PRE-FEASIBILITY STUDY REPORT
FOR
THE DEVELOPMENT OF PETROCHEMICAL INDUSTRY
IN
THE PHILIPPINES

NOVEMBER 1975

JAPAN INTERNATIONAL COOPERATION AGENCY

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PREFACE

In compliance with a request by the Government of the Republic of the Philippines, the Government of Japan has decided to undertake a petrochemical industrial development survey in the Philippines, and has consigned the actual execution of the survey to the Japan International Cooperation Agency (JICA).

JICA formed a survey team consisting of 14 experts led by Mr. Takeshi Chino (Director, Polymer Industry Department, UNICO International Corporation). Seven members of the team visited the Philippines for 24 days from 25th February to 20th March, 1975 to undertake the field survey.

The field survey team held discussions with Governmental agencies of the Philippines such as the Board of Investment (BOI), Philippines National Oil Corporation (PNOC), the National Economic Development Agency, etc. At the same time, the team conducted surveys pertaining chiefly to the market conditions and site conditions in Cebu City, Iligan City, etc. centering on the Greater Manila area.

On the other hand, the rest of the team members who remained in Japan conducted a survey for formulating the orientation for the petrochemical industrial development in the Philippines, and duly submitted to the Philippines Government the Orientation Study Report in April, 1975 in which some results of the field survey were properly incorporated.

The survey team analyzed and scrutinized the data, information, and materials obtainted through the survey, and hereby compiled this report on the basis of the above-mentioned Orientation Study Report, by incorporating the results of technological studies and economic evaluations of a proposed olefin complex development programme.

I sincerely hope that this report will effectively assist the development of petrochemical industry in the Republic of the Philippines, and at the same time that it will contribute greatly to the furtherence of friendly relationship between the Philippines and Japan.

I am deeply indebted to the officials of the Government of the Republic of the Philippines who extended valuable cooperation to the execution of the field survey by the team. My deep appreciation is also expressed for the effective assistance given by the members of the Japanese Embassy in the Philippines, the offcials of the Ministry of International Trade and Industry and the Ministry of Foreign Affairs of the Government of Japan.

November 1975

Shinsaku Hogen
President
Japan International Cooperation
Agency

Letter of Transmittal:

Mr. Shinsaku Hogen
President
Japan International Cooperation Agency

Dear Sir,

Re: Pre-feasibility Study for the Development of Petrochemical Industry in the Philippines

It is our pleasure to submit to you our final report (in English and Japanese) regarding the captioned study.

Upon receipt of an esteemed order for the execution of this survey from your Agency, we formed a survey team consisting of UNICO's experts, experts from Japan Gasoline Co., Ltd. and Mr. M. Miyabayashi of the Ministry of International Trade and Industry of Japan. We have divided the project team into the home work group and the field survey group, for the purpose of effectively undertaking the studies of the policies covering the general aspects of the petrochemical industrialization, and also for scrutinizing the pre-investment economical viability of the project, both of which are the major objectives of the survey.

On the basis of such a formation of the experts, we formulated an overall organization covering the assignments to the member experts and the work schedule for the study. We have completed the planned survey within the prescribed time limit.

Upon receipt of your order dated 1st February, 1975, all the members of the team primarily finalized and confirmed the survey methodology, work assignments, work schedule, etc. Until the departure of the field survey group, the home work group undertook to make all the necessary preparation for the examination of the petrochemical industrial development policies, while the field survey team prepared the questionnaire sheets to be used during the field survey, the topics of discussions to be held on site, and other relative materials. During this preparation period, the two groups maintained close and intimate coordination and communications.

The field survey team conducted, in respective fields of the assigned member experts, such work as discussions with the personnel and officials of the Government of the Philippines, collection of data and information, observation of the actual site conditions, etc. After the completion of the field survey, the team returned to Japan to join the home work group. A member of the field survey team remained in the Philippines to compile a report on the results of the survey for authorization by the relative governmental agencies of the Philippines.

Upon the departure of the field survey group, the home work group commenced the examinations and scrutinizations of the policies to be taken by the Government of the Philippines regarding the petrochemical industrial development. This study gradually incorporated the actual results of the survey brought back one after another by the members of the field survey group. As a result, we have presented to your Agency our Orientation Study Report in English on 31st March, 1975.

On 1st April, 1975, we have started a survey on the pre-investment economical viability of the development of an olefin complex in the Philippines. This study was mainly led by the members of the field survey group. On 31st July, 1975, we have compiled a draft report of this study, and then visited the Philippines for 7 days from 7th September, 1975 for the purpose of briefing the contents of the results of the survey to the officials of the governmental agencies concerned of the Philippines. The visiting members of the experts then also conducted a final discussions with the governmental officials in the Philippines.

The report which we hereby present to your Agency has thus been prepared. By this presentation, we consider that the olefin complex construction project in the Philippines appears to have sufficient economic viability within the framework of the findings made through this feasibility study, particularly in view of the high level of domestic prices of plastic resins in the Philippines due to a comparatively high level of current import duties. Therefore, we would like to state that a further detailed examinations and scrutinizations of the economic viability of this project be conducted prior to the finalization of the governmental policies of the Philippines regarding the implementation of this olefin complex project.

We would like to take this opportunity to express our deep appreciation for kind and effective cooperation extended by the officials of the Government of the Philippines, the staffs of the Japanese Embassy in the Philippines, the Ministry of International Trade and Industry, Ministry of Foreign Affairs, and other governmental agencies of Japan as well as by the personnel of private companies of both the Philippines and Japan, without whose valuable assistance the compilation of this report would not have been as successful as it is.

Yours faithfully,

Takeshi Chino
Team Leader
(UNICO International Corporation)

Abbreviations

(Technical Terms)

BFW	Boiler Feed Water
BOD	Biological Oxygen Demand
BTX	Benzene, Toluene, Xylene
CCW	Circulating Cooling Water
C-X(CHX)	Cyclohexane
DEG	Diethylene Glycol
DMT	Dimethyl Terephthalate
E	Ethylene
EDC	Ethylene Di-chloride
EP (ELEC.P)	Electric Power
FG	Fuel Gas
FO	Fuel Oil
FW	Filtered Water
HDPE	High Density Polyethylene
HP.STM	High Pressure Steam
INERT	Inert Gas
INST.A	Instrument Air
ISBL	Inside Battery Limit
LDPE	Low Density Polyethylene
LNG	Liquefied Natural Gas
LPG	Liquefied Petroleum Gas
LP.STM	Low Pressure Steam
MP.STM	Middle Pressure Steam
m-xylene (Xylene)	Mixed Xylene
NG	Natural Gas
NGL	Natural Gas Liquid
NOx	Nitrogen Oxide
OSBL	Outside Battery Limit
PP	Polypropylene
PS	Polystyrene
p-TPA	Pure Terephthalic Acid
PVC	Polyvinyl Chloride

PLA.A	Plant Air
PW	Polished Water
p-Xylene (p-X)	Paraxylene
SEA.W	Sea Water
SM	Styrene Monomer
SOx	Sulfur Oxide
TPA (TA)	Terephthalic Acid
VCM	Vinyl Choloride Monomer
WELL.W	Well Water
GP	General Purpose (Polystyrene)
HI	High Impact (Polystyrene)

Abbreviations

(Measure, Scal, etc.)

bbl	Barrel
MMscfcd	Million standard cubic feet per current day
BTU/scf	British thermal unit per standard cubic feet
BTU/lb	British thermal unit per pound
MMKcal	Million Kilo-calorie
BPSD	Barrel per stream day
KWH	Kilo watt hour
t/hr, t/d t/m, t/y	Metric ton per hour, day, month, year
wt%	Weight per cent
vol%	Volume per cent
MT, T, Ton, ton	Metric ton
lb	Pound
°C	Degree centigrade
°F	Degree Fahrenheit
psig	Pound per squre inch at gauge pressure
psia	Pound per square inch at absolute pressure
m^2	Square meter
m^3	Cubic meter
Kl	Kilo litre
mm	Millimeter
cm	Centimeter
m	Meter
Km	Kilo meter
ha	Hectare
GPM	Gallon per minute
Kv	Kilo-volt
MTA	Metric ton per annum
sq.ft	Square feet
gpm	Gallon per minute
hr	Hour
mol	Molecule
cm^2G	Square centimeter per gauge pressure
psf	Pound per square foot

Abbreviations

(Name of Party)

BOI	The Board of Investment, Philippines
BRC	Bataan Refinery Corporation
FRC or Filoil	Filoil Refinery Corporation
JGC	Japan Gasoline Co., Ltd.
MERALCO	Manila Electric Company
NPC	National Power Corporation
PNOC	Philippine National Oil Company
UNICO	UNICO International Corporation

(Commercial Terms)

₱ or Peso	Philippine Peso
US$ or Dollar	U.S. Dollar
¥ or Yen	Japanese Yen
DCF	Discounted Cash Flow
IRR	Internal Rate of Return
C & F	Cost and Freight
CIF	Cost, Insurance and Freight
FOB	Free on Board
GDP	Gross Domestic Product

CONTENTS

Organization of the Survey Team

Members	Title	Allocation of Responsibility
A. Takeshi Chino (Team Leader)	Manager, Polymer Industry Department UNICO International Corporation	General Management Market Survey
B. Masaaki Shiraishi (Assistant Team Leader)	Manager, Department of Regional Study UNICO International Corporation	Survey on Economic and Financial Conditions
C. Shinichi Yamaguchi	Team Manager, Technical Department Technology and Business Development Division Japan Gasoline Co., Ltd.	Survey on Petroleum Refinery and Revamping Plan
D. Koichi Shibao	Manager, Engineering Department UNICO International Corporation	Survey on Project Scheme and Related Industries
E. Tadahiro Yoshida	Project Engineer UNICO International Corporation	Survey on Off-site and Utility Facilities
F. Shozo Nakamura	Project Engineer UNICO International Corporation	Survey on Construction Cost Estimation and Raw Materials
G. Masayasu Miyabayashi	Chief, Petrochemicals Section Basic Chemicals Products Division Ministry of International Trade and Industry	General Coordination

ON-SITE SURVEY RECORD

Date (1975)			Route of Trip A	B	C	D	E	F	G	Visits	Visitor
Feb.	25	Tues.	T/M	T/M	T/M		T/M	T/M			
	26	Wed.	M	M	M		M	M		2,17	A B C E F
	27	Thurs.	M	$M_{(Ca)}$	$M_{(Ca)}$		$M_{(Ca)}$	$M_{(Ca)}$		13	B C E F
										50	A
	28	Fri.	M	$M_{(Ca)}$	$M_{(Ca)}$		$M_{(Ca)}$	$M_{(Ca)}$		13	B C E F
										50	A
Mar.	1	Sat.	M	M	M		M	M		(Inside Work)	
	2	Sun.	M	M	M		M	M		"	
	3	Mon.	M	M	M	T/M	M	M		2	A B C D E F
	4	Tues.	$M_{(Ca)}$	M	$M_{(Ca)}$	$M_{(Ca)}$	$M_{(Ca)}$	$M_{(Ca)}$		13	C D E F
										20	A
										2,4,6	B
	5	Wed.	M	$M_{(Ca)}$	$M_{(Ca)}$	M	M	$M_{(Ca)}$		13	B C F
										30,31,32,33,34	A
										7,51	E
										21,23	D
	6	Thurs.	M	M	M	M	$M_{(Ca)}$	$M_{(Ca)}$	T/M	35,36,37,38	A
										1,2	B C D
										13,20,25	E F
	7	Fri.	M	M	$M_{(Ca)}$	M	M	M	$M_{(Ca)}$	36,37,39,48	A
										21	B D

Date (1975)		Route of Trip A	B	C	D	E	F	G	Visits	Visitor
Mar.	7 Fri.								11,49	E F
									13	C G
									26	D
									2	B
	8 Sat.	M	M	M	M	M	M	M	(Inside Work)	
	9 Sun.	M	M	M	M	M	M	M	"	
	10 Mon.	M	M	M	M	$M_{(B)}$	$M_{(B)}$	M	21,52	A
									2,3	B G
									16,53	D
									12,14	E F
									58	A B C D E F G
	11 Tues.	M	M	M/T	M	M/T	M	M	40,41	A G
									1,2	B D
									27	D
									54	F
	12 Wed.	M	M		M		M	M	1,3	A
									4,6,10	B G
									8,9	F
									28,29	D
	13 Thurs.	M	M		M		M	M	17,18	A G
									5,55	B
									21	A D G
									(Report Compilation)	F

Date (1975)			Route of Trip A	B	C	D	E	F	G	Visits	Visitor
Mar.	14	Fri.	M/Ce	M	M/I			M/T	M/Ce	42,43,44	A G
										15,22	D
										1,2	B
	15	Sat.	Ce	M		I/Ce			Ce	45,46,47	A G
										56	D
										(Report Compilation)	B
	16	Sun.	Ce/M	M		Ce/M			Ce/M	"	B
	17	Mon.	M/T	M		M			M	17,18	A
										1,2,50	A G
										55	B
										(Report Compilation)	D
	18	Tues.		M		M			M	57	B D G
	19	Wed.		M		M			M	2,17,18	B D G
	20	Thurs.		M/T		M/T			M/T		

Survey Members:

A - Mr. Takeshi Chino
B - Mr. Masaaki Shiraishi
C - Mr. Shinichi Yamaguchi
D - Mr. Koichi Shibao
E - Mr. Tadahiro Yoshida
F - Mr. Shozo Nakamura
G - Mr. Masayasu Miyabayashi

Itinerary:

T - Tokyo
M - Metropolitan Manila
Ca - Cavite
B - Bataan
Ce - Cebu
I - Iligan

Others:

/ - denotes transfer of location
( ) - denotes round-trip within one day

Please refer to the List of Visits in accordance with the numbers given in the above Table.

List of Visits

Ref. No.	Name of Party	Location
A	The Philippines Government Concerned	
1	Board of Investments (BOI)	Metropolitan Manila
2	Philippine National Oil Company (PNOC)	"
3	National Economic Development Authority (NEDA)	"
4	Department of Agriculture	"
5	Development Bank of the Philippines (DBP)	"
6	Fertilizer Industries Authority (FIA)	"
7	Weather Bureau	"
8	Bureau of Geology	"
9	Bureau of Water Resources	"
10	Bureau of Agricultural Economic Statistics	"
11	National Air and Water Pollution Control Commission	"
12	National Power Corporation	"
13	Filoil Refinery Corporation (FRC)	M. Manila (Cavite)
14	Bataan Refining Corporation (BRC)	Bataan
15	Maria Cristina Hydropower Station (NPC)	Iligan
16	Philippine Textile Research	Metropolitan Manila
B	The Japanese Government Concerned	
17	Embassy of Japan	Metropolitan Manila
18	Japan International Cooperation Agency (JICA)	"
C_1	Private Firm (Chemical Industry)	
19	Philippine Polystyrene Products, Inc. (Office)	Metropolitan Manila
20	Philippine Polystyrene Products, Inc. (Factory)	M. Manila (Cavite)
21	Mabuhay Vinyl Corporation (Office)	Metropolitan Manila
22	Mabuhay Vinyl Corporation (Factory)	Iligan
23	Resins, Incorporated	Metropolitan Manila

Ref. No.	Name of Party	Location
24	Philippine Vinyl Consortium, Inc. (Office)	Metropolitan Manila
25	Philippine Vinyl Consortium, Inc. (Factory)	M. Manila (Cavite)
26	International Chemical Industries Inc. (INCHEM)	Metropolitan Manila
27	Chemical Industries of the Philippines, Inc.	"
28	Philippine Synthetic Products, Inc.	"
29	SC Johnson & Sons, Inc.	"
C_2	Private Firm (Plastic Processor)	
30	Cygnus Industries, Inc.	Metropolitan Manila
31	Polycon Manufacturing Corporation	"
32	Manila Plastic Products	"
33	Arrow Plastic Industries Corporation	"
34	Pentagon Packaging Corporation	"
35	Itemcop	"
36	Formtex Manufacturing Corporation	"
37	Producers Packaging Corporation	"
38	General Bag & Container Corporation	"
39	Philippine Manufacturing Industries	"
40	Rubber World (Phils.) Inc.	"
41	Freeman, Incorporated	"
42	Stanley Plastic Products Co., Inc.	Cebu
43	Cebu Styropor Corporation	"
44	New Oriental Printing Press	"
45	Solid Plas Manufacturing, Inc.	"
46	Cebu Plastic Industries, Inc.	"
47	ABE Industries	"
48	Plastimer Industrial Corporation	Metropolitan Manila
C_3	Private Firm (Others)	
49	Manila Electric Company (MERALCO)	Metropolitan Manila
50	Transworld Trading Co., Inc.	"
51	Allied Technical & Management Corp.	"
52	Mitsui & Co., Ltd. (Manila Branch)	"

Ref. No.	Name of Party	Location
53	Mitsubishi Corporation (Manila Branch)	Metropolitan Manila
54	Engineering Equipment, Inc.	"
55	Konsulta Philippines, Incorporated	"
56	Cebu Oxygen and Acetylene Co.	Cebu
57	Asian Development Bank (ADB)	Metropolitan Manila
58	Hyatt Hotel	"

Note: Metropolitan Manila consists of 27 cities and municipalities including the original eight of Manila and Suburbs (i.e., Manila City, Quezon City, Caloocan City, Pasay City, San Juan, Makati, Mandaluyong and Navotas) and additional areas such as Malabon, Pasig, Pateros, Cavite, etc.

FOREWORD:

1. Background

(1) Since the decade of 1960s, the Government of the Philippines and the private sector enterprises of the country have continually been contemplating the establishment of the integrated petrochemical industry. A number of study reports, or outlines of feasibility studies have been compiled by the governmental agencies of the Philippines, by international organizations, or by private enterprises.

These reports unanimously conclude that the forecast size of the market of the country during the last half of the 1970s for petrochemical industrial products will be sufficiently large to justify the establishment of a petrochemical complex of a commercial size within the Philippines.

(2) On the other hand, a great confusion took place in the economy of most of the countries in the world since the "oil crisis" in 1973. Consequently, global recession became apparent. The increase in the oil price which triggered the confusion immediately gave a serious blow to all the industrial sectors in which oil is used as a feedstock.

As a result, a chain reaction took place which started with the raw material price increase. The consequential production cost increase boosted the product prices, and naturally caused a drastic fall in the demand. The decline in the demand increased the amount of inventories which directly caused the lowering of operational rates of production facilities. As a result the economic environment of the petrochemical industry has completely changed within the past few years.

This being the circumstance, it became imperative that the petrochemical industrialization projects of the Philippines be reviewed in accordance with the new economical environment, as all the survey reports and the project plans which have thus far been submitted to the authorities had covered the situation prevailing before the advent of the oil crisis.

(3) The general background of the petrochemical industrialization in the Philippines is as follows:

a. No commercial production of oil or natural gas has been undertaken in the Philippines so far. Therefore, all the petroleum products for domestic consumption have been produced on the basis of imported crude oil.

b. The country presently has four petroleum refineries, thereby having potential ability to supply the feedstocks for domestic petrochemical industry.

c. Among the Southeast Asian countries, the potential market for petrochemical industrial products in the Philippines is comparatively large, and the feasibility of materializing the establishment of petrochemical industry is high.

d. The Government of the Philippines is interested in the development of the petrochemical industry inside the country for economical and political reasons. The authorities have therefore registered the production of various petrochemical derivatives as the promoted industry.

From this viewpoint, a vast extent of favorable effects are expected of the establishment of the petrochemical industry in this country.

The expectation chiefly centers on the possible boost to be given to the industrial sectors of the Philippines which are related to the petrochemical industry, and the stable supply of plastics raw materials will not only contribute to the stabilization of the various prices, but also will support further development of the plastics industry of the country. This will certainly contribute to the saving of the foreign exchange, to the improvement of general domestic production activities, and to the absorption and reinforcement of modern technology.

(4) On the basis of such a background, the Government of the Philippines requested to the Government of Japan that the latter extend technical cooperation in the form of conducting pre-feasibility studies on the petrochemical industrial development in the Philippines.

In response to the request, the Japanese authorities appointed UNICO International Corporation, a Japanese industrial consultants.

(5) On 1st, February, 1975, a survey team was organized by UNICO. As an associate member of the team, the Japan Gasoline Co., Ltd. took part in the studies to undertake relative surveys on the petroleum refining facilities which are the sources of raw material supply to the envisaged petrochemical industry.

On 25th, February of the same year, the field survey team of UNICO, led by Mr. T. Chino, was sent to the Philippines to discuss the details of the surveys with the governmental authorities of the Philippines, and to undertake the field surveys.

(6) As the basic policy for the survey, the studies were divided into two phases, namely, the Orientation Study, and the Pre-feasibility Study.

The Orientation Study centered on the examination of the overall feasibility of the petrochemical industrialization in the Philippines including olefins, aromatics, and chemical fertilizers, and the establishment of the policies for the subsequent studies.

The Pre-feasibility Study, on the other hand, chiefly involved the formulation of a preliminary plan for the establishment on an olefin complex with economic viability evaluations, on the basis of the basic policies and the field survey data obtained through the Orientation Study. The report on the Orientation Study was submitted to the Government of the Philippines by the Japanese Government in April, 1975.

2. Objectives of the Study

(1) The major objective of this study is to evaluate the economic viability of the establishment of a petrochemical complex for the production of olefinic resins (LDPE, HDPE, VCM, and PP) in the Philippines.

(2) For the attainment of this objective, the following points were examined:

a. Availability and the methods of raw material supply

b. Methods of raw material supply and allocation to various petrochemical industrial sectors

c. Analyses of market structure and market forecasts (price and demand)

d. Comparative studies of the domestic products and the products in the international market

e. Studies on the optimum scale of the envisaged petrochemical complex

f. Establishment of conceptual form of the envisaged petrochemical complex

g. Analyses and evaluation of the economic and financial viability of the envisaged petrochemical complex

h. Problems in the implementation of the envisaged petrochemical complex and the recommendation for the solution of the problems

(3) Further, in addition to the economic and financial viability evaluation of the olefin complex which is the major subject of the study, and overall survey was also undertaken regarding the major related petrochemical industries, i.e., the establishment of an aromatics complex and the chemical fertilizer

industry. The basic policies for the development of these industries were also formulated by the study.

3. Composition of the Survey Reports:

As stated in above 1-(6), the findings of the two-phase studies have been separately compiled in the following reports. These two reports together shall therefore constitute the documentation of the subject survey:

a. ORIENTATION STUDY REPORT FOR THE DEVELOPMENT OF PETROCHEMICAL INDUSTRY IN THE PHILIPPINES

   Dated : March 31st, 1975

b. PRE-FEASIBILITY STUDY REPORT FOR THE DEVELOPMENT OF PETROCHEMICAL INDUSTRY IN THE PHILIPPINES

In view of the major objectives of the study, the latter of the above two volumes of reports shall be the main report in which the items encompassing both volumes are included.

PART I

RESULT OF OLEFIN COMPLEX STUDY

PART I

RESULT OF OLEFIN COMPLEX STUDY

CONTENTS

CHAPTER 1. SUMMARY OF THE STUDY

1. Summary of the Study

1-1 Major Prerequisite Conditions for the Survey

Followings are the major prerequisite conditions established as assumptions for this study. The detailed prerequisite conditions for each item of survey are respectively stipulated in this report.

(1) This project shall be nominated as a pioneer industry by the BOI in accordance with the Investment Incentive Act (Republic Act 5186 as amended by P.D. No.92). Therefore, this project shall receive all the benefits provided by the Act.

(2) The plant site shall be selected at the land premises adjacent to the Cavite Refinery of Filoil in Rosario, Cavite.

(3) The objectives of this project is to construct an olefin complex from which the following products will be turned out:

Low density polyethylene (LDPE)
High density polyethylene (HDPE)
Vinyl chloride monomer (VCM)
Polypropylene (PP)

Further, caustic soda will be by-produced from the electrolysis plant from which chlorine is supplied to VCM production.

(4) All the prices have been based on the prevailing price level during the last half of 1974, or first half of 1975.

The escalation rate of international inflation is set at 7%/y for the purpose of estimation. Also, regarding the establishment of the future prices, the estimated prices for 1980 was used as fixed values. As and when necessary, the domestic inflation escalation rate inside the Philippines has been set at 10%/y.

(5) All the prices are expressed in terms of the United States currency, and the currency of the Philippines was converted into the United States currency by applying an exchange rate which has been obtained through modification geared to the difference between the rate of progress of the international inflation and the inflation inside the Philippines.

(6) The method of project evaluation was those usually employed by the BOI unless otherwise specified.

(7) The project schedule assumes the commencement of project implementation in early 1976, and commencement of commercial operation in the mid-1979.

1-2 Market

1-2-1 Features of the Market

The past records of the marketing of olefinic plastics products in the Philippines are featured by the following points:

(1) The plastics market in the Philippines is presently on a developing stage.

The market showed a considerable extent of demand fall from 1973 to 1974. Nevertheless, the overall picture of the past trend displays a steady development. In comparison with the situation prevailing in Japan and Korea, the plastics materials marketing in the Philippines shows the following characteristics;

Low price elasticity
High GDP elasticity

The average elasticity figures in this respect in the Philippines from 1968 to 1974 can be summarized as follows:

	Price Elasticity	GDP Elasticity
PE	0.68	1.89
PP	1.16	3.15
PS	1.15	1.50
PVC	0.35	1.82

(2) Resin-wise demand structure of plastics:

The following figures show the resin-wise demand structure of plastics commodities in 1972 in the Philippines when the demand structure is deemed to have shown a normal status.

	(%)
PE	50.5
PP	27.9
PS	5.4
PVC	16.2
Total	100.0

It is clear that the demand rates for polyolefins such as PE and PP are extremely high when compared with Japan, the U.S.A., West Germany, etc. in which plastics demand is extremely high.

(3) Application-wise demand structure of plastics:

a) LDPE

Of the total demand for LDPE, 65% is used as wrapping film, and 20% in the form of injection molded products.

b) HDPE

Mono-filament application takes up 60% and 27% in the form of injection molded products.

c) PP

Woven bag utilization occupies 45%, and 20% each in the form of film and in the form of injection molded products.

d) PS

Unlike the other types of plastics, the demand structure for PS in the Philippines is similar to that of Japan.

e) PVC

Approximately 80% of the total production is made in the form of soft products.

The demand structure of plastics in the Philippines still show concentration on certain products. Along with the progress in the diversification in the fields of application, the demand for plastics in the Philippines will further expand.

(4) Consumption distribution of plastics materials and products:

a) Plastics material consumption:

Approximately 95% of the total consumption is concentrated in the Manila district.

b) Plastics product consumption:

Luzon : 50%
Visayas : 30%
Mindanao : 20%

1-2-2 Demand Forecast

(1) Medium-range demand forecast:

The estimated demand for 1979 obtained on the basis of the macroscopic demand structure formulated by the elasticity analysis of the actual demand records may be summarized as follows:

		(t/y)
PE	54,400 - 79,600	
PP	39,100 - 45,900	
PVC	21,400 - 31,000	

(2) Long-range demand forecast:

The demand figures calculated regarding the trend from 1980 onwards by assuming the elasticity figures are as shown below:

	Normal Demand				Optimistic Demand			
	Elasticity		Demand (1,000 t)		Elasticity		Demand (1,000 t)	
	Price	GDP	1980*	1985*	Price	GDP	1980*	1985*
LDPE	1.05	2.10	54.2	106.7	1.50	2.00	76.4	150.3
HDPE	1.20	2.20	26.8	52.8	1.50	2.00	37.8	74.4
PP	0.90	1.80	51.9	98.0	1.50	2.00	61.2	120.4
PVC	0.73	1.79	30.6	56.1	1.50	1.50	35.5	58.9

Note: * Forecasted demand from July to June in next year

1-2-3 Fostering of Plastics Market

(1) Dispersion of plastics molding/processing industrial activities into local cities:

In order to achieve the reduction in the distribution cost and the extension of plastics products, it is desirable that the plastics processing industry be dispersed in various local cities. For this purpose, it seems necessary that following policies be implemented;

a) Formation of industrial complexes:

Especially steady supply of utilities should be the main objective.

b) Establishment of local industrial training centers:

The objectives of these institutes are the facilitation of industry dispersion and promotion of market development.

(2) Establishment of National Polymer Research Institute and Industrial Training Center:

a) Formulation of standards for plastics raw materials and products

b) Improvement and development of design of the products

c) Training

d) Management training

e) Research and development for polymer synthesis and evaluation

f) Collection and distribution of information

(3) Financial policies for the forthtrain of plastics molding processing, molding machinery, and mold manufacturing industries.

1-3 Raw Materials, Utilities, and By-products

1-3-1 Raw Material Supply Sources

If the Cavite Refinery of Filoil is assumed to be the supply source of the raw materials for the olefin complex, the limitation on the ethylene production will be at 160,000 t/y in view of the existing refinery capacity (30,000 BPSD) on an assumption that the utilized raw materilas are up to the light gasoil fraction. If any revamping is conducted to the existing refinery facilities, the possibility of the capacity enhancement will be up to 57,000 BPSD, with which approximately 300,000 t/y of ethylene production will become possible.

On the other hand, as the result of the survey made for the selection of the optimum scale for the complex on the basis of the estimated size of the market in the future, the optimum ethylene plant scale is found to be less than 300,000 t/y. Therefore, the raw material supply capacity of the revamped Filoil Refinery will be sufficient to cover the olefin complex requirements.

If the ethylene plant scale is set at 200,000 t/y, the required capacity of the refinery will in turn be 38,000 BPSD. In this event, the cost of revamping the refinery will be as follows:

a) With direct desulfurization : US$57,610,000

b) With indirect desulfurization : US$40,320,000

1-3-2 Raw Material Prices

Exemption of various taxes and levies on the crude oil is assumed for calculateing the raw material prices on the basis of the refinery net-back. The obtained results are as shown below. It should be noted that the price figures mentioned below are the estimated prices in 1980 with the inflation escalation factor taken into account.

Naphtha :	US$157.20/t
Kerosene:	US$144.60/t
Gas Oil:	US$147.70/t

1-3-3 Evaluation of the By-products

(1) The evaluation of the excess hydrocarbon fraction by-produced from the ethylene plant was conducted totally on the basis of fuel evaluation except for the cracked gasoline which can be used for gasoline blend. The signifies that the economic viability of the ethylene plant is viewed from the safer side.

(2) Regarding the caustic soda by-produced from the electrolysis of salt is considered to be evaluated at the present price range (US$400 to US$500/t) in view of an abnormally high level of the market price of caustic soda in the Philippines. Therefore, no escalation should be taken into account in evaluating the price of caustic soda.

1-3-4 Supply and Prices of Utilities

(1) Except electrical power, all the utilities shall be supplied from a utility center to be constructed inside the complex.

