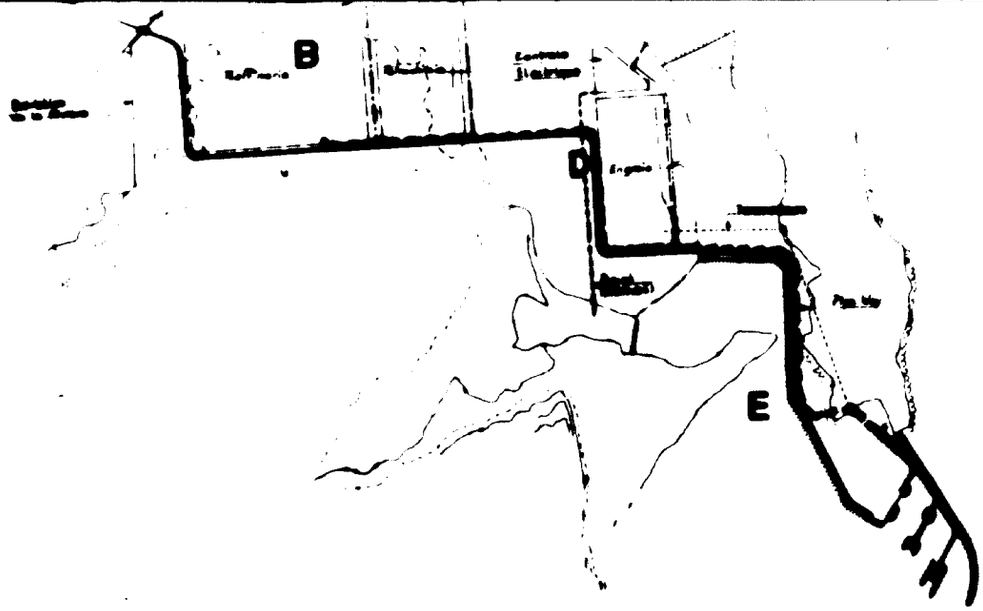

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DIVISION DES ETUDES INDUSTRIELLES

PETRO VIET NAM

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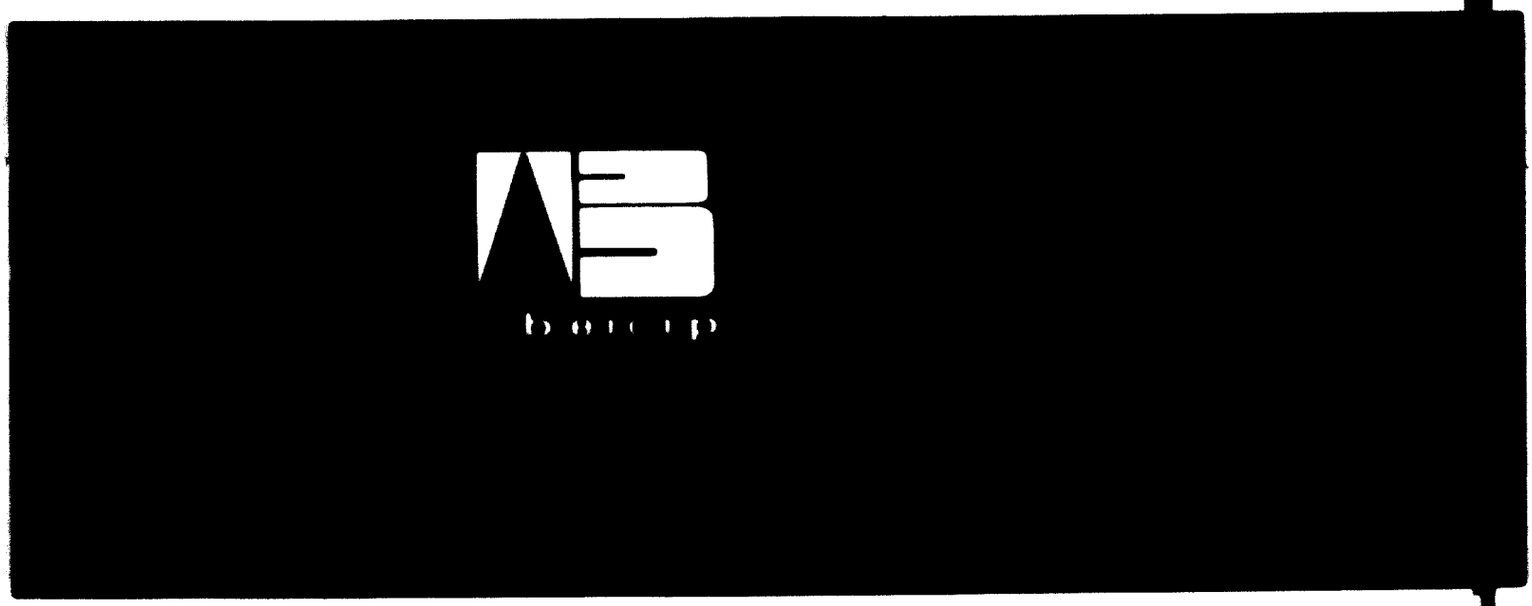