(2) It was estimated that in-plant electrical power generation will be uneconomical. Therefore, external purchase of the power is taken as the basis, and purchase price was estimated with an escalation from the present level in order to be conservative in this respect.

(3) The fuel shall be the by-products from the ethylene plant, as well as the fuel oil to be supplied from the refinery.

(4) No sufficient data and information have been made available to warrant complete dependence upon well water regarding

supply of industrial water. Therefore, utilization of sea water is contemplated. However, the sea water intake cost is high, and the effects of the water cost upon the ethylene price is rather significant.

(5) Regarding the price of utilities to be supplied from the utility center, the price levels were set by calculating on condition that the profit rate of the utility center shall be on a fixed level.

1-4 Selection of Project Scheme

In order to discover a guide-line for establishing a petrochemical industry centering on an olefin complex in the Philippines, scrutinizations were carried out to confirm an optimum complex scheme. Further, studies were made regarding the prerequisite conditions for the selection of the scheme, and the effects of variable factors on the profitability of the project in order to examine the possibility of petrochemical industrialization.

(1) The major problems regarding the above-mentioned product selection, process route finalization and site selection are boiled down to the comparison among the following three cases pertaining to the supply of VCM:

a) Establishment of a VCM plant inside the complex

b) Production of VCM on the basis of carbide process acetylene by utilizing low-cost hydro-electric power generated in the Iligan district.

c) Importation of VCM and EDC

If the electrical power cost is less than US¢1/KWH or less, the case (b) above becomes feasible. Regarding the case (c), it is possible for the domestically proruced VCM to have competitiveness by means of producing the electrical power cost, rationalization in by-product prices and production facilities in accordance with the actual situation of the Philippines to reduce the production cost. However, the existence of chlorine delivertives does not affects the economy of the entire complex. Therefore, the study in this respect was undertaken by employing the case a).

(2) For evaluating the economy of the complex, the material and utility balance and the construction cost figures were calculated regarding individual plants within the complex, as well as regarding the entire complex. On the basis of obtained data, the investment requirements and the profitability (the present value of the project, DCFM-IRR) were calculated by utilizing a computer model. This model combines the price-GDP-elasticity models, and estimates the domestic demand in accordance with the pre-designated price trend and GDP growth rate.

(3) The criterion for selecting an economically optimum complex scheme is to attain the maximum present value of the project which has been discounted by the standard profit rate (cut off rate) at 15%. The following conclusions were obtained

as a result of the study:

a) In view of neutral domestic demand forecast, an ethylene complex of 150,000 t/y capacity is economically optimum (case 2 of the following).

Complex Schemes

(Unit: t/y)

Plant \ Case	Base Case (Representative Scheme) Case 1	Optimum on the Neutral Market View Point Case 2
LDPE	110,000	90,000
HDPE	60,000	40,000
PP	90,000	72,500
VCM	55,000	40,000
Electrolysis	32,600(as Cl_2)	23,700(as Cl_2)
Ethylene	203,000	154,300

b) A high extent of aptitude of the Philippines in adapting itself to petrochemical industrialization is evidently shown by the country's highest growth rate of plastics resin demand in South East Asia before the oil crisis. A preliminary calculation on the basis of optimistic demand forecast shows that complex with 300,000 t/y capacity is the optimum scheme. Further, it is desirable to bring the scale of the complex as close to the international standard as practicable; however such an upward expansion should be made within the limitation of the allowable range of the economic viability. Also, as will be mentioned in the following c), it seems worth studying the conditions which will make the complex economically viable, such as the time of construction of the plant, etc.

In view of the above consideration, it seems advisable to project the construction of a complex of approximately 200,000 t/y production capacity as shown in Case 1 above.

c) In view of the economic viability of project, the important prerequisite condisions are the assessment of the adequacy of the time to start operation, the trend of economic growth and inflation progress, the future direction of the market development, etc. Therefore, it seems to be necessary to start studying the establishment of necessary conditions to enable the construction of complex after founding an optimum scale. In practice, the following considerations should be properly exercised:

(a) Establishment of a strategy for market development for plastics products and other final petrochemical industrial products.

(b) Adjustment of the time for imprementation of the project in line with the position and the status of the national economy of the Philippines

1-5 Outline of the Complex Project

The outline of the olefin complex project established on the basis of the foregoing studies is as follows:

1-5-1 Structure, Business Activities, and Design/Production Capacity of the Complex

The complex shall consist of the following seven independent plants. The production capacity and the items of the products are as follows:

Name of plant	Products and Business	Design Production Capacity
A. Ethylene Plant	Olefin raw materials, supply of fuel	203,000 t/y (ethylene)
B. Utility center	Supply of utilities and common services	various
C. LDPE plant	Production and marketing of LDPE	110,000 t/y
D. HDPE plant	Production and marketing of HDPE	60,000 t/y
E. Electrolysis plant	Supply of Cl_2 for VCM plant, and production and marketing of *caustic soda	32,560 t/y (chlorine)
F. VCM plant	Production and marketing of VCM	55,000 t/y
G. PP plant	Production and marketing of PP	90,000 t/y

*Caustic soda: 36,960 t/y

The operational rates have been established as follows in accordance with respective design capacity:

1980	:	60%
1981	:	75%
1982	:	90%

1-5-2 Supply of Raw Materials

(1) The basic raw materials shall be supplied to the complex directly from the Filoil Refinery to the ethylene plant of the complex.

(2) The industrial salt for electrolysis plant shall be supplied by importation or from domestic sources.

1-5-3 Total Capital Requirements for Complex Construction

(Unit: US$1,000).

	Foreign Currency	Local Currency	Total
Construction Cost	433,433	106,272	539,705
Pre-operational Expenses	5,434	26,746	32,180
Interest during Construction	78,040	-	78,040
Guarantee Fee	-	26,030	26,030
Land (Reformed)	-	10,919	10,919
*Total Capital Investment	516,907	169,967	686,874
Working Capital	-	40,139	40,139
Total Capital Requirement	516,907	210,106	727,013

* 5% contingency is included in each item.

1-5-4 Finance Schedule for the Required Capital

Long Term Foreign Loan	US$480,810,000	(70%)
Paid-in Capital	US$206,064,000	(30%)
Short Term Local Loan	US$40,139,000	(Working Capital)
Total Capital Requirement	US$727,013,000	

1-5-5 Marketing Plans and Sales Price of the Products

The products turned out from the complex will be marketed on an ex-factory basis to the domestic market, the level of the consumption of which has been estimated by the market demand forecast. The excess products after fulfilling the domestic market will be allocated for exportation. The sales price figures are as follows:

(Unit: US$/t)

	Domestic Price	Export Price
LDPE	1,347.70	681.-
HDPE	1,347.70	773.-
VCM	691.70	-
Caustic Soda	417.-	-
PP	1,371.50	813.-

As a result of a long-range projection for the marketing schedule on the basis of the medium-range market projection, it is estimated that the total consumption of each product within the domestic market will be achieved in the years stipulated below:

LDPE	:	1986
HDPE	:	1987
VCM	:	(no exportation)
Caustic soda	:	(no exportation)
PP	:	1985

1-6 Financial Analysis and Economic Evaluation

The economic evaluation of the entire complex was conducted on the basis of individual financial analysis for each one of the independent constituent plants of the complex, and the following results were obtained:

1-6-1 Profitability Analysis

Profitability will be on a lower side up to the third year after the commencement of the operation. However, the profitability will start soundly increase from the fourth year onwards, and as a whole, the profitability will attain approximately the same level as the average profitability of typical Japanese petrochemical industrial companies. The internal rate of return (IRR) assessed by the DCF method was discovered to be 16% against the total capital requirement. This IRR exceeds the marginal rate of return which is estimated to be 12% to 13%. The results of break-even analysis also warrants an ample margin of safty.

1-6-2 Liquidity Analysis

The liquidity is on a lower side up to the fourth year after the commencement of the operation. However, no serious problem seems to be present in this respect as the liquidity is on a lower side up to the fourth after the commencement of the operation; however, no serious problem seems to the present in view of the number of days in account receivables.

1-6-3 Solvency Analysis

Due to the fact that in this study all the profit is deemed to be in reserve, it seems necessary to formulate a much more detailed financial shcedule. However, the solvency for debt is ample, thereby presenting as serious problem.

1-6-4 Overall Evaluation of the Economic Viability

As far as the subject schemes for this study are concerned, it is evaluated that the overall economic viability is ample. As the basis for the selection of the subject schemes and various conditions and materials used for the evaluation were set on the safer side, it is expected that much better results will be obtained through a re-evaluation of the economic viability with much higher accuracy on the basis of a more detailed examination. However, it should be noted that no comparative study has been conducted in relation to the other investment opportunities in the Philippines, and therefore further study in this respect is necessary.

1-6-5 Results of Other Analyses

(1) Foreign exchange balance:

Foreign exchange balance including the initial investment will yield a credit of more than US$500 million during a 10-year period of operation.

(2) Various economic indexes pertaining to national benefit:

Refer to Chapter 5, Part I regarding the various indexes based on the standard formula of the BOI.

CHAPTER 2. MARKET

CHAPTER 2. MARKET

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2. Market

2-1 Domestic Production and Marketing of Olefinic Plastics

Olefinic plastics now being produced in the Philippines are PVC and PS. There is only one PVC manufacturer in operation in the country, and the second plant is now under construction. There are two PS manufacturers in the Philippines.

(1) Mabuhay Vinyl Corporation

(a) Existing plant:

Production capacity:	PVC, 10,000 t/y
Location:	Iligan City
Raw Materials:	Carbide process acetylene supplied by Maria Cristina Chemical Co.

(b) New plant:

Production capacity:	PVC, 18,000 t/y (including copolymer 1,800 t/y)
Location:	Iligan City
Raw Materials:	Imported VCM

(2) Philippine Vinyl Consortium (under construction)

Production capacity:	PVC 20,000 t/y
Location:	Rosario, Cavite
Raw Materials:	Imported VCM

(3) Philippines Petrochemical Products, Inc. (PPPI)

Production capacity:	PS 7,700 t/y
Location:	Rosario, Cavite
Raw materials:	Imported styrene monomer

(4) Polystyrene Manufacturing Co., Inc.

Production capacity:	PS 5,000 t/y
Location:	Valenzuela, Bulacan
Raw materials:	Imported styrene monomer

Polystyrene Manufacturing Company, Inc. started commercial operation in Autumn, 1974, and the monthly sales output was 20 to 30 tons during mid-1975. The past records of sale of PVC and PS are as shown in Tables 2-1 and 2-2.

Table 2-1 Shipment of PVC Resin in the Philippines

		(Unit: tons)
1969		7,732
1970		7,119
1971		9,036
1972		9,849
1973		16,672 1)
1974	I	3,211
	II	2,991
	III	1,446
	IV	- (640) 1), 2)

Source: Mabuhay Vinyl Corp. Annual Report 1973
1974 Quarter Report of Operation

Note: 1) Including exports
2) Estimation

Table 2-2 Sales Amount of PS in the Philippines in 1974

	Total Shipment(ton)		Total Shipment(ton)
January	84	July	77
February	77	August	83
March	88	September	119
April	59	October	73
May	39	November	63
June	72	December	99

Total 930

Source: Trans World Trading Co.

Notes: 1)

General purpose	(GPS)	510 tons
High impact	(HPS)	231
Expandable	(EPS)	85
Others (off color, off grade)		104
Total		930

2) Average sales price in 1974 is 10.14 ₱/kg including EPS.

2-2 Foreign Trades of Plastics

According to the Trade Statistics of Plastics of the Philippines, the trends of imports and exports of plastics products have been as shown in Tables 2-3 and 2-4. The import amount shown in Table 2-3 kept increasing until 1973, and a vast drop was recorded during 1974. Also, the figures in the table illustrate that the amount of the plastics in the category of the "Others" has been increasing year after year. Therefore, this table is not necessarily sufficient to show the actual status of the product-wise categorization. Table 2-5 was therefore compiled by summarizing the amount figures of exports destined to the Philippines from Japan, the U.S.A., West Germany, and Hong Kong from which the Philippines imports large amounts of plastics.

Table 2-3 Import Statistics of Major Plastics in the Philippines

(Philippine Statistics)

(US$/ton)

	Polyethylene			Polystyrene			PVC**			Others***		
	Quantity (ton)	Unit price FOB	Unit price CIF	Quantity (ton)	Unit price FOB	Unit price CIF	Quantity (ton)	Unit Price FOB	Unit Price CIF	Quantity (ton)	Unit price FOB	Unit price CIF
1969	16,548	256	282	2,809	271	307	2,039	337	371	20,305	365	402
1970	15,968	277	299	3,396	265	290	3,371	325	357	29,954	342	370
1971	23,919	255	276	4,771	247	274	6,342	281	313	45,744	283	311
1972	25,850	237	-	5,045	247	-	9,057	279	-	39,245	293	-
1973	41,854	373	407	2,868	491	532	2,340	464	495	45,139	465	507
1974*	27,458	705	754	1,552	859	915	3,363	886	952	28,733	820	889

Source: Foreign Trade Statistics of the Philippines

Notes: * NEDA

** Total of resin and compound

*** Including polypropylene

Table 2-4 Exports of Plastic Materials from the Philippines

	599-01.03 Alkyds	599-01.05 Polystyrenes	599-01.06 Acrylics	599-01.07 Cellulosics, excluding vulcanized fiber	599-01.11 Vinyl plastics (excl."PVC")	599-01.16 Silicones	599-01.17 Commarone-Indene resins and plastics	599-01.29 Synthetic plastic materials in primary forms	599-01.31 Polyvinyl chloride resin in unfinished form(uncompounded)	599-01.32 Polyvinyl chloride resin in unfinished form(compound)
1969 Quantity	11,512	-	-	-	33,280-	-	362,682-	-	-	-
1969 FOB US$	5,357	-	-	-	36,819	-	90,763	-	-	-
1969 FOB Pesos	20,893	-	-	-	143,595	-	353,978	-	-	-
1969 CIF value (2)	5,649	-	-	-	38,490	-	101,131	-	-	-
1970 Quantity	-	-	-	-	2,508	-	412,202	-	-	-
1970 FOB US$	-	-	-	-	2,341	-	91,189	-	-	-
1970 FOB Pesos	-	-	-	-	9,130	-	563,036	-	-	-
1970 CIF value	-	-	-	-	2,472	-	99,733	-	-	-
1971 Quantity	-	-	-	20	19,012	-	1,852,943	-	-	-
1971 FOB US$	-	-	-	138	5,700	-	384,258	-	-	-
1971 FOB Pesos	-	-	-	868	36,014	-	2,363,231	-	-	-
1971 CIF value	-	-	-	158	6,080	-	410,410	-	-	-
1972 Quantity	-	-	33,419	-	13,866	-	3,086,289	13,866	-	-
1972 FOB US$	-	-	14,179	-	8,060	-	703,729	8,060	-	-
1972 FOB Pesos	-	-	93,021	-	54,636	-	4,729,010	54,636	-	-
1972 CIF value	-	-	-	-	-	-	-	-	-	-
1973 Quantity	212,979	57,000	-	404	541,832	73	3,545,762	362,091	3,903,700	405,000
1973 FOB US$	137,054	46,000	-	1,075	157,020	499	994,544	146,126	1,107,499	188,250
1973 FOB Pesos	-	-	-	-	-	-	-	-	-	-
1973 CIF value	141,811	46,960	-	1,084	167,969	502	1,062,055	151,957	1,169,707	195,525
1974 Quantity	449,346	1,559,543	763,352	-	-	-	180,515	236,544	114,000	55,000
1974 FOB US$	531,275	1,185,221	456,006	-	-	-	69,523	177,476	89,882	57,000
1974 CIF value	540,170	1,227,426	484,213	-	-	-	74,089	133,103	91,742	57,996

Source: Foreign Trade Statistics of the Philippines

Table 2-5 Import Statistics of Major Plastics in the Philippines
(Export Statistics of Foreign Countries)

(tons)

		1969	1970	1971	1972	1973
LDPE	Japan	14,813	14,806	20,848	18,394	19,697
	U.S.A.	1,431	825	1,658	3,226	6,694
	W.G.	467	1,492	2,073	207	645
	H.K.	0	23	1	13	984
	Total	16,711	17,146	24,580	21,840	28,020
HDPE	Japan*	3,847	6,529	9,933	9,213	11,381
	U.S.A.	409	492	328	825	797
	W.G.	**	**	**	2,380	3,991
	H.K.	96	0	23	23	21
	Total	4,352	7,021	10,284	12,441	16,190
PP	Japan	8,205	15,019	22,022	23,037	22,337
	U.S.A.	0	27	0	70	1,931
	W.G.	50	0	0	0	72
	H.K.	0	0	0	0	20
	Total	8,255	15,046	22,022	23,107	24,360
PS	Japan	2,032	3,149	3,579	4,780	1,566
	U.S.A.	1,039	764	1,204	972	1,729
	W.G.	529	468	628	679	998
	H.K.	78	279	191	336	413
	Total	3,678	4,660	5,602	6,767	4,706
PVC resin	Japan	240	539	638	758	430
	U.S.A.	78	216	112	64	128
	W.G.	715	814	1,103	1,200	741
	H.K.	74	18	23	0	32
	Total	1,107	1,587	1,876	2,022	1,331
PVC compound	Japan	713	583	1,141	1,558	1,629
	U.S.A.	967	760	243	304	579
	W.G.	30	64	0	0	0
	H.K.	0	0	2	1	7
	Total	1,710	1,047	1,386	1,863	2,215

Source: Foreign Trade Statistics of Japan, U.S.A., West Germany and Hong Kong
Notes: * According to the information of Japan Trade Firm
** HDPE is included in LDPE

2-3 Prices of Olefinic Plastics

2-3-1 Ex-factory Prices of Domestically Produced Products

(1) PVC:

The domestically produced product prices on an ex-factory basis of PVC are as follows:

1973	May	2.350 ₱/kg
	June	2.550
	July	2.600
	Aug.	3.850
1974	Jan.	4.575
	April	5.125
	June	6.325
	July	6.400
	Sept.	5.800
1975	Jan.	5.600

Source : Mabuhay Vinyl Corp.

The above-stipulated price figures are the typical examples of manufacturer's ex-factory prices of PVC resins, and therefore do not represent the average price level.

(2) PS:

The type-wise ex-factory prices of PS are shown in Table 2-6. When compared to the price levels privailing during the first half of 1974, the level is presently showing a downtrend.

Table 2-6 Sales Prices of PS in the Philippines (Unit: ₱/lb)

	GPS	HPS	EPS
January	4.70	5.80	11.0
February	4.70	5.80	11.0
March	4.70	5.55	11.0
April	4.65	5.55	11.0
May	4.65	5.55	11.0
June	4.65	5.55	11.0
July	4.35	5.55	11.0
August	4.35	5.55	11.0
September	4.35	5.55	11.0
October	3.70	4.65	11.0
November	3.00	4.00	11.0
December	3.00	4.00	11.0

Source: Trans World Trading Co.

Note: Average sales price in 1974 is 10.14 ₱/kg including EPS.

2-3-2 Prices of Imported Plastics

Table 2-7 shows the past trend of the major imported plastics items in value. As in the case of Table 2-5, these statistical figures represent a summary of the statistics collected by the exporting countries. Table 2-11 shows the FOB prices of the plastics in terms of per-ton-unit on the basis of the data shown in Tables 2-5 and 2-7.

In order to prepare the above-mentioned unit prices of the imported plastics and the ex-factory prices of the domestic products, it is necessary to convert the FOB prices in Table 2-11 into the landed price. The conversion shall be conducted as follows:

$$(\text{landed price}) = \left\{(\text{FOB Price}) + (\text{ocean freight and insurance})\right\} \times (\text{import exchange rate})$$

Table 2-7 Import Amount of Major Plastics in the Philippines Evaluated by U.S. Dollar

(US$ at FOB price)

		1969	1970	1971	1972	1973
PE	Japan	4,947,673	5,752,913	7,323,360	6,642,347	10,586,197
	U.S.A.	610,139	450,935	730,794	990,958	3,316,000
	W.G.	157,453	368,219	537,771	547,500	1,415,556
	H.K.	35,543	6,055	5,645	12,106	362,718
	Total	5,750,808	6,578,122	8,597,570	8,192,911	15,680,471
PP	Japan	2,505,570	4,366,008	5,239,525	5,531,711	8,593,014
	U.S.A.	0	13,901	0	40,436	1,128,231
	W.G.	17,615	0	0	0	34,074
	H.K.	0	0	0	0	14,876
	Total	2,523,185	4,379,909	5,239,525	5,572,147	9,770,195
PS	Japan	456,601	732,296	803,011	1,119,711	677,704
	U.S.A.	292,870	214,826	403,536	274,523	796,160
	W.G.	265,854	211,233	283,901	285,313	532,593
	H.K.	26,347	101,868	60,680	101,282	250,988
	Total	1,041,672	1,260,223	1,551,128	1,780,829	2,257,445
PVC resin	Japan	73,707	146,475	176,028	209,870	207,201
	U.S.A.	93,743	121,591	95,903	59,871	103,099
	W.G.	222,764	245,753	359,752	358,438	251,481
	H.K.	30,529	12,120	9,000	0	12,177
	Total	420,743	525,939	640,683	628,179	573,958

Source: The same as Table 2-5

Table 2-8 shows the exchange rates to be used for converting the FOB prices expressed in various currencies into U.S. Dollar. Table 2-9 shows the product-wise import duty rates and the import exchange rates computed on the basis of the import duty rates. Regarding the ocean freight and insurance, an annual gross average was calculated by checking the defference between CIF prices and FOB prices based on the statistics of the Philippines shown in Table 2-3. The obtained results are shown in Table 2-10. Table 2-11 shows the gross average FOB prices of various countries, CIF prices obtained above, and the landed prices of various types of plastics resins.

Table 2-8 Exchange Rate

(National currency/US$)

	Philippines	Japan	Germany, F.R.	Hong Kong[3]
	Peso	Yen	D. Mark	H.K.$
1969	6.48[1]	358	3.69	5.78
1970	6.48	358	3.65	5.78
1971	6.48	358	3.23	5.78
1972	6.73	308[2]	3.20	5.65
1973	6.78	294[2]	2.70	5.09

Source: U.N. Monthly Bulletin of Statistics

Notes: 1) Actually, at the end of 1969, exchange rate of peso per US$ was 3.93. For convenience of further calculation, 6.48 peso/US$ was assumed.

2) Average value of exchange rate in the beginning and at the end of the year

3) Annual Review of Asian Countries

Table 2-9 Import Tax and Import Exchange Rate

(1) Import tax

	PE, PP, PS	PVC
		(%)
1969	20	50
1970	20	50
1971	30	50
1972	30	50
1973	30	50

Source: Trans World Trading

(2) Import exchange rate*

	PE, PP, PS	PVC
		(Peso/US$)
1969	9.2	11.4
1970	9.2	11.4
1971	10.0	11.4
1972	10.3	11.9
1973	10.4	11.9

Note: *Exchange rate for the calculation of landed cost in peso from CIF price in U.S. dollar

Table 2-10 Average Freight Charge and Insurance for Imported Plastic Materials

(US$/ton)

	1969	1970	1971	1972	1973	1974
Polyethylene	26	21	22	-	34	48
Polystyrene	36	25	27	-	41	56
PVC	35	32	32	-	31	69
Others	37	28	27	-	42	67
Average*	33	26	26	-	38	60

Source: Table 2-3

Note: * Weight average by means of average imported quantity for 1969 - 1974 by kinds of materials; PE 0.37, PS 0.05, PVC 0.07 and others 0.51.

Table 2-11 Average Landed Price of Major Plastics in the Philippines

	PE			PP			PS			PVC		
	FOB (US$/ton)	CIF* (US$/ton)	L.P.** (P/kg)	FOB (US$/ton)	CIF* (US$/ton)	L.P.** (P/kg)	FOB (US$/ton)	CIF* (US$/ton)	L.P.** (P/kg)	FOB (US$/ton)	CIF* (US$/ton)	L.P.** (P/kg)
1969	273	306	2.815	306	339	3.119	283	316	2.907	380	413	4.708
1970	272	298	2.742	291	317	2.916	270	296	2.723	331	357	4.070
1971	247	273	2.730	238	264	2.640	277	303	3.030	342	368	4.195
1972***	239	265	2.730	241	267	2.750	263	289	2.977	311	337	4.010
1973	355	393	4.087	401	439	4.566	480	518	5.387	431	469	5.581

Source: Tables 2-5, 2-7, 2-8, 2-9, and 2-10

Notes: * CIF price is obtained by adding freight charge and insurance on FOB price in the Table 2-10

** Landed price is derived from the import exhange rate in the Table 2-9 (2)

*** Freight charge and insurance cost is assumed as the same as in 1971.

2-3-3 Average Ex-factory Prices of Plastics in the Philippines

No actual production of PS was carried out in the Philippines until the end of 1973. The import price (landed price) of the PS can be deemed as the domestic price as in the case of PE and PP which are totally imported at present. As far as PVC is concerned, it is necessary to calculate the average of the domestic price and import price. Table 2-12 shows the average domestic price of PVC resins. These average prices have been calculated by means of weight average by quantities.

Table 2-12 Average Selling Price of PVC Resin in the Philippines

	Average landed price of imported PVC resin (Peso/kg)	Imported PVC resin* (ton)	Selling price of domestic product** (Peso/kg)	Sales quantity of domestic PVC* (ton)	Average selling price (Peso/kg)
1969	4.708	1,962	1.40***	7,346	2.097
1970	4.070	2 291	1.40	6 763	2.076
1971	4.195	2 569	1.89	8 584	2.421
1972	4.010	2 954	2.05	9 343	2.521
1973	5.581	2 439	2.84	15 838	3.206

Source: Tables 2-6 and 2-11

Notes: * Interms of resin consumption

** By courtesy of Mabuhay Vinyl Corporation

*** Assumption

2-4 Demand Structure of Olefinic Plastics

2-4-1 Type-wise Demand Structure

(1) Demand for PVC:

PVC in the Philippines consists of the PVC resin and PVC compounds regarding both domestic and imported products. The latter is blended with plasticizers, stabilizers, etc., and is prepared ready for immediate molding , while the users or compound makers blend the necessary additives to the former.

The PVC compounds manufactured by Mabuhay Vinyl Corporation has been deemed to occupy 10% of the total PVC produced by this company, and an assumption is further made that PVC resin is contained in the compounds of both domestically produced and imported, by the extent of 50%. On the basis of these assumptions, the demand extent of PVC resins inside the Philippines have been estimated as shown in Table 2-13.

Table 2-13 Apparent Consumption of PVC

(tons)

	Imports		Shipment of domestic produced PVC*		Total consumption				
							As resin***		
	Resin	Compound	Resin	Compound**	Resin	Compound	Imports	Domestic	Total
1969	1,107	1,710	6,959	773	8,066	2,483	1,962	7,346	9,308
1970	1,567	1,407	6,407	712	7,994	2,119	2,291	6,763	9,054
1971	1,876	1,386	8,132	904	10,008	2,290	2,569	8,584	11,153
1972	2,022	1,863	8,864	985	10,886	2,821	2,954	9,343	12,297
1973	1,331	2,215	15,005	1,667	16,336	3,882	2,439	15,838	18,277

Source: Tables 2-1 and 2-5

Notes: * Mabuhay Vinyl Corporation Annual Report 1973

** Shipment of compound is assumed as 10% of the total sales by Mabuhay Vinyl Corp.

*** Resin content in PVC compound is assumed as 50%.

(2) Type-wise demand structure:

Table 2-14 shows the trend of the demand for major four types of plastics, i.e., PE, PP, PS, and PVC.

Table 2-15 shows a comparison of the demand rates of these four types of plastics with those in Japan, Korea, the U.S.A. , and West Germany. Although the year for the statistics is 1972 except West Germany in the case of which the statistics of 1970 was adopted here because of the stipulation of the PS statistics of the country. For the countries except for the Philippines and Korea, the described figures are the production rate.

The demand rate of PE is highly analogous in all the countries; however, the countries show independently unique structures regarding the other types of plastics. The features of the structure of the Philippines are the high demand rate for PP, and comparatively low rate for PVC.

Table 2-14 Trend of Domestic Consumption of Major Plastics in the Philippines

(Unit: tons)

	PE	PP	PS	PVC
1969	21,063	8,255	3,678	9,308
1970	24,167	15,046	4,660	9,054
1971	34,864	22,022	5,602	11,153
1972	34,281	23,107	6,767	12,297
1973	44,210	24,360	4,706	14,171

Table 2-15 Comparison of Consumption Share of Major Plastics in 1972

(Unit: %)

	Philip-pines	Japan	Korea	U.S.A.	West Germany
P E	50.5	40.1	43.8	41.5	37.5
P P	27.9	16.7	19.5	9.2	3.8
P S	5.4	14.0	7.3	25.5	19.8
PVC	16.2	29.2	29.4	23.8	38.9
Total	100.0	100.0	100.0	100.0	100.0

2-4-2 Macroscopic Demand Structure of the Plastic Materials

The following equation proves itself to be valid for the correlation the domestic demand for the plastic materials, the GDP (gross domestic product) which is the index for the position of economy of the country, and the prices of various plastics materials.

$$\log Q = \beta - e_p \log P + e_\theta \log \Theta \quad ..... (1)$$

Where:

Q: plastics domestic demand (1,000 tons)
P: actual price (₱/kg)
Θ: actual GDP (₱10^6)

The actual price was obtained by dividing the price by the GDP deflactor. The economic indicators of the Philippines are shown in Table 2-16.

Table 2-17 shows the contrast among the domestic demand, prices, and GDP.

The "e_p" and "e_θ" in formula (1) respectively represent price elasticity and GDP elasticity, and the obtained figures for these are as shown in Table 2-18.

Table 2-16 Trend of Economic Indicators in the Philippines

	GNP in current price in calendar year 10^6 peso	GNP in constant 1967 prices 10^6 peso	GDP in current price in calendar year 10^6 peso	GDP in market price at constant 1967 prices 10^6 peso	GDP deflator (1967=100)
1968	29,918	28,385	30,324	28,801	105.40
1969	33,527	30,033	33,812	30,337	111.63
1970	40,584	31,746	41,363	32,159	127.84
1971	49,434	33,717	50,031	33,845	146.61
1972	55,859	34,932	56,724	35,315	159.91
1973	69,559	38,403	70,009	38,603	181.13
1974	94,800	40,651	94,349	40,598	233.20

Source: By courtesy of Mr. P. Intal, Jr., NEDA (March, 1975)

Table 2-17 Consumption, Real Price of Major Plastics and GDP in the Philippines

	PE			PP			PS			PVC			GDP at constant 1967 price (₱ 10^6)
	Consumption (tons)	Price (₱/kg) Current	Real*	Consumption (tons)	Price (₱/kg) Current	Real	Consumption (tons)	Price (₱/kg) Current	Real	Consumption (tons)	Price (₱/kg) Current	Real	
1969	21,063	2.815	2.522	8,255	3.119	2.794	3,678	2.907	2.604	9,308	2.097	1.879	30,337
1970	24,167	2.742	2.145	15,046	2.916	2.281	4,660	2.723	2.130	9,054	2.076	1.624	32,159
1971	34,864	2.730	1.862	22,022	2.640	1.801	5,602	3.030	2.067	11,153	2.421	1.651	33,845
1972	34,281	2.730	1.707	23,107	2.750	1.720	6,767	2.977	1.862	12,297	2.521	1.577	35,315
1973	44,210	4.087	2.256	24,360	4.566	2.521	4,706	5.387	2.974	18,277	3.206	1.770	38,603

Source: Tables 2-11, 2-12 and 2-16

Note: * Real price is derived from current price divided by GDP deflator.

Table 2-18 Elasticities of Plastics Materials in the Philippines

	Price Elasticity(e_p)	GDP Elasticity(e_y)
P E	0.68	1.89
P P	1.16	3.15
P S	1.15	1.50
PVC	0.35	1.82

(1) Estimation of the demand and prices of olefinic plastics in 1974:

It was impossible to obtain the actual records of the demand and prices for 1974 due to the insufficiency of the information regarding the trade statistics on the part of the exporting countries. Therefore, an estimation on these points has been made. Table 2-19 shows a summary of the export amounts up to certain periods in 1974 shipped from Japan, the U.S.A., West Germany and Hong Kong. Similarly, Table 2-20 shows the average prices of the exports from these countries in 1974.

Table 2-19 **Import Statistics of Major Plastics in 1974**

(Export Statistics of Foreign Countries to the Philippines)

(tons)

Period		PE			PP	PS	PVC	
		LDPE	HDPE	Total			Resin	Compound
Japan	Jan.-Dec.			20,328	12,183	678	357	713
U.S.A.	Jan.-Nov.	4,087	510	4,597	241	532	989	1,465
W.G.	Jan.-Sep.	248	1,991	2,239	20	330	623	40
H.K.	Jan.-Aug.	25	0	25	10	0	49	0

Source: Foreign Trade Statistics of Japan, U.S.A., West Germany and Hong Kong

Table 2-20 **Average Unit Prices of Major Plastics in 1974 in the Philippines**

	PE	PP	PS	PVC	
				Resin	Compound
Average FOB price (US$/t)	703.95	718.08	881.60	878.47	993.12
Average freight charge & insurance (US$/t)	50	50	50	50	50
Average CIF price (US$/t)	753.95	768.08	931.60	928.47	1,043.12
Landed price (₱/kg)	7.92	8.06	11.18	11.14	12.52

Source: Foreign Trade Statistics of Japan, the U.S.A., West Germany and Hong Kong

Notes: 1) Exchange rate to US$; Japan ¥298
W. G. DM2.60
H. K. H.K.$5.09

2) Import exchange rate; PE,PP 10.5
PS,PVC 12.0

Table 2-21 **Estimation of Importation of Major Plastics in the Philippines in 1974**

(tons)

Japan	PE	PP	PS	PVC	
				Resin	Compound
Japan	20,328	12,183	678	357	713
U.S.A.	5,015	263	580	1,079	1,598
W. Germany	2,986	27	440	831	53
Hong Kong	38	15	0	74	0
Total	28,367	12,488	1,698	2,341	2,364

Source: Table 2-19

Table 2-22 Estimated Consumption in 1974

	(tons)
P E	28,367
P P	12,488
P S	2,628
PVC	11,257*

Note: * Exportation is not included

Table 2-23 Estimated Prices of Major Plastics in 1974 in the Philippines

(₱/kg)

	PE	PP	PS	PVC 1)
Landed price of imported material	7.92	8.06	11.18	11.14
Sales price of domestic material	-	-	10.14	5.65
Average sales price	7.92	8.06	10.81	9.01
Real price	3.396	3.456	4.636	3.864

1) Resin base

Table 2-21 shows the total import amount of major plastics for 1974 estimated on the basis of the figures in Table 2-19. Table 2-22 shows the estimated extent of the demand after adding the domestically produced PVC and PS, while Table 2-23 shows the average prices thereof.

(2) Approximation of the figures calculated by the demand model formula to the actual consumption, and international comparison of the elasticity:

Figs 2-1 through 2-4 show a comparison between the values calculated through the model formula (1) by employing the elasticity figures shown in Table 2-18 and the actual record figures. The reason for the fact that the calculated values for PE and PP for the year 1973 are lower than the respective actual records seems to be the mainfestation of the large extent of excess inventory with the presence of temporary demand during 1973, a general phenomenon noted in all the other Southeast Asian countries during the year.

These figures show that a simple demand model (1) is able to represent the macroscopic demand structure of plastics with considerable validity. Fig. 2-5 illustrates a comparison of this elasticity with Japan and Korea.

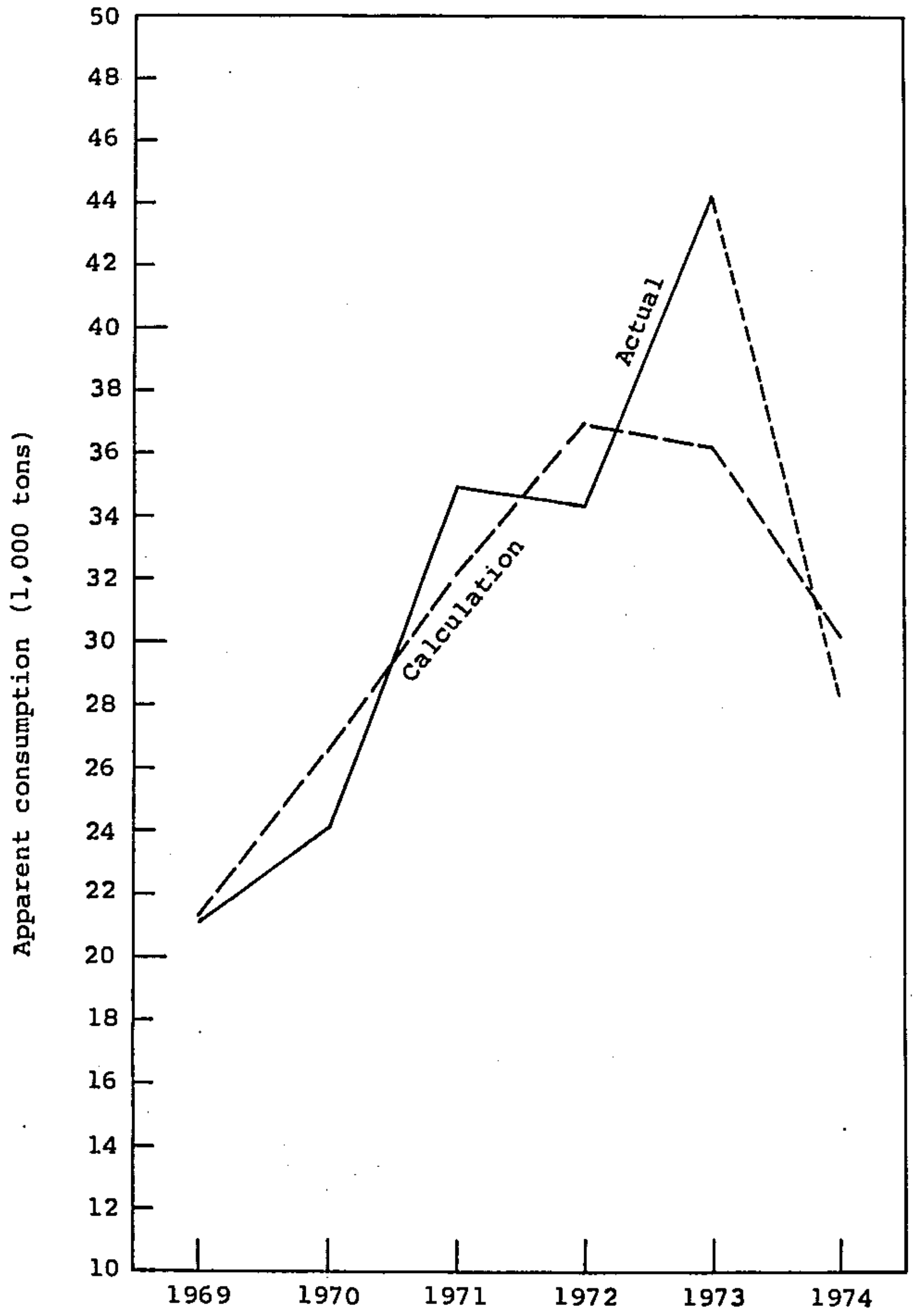

Fig. 2-1 Trend of Apparent Consumption of PE in the Philippines

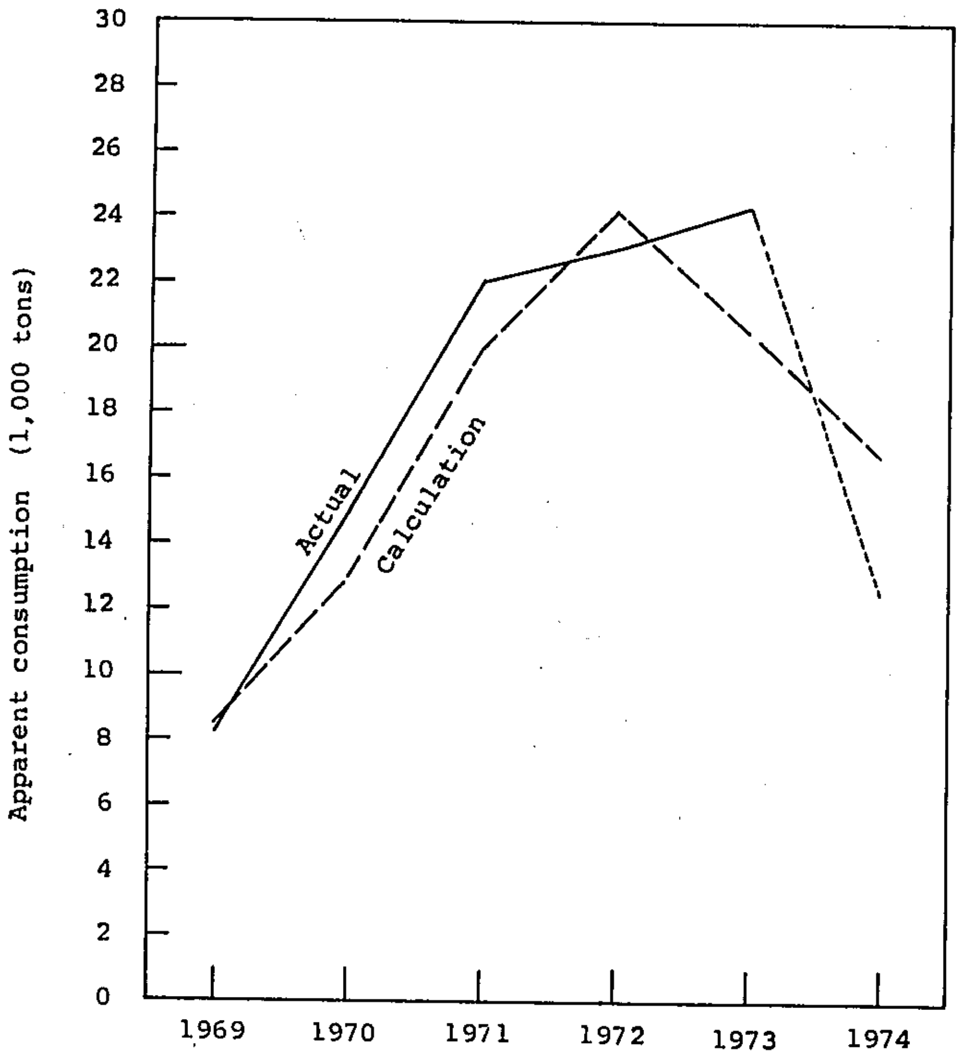

Fig. 2-2 Trend of Apparent Consumption of PP in the Philippines

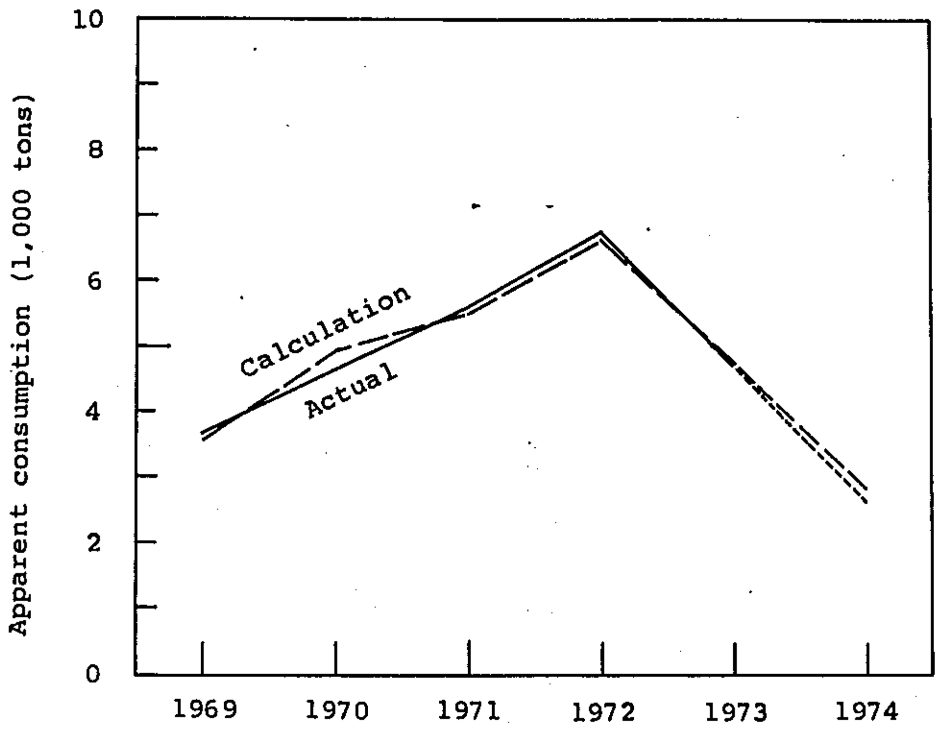

Fig. 2-3 Trend of Apparent Consumption of PS in the Philippines

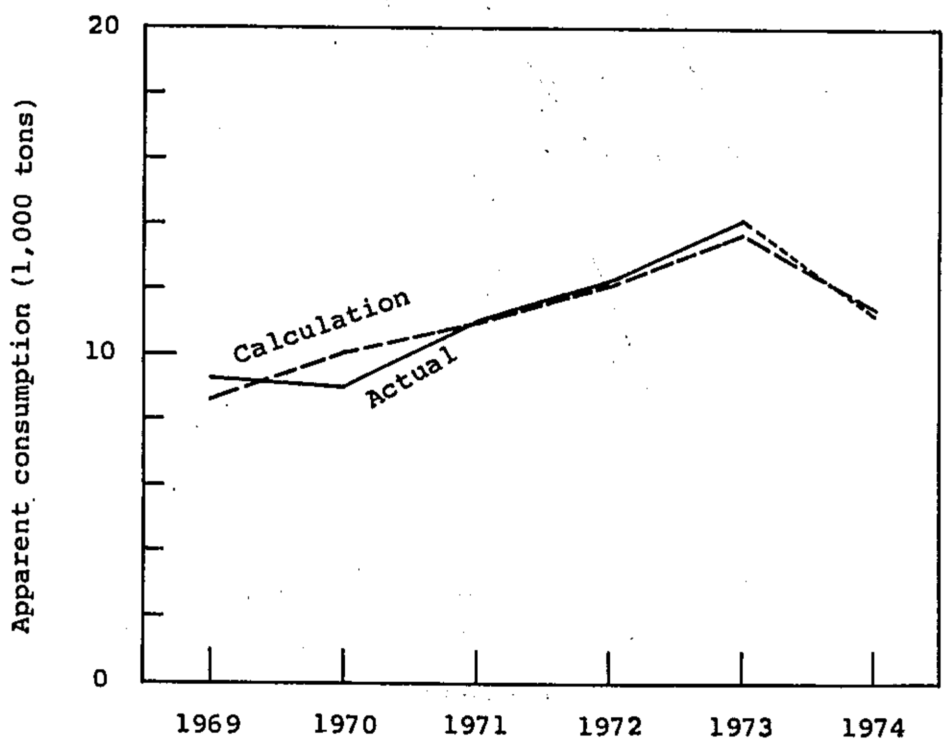

Fig. 2-4 Trend of Apparent Consumption of PVC in the Philippines

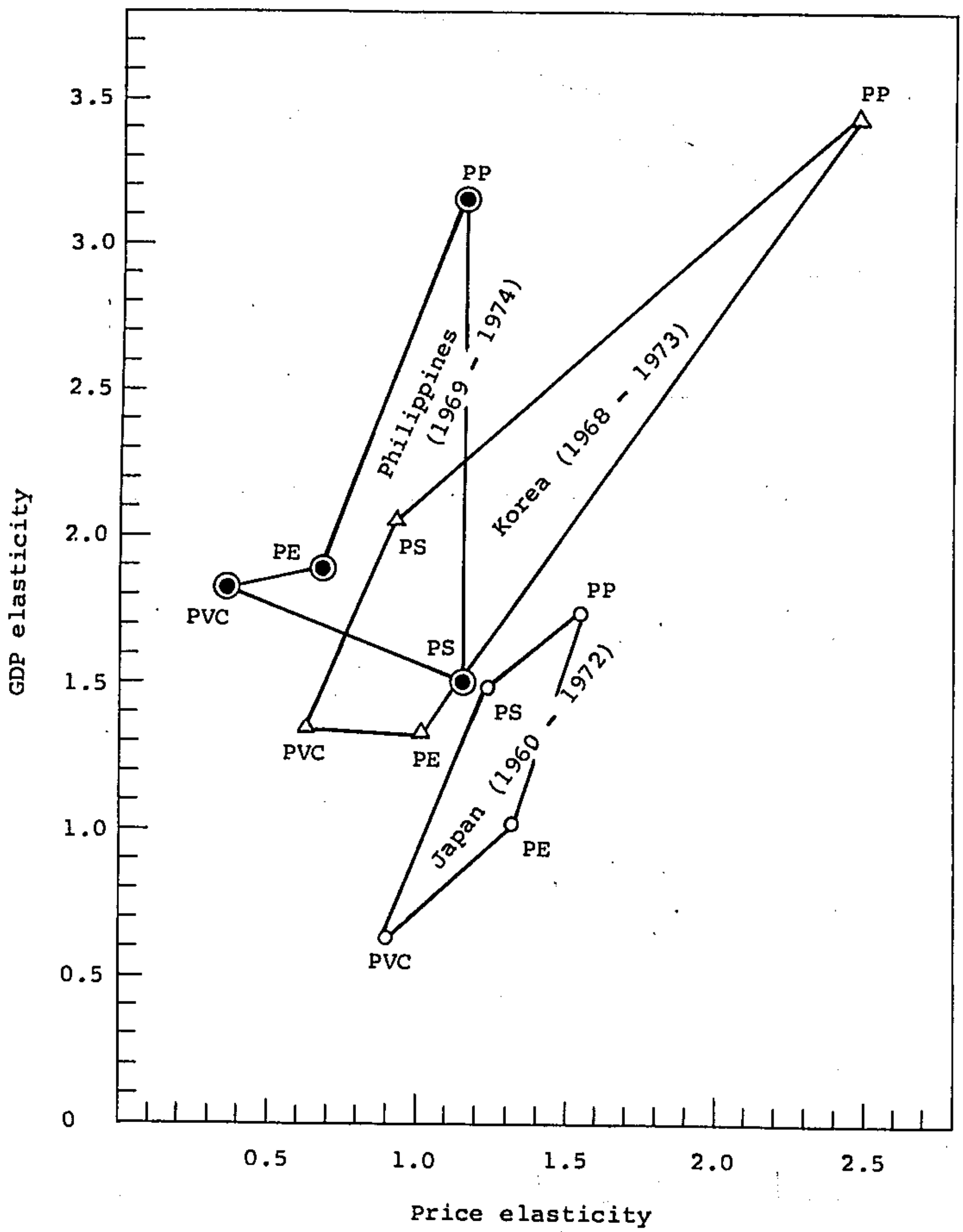

Fig. 2-5 International Comparison of Elasticities for Major Plastics

The price elasticity of the Philippines is lower than that of Japan and Korea regarding all the plastics. Only exception is PS which shows a higher extent of elasticity than that of Korea and almost comparable to that of Japan. The GDP elasticity of the Philippines is generally higher than that of Japan and Korea. This seems to be due to the comparatively short history of plastics industry of the Philippines when compared to Japan or Korea, and at the same time, signifies that the situation in the Philippines is now on accelerated development. Generally, the GDP elasticity will reduce as the time goes by, and the price elasticity trends to increase upon the commencement of domestic production of plastic materials.

2-4-3 Application-wise Demand Structure of the Plastic Products

The application-wise demand structure of major plastic products is as follows:

(1) LDPE:

The trend of the application-wise demand structure of LDPE is as shown in Table 2-24. When trends are compared to that of Japan in 1972, it seems that the Philippines still has considerable allowance for further diversification of the application field.

Table 2-24 Demand Structure of LDPE in the Philippines

(Unit: %)

	1971	1972	1973	Japan (1972)
Film	65	65	65	60
Paper Coating	8	8	8	12
Injection	15	15	20	7
Blow Molding	10	10	5	3
Others	2	2	2	18

Source: Trans World Trading Co., Inc.

(2) HDPE:

The application-wise demand structure of HDPE is as shown in Table 2-25. It is notable that the demand rate for monofilament is high.

Table 2-25 Demand Structure of HDPE in the Philippines

(Unit: %)

	1971	1972	1973	Japan (1972)
Monofilament	60	65	60	11
Injection	25	20	27	38
Blow Molding	15	12	10	23
Film & Others	0	3	3	28

Source: Trans World Trading Co., Inc.

(3) PP:

Table 2-26 shows the application-wise demand structure of PP. When compared with the situation in Japan as of 1972, the application rate in the Philippines for injection molding is low, and the demand for flat yarns is notably high.

The major application of the flat yarns is for the woven bags. As shown in Table 2-27, the demand amounted to 90 million bags, and if it is assumed that the average weight per bag is 150 g, the necessary amount of the plastics material is 13,500 tons.

Table 2-26 Demand Structure of PP in the Philippines

(Unit: %)

	1971	1972	1973	Japan (1972)
Film	15	18	20	23
Flat Yarn	45	45	45	12
Injection	28	23	20	44
Blow Molding	2	2	2	2
Tape, Monofilament and Others	10	12	15	19

Source: Trans World Trading Co., Inc.

Table 2-27 Consumption of Woven Bags in the Philippines

	(Unit: 10^6 bags)
Rice	36
Feeds	16
Raw Sugar	12
Fertilizer	12
Refined Sugar	9
Bran (Mort)	3
Starch	2
Total	90

Source: ITEMCOP & Trans World Trading Co., Inc.

(4) PS:

Table 2-28 shows the application-wise demand structure of PS. Unlike the other plastic materials, the structure is strikingly similar to that of Japan. However, the demand structure in Japan pertains mostly to GP and HI, and does not include foamed polystyrene or ABS.

Table 2-28 Demand Structure of PS in the Philippines

(Unit: %)

	1973	Japan (1972)
Packaging	35	28
Toy	11	8
Kitchenware	30	23
Electric Appliances	24	30
Others	-	11

Source: Trans World Trading Co., Inc. & PPPI

(5) PVC:

The demand structure of PVC resin in the Philippines is as shown in Table 2-29. Most of the demand is for soft PVC, and hard PVC takes up only 20% of the total. The highest extent of demand is shown for imitation leather which comprises approximately 50% of the whole demand. On the other hand, the PVC resin demand structure in Japan in 1972 consisted of 30% for soft and 58% for hard PVC, and demand for imitation leather took up only 6%. The highest demand for hard PVC is shown by pipes and joints which occupies 31%, followed by flat sheets and corrugated sheets taking up 10%. The structure is shown in Table 2-30.

Table 2-29 The Market Distribution of PVC Resin by Kind

	%		%		%
Calender	60	Expanded sheets with backing	70	Shoes, hand bags	40
				Chair	10
				Laggage	20
				Others	30
		Non-expanded sheets with backing	10		
		Sheets without backing	20	Transparent	
				Opaque	
Construction material	25	Pipe	70	Electric conduit pipe	85
				Others	15
		Corrugated sheet	10		
		Wire and cable (imported[1], 40 - 50 tons/month)			
		Electric tape	10		
		Tile	10		
Packaging	5	Extrusion sheet for thermoforming			
		Blow molding			
Others	10	Injection molded articles			
		Toys			
		Music records			
		Footwears			

1) Import tax 30 %. Mabuhay has a 600 tons/month capacity for wire and cable compound.

Source: By the courtesy of Mabuhay Vinyl Corporation, Sunta Rubberized Industrial Corporation.

Table 2-30 Demand Structure of PVC in Japan

(Unit: %)

Rigid	Flat Plate		4
	Corrugated Plate		6
	Pipe		28
	Fittings		3
	Sheet		9
	Rain Gutter		3
	Others		6
	Rigid Total		58
Soft	Film & Sheet	General Use	10
		Agricultural Use	5
		Total	15
	Leather		6
	General Extruded Items		6
	Others		3
	Soft Total		30
Electric Wire Coating			8
Flooring Materials			2
Fiber			1
Others			1
Domestic Consumption Total			100

Source: Japan PVC Association

2-4-4 Regional Distribution of Plastics Demand

(1) Plastics materials:

Approximately 95% of the plastics molding industry is concentrated in the Greater Manila City, the remaining 5% scattered in Cebu City, etc. The present situation of the distribution is shown in Fig. 2-6.

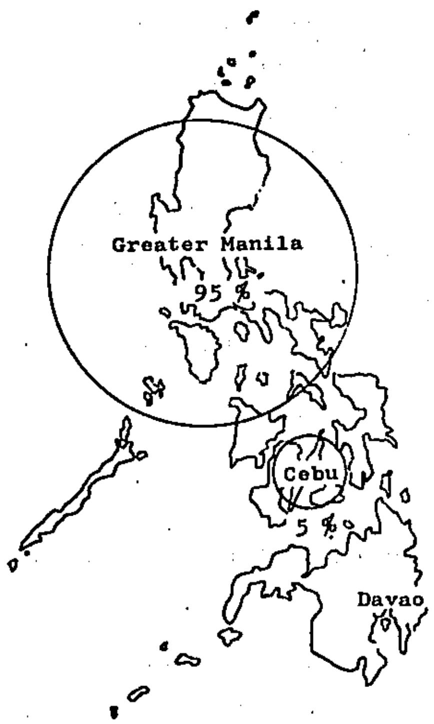

Fig. 2-6 Regional Distribution of Plastics Processing Firms

(2) Plastics products:

The general consumer's plastics goods produced in the Greater Manila City are distributed to various local areas through sales offices of the manufactures or through sales agencies. The distribution rates of the products seem to be 50% for the Luzon district, 30% for Visayas district, and 20% for Mindanao district. The industrial goods such as machine parts, cosmetics containers, etc. are sold to the respective manufacturer users in and around Manila City. Fig. 2-7 shows the distribution of demand for plastics general consumption goods.

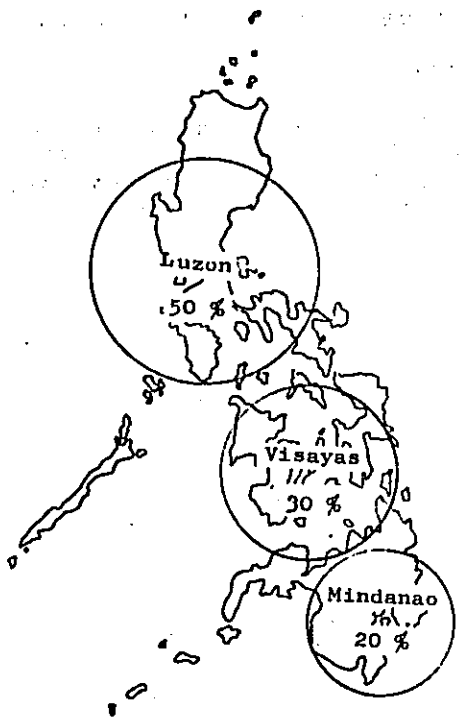

Fig. 2-7 Regional Distribution of Plastics General Consumption Goods

2-5 Demand Forecast for Olefinic Plastics

By employing the macroscopic demand model formula (1) as well as the elasticity described in the foregoing section, the future demand forecast for each plastics product has been made on the basis of the estimated future prices and GDP level.

2-5-1 Price Forecast

By taking the 1974 price as the basic price, the real price in 1975 is estimated to fall by 10%, and the downtrend will persist until 1979 at a rate of 2% drop every year. The price in 1974 showed a pattern in which the import price attained a peak during the first half of this year and then a downtrend began to manifest itself, thereby showing the average price on a higher side. Also, since the last half of 1974 until 1975, the price trend was generally soft because of overall recession in demand. Therefore, it is forecast that the actual price in 1975 will considerably decrease. The nominal price of plastics may keep increasing in the future depending upon the extent of progress of inflation, and the future behavior of the prices of raw materials such as crude oil. However, it is rather reasonable to deem that the actual price will on the contrary fall gradually. However, the range of the price decrease may not be as large as the trend shown so far, and will be approximately 2% at the most.

2-5-2 GDP Forecast

According to the Four Year Plan for Economic Development (from fiscal 1974 to fiscal 1977), the target growth rate GNP from 1974 to 1977 is 7% in real terms. Also, according to the Center for Research and Communication (CRC), the average net growth rate of GNP from 1976 to 1980 will also be 7%.

2-5-3 Demand Forecast of Various Plastics Materials

The domestic demand is forecast up to 1979 regarding LDPE, HDPE, PP, and PVC, which are the items related to this project, by means of employing the future values of the elasticity coefficient.

(1) Forecast on the minimum demand:

Except for 1974 when the drop of demand was conspicuous, it is possible to deem that the behavior of domestic demand during the surveyed period from 1969 to 1973 displays an almost linear correlation with the net GDP growth.
If it is assumed that this correlation will valid also in the future, the average elasticity of each plastics materials from 1975 to 1979 will be as shown in Table 2-31.

If the elasticity is assumed as in the case of Table 2-31, and the price and GDP forecast values discribed in the foregoing 2-5-1 and 2-5-2 are employed, results as shown in Table 2-32 will be obtained as the minimum demand data.