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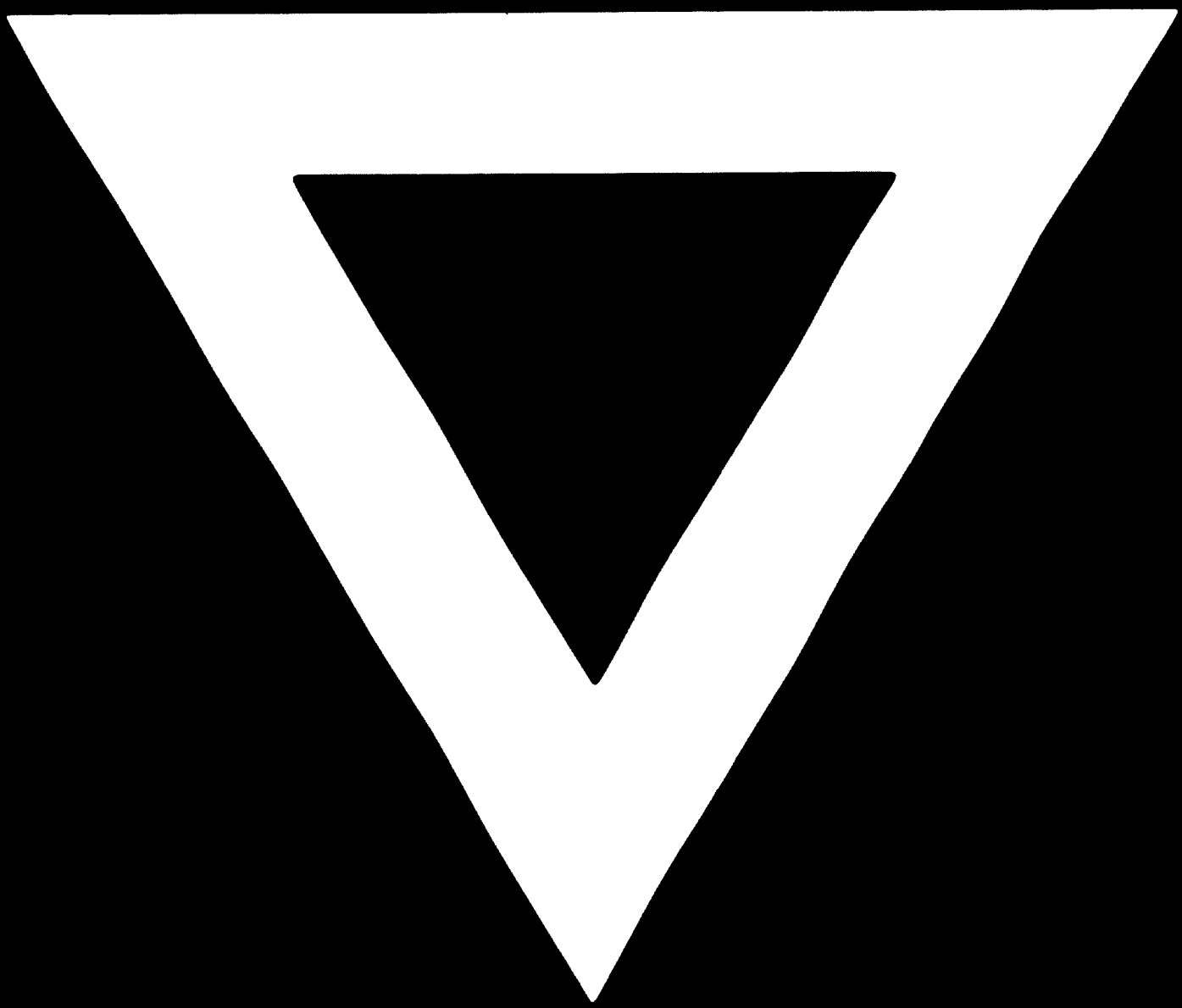

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