Table 2-31 Estimated Elasticities for 1975/1979 (Minimum)

	Elasticities	
	Price (e_p)	GDP (e_g)
P E	0.59	1.17
P P	1.03	1.89
PVC	0.28	1.35

Table 2-32 Prediction of the Minimum Consumption in 1979

(Unit: tons)

	1974		1979
	Actual	Calculated	Forecast
P E	28,367	30,200	50,100
P P	12,488	16,700	38,400
PVC	11,257	11,400	19,000

(2) Forecast on the target demand:

In view of the application-wise demand structure of plastics materials in the Philippines, it is deemed that the range of application of the plastics will be further expanded in the future. It is also expected that the growth rate will accelerate during forthcoming few years along with the development of the related consuming industries.
The GDP and price elasticities will at least be maintained on a level same as the actual achieved value for a 5 year period from 1975 to 1979.

In view of the achieved value in the past, the demand for PP shows the highest growth rate among the major plastics. If the current trend is to persist in the future, the demand is estimated to be considerable. However, regarding the future expansion of demand for PP, the following two problems are present:

(a) As long as the future petrochemical industry of the Philippines keep employing naphtha as the raw materials, the production rates of ethylene and propylene will be limited, thereby making it difficult to concentrate on the production of propylene derivatives alone in a large amount. Therefore, some portion of the future PP demand will have to be replaced by LDPE, HDPE, PS, etc.

(b) Although the PP demand shows an acute increase up to 1971, the trend stagnated during 1972 and 1973. As is evident from Table 2-26, this has been due to the nearly complete saturation of the woven bags which almost completely replaced traditional bags by 1971, and thereafter merely showed an extent of natural increase. It is estimated that the demand growth rate in this field is approximately 10%/y. Even it the growth rate is estimated optimisticly at 20% by including other applications, for instance, the replacement of the traditional materials in the industrial applications by PP, the growth rate of total PP demand will be approximately 15%. Therefore, because of the conspicuous drop in the demand for PP in 1974, the outlook on the future trend of PP demand is not necessarily bright.

If an assumption is made that the PP demand growth will stagnate to a certain extent, and other plastics will keep growing due to the development of new consumption outlets, the demand extents as shown in Table 2-33 will be embodied by 1979. In this case, the values of the elasticity will be as shown in Table 2-34, with an average growth rate of 17% for PE, 20% for PP, and 18% for PVC. It should be noted here that the demand ratio between LDPE and HDPE in Table 2-33 with assumed to be 60 : 40.

Table 2-33 Prediction of Normal Consumption in 1979

(Unit: tons)

	1974 Actual	1974 Calculated	1979 Forecast
LDPE	28,367	30,200	39,600
HDPE			26,400
P P	12,488	16,700	42,000
PVC	11,257	11,400	26,200

Table 2-34 Estimated Elasticities for 1975/1979 (Normal)

	Elasticities Price (e_p)	GDP (e_g)
LDPE	0.76	1.97
HDPE	0.80	1.97
P P	0.93	2.20
PVC	0.81	2.00

(3) Optimistic forecast:

If an optimistic assumption is made that the plastics industry will recover soundly by 1979 from the vast drop in 1974 in the Philippines, thereby displaying a growth rate comparable to that manifested itself in the first half of 1960s in Japan, it is possible to estimate that the value of the price elasticity at 1.20, and GDP elasticity at approximately 2.50. Here, if the same elasticity values are applied to PE, PP, and PVC, the demand figures as shown in Table 2-35 can be obtained.

Table 2-35 Optimistic Prediction in 1979

(Unit: tons)

P E	88,000
P P	48,300
PVC	33,200

(4) Summary of demand forecast:

Table 2-36 shows the expected figures of demand extent in 1979 obtained on the basis of the minimum demand forecast values, target demand forecast values, and the optimistic demand forecast values as the most likelyhood estimation.

Table 2-36 Expected Demand in 1979

(Unit: tons)

P E	54,400 - 79,600
P P	39,100 - 45,900
PVC	21,400 - 31,000

CHAPTER 3. RAW MATERIALS, UTILITY AND BY-PRODUCTS

CHAPTER 3. RAW MATERIALS, UTILITY AND BY-PRODUCTS

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TABLES AND ILLUSTRATIONS

3. Raw Materials, Utility and By-products

3-1 Possibility of Utilization

As the Filoil Refinery operates at Rosario, Cavite, which is the subject site of this study on petrochemical complex, it is assumed that the raw materials for ethylene production will be supplied from this oil refinery.

If the present capacity of the Filoil Refinery at 30,000 BPSD is taken as a basis, the maximum capacity of the ethylene plant will be 160,000 t/y including the use of the light gas oil for ethylene cracking. (Refer to the Orientation Study Report). The maximum ethylene capacity of the complex in this study is 250,000 t/y. Therefore, the Filoil Refienry cannot supply the whole amount of the required raw materials. As a remediral measures, it is necessary to effect purchasing from outside the materials to solve the shortage (importation or purchasing from other oil refineries) or to improving the existing Filoil Refinery to enable the supply of a sufficient amount of the raw materials. Concerning the improvement of the Filoil Refinery, it was concluded that increasing the production up to 57,000 BPSD is possible by using the presently idling FCC facilities as studied in Chapter 1, Part II. It was therefore assumed that the Filoil Refinery will supply the entire amount of the necessary raw materials through its improvements to the ethylene plant.

3-2 Form of Raw Materials

The amount of supply of raw materials from the improved Filoil Refinery will still be insufficient for ethylene production by cracking naphtha as is presently done in Europe or Japan. Therefore, the utilization of heavier fraction becomes imperative.

For the above reasons, the commercially crackable fractions by the present techniques shall have to be up to normal pressure gas, then, full range naphtha, kerosene and gas oil shall have to be considered as the raw materials of ethylene. Through the meeting with PNOC; it was determined that the subject of this study shall be the Kuwait crude oil. Therefore, all the forms of each fraction which will be obtained through feeding the Kuwait crude oil to the topper were taken as the forms of the raw materials of ethylene. The forms are described in Table 3-1 .

Table 3-1 Estimated Yield and Properties from Kuwait Crude

	Full range naphtha	Kerosene	Diesel (Gas oil)
TBP cut points: °F	C_5 - 380	380 - 480	480 - 650
Yield : vol % on crude	23.8	8.6	14.4
Gravity: °API	63.9	44.6	35.8
Sp. Gr.: 60°F/60°F	0.724	0.804	0.846
Sulfur : wt %	0.035	0.35	1.37

Hydrocarbon type vol %

Paraffines	69.9	Saturates 81.5	Saturates 70.5
Monocyclo-paraffines	19.6	Aromatics 18.5	Aromatics 29.5
Bicyclo-paraffines	0.6		
Aromatics	9.9		

Vap. Press., REID : lb	4.0		
Viscosity : C_5	-	2.0@70°F 1.5@100°F	3.8@100°F 1.4@200°F
Flash, P-M : °F		140	230
Pour point : °F		below -40	15

3-3 Utilization Amount of the Fractions

There are two approaches concerning the utilization ratio when the fractions from Filoil Refinery are to be used as the raw materials for ethylene production.

(1) Filoil Refinery shall be fully operated at its maximum capacity, then, only the available raw material portion for ethylene production is used for petrochemical industry. In this case, there are two alternatives. The gas oil can firstly be used, then, the gasoline fractions is left unused as much as possible in order to sell the fractions on the market for obtaining as much profit as possible for the oil refinery. Another is to start with lighter fractions upwards, such as naphtha and so on, for ethylene production, in order to lower the operational rate

of the ethylene plant.

(2) Filoil Refinery is made into an exclusive oil refinery plant for supply only to the ethylene plant, so that the capacity of the oil refinery can be lowered in proportion to that of the production drop at the ethylene plant.

Of the above assumptions, (1) seems difficult in connection with the marketing of fuel oil which would be produced in a large quantity. Therefore, (2) is taken up for the purpose of this study with such an assumption that the quantity of naphtha, ethylene, kerosene, and gas oil is kept unchanged irrespective of the capacity of the ethylene plant.

A study of the oil refinery resulted in the yield ratio for naphtha, kerosene, and gas oil as shown in Table 3-2 when the Kuwait crude oil is used at the Filoil Refinery.

Table 3-2 Ratio of Raw Materials

	Full range naphtha	Kerosene	Gas oil
Yield against crude	0.238	0.086	0.144
Sp. Gr.	0.724	0.804	0.846
Wt. ratio	0.4744	0.1903	0.3353

3-4 Yield Ratio of Ethylene and By-products

The yield ratio of ethylene and by-products to each raw material as mentioned in the foregoing 3-2 considerably differs according to the operational conditions (especially in the case of gas oil, the pertinent data have mostly been collected from pilot plant tests, and little from commercial production) Therefore, the estimation was made as shown in Table 3-3 as the bases for this study.

In view of the ratio given in the foregoing 3-3 for each fraction (raw material) and yield ratio of ethylene and by-products to each raw material, the yield ratio of ethylene and by-products to the ethylene feedstock will be as mentioned in Table 3-4.

The required capacity of the oil refinery per ton of ethylene is calculated as follows:

$$\frac{0.4744}{0.2769} \times \frac{1}{0.724} \times \frac{1}{0.238} \times \frac{1}{0.159} = 62.53 \text{ bbl}$$

Naphtha (ton) kl/t crude oil quantity bbl/kl

Thus, the oil refinery capacity to meet a 200,000 t/y ethylene plant is approximately 38,000 BPSD.

Table 3-3 Yield of Ethylene and By-products

	Full range naphtha (C_5/380°F)	Kerosene (380°F/480°F)	Gas oil (480°F/650°F)
Hydrogen rich gas	0.0127	0.0105	0.0094
Methane rich gas	0.1377	0.1326	0.1115
Ethylene	0.2920	0.2710	0.2588
Propylene	0.1529	0.1430	0.1453
Mixed C_3	0.0087	0.0112	0.0161
Mixed C_4	0.1052	0.1002	0.0940
C_5 - 205°C	0.2493	0.2095	0.1851
Fuel oil 205°C$^+$	0.0415	0.1220	0.1798

Table 3-4 Products Yield in Total

Total raw materials

Naphtha	0.4744
Kerosene	0.1903
Gas oil	0.3353

Yields of each product

Hydrogen rich gas	0.0112
Methane rich gas	0.1279
Ethylene	0.2769
Propylene	0.1484
Mixed C_3	0.0117
Mixed C_4	0.1005
C_5 - 205°C	0.2202
Fuel oil 205°C$^+$	0.1032

3-5 Raw Material Prices

Calculation of the prices for the feedstock for supply to the ethylene plant was made on the basis of the existing ex-refinery prices, excluding the commodity tax, and deducting the import duty for crude oil, as follows:

Raw Material Prices in 1980

Naphtha	:	157.2 (US$/t)
Kerosene	:	144.6
Gas Oil	:	147.7

The above price for gas oil includes de-sulphurization cost to turn out an ethylene feedstock. Refer to 4-1-6, Part III for the calculation formulae to obtain the above prices.

3-6 Evaluation of the By-products

The evaluation of the hydrocarbon by-products has a considerable effect on the prices of ethylene and polypropylene which are petrochemical raw materials. In the case particularly of cracking heavy fractions such as gas oil, etc., the quantity of the by-products is larger than that in naphtha cracking. When there is a sizable market with little problem for selling, they may be evaluated high. In consideration of the present conditions in the Philippines, it is not easy to find any product which promises a secure field of application, and even if found, it is mostly limited to applications within the complex itself. For the present evaluation, therefore, all the products except craked gasoline to which gasoline blending is possible are evaluated by the "fuel evaluation" to be on a safer side. Refer to Table 3-5 for the evaluation details. Concerning the standard methods for the calculation (of the 1980 prices), refer to 4-2, Part III.

Table 3-5 Evaluation of By-products

(Unit: US$/ton)

Hydrogen rich gas	261.0
Methane rich gas	132.4
Mixed C_3	122.2
Mixed C_4	120.3
C_5 - 205°C	157.2
Fuel oil 205°C$^+$	110.3

3-7 Supply and Prices of Utility

The required utility is planned to be supplied by a utility center, for supply to each plant within the complex. The capacity of the utility facilities has been so established that the utility center can supply the necessary utilities for a petrochemical complex centered on a 200,000t/y ethylene plant which is the basic capacity for the present study.

The electric power is to be purchased mainly from outside, and its price is estimated on the basis of US¢4/KWH which is the average price being paid by Filoil Refinery at present. This price for the power, however, is considerably higher than that of the hydroelectric power supplied by NPC, although the service area is not the same. NPC now plans to convert its Meralco Thermal Power Plant in Manila district gradually into an atomic power plant, then to use the existing Thermal Power Plant as a back-up. When the plans are implemented, the generation costs are expected to be considerably lowerd. This lower power price will considerably affect the economic viability of the complex. Nevertheless, the present price is used in the price calculation for this study for the sake of safety allowance. All the necessary facilities would have to be constructed in order to generate the power within the utility center, if outside purchasing of the power is to be avoided. Also, the power cost will have to be considerably higher because of the small-scale of the thermal generation plant.

Concerning the fuel supply, the by-products from the ethylene plant and the fuel oil from Filoil Refinery are to be used. The ex-refinery price prevailing in the Philippines at present less commodity tax was used as the basic figure. Special commodity tax and the special fund (a contribution by the Japan Petrochemical Industrial Association) were exempted as intra-complex deals.

The utility price calculated on the basis of the foregoing is shown in Table 3-6. For actual calculation, refer to 4-3, Part III.

Table 3-6 Prices of Utilities at the Operational Rate of 90 Per Cent

High Pressure Steam	15.1 US$/t
Medium Pressure Steam	11.6 US$/t
Low Pressure Steam	6.52 US$/t
Electric Power	0.0675 US$/KWH
Well Water	0.0542 US$/$m^3$
Sea Water	0.103 US$/$m^3$
Boiler Feed Water	1.01 US$/$m^3$
Instrument Air	0.0257 US$/$Nm^3$
Plant Air	0.022 US$/$Nm^3$
Nitrogen/Oxygen	0.127 US$/$Nm^3$
Fuel	10.9 US$/MMKcal

Further question regarding the utility price remains in the use of sea-water. No estimation of the amount of the required water has yet been made concerning the well-water which should be comparatively easily and cheaply available. Therefore, the economic calculation is based on using sea-water, which is amply available. As the sea is shallow, the sea-water intake pipe must be extended offshore for a considerable distance, thereby necessitating a considerably large-scaled facility. Therefore, the sea-water price is considerably higher than the well-water, and the effects on the ethylene price are not small. In the actual implementation stage of the project, a detailed survey on the availability of under-ground water must be made, and if found available, the water should firstly be supplied to the complex.

3-8 Material Balance under the Standard Case for the Complex

Fig. 3-1 shows the raw material balance of a complex for the 200,000 t/y ethylene plant which is the basic case for this study.

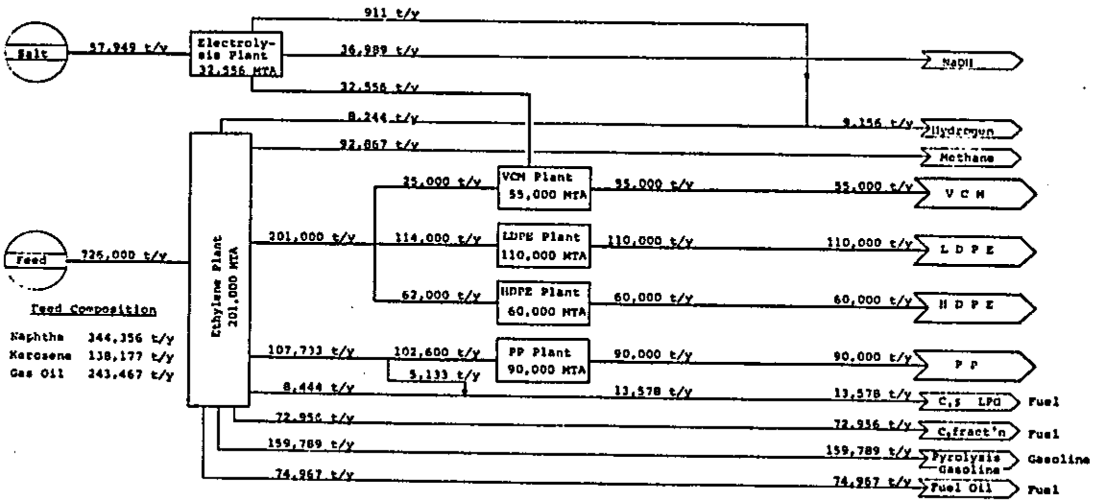

Fig. 3-1 Overall Material Flow

(at 100% operation)

CHAPTER 4. PROJECT SELECTION

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4. Project Selection

4-1 Introduction

In order to evaluate the possibility of petrochemical industrialization in the Philippines and also to search for the optimum guideline, therefore, studies were made regarding the complex scheme selection and the extent of the effects exerted by various factors upon the economy of the schemes of a petrochemical complex to mainly undertake the production of olefins and the derivatives thereof.

As a result of meetings and discussions with the Government of the Philippines during the field survey by the Consultant, it has been decided tentatively that the complex plant site be Rosario, Cavite, with the target commencement of the operation in mid-1979. The subject of the selection of the products to be turned out from the complex have been established as being LDPE, HDPE, PP, VCM, and also, the raw material ethylene, propylene, chlorine and by-product caustic soda. Therefore, the problems in scheme selection regarding the site, products, and process routes will reside in the following three areas in view of the relationship with the existing or under-construction plant in the country.

(a) Installation of a VCM and electrolysis plant within the complex

(b) Installation of the plant in the Iligan district in which low-cost hydro-electrical power can be utilized, and the production of VCM shall be conducted by employing the carbide process acetylene

(c) Importation of VCM and EDC

Regarding these problems, a simple comparative study was carried out in 6-1, Part II of this report, and it was revealed that both cases (a) and (b) will be feasible depending upon the prerequisite economic conditions for the comparison, particularly depending on the prices of caustic soda and electrical power. The matter of whether or not to install the chlorine derivatives plant within the complex does not seriously affect the viability of the complex as a whole. Therefore, studies in this respect were conducted for the feasibility assessment of the complex itself by adopting the case (a).

The economic evaluation was conducted by employing the prerequisite conditions and the bases for economic evaluation the details of which will be described in Section 4-2. The economic calculation for each plant and for the complex as a whole were undertaken by employing a computer model which simulates the material balance and the economic viability of the complex as shown in 2-1, Part III. Simulation studies were also conducted for the cases in which major prerequisite conditions, the evaluation bases and other factors of the project should vary, in order to assess the extent of the effects upon the scheme selection. In doing so, the sensitivity analysis of the profitability and production cost regarding such changes was undertaken, and also, studies were made regarding the possibility of the remedial action to be taken for the solution of the project. (Ref. 6-2, Part II)

The following conclusions were obtained through the above-mentioned studies:

(1) From the neutral perspective of the domestic demand, the economically optimum scale of the petrochemical complex will be approximately 150,000t/y.

(2) A complex having a scale of 200,000t/y may be set as a target after taking into consideration the factors such as the internationally competitive complex scheme, the potential market growth in the Philippines, the effects upon profitability of economic growth rate, and inflational rate of the country, etc. If an opportunistic view is taken regarding the potential market growth, the optimum scale of the complex may even be 300,000t/y. Therefore, the detailed financial analysis to be undertaken in the following part of this writing shall be based on a scale figure of 200,000t/y for the complex.

(3) It seems possible to bring the VCM production cost to the viable with the cost of imported VCM by means of adjusting the caustic soda price, reducing the electrical power cost, or by cutting the plant and facility costs. Regarding the plant and facility cost, it seems possible to effect the cost reduction by designing appropriately the caustic soda refining facilities and pollution control facilities gearing to the status of the Philippines.

4-2 Prerequisite Conditions for Project Selection and the Basis for Project Evaluation

4-2-1 Prerequisite Conditions

(1) Time of operation commencement

Commencement of construction	:	January, 1976
Completion of construction	:	End, December, 1978
Commercial operation	:	July, 1979
Project period	:	10 years

(2) Site: Rosario, Cavite

A 250ha. premises adjacent to the Filoil Refinery

(3) Currency exchange rate:

₱7 = US$1.00 = ¥300 (as of 1974)

In this report, the value expression shall be made in US Dollars.

(4) Inflation:

(a) Prior to the commencement of operation:

Domestic inflation rate : 10%/year

Overseas inflation rate : 7%/year

(b) After the commencement of operation:

0% for both domestic and overseas inflation

(5) Economic growth rate:

GDP growth rate within the Philippines = 7%/year

4-2-2 Basis for Project Evaluation

(1) Financial categories own capital: 30% of the fixed capital requirement

Long-term loan: 70% of the fixed capital requirement

(2) Financial conditions:

(a) Interest rate:

Interest on long-term loan for fixed capital: 9.1%p.a.

(including 1.5% guarantee fee on unpaid balance)

Short-term loan for working capital: 18%p.a.

(b) Repayment conditions:

Long-term loan: Equal annual installments for 10 years after the commencement of operation

Short-term loan: Individual repayment within one year

(c) Interest during construction period, etc.:

The interest incurred during the construction period shall be incorporated into the principal as an aggregate at the time of the commencement of the operation.

(d) Guarantee fee for long-term loan:

Commitment fee: 1%
Guarantee for unused loan: 0%
Guarantee for used loan: 1.5% (included within the 9.1% interest rate)

(3) Depreciation, etc.:

(a) Depreciation:

Production facilities (ISBL): Straight-line equal depreciation for 10 years

Off-site facilities: Straight-line equal depreciation for 15 years

Amortization: Straight-line for 10 years

Sulvage value: Land cost and 5/15 of the off-site facilities cost

(b) Taxes, levies, etc.:

Import duties on equipment and materials for construction: 0%

Real property tax and insurance: 1.6%p.a. of the booked value

Corporate income tax: 35% on the gross profit

Sales tax: average 4% on the sales amount of the final products

(4) Investment:

(a) Land cost: US$15/$m^2$

(b) Pre-operating expenses:

Project administration expenses: 2% of the fixed assets

Training expenses: Equivalent for one-year worth of a labor cost

Start-up expenses: 4% of annual raw material costs and utility costs

(c) Contingency: 5% of the net investment excluding the interest during construction period

(d) Interest during construction period:

Capital cost expenditures are assumed to bear the same loan/equity ratio during the period of construction, and to take place in one single outlay at the middle of the year, the data from which interests start running.

(5) Production costs:

(a) Labor cost: average US$4,000/man-year

However, the cost includes all types of housing allowances, fringe benefits, etc.

(b) Maintenance cost:

For the off-site facilities, 1% of the construction cost was entered as the annual expenses for maintenance. Regarding other plants, the amount shall be fixed in accordance with the characteristics of the processes.

(c) Plant overhead cost:

The common section, i.e., the labor cost in the maintenance, safety and medical sectors have been alloted to the process plants and the utility plants.

(d) General administration cost:

3% of the production cost

(e) Contingency: 5% of the production cost

(6) Raw material costs:

(a) Ethylene plant feed:

Composition

	(wt%)	Price (US$/t)
Naphtha	47.4%	157.2
Kerosene	19.0	144.6
Light gas oil	33.6	147.7

Prices: US$151.6/t as of 1980

(b) Industrial salt: US$35.0/t as of 1980

(7) By-product prices:

(a) Polymer grade propylene:

The price has been assumed at 80% of the ethylene price.

(b) Caustic soda: US$400.0/t

(c) Hydrogen: US$261.0/t

(d) LPG : US$122.2/t

(e) By-product hydrocarbon: US$138.5/t

The average price of the hydrocarbons by-produced from the ethylene plant was calculated on the basis of the yield at cracking of the raw materials which were stipulated in above (6).

	(wt%)	(Price) US$/t
Hydrogen rich gas:	2.0%	261.0
Methane rich gas :	22.7	132.4
Mixed C_4 :	17.9	120.3
Pyrolysis gasoline :		
(C_5-205 °C)	39.1	157.2
Fuel oil (205 °C^+)	18.3	110.3
Total	100.0	138.5

(8) Fuel and utility prices:

Electlicity:	US¢6.7/KWH
Medium-pressure steam:	US$11.6/t
High-pressure steam:	US$15.1/t
Industrial water:	US$0.054/t
Boiler feed water:	US$1.01/t
Sea water:	US$0.103/t
Nitrogen :	US$0.127/Nm^3
Fuel:	US$10.9/MMKcal

(9) Demand for and prices of the final products:

(a) Domestic demand:

As has been explained in Chapter 2, Part I, the demand forecast for the final products (LDPE, HDPE, PP, and PVC) has been estimated by employing the price and GDP elasticity models. The economic growth rate was estimated at 7%/y, and the price trend has been estimated as explained below.

(b) Trend of domestic prices:

As mentioned in Chapter 2, Part I, it has been estimated that the real price prior to the commencement of the operation will fall by 10% during the period from 1974 to 1975, and at 2%/y thereafter until June, 1979, when the operation will commence (average 3.5%/y). However, the present price level of PVC is high on average. This has been due to the effect of the import duty levied upon the imported PVC and the discrepancy becomes more conspicuous when the average price of the imported and domestic goods is applied. The price of PVC should be less than 70% of the price of PVC on international market.

Although it is probable that the price of PVC will increase due to the pollution problems, etc., it should still be true that PVC is the most inexpensive plastic material. It has been estimated in this writing that the price of PVC will have attained a 90% level of the PE price at the time of the production commencement. This signifies an average 7.5%/y fall in the real price.

The estimated domestic prices of various resins are as shown in Table 4-1. It has been assumed here that the actual price will be affected by an inflation factor of 7%/y.

(c) Exportation:

It has been assumed that all the remaining domestic production will be allocated for exportation after fulfilling the domestic demand. However, a 30% level was taken as a tentative maximum for the export quantity (even in the case of Japan where the export rate is the highest in the world, the actual level is less than 20%).

Table 4-1 Estimated Domestic Price in the Philippines

(US$/t)

	Domestic Price in the Philippines* @ 1974	Estimated Domestic Price @ June, 1979	Projection of Import Price* (from Japan) @ 1980
L D P E	1,130	1,348	1,387
H D P E	1,130	1,348	1,560
P P	1,150	1,372	1,635
P V C	1,290	1,219	1,179

* Including sales tax

(d) Export prices:

It has been generally observed in advanced countries that the export prices of the petrochemical products is on a level considerably lower than the ex-factory price for domestic market, except for a temporary abnormal circumstances such as the one present immediately after the oil crisis. In the case of Japan which is the typical exporting country of the world today, there have been cases in which the export prices were less than 50% of the ex-factory price for the domestic market. In this writing, assumption has been made that the export price will be 70% to 80% of the domestic ex-factory price by taking into consideration the increment in the marginal cost prevailing since the oil crisis. The figures of the assumed export prices are shown in Table 4-2.

Table 4-2 Estimated Export Price

(US$/t)

	Ex-factory Price in Japan @ 1980	Export Price 70% of Ex-factory Japan	Export Price 80% of Ex-factory Japan
L D P E	852	596	681
H D P E	966	676	773
P P	1,015	711	813
P V C	624	437	499

(10) Demand and prices of intermediate raw materials:

(a) Demand for intermediate raw materials:

Regarding the LDPE, HDPE, and PP, the domestic demand level of intermediate raw materials correspond to the necessary amount for the production of these items. Regarding VCM, domestic production has already been undertaken in Iligan on the basis of acetylene. A number of different cases seem possible regarding the manner of VCM production inside the philippines. To cite some examples, the following are the feasible cases:

1) The transportation of the required amount of the VCM to the Iligan district after carrying out the production of the total amount to cover the domestic demand in the petrochemical complex.

2) Production of the VCM to cover the total domestic amount in the Iligan district by utilizing the carbide process acetylene, and the required amount of the VCM shall be transported to the Manila district.

3) Production shall be carried out in respective districts to cover the locally required amounts.

Whichever case of the above is selected, no serious effect will be exerted upon the overall profitability of the total petrochemical complex. Therefore, the (1) of the above has been selected as the standard case for the sake of this study. In this case, the demand level for VCM shall correspond to the domestic demand level of PVC.

The PVC price was estimated by adding to the VCM price a US$350/t "value added", and further calculation was made on this basis by employing the price/GDP elasticity model.

(b) Intermediate product prices:

Unless otherwise specifically noted, the intermediate product prices has been so established that the internal rate of return becomes 15% which is the investment criterion for private industry embarkation.

(11) Method of economic evaluation:

On the stage of project selection, the following three types of evaluations were conducted:

(a) Internal rate of return on project (IRR on project)

(b) Internal rate of return on equity (IRR on equity)

(c) Present value of the project

The selection of the economically optimum project scheme was conducted on a condition the present value of the project should be maximized when discounted by the cut-off rate. As has been discussed in 2-2, Part III, the selection of the project scheme was conducted in view of the optimum utilization of the capital.

The method of the above three evaluations is as follows:

(a) IRR on project:

This signifies the internal rate of return for the gross cash flow against the gross investment; fixed capital requirement. The relative calculations are made in accordance with the following formulae.

$$I_o = \sum_{i=1}^{n} \frac{R_i}{(1+r)^i} + \frac{S_n}{(1+r)^n}$$

$$R_i = D_i + F_i + N_i$$

Where:

I_o: Fixed capital investment amount including interest during construction period

R_i: Gross cash flow in i'th year

D_i: Depreciation and amortization in i'th year

F_i: Financial cost for the loan for fixed capital in i'th year, i.e., the interest and guarantee fee for long-term loan (L/G cost)

N_i: Net profit after tax in i'th year

S_n: Salvage value, the undepreciated portion of the fixed capital (1/3 of the off-site facility cost) and the cost of the land which is not subject to depreciation

n : Project life

r : Internal rate of return on project

(b) IRR on equity:

This is an index for the profit rate against the equity portion of the fixed capital after the commencement of the construction. In other words, this signifies the internal rate of return of the net cash flow against the investment cash flow, and are calculated through the following formulae:

$$\sum_{i=-n_c}^{n} \frac{R_i - I_i}{(1+r')^i} = 0$$

$$R_i = D_i + N_i,$$

$$I_i = E_i + B_i - S_i$$

Where:

E_i: Paid-up equity in the i'th year

B_i: Repayment on principal in the i'th year

n_c: Construction period

r': Internal rate of return on equity

Other factors are the same as in the case of (a).

(c) The present value of the project

If it is assumed that the cut-off rate is as "s", the present value of the project can be obtained through the following formula:

$$PV = \sum_{i=1}^{n} \frac{R_i}{(1+s)^i} + \frac{S_n}{(1+s)^n} - I_o$$

Where:

PV: The present value of the project (in US Dollars)

Other conditions are the same as in the case of (a).

4-3 Studies on the Optimum Complex Scheme

4-3-1 Product Prices

(1) The calculations of the domestic demand for the final products have been conducted by incooperating the price GDP elasticity model into a simulation model, and then by basing upon the expected domestic product price levels, in linkage with other pertinent economic calculations. The trend of domestic prices is as discussed in 2-5, Part I.

A comparison of the expected supply price trend in the Philippines with the import prices from Japan reveals are approximate analogy. Further, it has been assumed that the sales tax is applicable uniformly at a rate of 4%. Therefore, the net sales price is 96% of the actual sales price.

(2) As has been mentioned in the prerequisite conditions, the prices of intermediate products have been calculated in such a manner that the internal rate of return will become 15%. However, as far as VCM is concerned, the value obtained by subtracting from the PVC prices the "value added" of PVC at US$350/t has been taken as the actual prices of VCM at the stage of scheme selection.

It is difficult to strictly estimated the "value added" of PVC in the Philippines because of the possible difference which will take place in the transportation cost, etc., or depending on whether the plant is already existing or will be constructed in the future, and the site conditions.

In this writing, an estimation was made on the basis of the difference between the VCM import price at 1974 and the supply price of domestically reproduced PVC.

VCM import price:	495 (US$/t)	as of 1974
PVC supply price:	810	as of 1974
Value added:	315	as of 1974
Escalation :	35	as of 1974 to 1980
Equivalent value added:	350	as of 1980

(3) The estimated product prices are as shown in Table 4-3.

Table 4-3 Estimated Product Price

(US$/t)

	Product Price		Remarks
	excl. 4 % sales tax	incl. 4 % sales tax	
Ethylene	557.7	-	IRR=15%,excl. sales tax
Propylene	446.2	-	IRR=15%,excl. sales tax
Chlorine	255.7	-	IRR=15%,excl. sales tax
VCM	748.3	778.5	IRR=15%,excl. sales tax
LDPE	1,293.8	1,347.7	
HDPE	1,293.8	1,347.7	
PP	1,316.7	1,371.5	
PVC	1,170.2	1,218.9	

4-3-2 Domestic Demand Forecast

The demand forecast was conducted on the basis of the estimated product prices mentioned in the foregoing section, and from three different viewpoints with a tolerance in-cooperated, i.e., 4-3-4 optimistic viewpoint, 4-3-5 neutral viewpoint, and 4-3-6 pessimistic viewpoint. The pessimistic forecast was obtained by linearly extending the average demand increment achieved so far (Ref. Figs. 4-1 through 4-4).

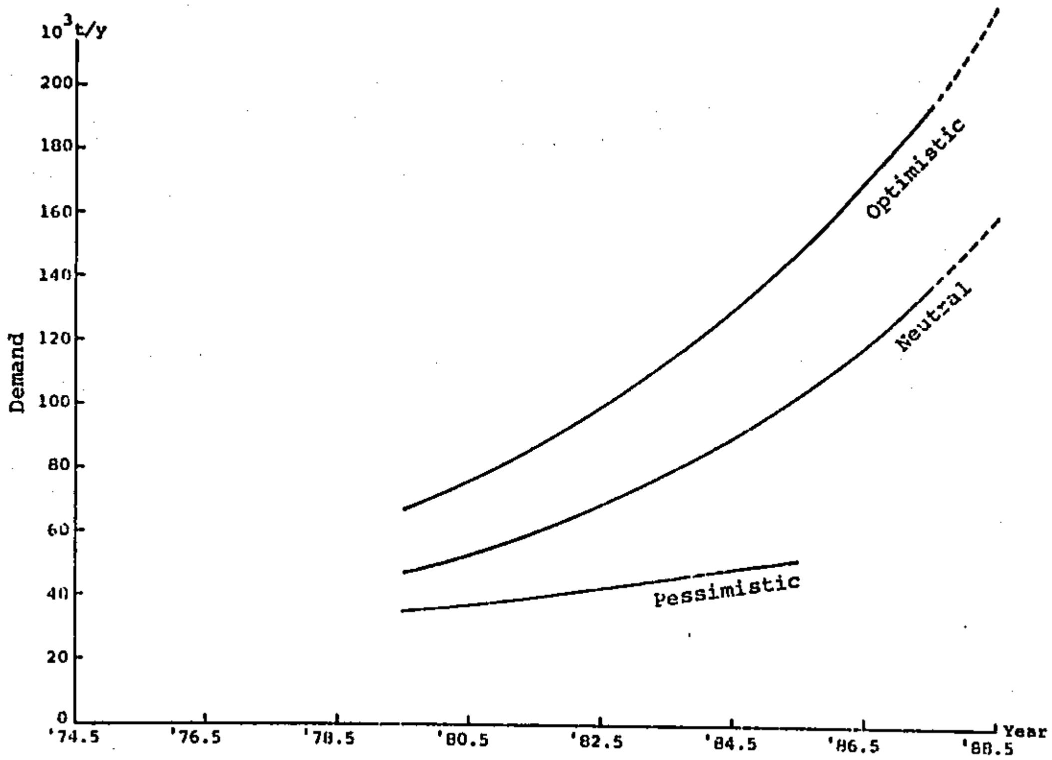

Fig. 4-1 Demand Projection of LDPE in the Philippines

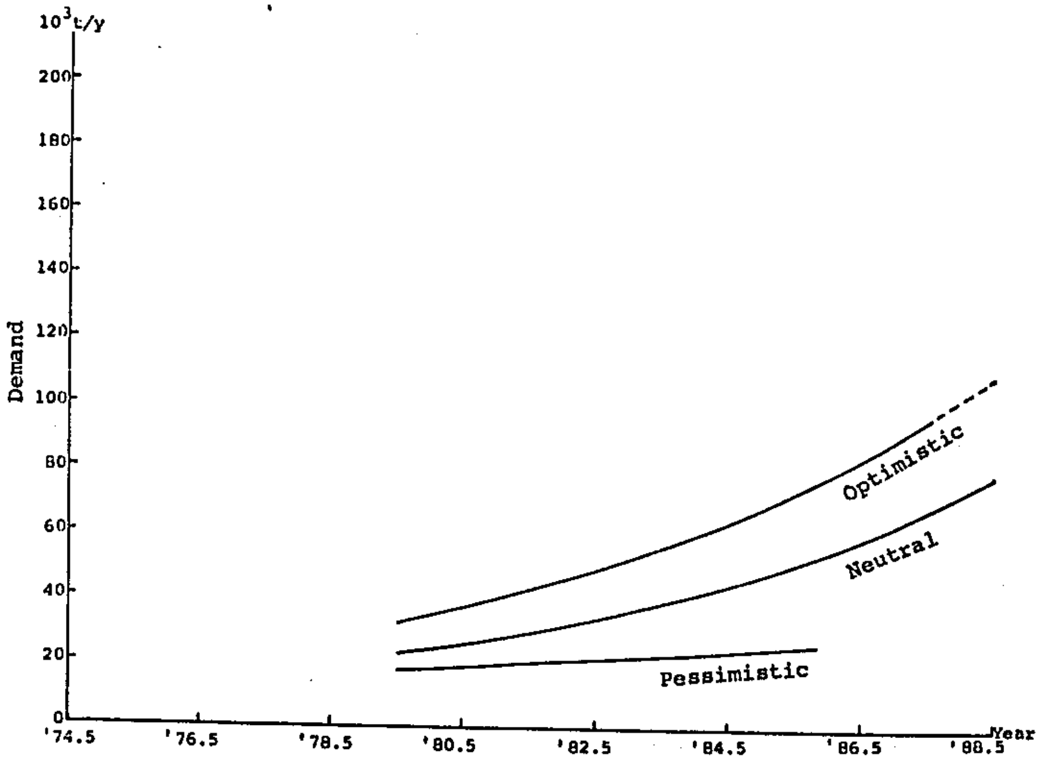

Fig. Fig. 4-2 Demand Projection of HDPE in the Philippines

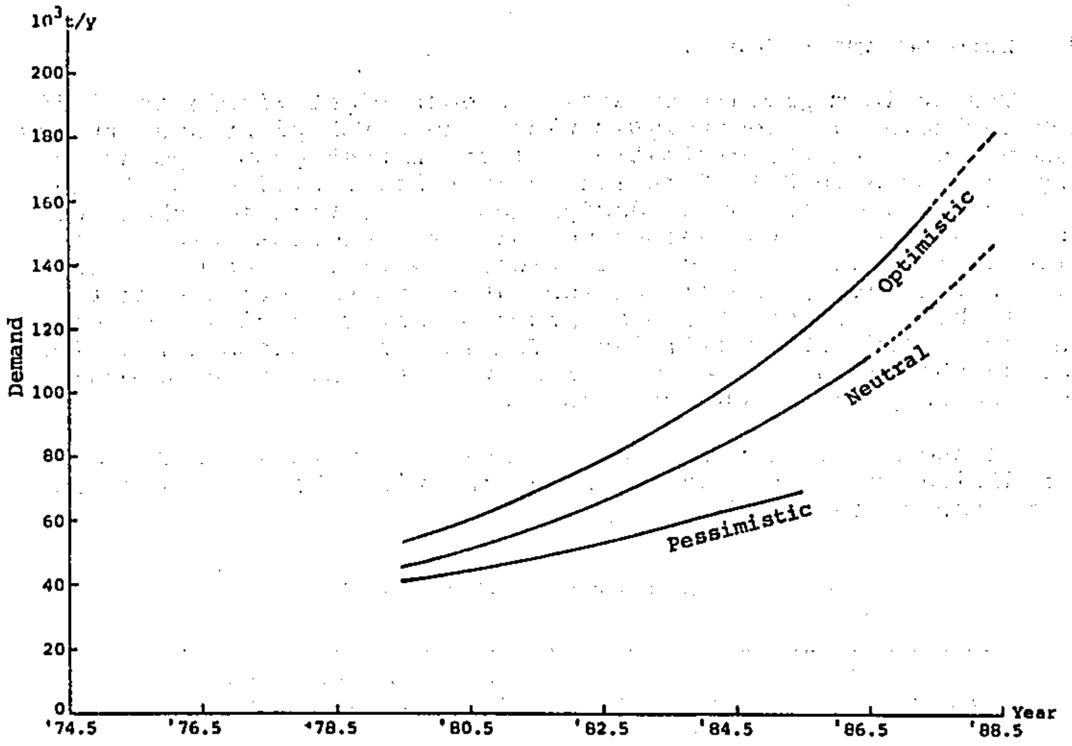

Fig. 4-3 Demand Projection of PP in the Philippines

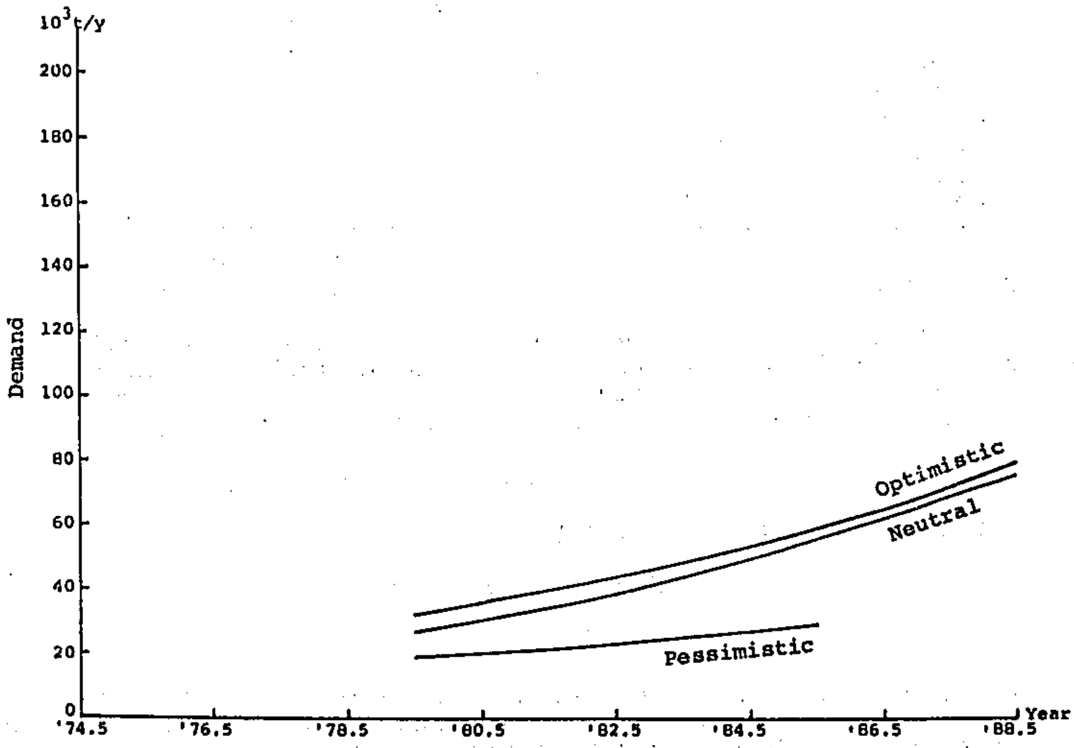

Fig. 4-4 Demand Projection of PVC in the Philippines

4-3-3 Base Scheme - Case I

The optimum production scale of each plant within an olefin complex including an electrolysis plant and a VCM plant was studied in combination with the estimations of the market growth potential. Firstly, as shown in 2-1, Part III basic schemes will be preliminarily chosen, and conceptual design and cost estimation shall be made on the selected processes concerning the process units, off-site facilities, and utility facilities. By taking the obtained results as the basis, the allocation rates and the utility unit price will be calculated for each process unit regarding the cost of the common off-site facilities. Simulation models shall be formulated on the basis of the above factors, and the economic evaluation of the complex is conducted thereon.

On the basis of base case as shown in Table 4-4 and Fig. 4-10, modifications were incorporated employing the scale factors regarding the cases of other complexes.

Table 4-4 Base Scheme Complex - Case I

Products	Plant capacity (t/y)	Consumption of ethylene (t/y)	Consumption of propylene (t/y)
LDPE	110,000	114,400	
HDPE	60,000	63,000	
VCM	55,000	25,700	
PP	90,000		102,600
Production of ethylene	203,100	(203,100)*	
Production of propylene	108,900		
Production of chlorine	32,600		

* Total consumption

4-3-4 Optimum Scale of Each Plant by Optimistic Demand Viewpoint

In addition to the prerequisite conditions and the evaluation bases, the following further prerequisite conditions have been established in order to study the economically optimum scale for each plant, and for the complex as a whole.

Export price : 90% of Japanese ex-factory price

Operational rate: First year : 70%

Second year: 85%

Third year onwards: 90%

In view of the above, the economically most advantageous scale was selected for each plant. The selection of optimum complex scheme was made in such a manner that the most advantageous scale is such that the present value is maximized; the present value has been calculated by discounting the gross cash flow by the standard profit rate of 15% for this project in the Philippines (Ref. to 2-2, Part III).

Also, in order to calculate the present value, economical calculations were undertaken regarding the cases of complexes with the production capacity of 150,000, 200,000, 250,000, 300,000, and 400,000t/y for ethylene production.

As a result of the above-mentioned study, optimum scheme was obtained as shown in Table 4-5. Fig. 4-11 shows the material balance of the complex and the relative process flow.

Table 4-5 Optimum Scheme Complex (Optimistic Demand Projection) - Case III

Products	Plant capacity (t/y)	Consumption of ethylene (t/y)	Consumption of propylene (t/y)
LDPE	180,000	187,200	
HDPE	100,000	105,000	
VCM	60,000	28,000	
PP	130,000		149,800
Production of ethylene	295,000	(295,000)*	
Production of propylene	158,000		
Production of chlorine	35,500		

* Total consumption

4-3-5 Optimum Scale of Each Plant by Neutral Demand Viewpoint

As in the case of 4-3-4, study an economic study was made regarding each plant and the complex as a whole, on the basis of the intermediate market forecast in addition to the already established forecast conditions and evaluation bases.

Export price: 70% of Japanese ex-factory price

Operational rate: First year : 70%

Second year : 85%

Third year onwards: 90%

By conducting economic calculations same as those conducted in the case of 4-3-4, conclusions were obtained as shown in Table 4-6. Figs. 4-5 through 4-9 show the present values, the internal rate of return against the gross investment and capital, and the extent of the variation in the cost caused by the change in the production scale regarding each project.

Table 4-6 Optimum Scheme Complex (Neutral Demand Projection) - Case II

Products	Plant capacity (t/y)	Consumption of ethylene (t/y)	Consumption of propylene (t/y)
LDPE	90,000	93,600	
HDPE	40,000	42,000	
VCM	40,000	23,700	
PP	72,500		82,700
Production of ethylene	154,300	(154,300)*	
Production of propylene	82,700		
Production of chlorine	23,700		

* Total consumption

Fig. 4-11 shows the material balance and process flow of the complex. The production cost changes are shown in Figs. 4-18 through 4-20. These data have been obtained by conducting calculations after presuming complexes having production capacity figures of 100,000, 150,000, 200,000, 250,000, and 300,000t/y which are analogous to the complexes establish as the basic case. The change which will take place in the total investment is shown in Fig. 4-21.

Tables 4-10 and 4-11 stipulate a summary of the investment, production cost, and profitability for the basic case, as well as for the optimum scheme. However, in view of the balance between the export amount and the domestic demand, the operational rates of the basic case have been modified as follows (Ref. Figs. 4-14 through 4-17 concerning production, domestic demand, and export amount):

Operational rate: First year : 60%

Second year : 75%

Third year onwards: 90%

Also, an assumption has been made that the export price will be 80% of Japanese FOB price.

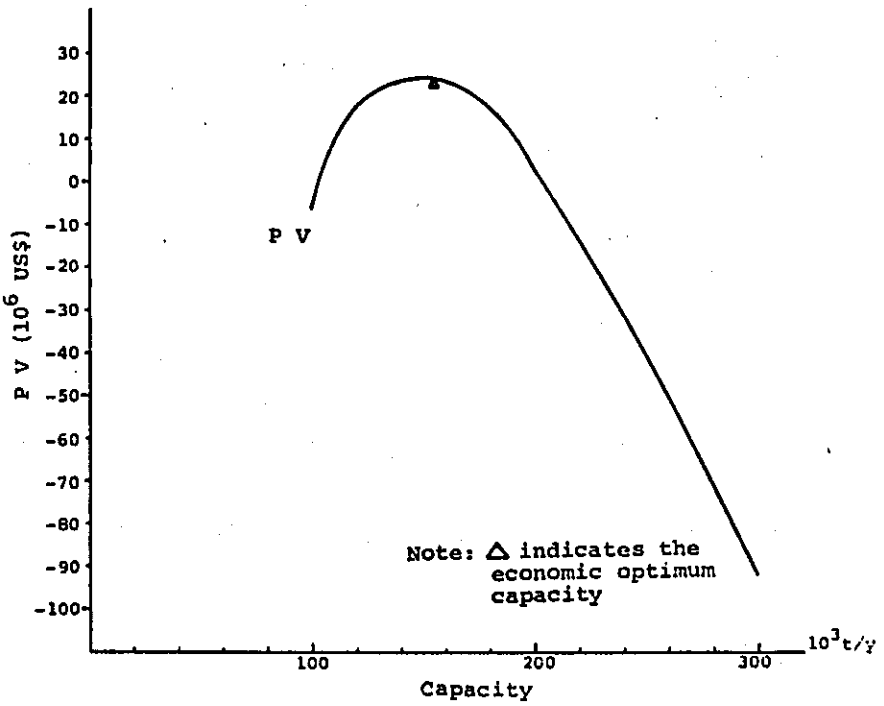

Fig. 4-5 Change of Present Value of Project by Capacity Change - Total Complex

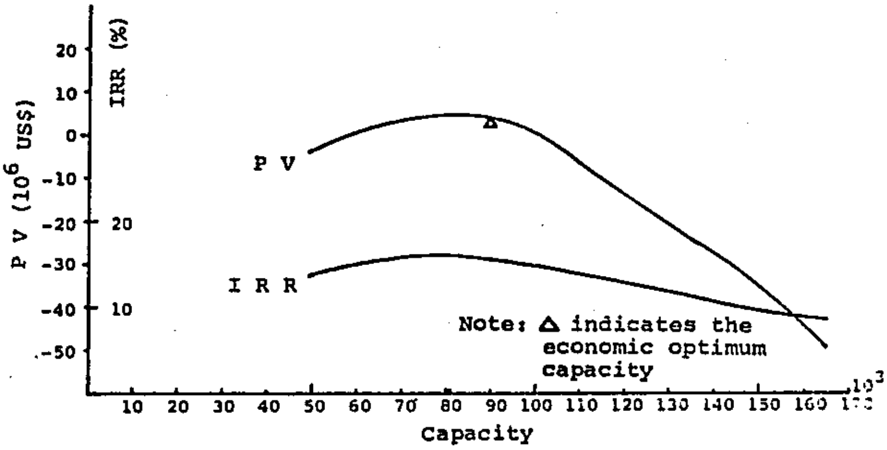

Fig. 4-6 Change of PV and IRR by Capacity Change - LDPE Plant

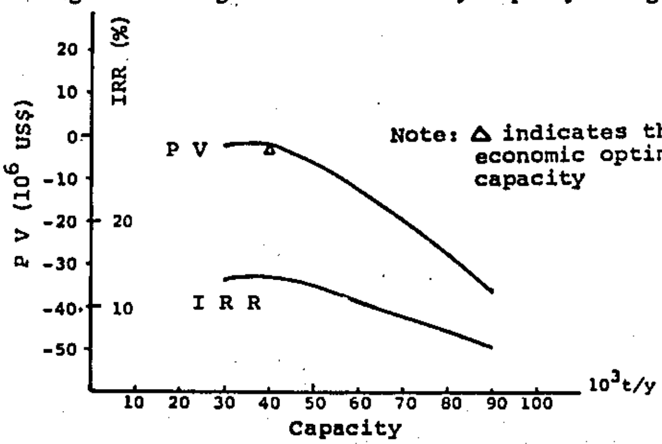

Fig. 4-7 Change of PV and IRR by Capacity Change - HDPE Plant

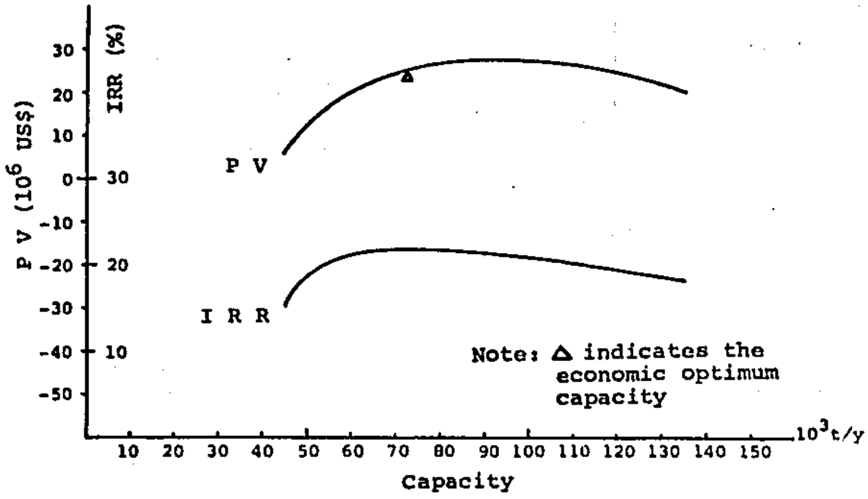

Fig. 4-8 Change of PV and IRR by Capacity Change - PP Plant

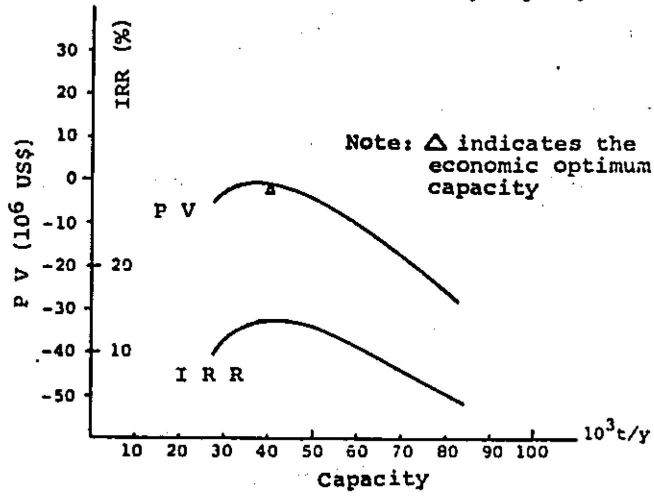

Fig. 4-9 Change of PV and IRR by Capacity Change - VCM Plant

4-3-6 Optimum Scale of Each Plant by Pessimistic Demand Forecast

As is evident from Figs. 4-1 through 4-4, the scale of the complex corresponding to the demand, on an assumption that commercial operation will be started in mid-1979, will be for 100,000t/y ethylene consumption, thereby failing in attaining the economic scale of production.

4-3-7 Complex without the Production of Chlorine Derivatives

The question as to whether or not the VCM and electrolysis plants be installed inside the Rosario, Cavite, complex depends on the solution of another question as to whether VCM should be produced on the basis of carbide process acetylene or shall be imported in the form of EDC or VCM.

Generally speaking, the production cost of VCM is lower by the ethylene route process than by producing from carbide process acetylene. However, the raw material for the PVC which will be domestically produced prior to the completion of the olefin complex consist mostly of VCM produced from the carbide process acetylene.

If an emphasis were to be placed on this point in view of the national benefit considerations, the acetylene process may become a popular process in the Philippines depending upon the price of hydroelectricity and the timing of the complex construction. (Ref. 6-1, Part II). At the same time, the VCM produced inside the Philippines by the ethylene route process at a comparatively small-scaled plant will suffer from a cost disadvantage in vying with the imported VCM which has been massed-produced (Ref. Table 4-7).

Table 4-7 Comparison of VCM Price

(US$/t)

	1975	1980
Ex-factory Price (in Japan)	283	382
CIF Price (from Japan)	350	420
Landed Price	-	562
Ex-factory Price/ Production Cost	-	748.3/ 644.5

Therefore, in some cases the utilization of imported VCM may be feasible from a pure economical consideration. However, VCM production consumes the highest amount of chlorine which will be generated through the electrolysis of salt. Therefore, if the domestic production of VCM were suspended, the imports of the by-produced caustic soda, which is one of the basic chemicals, will have to be increased. Therefore, regarding the production of VCM, evaluation should be made by taking into account the overall national benefit considerations pertaining to these points.

These leads to a possibility of excluding the VCM production scheme from the scope of the complex. Table 4-12 shows a summary of the investment, production cost, and profitability in such a case. If the VCM production is excluded from the scope of the complex, the consumption of ethylene will be reduced, thereby making the scale of the ethylene plant smaller, which will in turn boost the ethylene production cost. The economy of each project and the complex as a whole in such an event have been compared with the basic case (Ref. Tables 4-8 and 4-9). When the VCM production is excluded, the ethylene production will be reduced, and therefore, the amount of by-produced propylene will also fall. Therefore, the scale of the PP plant was adjusted to the reduced level of propylene production. Fig. 4-13 shows the material balance and the process flow of such a complex.

Table 4-8 Comparison between the Base Case and the Complex Excluding VCM and Electrolysis Plant

	Case I	Case IV
	Base Case	Complex Excluding VCM and Electrolysis Plant
Ethylene Plant	203,000 t/y	177,000 t/y
Polypropylene Plant	90,000 t/y	83,400 t/y
Total Investment	600.4 MMUS$	493.8 MMUS$
Ethylene Price	557.5 US$/t	560.9 US$/t
Propylene Price	446.2 US$/t	448.7 US$/t

Table 4-9 **Comparison of Profitability between the Base Case and the Complex Excluding VCM and Electrolysis Plant**

(PV: 10^6US$, IRR: %)

	Case I Base Case			Case IV Complex Excluding VCM and Electrolysis Plant		
Plant	PV	IRR on Project	IRR on Equity	PV	IRR on Project	IRR on Equity
Ethylene	0.0	15.0	19.3	0.0	15.0	19.3
Electrolysis	0.0	15.0	19.3			
V C M (P V C)	-8.0	10.8	11.4			
L D P E	5.3	16.0	20.0	4.1	15.8	19.6
H D P E	-4.2	13.4	15.8	-4.9	13.1	15.4
P P	32.5	22.5	29.9	31.6	22.8	30.4
Total Complex	25.6			30.9		

As is evident from Tables 4-8 and 4-9, the question of inclusion or exclusion of the VCM and electrolysis plants from the scope of complex will exert almost no influence upon the whole complex in view of the fact that the major raw material for VCM is chlorine (59.3%), and that the scale of VCM production is comparatively small.

4-3-8 Project Summary of the Alternative Schemes

The process flows and material balances for the alternative complex schemes are outlined in Figs. 4-10 through 4-13. The balances between projected domestic demand and production for each product are shown in Figs. 4-14 through 4-17. For reference, the changes in production cost and investment cost in relation to the capacity changes are shown in Tables 4-18 through 4-21. These changes were computed during the course of the calculations for the selection of the optimum economic scale. Therefore, the calculated costs for downstream product involve the influence of intermediate product price changes caused by the change in the complex scale.

Table 4-10 shows the summary of the economic calculation for each process plant of the base case, case I. The calculated results are obtained during the course of the economic calculations for the scheme selection on the basis of the neutral domestic demand projection and on an assumption that both the intermediate product and downstream product bear 4% sales tax.

Tables 4-11 and 4-12 show the summarized results of the calculation for an optimum scheme under the neutral domestic demand projection (case II), and for the scheme excluding the chlorine and chlorine derivative plants (case IV), respectively. In these tables, the sales tax for the intermediate product is assumed to be exempted. However, the sales tax for the downstream product at an average rate of 4%, is excluded both from sales price and production cost for the sake of simplicity in computation.

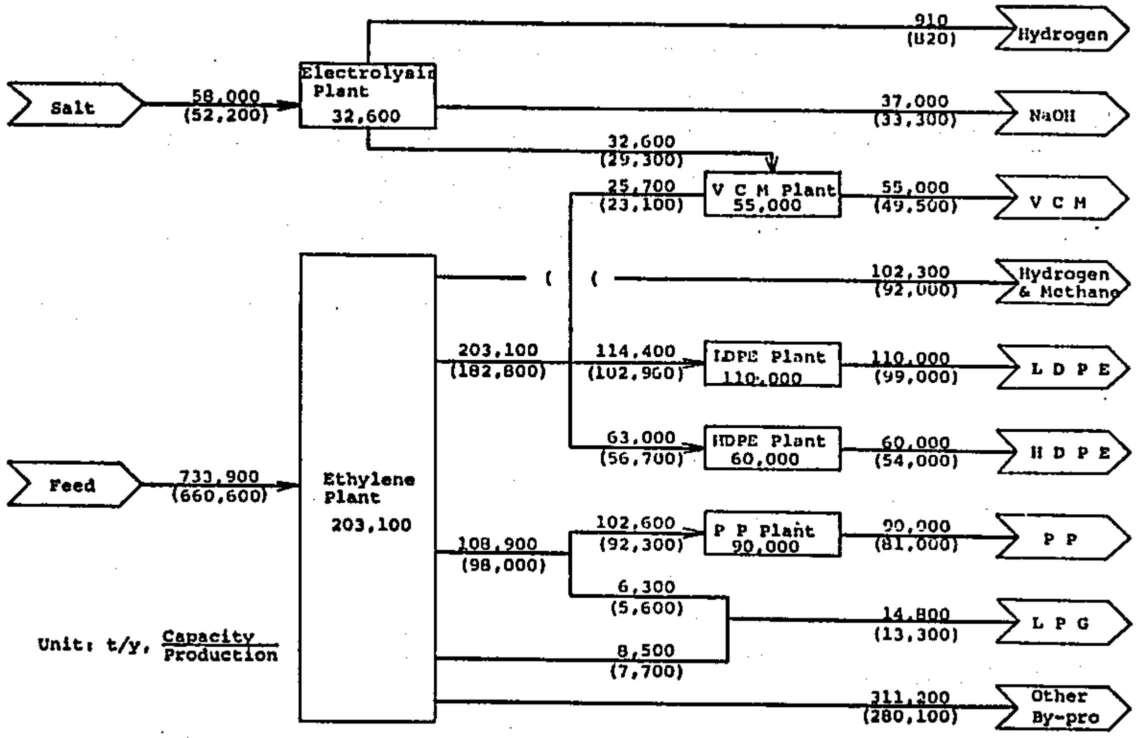

Fig. 4-10 Process Flow and Balance for Case I–Base Case

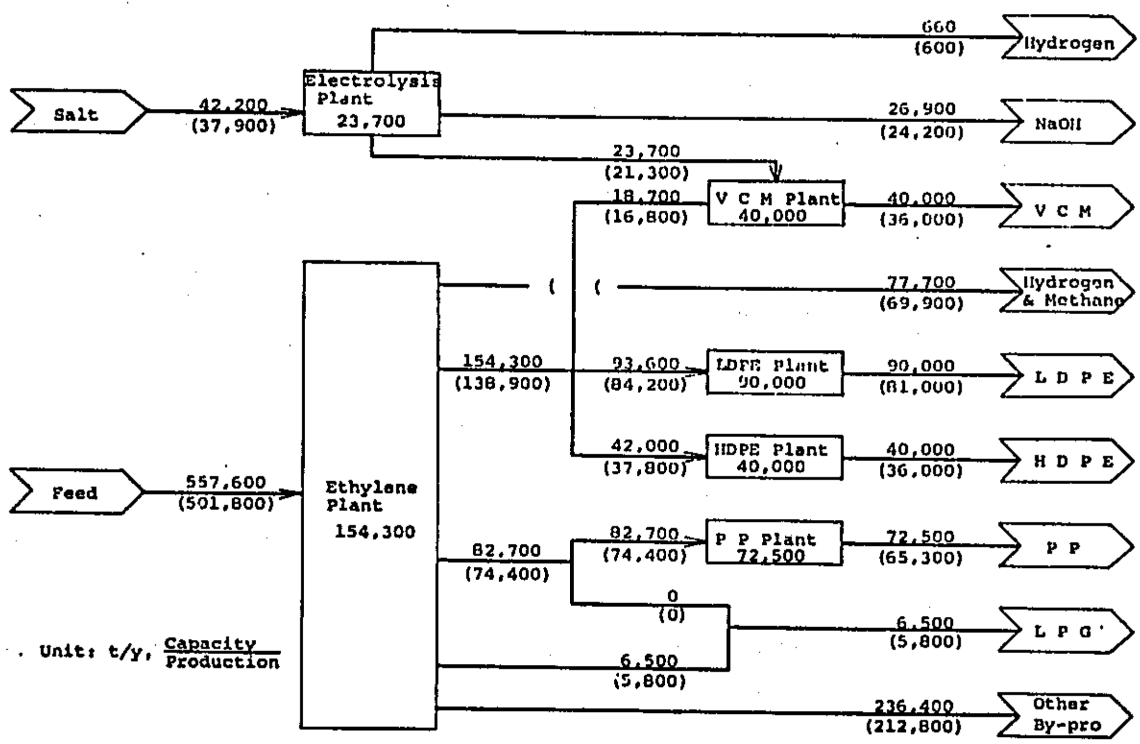

Fig. 4-11 Process Flow and Balance for Case II
–Optimum Case Based on the Neutral View on the Demand

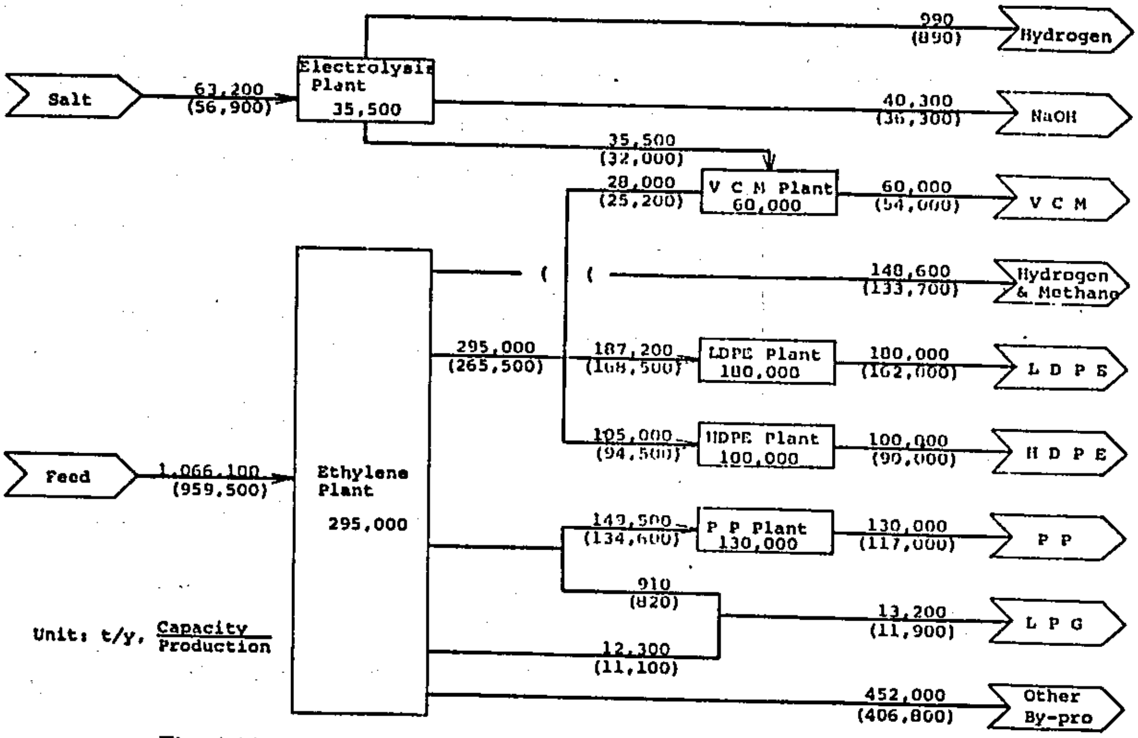

Fig. 4-12 Process Flow and Balance for Case III
—Optimum Case Based on the Optimistic View on the Demand

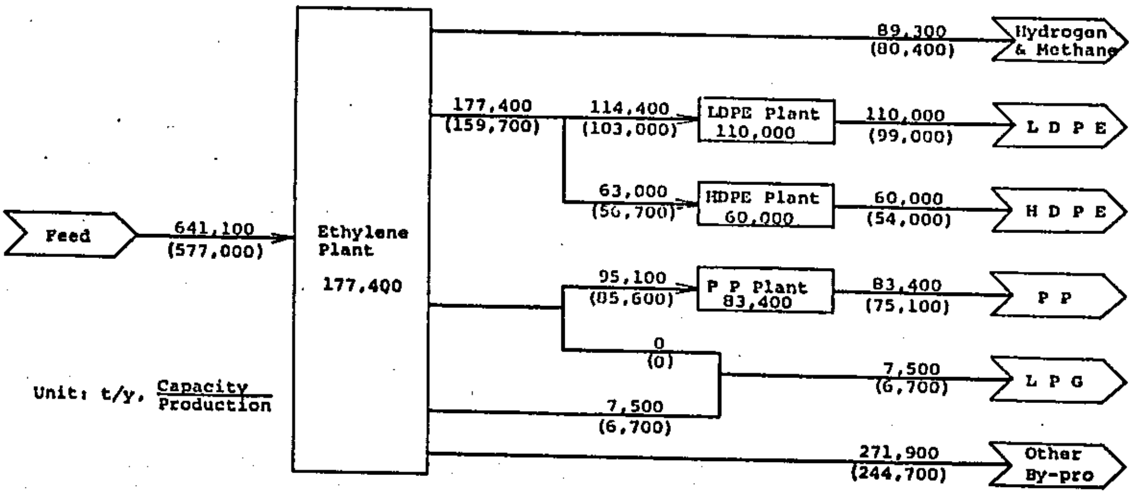

Fig. 4-13 Process Flow and Balance for Case IV
—Separate Complex Case Excluding Electrolysis and VCM Plant

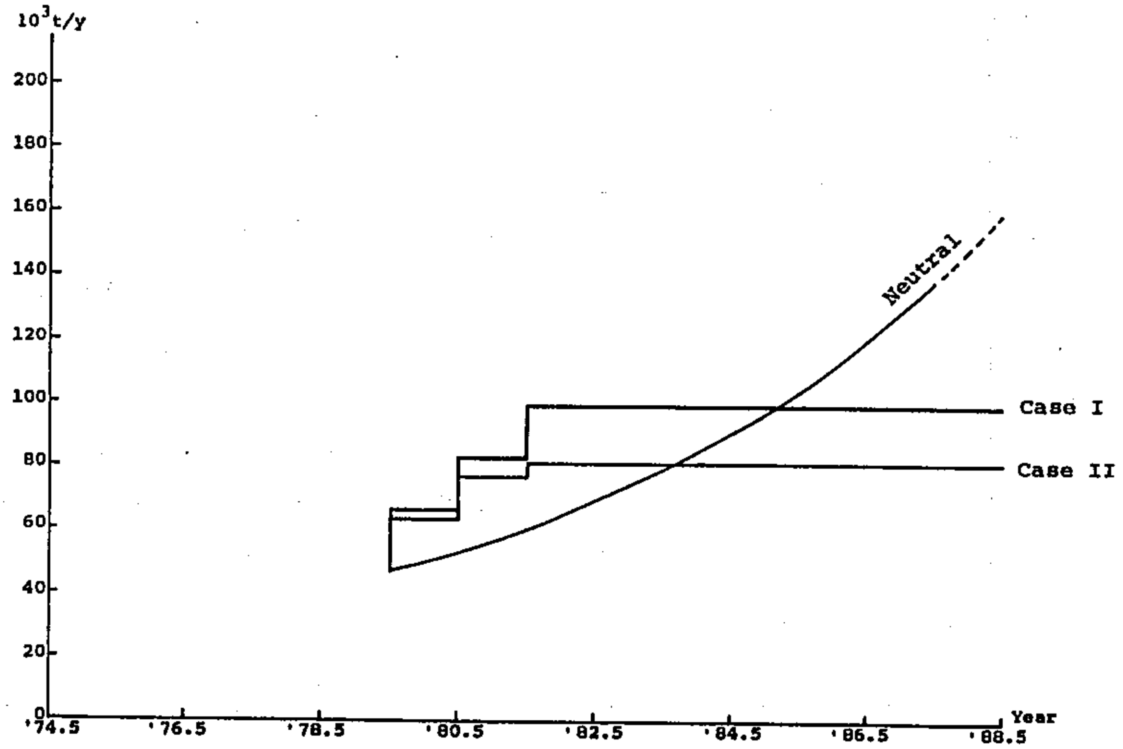

Fig. 4-14 Domestic Demand and Projected Production of LDPE in the Philippines Base/Optimum Capacity (Case I/Case II) and Neutral View on Demand

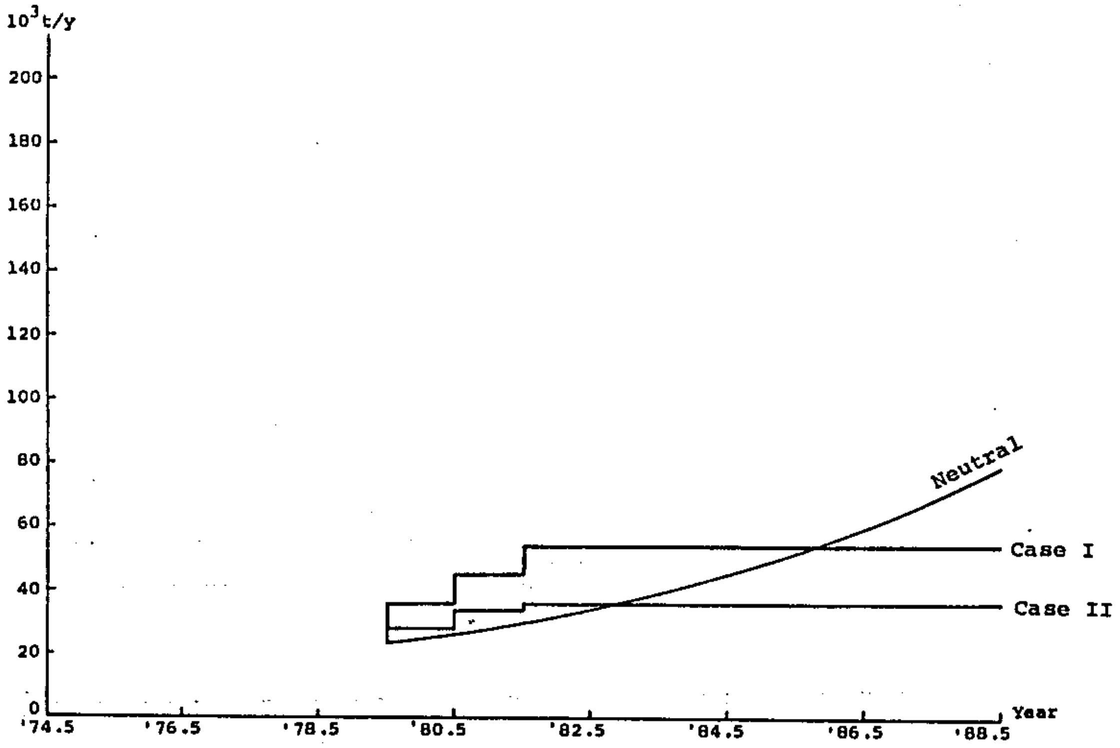

Fig. 4-15 Domestic Demand and Projected Production of HDPE in the Philippines Base/Optimum Capacity (Case I/Case II) and Neutral View on Demand

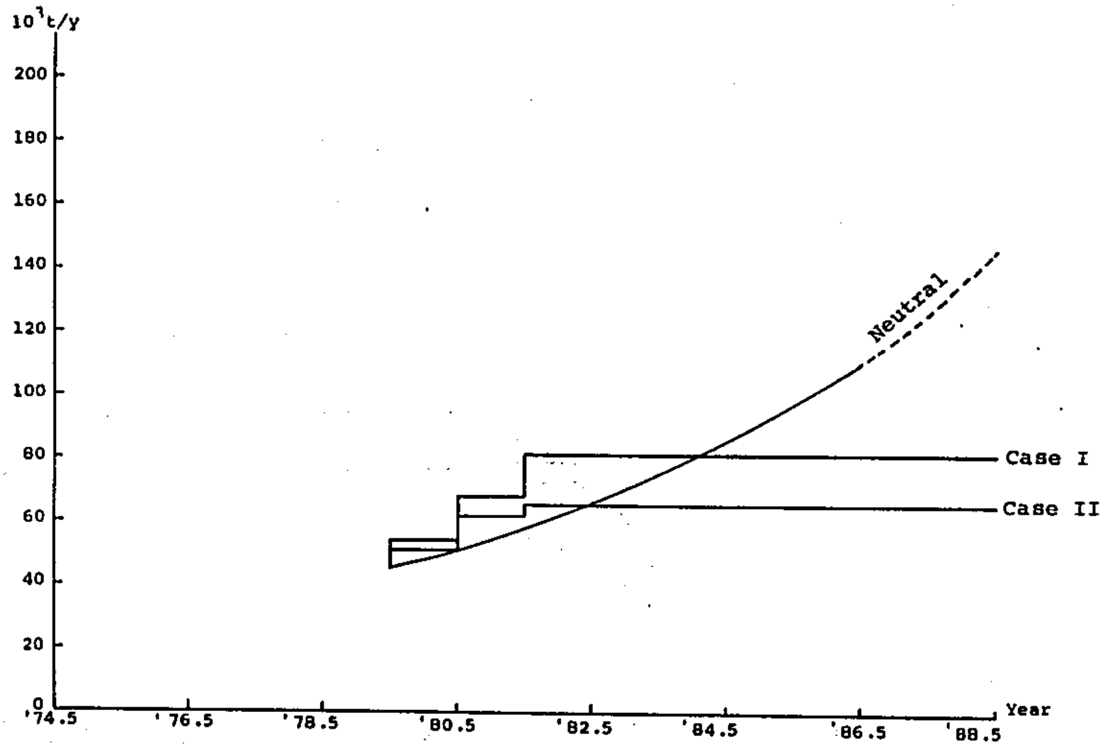

Fig. 4-16 Domestic Demand and Projected Production of PP in the Philippines Base/Optimum Capacity (Case I/Case II) and Neutral View on Demand

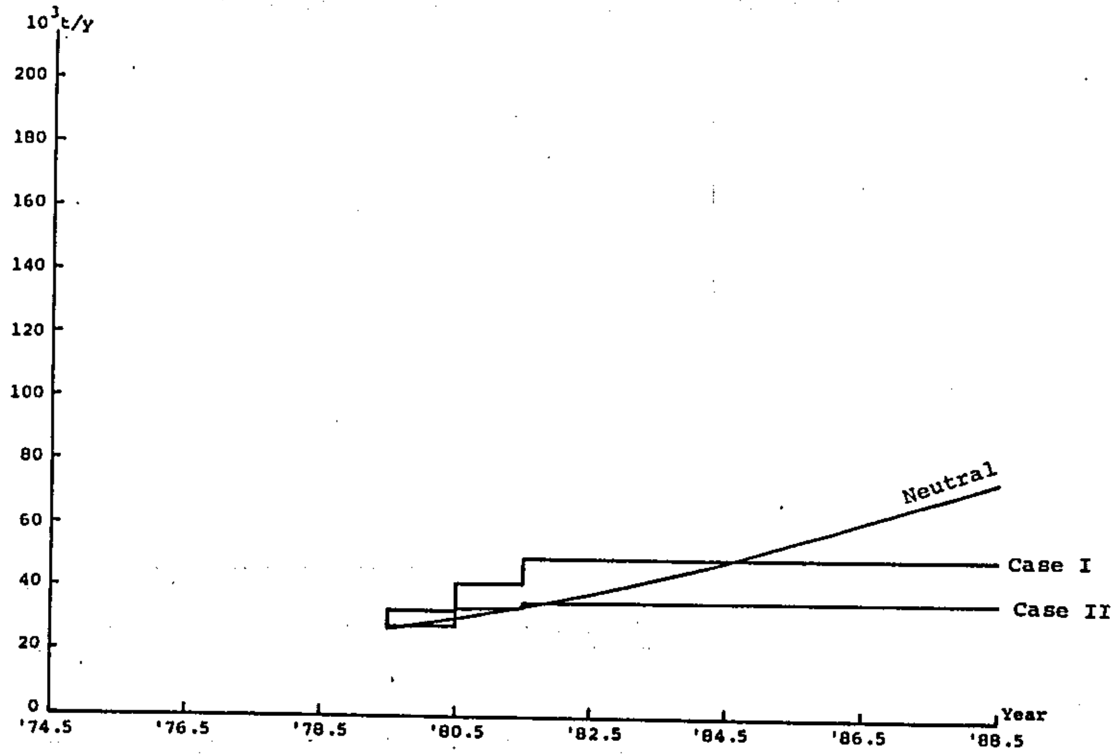

Fig. 4-17 Domestic Demand and Projected Production of VCM (PVC) in the Philippines Base/Optimum Capacity (Case I/Case II) and Neutral View on Demand

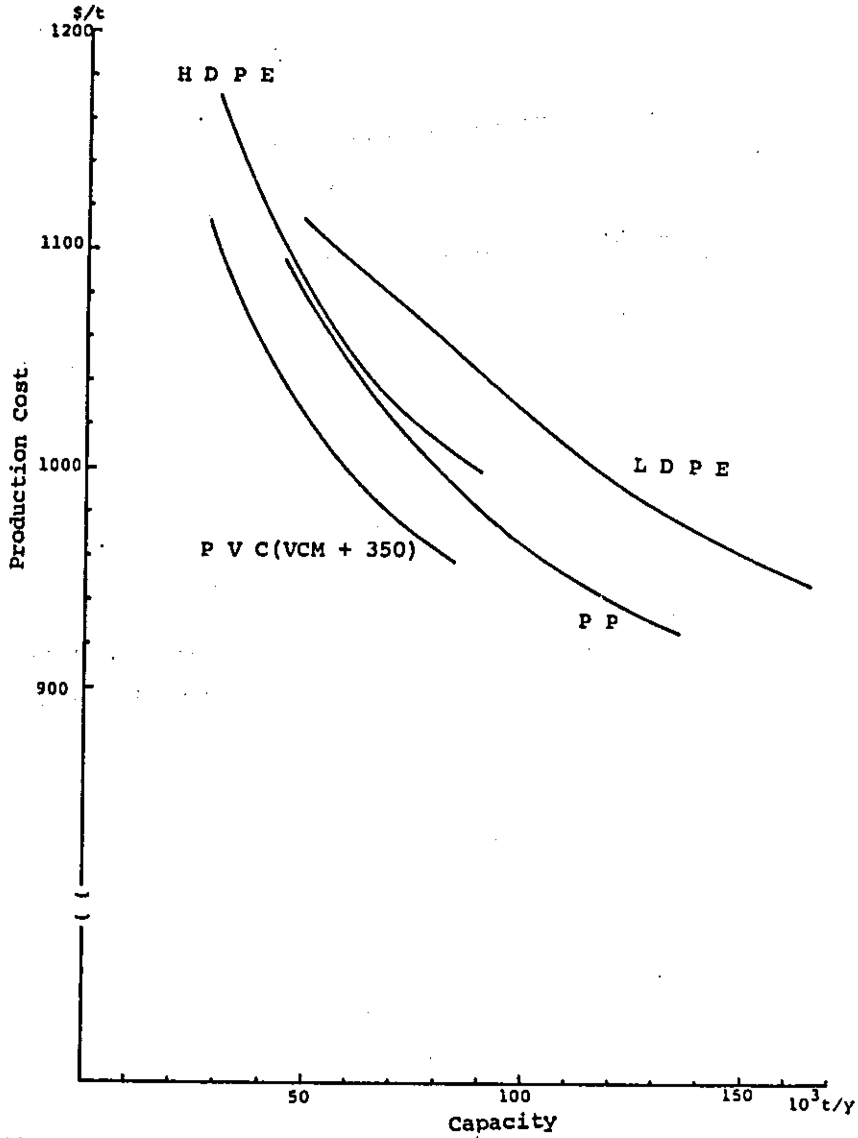

Fig. 4-18 Change of Production Cost by Capacity Change - LDPE, HDPE, PP and PVC

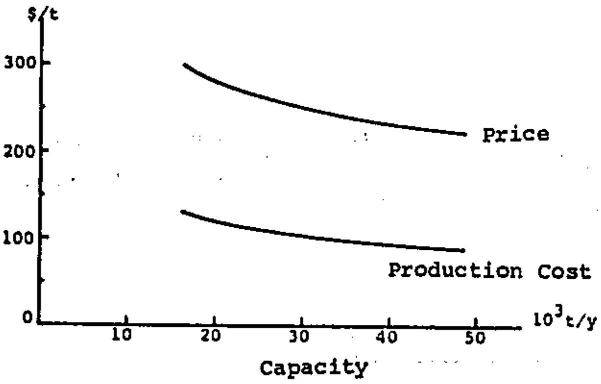

Fig. 4-19 Change of Production Cost and Price by Capacity Change - Chlorine

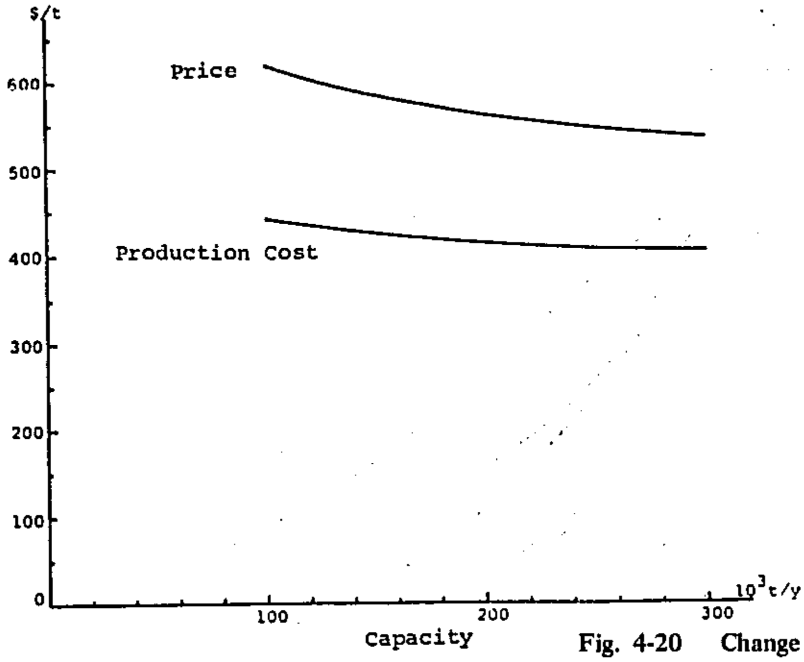

Fig. 4-20 Change of Production Cost and Price by Capacity Change - Ethylene

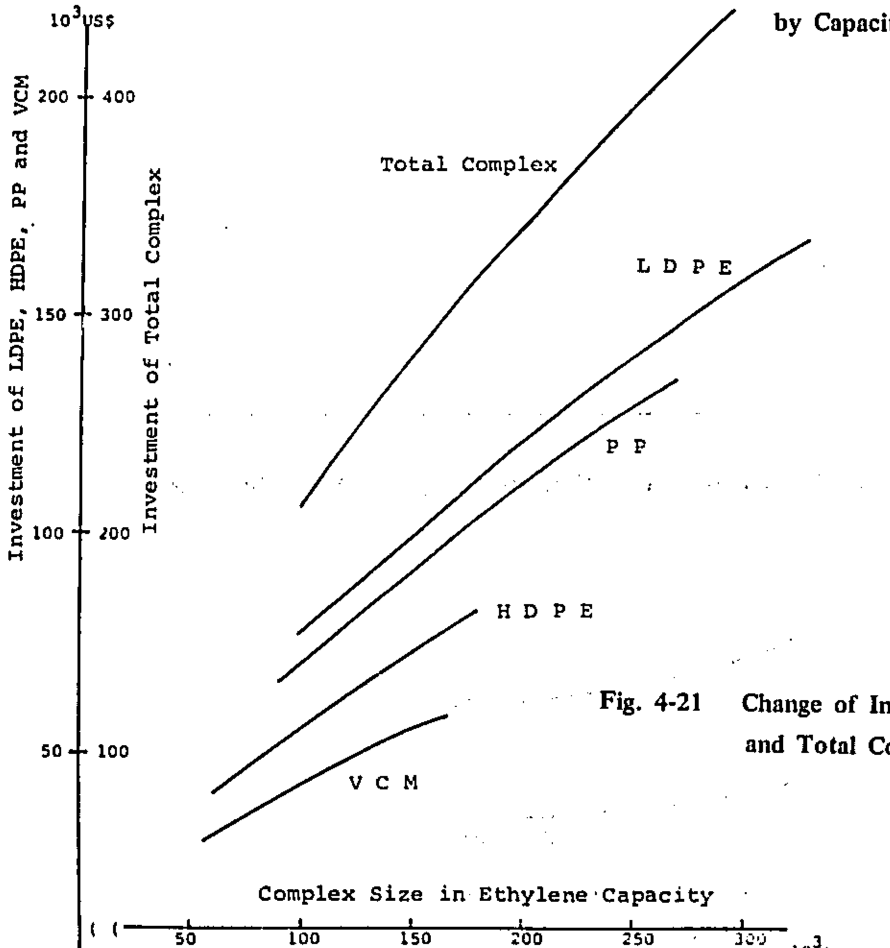

Fig. 4-21 Change of Investment of Each Process Plant and Total Complex by Capacity Change

Table 4-10 Summary of Investment, Unit Production Cost, and Profitability of Each Process Plant and Total Complex

Case Number : Case I

Purpose of Study: Base Case

Cal Number : No. 23-(3)

Ethylene Production Capacity: 200,000 MTA

	Unit	Complex Total	Ethylene	Chlorine	V C M* (P V C)	L D P E	H D P E	P P
Plant Capacity	10^3 MTA		203.1	32.6	55.0	110.0	60.0	90.0
Total Capital Requirement	10^6 $	600.4	227.2	36.7	44.1	127.2	62.1	103.1
I.R.R. on Investment	%		15.0	15.0	10.8	16.0	13.4	22.5
I.R.R. on Equity	%		19.3	19.2	11.4	20.0	15.8	29.9
Present Value of Project	10^6 $	25.6	0.0	0.0	-8.0	5.3	-4.2	32.5
Breakdown of Unit Production Cost @ 1984								
Variable Cost	$/T		180.0	-120.2	455.7	719.5	785.3	697.0
Fixed Cost	$/T		215.6	218.2	157.7	222.8	198.9	218.8
Distri. & Admini.	$/T		20.1	4.9	398.7	63.4	65.6	62.1
Total Production Cost	$/T		415.7	102.9	1,012.2	1,005.8	1,049.8	978.0
Sales Price								
Domestic	$/T		557.7	255.7	1,218.9**	1,347.7**	1,347.7**	1,371.5**
Export	$/T				499.2	681.0	773.0	813.0
Average	$/T		557.7	255.7	1,139.0	1,229.1	1,201.8	1,337.2
Sales Tax	$/T		22.3	10.2	43.3	44.3	40.2	51.5

Note: * The profitability of VCM plant is evaluated in such a manner that the price of product is equal to PVC but the production cost includes "value added in the PVC plant", 350 US$/t.

** Inclusive of sales tax

Table 4-11 Summary of Investment, Unit Production Cost, and Profitability of Each Process Plant and Total Complex

Case Number : Case II
Purpose of Study: Optimum Scheme Based on the Neutral Market View
Cal Number : No. 34
Ethylene Production Capacity: 150,000 MTA

	Unit	Complex Total	Ethylene	Chlorine	V C M (P V C)	L D P E	H D P E	P P
Plant Capacity	10^3 MTA		154.3	23.4	40.0	90.0	40.0	72.5
Total Capital Requirement	10^6 $	504.9	189.1	28.2	36.2	112.7	48.3	90.4
I.R.R. on Investment	%	17.5	15.0	15.0	15.9	17.7	16.8	23.6
I.R.R. on Equity	%		19.6	19.5	20.7	23.0	21.8	31.9
Present Value of Project	10^6 $	48.2	0.0	0.0	1.3	12.4	3.4	31.1
Breakdown of Unit Production Cost @ 1984								
Variable Cost	$/T		169.7	-120.2	457.4	720.4	786.1	697.8
Fixed Cost	$/T		233.1	229.0	175.8	238.1	227.6	235.0
Distri. & Admini.	$/T		20.4	5.5	399.8	64.3	67.1	62.9
Total Production Cost	$/T		423.2	114.4	1,033.0	1,022.8	1,080.8	995.8
Sales Price								
Domestic	$/T		558.6	257.8	1,170.2	1,293.8	1,293.8	1,316.7
Export	$/T				499.2	681.0	773.0	813.0
Average	$/T		558.6	257.8	1,170.2	1,293.8	1,293.8	1,316.7
Sales Tax	$/T		0.0	0.0	0.0	0.0	0.0	0.0

Table 4-12 Summary of Investment, Unit Production Cost, and Profitability of Each Process Plant and Total Complex

Case Number : Case IV

Purpose of Study: Complex Excluding of VCM and Electrolysis Plant

Cal Number : No. 30-(2)

Ethylene Production Capacity: 180,000 MTA

	Unit	Complex Total	Ethylene	Chlorine	V C M	L D P E	H D P E	P P
Plant Capacity	10^3 MTA		177.4			110.0	60.0	83.4
Total Capital Requirement	10^6 $	493.8	206.4			127.2	62.1	98.1
I.R.R. on Investment	%		15.0			15.8	13.1	22.8
I.R.R. on Equity	%		19.3			19.6	15.4	30.4
Present Value of Project	10^6 $	30.9	0.0			4.1	-4.9	31.6
Breakdown of Unit Production Cost @ 1984								
Variable Cost	$/T		168.7			722.8	788.6	699.9
Fixed Cost	$/T		224.0			222.9	199.0	224.5
Distri. & Admini.	$/T		19.9			63.6	65.8	62.6
Total Production Cost	$/T		412.6			1,009.4	1,053.4	986.9
Sales Price								
Domestic	$/T		560.9			1,293.8	1,293.8	1,316.7
Export	$/T					681.0	773.0	813.0
Average	$/T		560.9			1,184.7	1,161.6	1,316.7
Sales Tax	$/T		0.0			0.0	0.0	0.0

4-4 Effects of the Prerequisite Economic Conditions upon the Project Selection

Study has been made regarding the effects upon the complex scheme selection exerted by the changes which will take place in the market conditions and the profitability of the complex caused by the alteration in the major economic evaluation bases or in the prerequisite conditions as follows.

4-4-1 Effects of Economic Growth Rate

The domestic demand consumption is based on a prerequisite condition that the GDP economic growth rate of the Philippines at 7%/y which is the target rate by the National Economic Development Plan. However, in practice the global economic recession affected the countries all over the world since the oil crisis, and in some advanced countries, the absence of economic growth is even predicted for some years to come.

On the other hand, in the case of the developing countries, the economic recession will exert an adverse effect in the form of stagnation in the exportation of their primary products and the price hike in the importation of industrial products. Conversely, however, developing countries have a potential for rapid expansion of demand for petrochemical industrial products if certain conditions were satisfied, and this point has been proven historically in some cases.

In view of the above points, comparative studies conducted regarding the domestic demand and the profitability by assuming the economic growth rate of the Philippines at levels of 5, 7, and 9%/y (Ref. Tables 4-13 and 4-14). The effects of economic growth on domestic demand are evidently shown in Table 4-13. If the domestic demand is assumed at 100 in the basic case in which the economic growth rate is 7%/y, the domestic demand levels in the cases of economic growth rates being 5%/y and 9%/y will respectively be 70 and 140 in mid-1983 which is five years after the commencement of the operation. In other words, the difference between 5%/y and 9%/y in the economic growth rate manifests itself in 2-fold effects in terms of demand. Because of such an effect, the influence upon the project profitability is also serious. Thus, the profitability at 5%/y and 9%/y will respectively result in the difference between -80×10^6 U.S. Dollars and 90×10^6 U.S. Dollars in terms of the present value, and 11.6% and 18.8% in terms of the internal rate of return.

In the case of a project in which the plant scale is reduced, for instance, the optimum scheme by the intermediate demand forecast will show a higher degree of advantage when compared to a large-scale complex in the event of stagnation in the economic growth. However, the reduction of the scale from 200,000t/y to approximately 150,000t/y will not be effective to cope with an economic growth stagnation by 2%/y. In the case of 5%/y of economic growth rate, the present value is -22.3×10^6 U.S. Dollars, and 13.9% in terms of internal rate of return (Ref. Table 4-15).

Table 4-13 Comparison of Domestic Demand Affected by Change of GDP Growth Rate

(10^3t/y)

GDP Growth rate \ year		(1) 79.5	(2) 80.5	(3) 81.5	(4) 82.5	(5) 83.5	(6) 84.5	(7) 85.5	(8) 86.5	(9) 87.5	(10) 88.5
	5 %	38.9	42.9	47.3	52.2	57.5	63.4	69.9	77.1	85.0	93.7
LDPE	7 %	47.4	54.2	62.1	71.1	81.4	93.2	106.7	122.1	139.8	-
	9 %	57.4	68.2	81.1	96.3	114.4					
	5 %	19.3	21.2	23.4	25.8	28.5	31.4	34.6	38.2	42.1	46.4
HDPE	7 %	23.4	26.8	30.7	35.2	40.3	46.1	52.8	60.5	69.2	79.3
	9 %	28.4	33.8	40.1	47.7	56.8					
	5 %	22.0	24.0	26.2	28.6	31.2	34.1	37.2	40.1	44.3	48.3
PVC	7 %	27.1	30.6	34.5	39.0	44.0	49.7	56.1	63.3	71.4	74.3
	9 %	33.0	38.8	45.2	53.2	62.6					
	5 %	36.4	39.9	43.7	47.9	52.5	57.5	63.1	69.1	75.8	(81.0)
PP	7 %	45.7	51.9	58.9	66.9	76.0	86.3	98.0	111.3	-	-
	9 %	54.0	67.2	79.1	98.4	122.4					

Table 4-14 Comparison of Profitability Affected by Change of GDP Growth Rate - Base Case (Case I)

(PV: 10^6US$, IRR: %)

Plant	5%/y PV	5%/y IRR on Project	5%/y IRR on Equity	7%/y PV	7%/y IRR on Project	7%/y IRR on Equity	9%/y PV	9%/y IRR on Project	9%/y IRR on Equity
Ethylene	0.0	15.0	19.3	0.0	15.0	19.3	0.0	15.0	19.3
Electrolysis	0.0	15.0	19.2	0.0	15.0	19.2	0.0	15.0	19.2
V C M (P V C)	-32.6	-	-	-8.0	10.8	11.4	6.1	18.5	24.8
L D P E	-33.2	8.5	7.5	5.3	16.0	20.0	29.3	20.6	27.5
H D P E	-23.0	5.5	2.3	-4.2	13.4	15.8	8.4	18.3	23.6
P P	8.9	17.1	21.9	32.5	22.5	29.9	46.4	25.9	35.0
Total Complex	-79.9	11.6		25.6			90.2	18.8	

Table 4-15 Comparison of Profitability Affected by Change of GDP Growth Rate - Optimum Case (Case II)

(PV: 10^6US$, IRR: %)

	5%/y Operational Rate 1st;60%, 2nd;75%, 3rd;90%			7%/y Operational Rate 1st;70%, 2nd;85%, 3rd;90%		
Plant	PV	IRR on Project	IRR on Equity	PV	IRR on Project	IRR on Equity
Ethylene	0.0	15.0	19.3	0.0	15.0	19.3
Electrolysis	0.0	15.0	19.2	0.0	15.0	19.5
V C M (P V C)	-10.6	7.6	5.9	1.3	15.9	20.7
L D P E	-17.1	11.2	12.2	12.4	17.7	23.0
H D P E	-6.9	11.4	12.6	3.4	16.8	21.8
P P	12.3	18.4	23.9	31.1	23.6	31.9
Total Complex	-22.3	13.9		48.2	17.5	

4-4-2 Effects of the Timing for Commencement of the Plant Operation

The determination of time for commencing the operation of the plant has a close bearing upon the extent of the domestic market growth. For instance, if the commencement is unduly delayed, the possibility for low-cost exportation will be reduced if the plant capacity scale is set on the same level because of the growth of the domestic market during the period of the delay. Therefore, the longer the delay in the commencement, the higher will be the project profitability. Thus, when the economic viability of the project does not warrant a reasonable rate of profit, there may be cases in which a delay in the commencement of the plant operation may be necessary. However, the delay will naturally cause opportunity loss that the profit would have been gained from the existing market in the meantime.

The comparison was made regarding the present value and the internal rate of return of the project regarding the complex of the basic scheme as shown in Table 4-16 on the basis of the operation commencement in mid-1979, for each project. The results of the calculations reveal that for the basic scheme complex, the internal rate of return of the all projects will exceed 15% if delayed by one year. However, as is evident from Fig. 4-22, the present value of the project will be vastly improved by delaying the start-up by one year from mid-1979; however, any further delay will yield no effects comparable to those gained by the first one-year delay.

Table 4-16 Comparison of Profitability Affected by Change of Start up Year (Case I)

(PV: 10^6US$)

Plant	'79.5 start				'80.5 start				'81.5 start			
	PV* cal	PV** '79.5	IRR on Project (%)	IRR on Equity (%)	PV* cal	PV** '79.5	IRR on Project (%)	IRR on Equity (%)	PV* cal	PV** '79.5	IRR on Project (%)	IRR on Equity (%)
LDPE	5.3	5.3	16.0	20.0	19.2	16.7	18.6	24.3	31.2	29.6	21.0	28.2
HDPE	-4.2	-4.2	13.4	15.8	2.9	2.5	16.1	20.2	9.1	6.9	18.6	24.2
PP	32.5	32.5	22.5	29.9	40.2	35.0	24.4	32.8	45.9	34.6	25.8	34.8
VCM (PVC)	-8.0	-8.0	10.8	11.4	0.5	0.4	15.3	19.2	5.8	4.4	18.4	24.5
Ethylene	0	0	15.0	19.3	0	0	15.0	19.3	0	0	15.0	19.3
Electrolysis	0	0	15.0	19.3	0	0	15.0	19.3	0	0	15.0	19.3
Total	25.6	25.6			62.8	54.6			91.8	69.4		

* Present Value of project calculated on each start up year basis

** Present Value of project modified on 1979.5 start up year basis

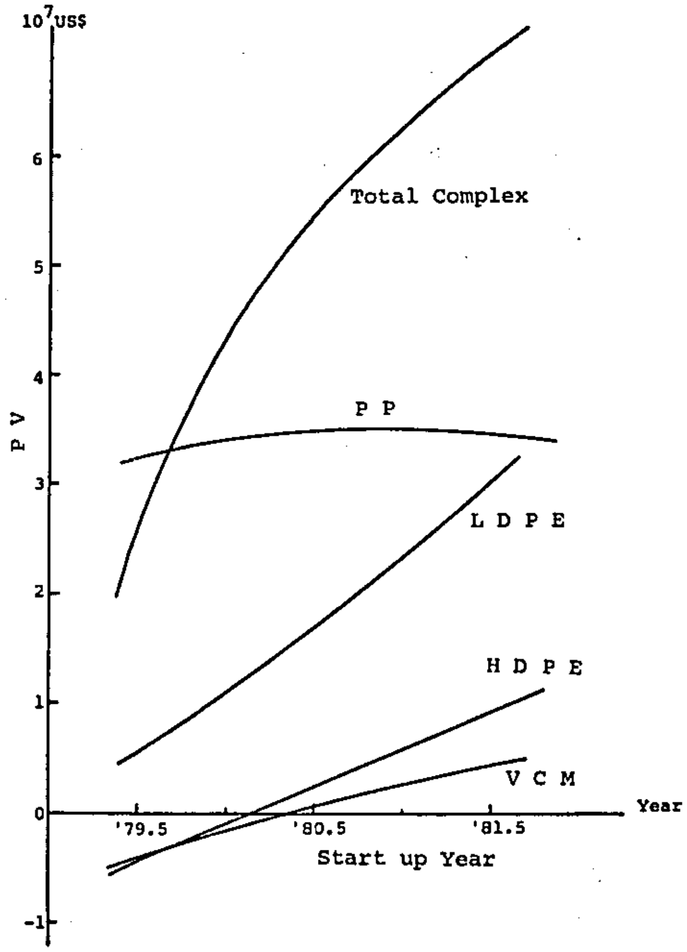

Fig. 4-22 Change of PV of Total Complex and Each Process Plant by Change of Start up Year

4-4-3 Effects of Inflation

The prerequisite conditions pertaining to inflation stipulate that the progress rate prior to the commencement of the operation shall be 10%/y inside the Philippines, and 7%/y internationally. (However, the difference between the degree of inflation progress in the Philippines and overseas at the time of the operation commencement shall be deemed to be adjusted by the change in the rate of exchange of foreign currency.) It must be noted here the effects of inflation after the commencement of the operation has been disregarded to evaluate the viability of a project on the safer side. Actually, however, the progress of inflation all over the country is inevitable. Therefore, in this study a comparative study was conducted by effecting calculations on an assumption that the inflation factor for the raw materials, intermediate products, utilities, and final products, shall be 7%/y generally, and 10%/y on labor cost, both for the period after commencement of the operation.

The obtained results are shown in Table 4-17. In the case of chemical plants and other capital-intensive industries, the effects of inflation work favorably on the profitability of the operation. However, the capital recovery for effecting re-investment will inevitably fall short, if depreciation alone is provided. A summary of the investment, production cost, and profitability by assuming 7%/y as the inflation factor after the commencement of operation is shown in Table 4-18.

Table 4-17 Comparison of Profitability Affected by Change of Inflation (Case I)

(PV: 10^6US$, IRR: %)

Inflation	0%/y after Start Operation			7%/y after Start Operation		
Plant	PV	IRR on Project	IRR on Equity	PV	IRR on Project	IRR on Equity
Ethylene	0	15.0	19.3	0	15.0	18.0
Electrolysis	0	15.0	19.2	0	15.0	18.9
VCM	0	15.0	19.1	0	15.0	18.8
LDPE	5.3	16.0	20.0	69.5	25.6	33.0
HDPE	-4.2	13.4	15.8	27.9	23.8	30.2
PP	32.5	22.5	29.9	88.3	31.5	40.7
Total Complex	33.5			185.7		

4-4-4 Effects of Marketing Policy

As has been mentioned in Chapter 2, Part I, the existence of a considerable size of market is indispensable as a condition for wholesome growth of a petrochemical complex. Particularly in the case of the Philippines where the imported hydrocarbons will be the basic raw materials, it is highly necessary to have the considerable domestic market growth in which the profitability is comparatively high, rather than directing the establishment of an export-oriented petrochemical complex. In this connection, a study has been made regarding the relationship between the supply price and demand employing the price-GDP-elasticity model for demand. Further, scrutinization was conducted to choose the desirable growth pattern of the domestic demand in view of the profitability of the projects (Ref. 2-5, Part I, concerning the possibility of the substitution by each petrochemical industrial product).

(1) Supply price and the size of market

If the supply price is lowered, the market will expand; however, the extent of profitability deterioration due to the lowered price is much greater than the demand expansion.

Therefore, in the case of a project in which a certain allowance is available in the profitability, it is possible to reduce the supply price in order to grow the market, and further, to foster the downflow industries. However, in the case of a tight-profitability project, the necessary level of the profitability of the project will be possibly secured by maintaining the supply price level high; however, by so doing the growth of the domestic market may be sacrificed. Therefore, as a criterion for evaluating the optimum degree for a certain project scheme, the extent of capability for lowering the supply price is an important point. In the study, a calculation was made to obtain the minimum price figure

Table 4-18 Summary of Investment, Unit Production Cost, and Profitability of Each Process Plant and Total Complex

Case Number : Case I
Purpose of Study: the Effects of Inflation (7%/year after start up)
Cal Number : No. 28-(2)
Ethylene Production Capacity: 200,000 MTA

	Unit	Complex Total	Ethylene	Chlorine	V C M	L D P E	H D P E	P P
Plant Capacity	10^3 MTA		203.1	32.6	55.0	110.0	60.0	90.0
Total Capital Requirement	10^6 $	596.4	226.2	36.6	43.6	126.2	61.5	102.3
I.R.R. on Investment	%		15.0	15.0	15.0	25.6	23.8	31.7
I.R.R. on Equity	%		18.8	18.9	18.8	33.0	30.2	40.7
Present Value of Project	10^6 $	185.7	0.0	0.0	-0.015	69.5	27.9	88.3
Breakdown of Unit Production Cost @ 1984								
Variable Cost	$/T		253.0	-152.3	508.5	860.1	942.8	837.9
Fixed Cost	$/T		231.9	236.2	169.2	238.7	214.0	234.2
Distri. & Admini.	$/T		24.5	4.2	34.3	71.3	74.3	70.0
Total Production Cost	$/T		509.5	88.2	712.1	1,170.2	1,231.1	1,142.1
Sales Price								
Domestic	$/T		657.0	246.8	819.6	1,695.9	1,695.9	1,725.9
Export	$/T					863.0	979.5	1,030.2
Average	$/T		657.0	246.8	819.6	1,547.7	1,514.0	1,683.2

at which the supply can be made at the optimum economic scheme within the framework of the intermediate forecast demand.

The obtained result is as shown in Table 4-19. In this calculation, the standard internal rate of return for each project was set at 15%. From this table, it is clear that the sensitivity of each project against the price factor is quite high, and it is also revealed that there is no significant difference between the possible supply price figures between the basic scheme and the optimum scheme.

Table 4-19 Comparison of Suppliable Prices

	Base Scheme (Case I)			Optimum Scheme (Case II)		
	Price ($/t)	Growth Rate (%)	Demand 1984.5 (t/y)	Price ($/t)	Growth Rate (%)	Demand 1984.5 (t/y)
LDPE	1,348	1.14	93,200	1,318	1.16	97,900
HDPE	1,348	1.14	46,100	1,345	1.15	46,600
PP	1,372	1.14	86,300	1,177	1.23	128,700
PVC	1,219	1.13	49,700	1,218	1.13	49,900

(2) Possibility of substitution between petrochemical industrial products

Regarding this point, a study was made on the possibility of enhancing the economy of the complex schemes by the substitution of the demand for a petrochemical product with others through the study on the replaceability among each petrochemical product. For instance, by substituting the demand for HDPE with PP and PVC, the number of small-scaled plants will be reduced as the HDPE plant will then be no longer necessary.

A study was made regarding an ideal level of demand for the basic scheme although the ideal level of demand thus obtained does not necessarily coincide with the level of supply, as the extent of growth of the demand for each product and the olefin yield level are different from each other. The ideal demand is expressed in terms of a demand curve which signify the attainment of 15% internal rate of return on project after the commencement of the operation. The curve is shown in Fig. 4-23.

The demand for PP is high, and that for LDPE, HDPE, and PVC, which are the ethylene delivatives, is comparatively low. Therefore, nearly all the amount of the propylene turned out from the ethylene plant is used for PP production. In view of the project profitability, it is more desirable to replace the demand for PP with that for HDPE and PVC, after comparing the respective ideal demand curves. However, it is actually impracticable to repalce PP application field with PVC because of the difference in the physical properties of PP and PVC. This leads to the necessity, if any, for the replacement of PP demand with that for HDPE and PS. Conversely, by replacing the HDPE application field with PP, it is possible to eliminate the HDPE plant. However, for increasing the propylene production, the production of the main products ethylene must also be increased. In this event, ethylene consumption will be reduced and the production will also fall, so that even the present propylene amount cannot be covered, thereby making it inevitable to reduce the PP production to a level lower than that of the present. Therefore, the elimination of the HDPE plant is highly difficult to undertake.

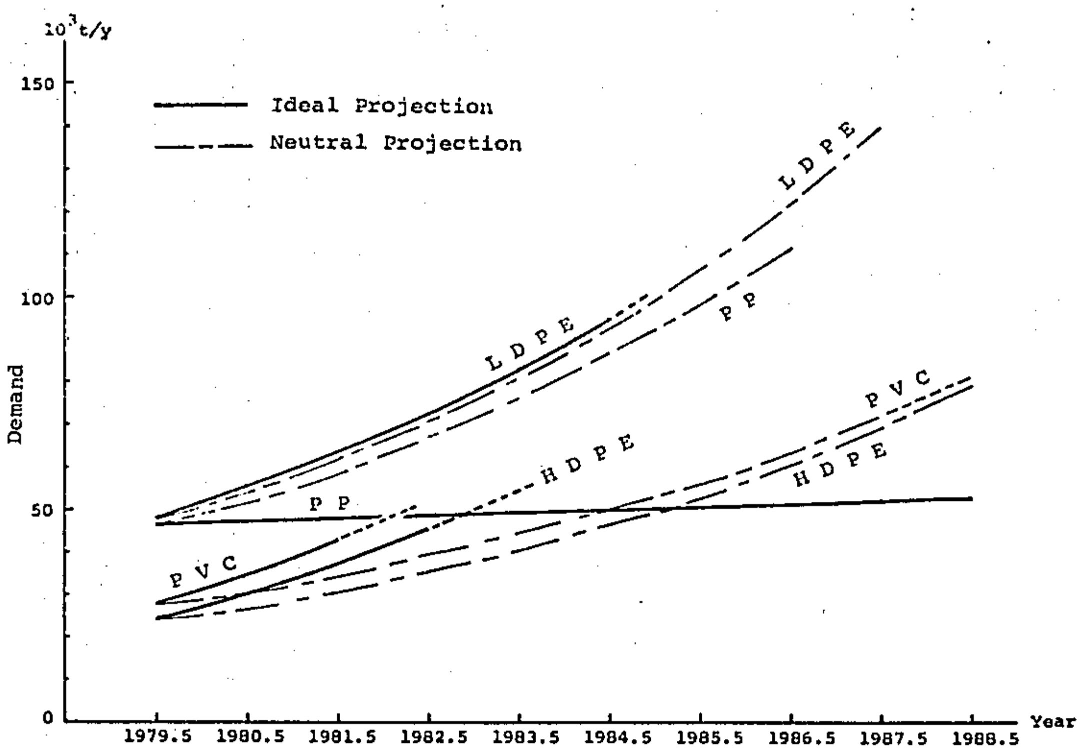

Fig. 4-23 Ideal Demand Projection

4-5 Selection of the Representative Complex Scheme

4-5-1 Observation on the Complex Scheme Selection

A study was made regarding the relationship between the demand forecast and the optimum complex scheme, and also regarding the extent of the effects exerted on the project economy by the change in the economic conditions which were taken as the prerequisite conditions for the scheme selection. As a result, it was discovered that the effects exerted by the changes in prerequisite economic conditions and demand forecast upon the project evaluation and the optimum scheme selection are extremely serious. Normally, when finalizing the production scale for a petrochemical complex, consideration will be duly made regarding the risk caused by the fluctuation in the above-mentioned external uncertain elements, and for the purpose of avoiding such a risk, the complex scheme is finalized at a level lower than the optimum scale obtained by the ordinary evaluation. In this sense, if the operation commencement is limited to mid-1979, and the expected profitability at over 15% internal rate of return, the adequate scale for ethylene production would be 150,000t/y or less (Case II). However, it is important in this respect to take into consideration the potential propensity towards petrochemical industries in the Philippines, for instance, the fact that the country displayed the highest extent of growth in petrochemical industrial products market in Southeast Asia in the past.

In view of the above, an ethylene plant capacity at a scale of 200,000t/y (Case I) was selected as the representative scheme which is deemed to have the international competitiveness in the ethylene plant capacity. In this case, all the derivatives plants, except for that of electrolysis and VCM production, are fully competitive internationally in view of the scale of production.

Table 4-22 shows the summary of investment, unit production cost, and profitability indices for each plant and the whole complex. The details of the production cost (1984 basis) for each product are shown in Tables 4-23 through 4-28, as well as the necessary detailed data for cost calculation such as utility and raw material consumption per unit product, the breakdown of investment cost, etc.

4-5-2 Change in Profitability and Production Cost by Variable Factors

A study was made regarding the change which will take place in the profitability of the complex as a whole, and in the production cost regarding the representative scheme caused by the change in the variable factors. The variable factors are, the basic raw material prices (of naphtha and salt), the final product prices (LDPE, HDPE, PP, and VCM), the operational rates, and the construction cost. As the index for profitability, the present value of the project was used. The sensitivity analysis for each project was conducted regarding the internal rate of return against the project (gross investment), and the production cost. The details in this respect are shown in 6-2, Part II.

(1) The whole complex

As shown in Fig. 4-24, the sensitivity analysis of the profitability of the complex as a whole reveals that the increment in the profit gained by the increase in the price displayed the highest degree of effects even when the reduction effects of domestic demand by the price increase is taken into consideration. However, the establishment of unreasonably high domestic price and large import duty barrier will adversely affect the wholesome growth of the domestic market, e.g., the plastics processing industry, etc.

Followed by the price factor, the variation in the construction cost and the basic raw material cost (naphtha) will affect the profitability by nearly the same extent. The effects exerted by the operational rate fluctuation are comparatively insignificant. This seems to be due to the reduction in the amount of low-cost exportation (approximately 1/2 of the domestic sales price level), if the operational rate should fall, thereby exerting no serious effects on the profitability. Table 4-20 shows the sensitivity of the present value of the complex as whole.

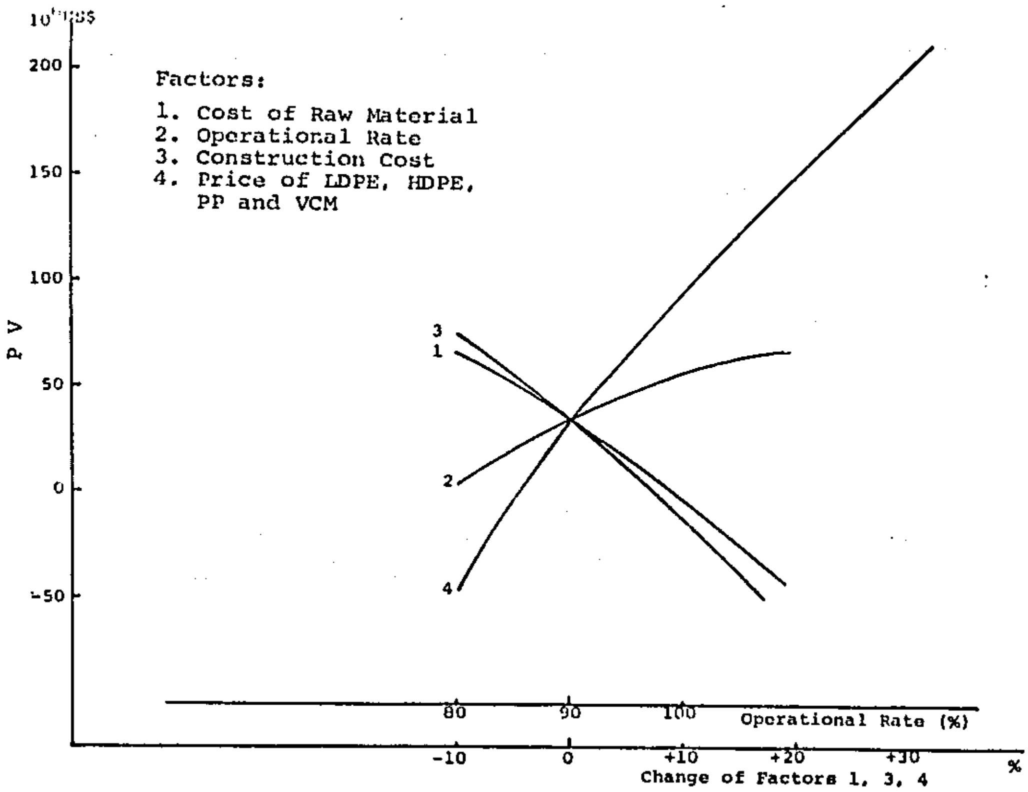

Fig. 4-24 Sensitivity of Present Value of Total Complex to Various Factor Change

Table 4-20 Sensitivity of Present Value - Total Complex

	Base Case	Sensitivity** %	
Domestic Price	100%	6.6	-
Construction Cost	600.4 x 10^6US$(100%)*	-4.4	-0.8 x 10^6US$/$10^6US
Price of Base Raw Material (Naphtha)	151.6 x 10^6US$(100%)	-3.5	-2.31 x 10^6US$/US$/t
Operational Rate	90%	1.8	-

Note: * Total investment

** Degree of change of each factor in order to change the present value by 1 per cent.

On the basis of the data shown in Table 4-20, the figures in Table 4-21 were obtained to show the degree of change in each variable factor which will result in uniform extent of profitability variation. For instance, reduction of the basic raw material price by US$1/t will exsert an effect equal to that resulted by increasing the domestic price by 0.35%, or by reducing the construction cost by 2.63 x 10^6 (US$) in terms of gross investment, or by increasing the operational rate by 1.3%.

Table 4-21 Equivalent Degree of Changes of Each Factor Based on Profitability

Factors / Equivalent	Unit	Domestic Price	Construction Cost	Price of Naphtha	Operational Rate
Domestic Price	%	1.0	-0.12	-0.35	0.15
Construction Cost	10^6US$	-8.3	1.0	2.63	-2.25
Price of Naphtha	US$/t	-2.86	0.35	1.0	-0.78
Operational Rate	%	3.7	-0.4	-1.3	1.0

(2) Possibility of reducing the production cost of each products

In 6-2, Part II, the sensitivity analysis of the variable factors was conducted regarding the internal rate of return and production cost for each plant. The following paragraphs describe the results of a study on the possibility of cost reduction for intermediate raw materials.

(a) Prices of ethylene and propylene

It is possible to reduce the ethylene cost by US$20/t, and propylene cost by US$10/t by switching the comparatively high-cost sea-water to circulation cooling water. It is also possible to increase the propylene price in order to reduce the cost difference between ethylene and propylene. In other words, it is feasible to increase propylene price by US$44/t, and to reduce ethylene price by US$20/t. By means of the above, the following figures will be obtained:

	(Calculated Value) US$/t	(Possible Value) US$/t
Ethylene :	557	517
Propylene:	446	490

(b) Chlorine price

It is possible to reduce the ex-factiry price of chlorine by US$150/t by effecting price increase for caustic soda, reduction in electrical power cost, or by reducing construction cost by means of eliminating the caustic soda purification process through the employment of new processes such as the ion-exchange membrane cell process, etc.

The following figures will be obtainable by effecting these provisions:

	(Calculated Value) US$/t	(Possible Value) US$/t
Chlorine :	257	107
Caustic Soda:	400	up to 500

(c) VCM price

It is possible to reduce the VCM price by US$180/t by means of cutting the prices for ethylene and chlorine, or by reducing the construction cost through the rationalization of the pollution control facilities by taking into account the specific situation of the Philippines.
If such provisions are actually practicable, it would be amply possible to cope well with imported prices.

	(Calculated Value) US$/t	(Possible Value) US$/t
VCM :	748	568 (excluding sales tax)

4-5-3 Project Summary and Breakdown of Production Cost for the Representative Complex Scheme - Case I

Table 4-22 shows a summary of the representative complex scheme, case I, which is selected for the further detailed economic and financial evaluation, and the detailed complex study, e.g., an arrangement of complex layout. The breakdown of production cost for each process plant is shown in Tables 4-23 through 4-28.

Table 4-22 Summary of Investment, Unit Production Cost, and Profitability of Each Process Plant and Total Complex

Case Number : Case I
Purpose of Study: Authorized Base Case. Ethylene, Chlorine Sales Tax 0.0%
VCM, LDPE, HDPE, PP Sales Tax 4.0%
Cal Number : No. 22
Ethylene Production Capacity: 200,000 MTA

	Unit	Complex Total	Ethylene	Chlorine	V C M	L D P E	H D P E	P P
Plant Capacity	10^3 MTA		203.1	32.6	55.0	110.0	60.0	90.0
Total Capital Requirement	10^6 $	600.4	227.2	36.7	44.1	127.2	62.1	103.1
I.R.R. on Investment	%		15.0	15.0	14.9	16.0	13.4	22.5
I.R.R. on Equity	%		19.3	19.2	19.1	20.0	15.8	29.9
Present Value of Project	10^6 $	33.5	0.0	0.0	-0.2	5.3	-4.2	32.5
Breakdown of Unit Production Cost @ 1984								
Variable Cost	$/T		180.0	-120.2	455.7	719.5	785.3	697.0
Fixed Cost	$/T		215.6	218.2	157.7	222.8	198.9	218.8
Distri. & Admini.	$/T		20.1	4.9	31.0	63.4	65.6	62.1
Total Production Cost	$/T		415.7	102.9	644.5	1,005.8	1,049.8	978.0
Sales Price								
Domestic	$/T		557.7	255.7	778.5	1,347.7	1,347.7	1,371.5
Export	$/T					681.0	773.0	813.0
Average	$/T		557.7	255.7	778.5	1,229.1	1,201.8	1,337.2
Sales Tax	$/T				31.1	44.3	40.2	51.5

Table 4-23 Breakdown of Production Cost and Investment of Ethylene Production

**** 1984 YEAR OF PRODUCTION COST CALCULATION ***** 75-05-19

* PROCESS	PYROLYSIS	* RATED CAPACITY	203085. (T/Y)	* TIME OF CONSTRUCTION	1979.5
* PRODUCTS	ETHYLENE	* OPERATION RATE	90. (%)		

* CAPITAL REQUIREMENT (UNIT= 1000*D)

* PROCESS UNIT	154519.	* LAND	2812.	* INT.DUR.CONST.	23976.
* OFF SITE	12780.	* PREOP. EXPENSE	10653.	* CONTINGENCY	9038.
TOTAL FIXED CAPITAL	213778.				
TOTAL WORKING CAPITAL	13395.				
TOTAL CAPITAL REQUIREMENT	227173.				

* PRODUCTION COST (PRODUCT BASE)	UNIT PRICE(D)	CON/PRO(/T)	AMOUNT (1000*D/Y)	UNIT COST (D/T)
FEED	151.600	3.614	100140.	547.9
C3	427.574	0.536	-41889.	-229.2
OTHER HYPRO.	138.500	2.036	-51540.	-282.0
LPG	122.200	0.042	-938.	-5.1
OTHER	1.800	1.000	329.	1.8
TOTAL RAW MATERIALS & BYPRODUCTS			6102.	33.4
ELECTRIC	0.067	88.800	1096.	6.0
M.STEAM	11.600	0.190	403.	2.2
H.STEAM	15.100	0.260	718.	3.9
IND.W	0.054	0.0	0.	0.0
B.F.W	1.010	0.300	55.	0.3
S.W	0.103	451.000	8491.	46.5
NITROGEN	0.127	8.000	186.	1.0
FUEL	10.900	7.960	15858.	86.8
TOTAL UTILITIES			26806.	146.7
. TOTAL VARIABLE COST			32908.	180.0
LABOUR			647.	3.5
TECHNICAL ASSISTANCE			0.	0.0
DEPRECIATION			16319.	89.3
AMORTIZATION			4316.	23.6
MAINTENANCE			4535.	24.8
TAX & INSURANCE			1685.	9.2
INTEREST FOR WORKING CAP.			3214.	17.6
INTEREST FOR FIXED CAP.			8563.	46.9
PLANT OVERHEAD			129.	0.7
. TOTAL FIXED COST			39409.	215.6
RUNNING ROYALTY			0.	0.0
SELLING EXPENSE			0.	0.0
GENERAL ADMINIST. EXPENSE			2170.	11.9
CONTINGENCY			1490.	8.2
. TOTAL PRODUCTION COST			75976.	415.7

* PROFIT & LOSS	TONNAGE (T/Y)	AMOUNT (1000*D/Y)	UNIT COST (D/T)
TONNAGES & SALES FOR DOMEST.	182776.	101941.	557.7
TONNAGES & SALES FOR EXPORT	0.	0.	0.0
GROSS SALES		101941.	557.7
SALES TAX		0.	0.0
NET SALES		101941.	557.7
PROFIT & LOSS BEFORE TAX		25964.	142.1
INCOME TAX		9088.	49.7
PROFIT & LOSS AFTER TAX		16877.	92.3
I.R.R. ON TOTAL INVESTMENT		0.150	
I.R.R. ON EQUITY		0.193	

Table 4-24 Breakdown of Production Cost and Investment of LDPE Production

***** 1984 YEAR OF PRODUCTION COST CALCULATION ***** 75-06-03

* PROCESS	HIGH PRESSURE POLYMERIZATION	* RATED CAPACITY	110000. (T/Y)	* TIME OF CONSTRUCTION	1979.5
* PRODUCTS	LDPE	* OPERATION RATE	90. (%)		

* CAPITAL REQUIREMENT (UNIT= 1000*D)

* PROCESS UNIT	83857.	* LAND	1890.	* INT.DUR.CONST.	14041.
* OFF SITE	8687.	* PREOP. EXPENSE	6192.	* CONTINGENCY	5031.
TOTAL FIXED CAPITAL	119699.				
TOTAL WORKING CAPITAL	7504.				
TOTAL CAPITAL REQUIREMENT	127203.				

* PRODUCTION COST (PRODUCT BASE)	UNIT PRICE(D)	CON/PRO(/T)	AMOUNT (1000*D/Y)	UNIT COST (D/T)
C2	557.730	1.040	57424.	580.0
OTHER	15.900	1.000	1574.	15.9
TOTAL RAW MATERIALS & BYPRODUCTS			58998.	595.9
ELECTRIC	0.067	1500.000	10024.	101.2
M.STEAM	11.600	1.000	1148.	11.6
H.STEAM	15.100	0.0	0.	0.0
IND.W	0.054	11.000	59.	0.6
B.F.W	1.010	0.0	0.	0.0
S.W	0.103	0.0	0.	0.0
NITROGEN	0.127	80.000	1006.	10.2
FUEL	10.900	C.0	0.	0.0
TOTAL UTILITIES			12237.	123.6
. TOTAL VARIABLE COST			71235.	719.5
LABOUR			612.	6.2
TECHNICAL ASSISTANCE			0.	0.0
DEPRECIATION			8540.	86.3
AMORTIZATION			2927.	29.6
MAINTENANCE			2353.	23.8
TAX & INSURANCE			900.	9.1
INTEREST FOR WORKING CAP.			1801.	18.2
INTEREST FOR FIXED CAP.			4805.	48.5
PLANT OVERHEAD			122.	1.2
. TOTAL FIXED COST			22061.	222.8
RUNNING ROYALTY			0.	0.0
SELLING EXPENSE			1485.	15.0
GENERAL ADMINIST. EXPENSE			2843.	28.7
CONTINGENCY			1952.	19.7
. TOTAL PRODUCTION COST			99577.	1005.8

* PROFIT & LOSS	TONNAGE (T/Y)	AMOUNT (1000*D/Y)	UNIT COST (D/T)
TONNAGES & SALES FOR DOMEST.	81385.	109681.	1347.7
TONNAGES & SALES FOR EXPORT	17615.	11996.	681.0
GROSS SALES		121677.	1229.1
SALES TAX		4387.	44.3
NET SALES		117290.	1184.7
PROFIT & LOSS BEFORE TAX		17713.	178.9
INCOME TAX		6200.	62.6
PROFIT & LOSS AFTER TAX		11514.	116.3
I.R.R. ON TOTAL INVESTMENT		0.160	
I.R.R. ON EQUITY		0.200	

Table 4-25 Breakdown of Production Cost and Investment of HDPE Production

**** 1984 YEAR OF PRODUCTION COST CALCULATION ***** 75-06-03

* PROCESS	LOW PRESSURE POLYMERIZATION	* RATED CAPACITY	60000. (T/Y)	* TIME OF CONSTRUCTION	1979.5
* PRODUCTS	HDPE	* OPERATION RATE	90. (%)		

* CAPITAL REQUIREMENT (UNIT= 1000*D)

* PROCESS UNIT	37817.	* LAND	1485.	* INT.DUR.CONST.	7077.
* OFF SITE	5612.	* PREOP. EXPENSE	3415.	* CONTINGENCY	2416.
TOTAL FIXED CAPITAL	57822.				
TOTAL WORKING CAPITAL	4290.				
TOTAL CAPITAL REQUIREMENT	62112.				

* PRODUCTION COST (PRODUCT BASE)	UNIT PRICE(D)	CON/PRO(/T)	AMOUNT (1000*D/Y)	UNIT COST (D/T)
C2	557.730	1.050	31623.	585.6
OTHER	51.900	1.000	2803.	51.9
TOTAL RAW MATERIALS & BYPRODUCTS			34426.	637.5
ELECTRIC	0.067	775.000	2825.	52.3
M.STEAM	11.600	7.000	4385.	81.2
H.STEAM	15.100	0.0	0.	0.0
IND.W	0.054	28.500	83.	1.5
B.F.W	1.010	0.0	0.	0.0
S.W	0.103	0.0	0.	0.0
NITROGEN	0.127	100.000	686.	12.7
FUEL	10.900	0.0	0.	0.0
TOTAL UTILITIES			7979.	147.8
. TOTAL VARIABLE COST			42405.	785.3
LABOUR			424.	7.9
TECHNICAL ASSISTANCE			0.	0.0
DEPRECIATION			3741.	69.3
AMORTIZATION			1689.	31.3
MAINTENANCE			1013.	18.8
TAX & INSURANCE			415.	7.7
INTEREST FOR WORKING CAP.			1050.	19.4
INTEREST FOR FIXED CAP.			2326.	43.1
PLANT OVERHEAD			85.	1.6
. TOTAL FIXED COST			10743.	198.9
RUNNING ROYALTY			0.	0.0
SELLING EXPENSE			810.	15.0
GENERAL ADMINIST. EXPENSE			1619.	30.0
CONTINGENCY			1112.	20.6
. TOTAL PRODUCTION COST			56688.	1049.8

* PROFIT & LOSS	TONNAGE (T/Y)	AMOUNT (1000*D/Y)	UNIT COST (D/T)
TONNAGES & SALES FOR DOMEST.	40289.	54298.	1347.7
TONNAGES & SALES FOR EXPORT	13711.	10598.	773.0
GROSS SALES		64896.	1201.8
SALES TAX		2172.	40.2
NET SALES		62724.	1161.6
PROFIT & LOSS BEFORE TAX		6036.	111.8
INCOME TAX		2113.	39.1
PROFIT & LOSS AFTER TAX		3924.	72.7
I.R.R. ON TOTAL INVESTMENT		0.134	
I.R.R. ON EQUITY		0.158	

Table 4-26 Breakdown of Production Cost and Investment of PP Production

***** 1984 YEAR OF PRODUCTION COST CALCULATION ***** 75-06-03

* PROCESS PP CONTINUOUS POLYMERIZATION		* RATED CAPACITY	90000. (T/Y)	* TIME OF CONSTRUCTION	1979.5
* PRODUCTS PP		* OPERATION RATE	90. (%)		
* CAPITAL REQUIREMENT (UNIT= 1000*D)					
* PROCESS UNIT	66968.	* LAND	1350.	* INT.DUR.CONST.	11707.
* OFF SITE	8074.	* PREOP. EXPENSE	4966.	* CONTINGENCY	4068.
TOTAL FIXED CAPITAL	97133.				
TOTAL WORKING CAPITAL	5959.				
TOTAL CAPITAL REQUIREMENT	103093.				

* PRODUCTION COST (PRODUCT BASE)	UNIT PRICE(D)	CON/PRO(/T)	AMOUNT (1000*D/Y)	UNIT COST (D/T)
C3	446.184	1.140	41201.	508.6
OTHER	39.700	1.000	3216.	39.7
TOTAL RAW MATERIALS & BYPRODUCTS			44416.	548.3
ELECTRIC	0.067	950.000	5194.	64.1
M.STEAM	11.600	5.500	5168.	63.8
H.STEAM	15.100	0.0	0.	0.0
IND.W	0.054	31.500	138.	1.7
B.F.W	1.010	0.0	0.	0.0
S.W	0.103	0.0	0.	0.0
NITROGEN	0.127	150.000	1543.	19.0
FUEL	10.900	0.0	0.	0.0
TOTAL UTILITIES			12043.	148.7
. TOTAL VARIABLE COST			56460.	697.0
LABOUR			492.	6.1
TECHNICAL ASSISTANCE			0.	0.0
DEPRECIATION			6621.	81.7
AMORTIZATION			2668.	32.9
MAINTENANCE			1811.	22.4
TAX & INSURANCE			703.	8.7
INTEREST FOR WORKING CAP.			1428.	17.6
INTEREST FOR FIXED CAP.			3904.	48.2
PLANT OVERHEAD			98.	1.2
. TOTAL FIXED COST			17726.	218.8
RUNNING ROYALTY			0.	0.0
SELLING EXPENSE			1215.	15.0
GENERAL ADMINIST. EXPENSE			2262.	27.9
CONTINGENCY			1553.	19.2
. TOTAL PRODUCTION COST			79216.	978.0

* PROFIT & LOSS	TONNAGE (T/Y)	AMOUNT (1000*D/Y)	UNIT COST (D/T)
TONNAGES & SALES FOR DOMEST.	76026.	104273.	1371.5
TONNAGES & SALES FOR EXPORT	4974.	4044.	813.0
GROSS SALES		108317.	1337.2
SALES TAX		4171.	51.5
NET SALES		104146.	1285.7
PROFIT & LOSS BEFORE TAX		24930.	307.8
INCOME TAX		8725.	107.7
PROFIT & LOSS AFTER TAX		16204.	200.1
I.R.R. ON TOTAL INVESTMENT		0.225	
I.R.R. ON EQUITY		0.299	

Table 4-27 Breakdown of Production Cost and Investment of Chlorine Production

***** 1984 YEAR OF PRODUCTION COST CALCULATION ***** 75-05-19

* PROCESS	DIAPHRAGM	* RATED CAPACITY	32560. (T/Y)	* TIME OF CONSTRUCTION	1979.5
* PRODUCTS	CHLORINE	* OPERATION RATE	90. (%)		

* CAPITAL REQUIREMENT (UNIT= 1000$)					
* PROCESS UNIT	24257.	* LAND	1485.	* INT.DUR.CONST.	4282.
* OFF SITE	2308.	* PREOP. EXPENSE	1553.	* CONTINGENCY	1480.
TOTAL FIXED CAPITAL	35366.				
TOTAL WORKING CAPITAL	1323.				
TOTAL CAPITAL REQUIREMENT	36688.				

* PRODUCTION COST (PRODUCT BASE)	UNIT PRICE(D)	CON/PRO(/T)	AMOUNT (1000*D/Y)	UNIT COST (D/T)
SALT	35.000	1.780	1826.	62.3
H2	241.000	0.028	-214.	-7.3
NAOH	400.000	1.136	-13316.	-454.4
OTHER	11.000	1.000	322.	11.0
TOTAL RAW MATERIALS & BYPRODUCTS			-11382.	-388.4
ELECTRIC	0.067	3320.000	6567.	224.1
M.STEAM	11.600	3.500	1190.	40.6
H.STEAM	15.100	0.0	0.	0.0
IND.W	0.054	18.200	29.	1.0
B.F.W	1.010	0.0	0.	0.0
S.W	0.103	0.0	0.	0.0
NITROGEN	0.127	20.000	74.	2.5
FUEL	10.900	0.0	0.	0.0
TOTAL UTILITIES			7860.	268.2
. TOTAL VARIABLE COST			-3522.	-120.2
LABOUR			361.	12.3
TECHNICAL ASSISTANCE			0.	0.0
DEPRECIATION			2447.	83.5
AMORTIZATION			852.	29.1
MAINTENANCE			676.	23.1
TAX & INSURANCE			273.	9.3
INTEREST FOR WORKING CAP.			288.	9.8
INTEREST FOR FIXED CAP.			1422.	48.5
PLANT OVERHEAD			72.	2.5
. TOTAL FIXED COST			6393.	218.2
RUNNING ROYALTY			0.	0.0
SELLING EXPENSE			0.	0.0
GENERAL ADMINIST. EXPENSE			86.	2.9
CONTINGENCY			59.	2.0
. TOTAL PRODUCTION COST			3016.	102.9

* PROFIT & LOSS	TONNAGE (T/Y)	AMOUNT (1000*D/Y)	UNIT COST (D/T)
TONNAGES & SALES FOR DOMEST.	29304.	7493.	255.7
TONNAGES & SALES FOR EXPORT	0.	0.	0.0
GROSS SALES		7493.	255.7
SALES TAX		0.	0.0
NET SALES		7493.	255.7
PROFIT & LOSS BEFORE TAX		4477.	152.8
INCOME TAX		1567.	53.5
PROFIT & LOSS AFTER TAX		2910.	99.3
I.R.R. ON TOTAL INVESTMENT		0.150	
I.R.R. ON EQUITY		0.192	

Table 4-28 Breakdown of Production Cost and Investment of VCM Production

**** 1984 . YEAR OF PRODUCTION COST CALCULATION ***** 75-06-03

* PROCESS	OXYCHLORINATION	* RATED CAPACITY	55000. (T/Y)	* TIME OF CONSTRUCTION	1979.5
* PRODUCTS	VCM	* OPERATION RATE	90. (%)		

* CAPITAL REQUIREMENT (UNIT= 1000*D)

* PROCESS UNIT	29181.	* LAND	900.	* INT.DUR.CONST.	4792.
* OFF SITE	2771.	* PREOP. EXPENSE	2221.	* CONTINGENCY	1754.
TOTAL FIXED CAPITAL	41618.				
TOTAL WORKING CAPITAL	2470.				
TOTAL CAPITAL REQUIREMENT	44088.				

* PRODUCTION COST (PRODUCT BASE)	UNIT PRICE(D)	CON/PRO(/T)	AMOUNT (1000*D/Y)	UNIT COST (D/T)
C2	557.730	0.467	12893.	260.5
CL2	255.690	0.592	7493.	151.4
O2	35.000	0.142	246.	5.0
OTHER	7.460	1.000	369.	7.5
TOTAL RAW MATERIALS & BYPRODUCTS			20509.	414.3
ELECTRIC	0.067	215.000	718.	14.5
M.STEAM	11.600	0.800	459.	9.3
H.STEAM	15.100	0.0	0.	0.0
IND.W	0.054	11.570	31.	0.6
B.F.W	1.010	0.036	2.	0.0
S.W	0.103	0.0	0.	0.0
NITROGEN	0.127	39.000	245.	5.0
FUEL	10.900	1.100	594.	12.0
TOTAL UTILITIES			2049.	41.4
. TOTAL VARIABLE COST			22558.	455.7
LABOUR			364.	7.4
TECHNICAL ASSISTANCE			0.	0.0
DEPRECIATION			2991.	60.4
AMORTIZATION			979.	19.8
MAINTENANCE			827.	16.7
TAX & INSURANCE			318.	6.4
INTEREST FOR WORKING CAP.			586.	11.8
INTEREST FOR FIXED CAP.			1669.	33.7
PLANT OVERHEAD			73.	1.5
. TOTAL FIXED COST			7807.	157.7
RUNNING ROYALTY			0.	0.0
SELLING EXPENSE			0.	0.0
GENERAL ADMINIST. EXPENSE			911.	18.4
CONTINGENCY			626.	12.6
. TOTAL PRODUCTION COST			31902.	644.5

* PROFIT & LOSS	TONNAGE (T/Y)	AMOUNT (1000*D/Y)	UNIT COST (D/T)
TONNAGES & SALES FOR DOMEST.	49500.	38538.	778.5
TONNAGES & SALES FOR EXPORT	0.	0.	0.0
GROSS SALES		38538.	778.5
SALES TAX		1542.	31.1
NET SALES		36996.	747.4
PROFIT & LOSS BEFORE TAX		5095.	102.9
INCOME TAX		1783.	36.0
PROFIT & LOSS AFTER TAX		3312.	66.9
I.R.R. ON TOTAL INVESTMENT		0.149	
I.R.R. ON EQUITY		0.191	

CHAPTER 5. FINANCIAL AND ECONOMIC EVALUATION

CHAPTER 5. FINANCIAL AND ECONOMIC EVALUATION

CONTENTS

TABLES AND ILLUSTRATIONS

5. Financial and Economic Evaluation

5-1 General Conditions

(1) These economic and financial analyses contained are based on the project scheme which was finally selected from amoung various alternatives previously stated in Chapter 4, Part I.

(2) The basic assumptions used in this analytical study are specified in 5-1, Part II, and assumptions other than those stated above are the same as those mentioned in Chapter 4, Part I.

(3) Generally, the methods of analysis applied in this study are in accordance with the practices of the Board of Investments (BOI) of the Philippines.

(4) This analytical study is made on the assumption that seven independent enterprises own respective major facilities which comprize the entire complex. The enterprises and their major facilities are enumerated below.

Enterprise	Major Facility
A	Ethylene Plant
B	Utility and Common Service Facility
C	LDPE Plant
D	HDPE Plant
E	Electrolysis Plant
F	VCM Plant
G	PP Plant

5-2 Total Project Cost

The total capital requirement for the entire complex is estimated at US$727,013,000. The breakdown is as follows:

	Foreign Currency (US$1,000)	Local Currency (US$1,000)	Total (US$1,000)
Process facilities installed	360,785	82,695	443,480
Off-site facilities installed	32,575	21,940	54,515
Spare parts	17,640	-	17,640
Catalyst and chemicals	980	-	980
License and know-how fees	23,090	-	23,090
Pre-operational expenses			
Start-up expenses	5,434	13,016	18,450
Organizational expenses	-	13,730	13,730
Financial charges			
Guarantee fee	-	26,030	26,030
Interest during construction	78,040	-	78,040
Land	-	10,919	10,919

	Foreign Currency (US$1,000)	Local Currency (US$1,000)	Total (US$1,000)
Total capital investment	518,548	168,326	686,874
Working capital	-	40,139	40,139
Total capital requirement	518,548	208,465	727,013

5-3 Financial Terms on Project Cost

The total cost of the project is assumed to be financed as follows:

Long-term foreign loan	:	US$480,810,000 (70%)
Paid-in capital	:	206,064,000 (30%)
Total investment cost	:	US$686,874,000 (100%)
Local loan for working capital	:	40,139,000
Total capital requirement	:	US$727,013,000

(1) The long-term foreign loan will be financed by a foreign financier in the form of suppliers' credit, direct loan, etc. Thus, a specific financial condition is applied, i.e., ten (10) times equally divided annual installments, in which the first installment comes due in the first operating year (1980). The interest on the loan is seven point six per cent (7.6%) per annum.

(2) A letter of guarantee will be issued by the Development Bank of the Philippines (DBP) in favor of the foreign financier covering the full amount of such a loan.

(3) The working capital is secured through a local loan with repayment due in 365 days and with an eighteen per cent (18%) per annum interest.

5-4 Financial Statements

The projected financial statements for the assumed seven companies are as stipulated in the following tables.

	Projected Income Statement	Projected Cash Flow	Projected Balance Sheet
Ethylene plant	Table 5- 1	Table 5- 2	Table 5- 3
Utility center	5- 4	5- 5	5- 6
LDPE plant	5- 7	5- 8	5- 9
HDPE plant	5-10	5-11	5-12
Electrolysis plant	5-13	5-14	5-15
VCM plant	5-16	5-17	5-18
PP plant	5-19	5-20	5-21

Table 5-1 Projected Income Statement

Ethylene Plant

(1,000 US$)

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
REVENUE										
Sales	95,429	119,285	143,142	143,142	143,142	143,142	143,142	143,142	143,142	143,142
EXPENDITURE										
Cost of Goods Sold	72,571	86,468	100,368	100,126	99,884	99,643	99,401	99,159	98,918	98,677
(GROSS PROFIT ON SALES)	22,858	32,817	42,774	43,016	43,258	43,499	43,741	43,983	44,224	44,465
Operating Expense	6,962	7,371	7,780	7,773	7,766	7,759	7,752	7,744	7,737	7,730
(NET PROFIT FROM OPERATION)	15,896	25,446	34,994	35,243	35,492	35,740	35,989	36,239	36,487	36,735
Financial Charge										
Local Loan	2,259	2,259	2,259	1,506	753	-	-	-	-	-
Foreign Loan	11,896	10,706	9,516	8,327	7,137	5,948	4,758	3,569	2,379	1,190
Guarantee Fee	2,526	2,274	2,021	1,768	1,516	1,263	1,010	758	505	253
Total Financial Charge	16,681	15,239	13,796	11,601	9,406	7,211	5,768	4,327	2,884	1,443
NET PROFIT BEFORE TAXES	(785)	10,207	21,198	23,642	26,086	28,529	30,221	31,912	33,603	35,292
DEDUCTION & TAX CREDIT										
Pre-operational Expense	(1,050)	(1,050)	(1,050)	(1,050)	(1,050)	(1,050)	(1,050)	(1,050)	(1,050)	(1,050)
Labor Training Expense	-	-	-	-	-	-	-	-	-	-
Direct Labor Cost	-	-	-	-	-	-	-	-	-	-
Net Operating Loss (carried over)	-	(785)	-	-	-	-	-	-	-	-
Total Deduction	(1,050)	(1,835)	(1,050)	(1,050)	(1,050)	(1,050)	(1,050)	(1,050)	(1,050)	(1,050)
TAXABLE INCOME	(1,835)	8,372	20,148	22,592	25,036	27,479	29,171	30,862	32,553	34,242
PROVISION FOR INCOME TAX	-	2,930	7,052	7,907	8,763	9,618	10,210	10,802	11,394	11,985
NET PROFIT AFTER TAX	(785)	7,277	14,146	15,735	17,323	18,911	20,011	21,110	22,209	23,307

Table 5-2 Projected Cash Flow Statement

Ethylene Plant

(1,000 US$)

	Pre-Operation	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
CASH RECEIPTS											
Net Income before Tax	-	(785)	10,207	21,198	23,642	26,086	28,529	30,221	31,912	33,603	35,292
Add: Depreciation	-	16,927	16,927	16,927	16,927	16,927	16,927	16,927	16,927	16,927	16,927
Amortization	-	4,690	4,690	4,690	4,690	4,690	4,690	4,690	4,690	4,690	4,690
Increase (decrease) in Account Payable	-	13,961	3,490	3,490	-	-	-	-	-	-	-
Foreign Loan	156,520	-	-	-	-	-	-	-	-	-	-
Local Loan	12,551	12,551	12,551	8,367	4,184	-	-	-	-	-	-
Stockholders' Equity	67,074	-	-	-	-	-	-	-	-	-	-
Total Receipts	236,145	47,344	47,865	54,672	49,443	47,703	50,146	51,838	53,529	55,220	56,909
CASH DISBURSEMENTS											
Process Facilities	160,330	-	-	-	-	-	-	-	-	-	-
Off-site Facilities	13,410	-	-	-	-	-	-	-	-	-	-
Land	2,954	-	-	-	-	-	-	-	-	-	-
License & Knowhow Fee	1,920	-	-	-	-	-	-	-	-	-	-
Pre-operating Expense	10,500	-	-	-	-	-	-	-	-	-	-
Financial Charge	34,480	-	-	-	-	-	-	-	-	-	-
Repayment											
Foreign Loan	-	15,652	15,652	15,652	15,652	15,652	15,652	15,652	15,652	15,652	15,652
Local Loan	-	12,551	12,551	12,551	8,367	4,184	-	-	-	-	-
Income Tax Payment	-	-	-	2,930	7,052	7,907	8,763	9,618	10,210	10,802	11,394
Increase (decrease) in Account Receivable	-	21,632	5,408	5,408	-	-	-	-	-	-	-
Increase (decrease) in Inventories·											
Raw Materials	-	-	-	-	-	-	-	-	-	-	-
Finished Goods	-	-	-	-	-	-	-	-	-	-	-
Total Disbursements	223,594	49,835	33,611	36,541	31,071	27,743	24,415	25,270	25,862	26,454	27,046
NET CASH FLOW	12,551	(2,491)	14,254	18,131	18,372	19,960	25,731	26,568	27,667	28,766	29,863
BEGINNING CASH BALANCE	-	12,551	10,060	24,314	42,445	60,817	80,777	106,508	133,076	160,743	189,509
ENDING CASH BALANCE	12,551	10,060	24,314	42,445	60,817	80,777	106,508	133,076	160,743	189,509	219,372

Table 5-3 Projected Balance Sheet

Ethylene Plant

(1,000 US$)

	Pre-Operation	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
ASSETS											
CURRENT ASSETS											
Cash	12,551	10,060	24,314	42,445	60,817	80,777	106,508	133,076	160,743	189,509	219,372
Account Receivable	-	21,632	27,040	32,448	32,448	32,448	32,448	32,448	32,448	32,448	32,448
Inventories											
Finished Goods	-	-	-	-	-	-	-	-	-	-	-
Raw Materials	-	-	-	-	-	-	-	-	-	-	-
Total Current Assets	12,551	31,692	51,354	74,893	93,265	113,225	138,956	165,524	193,191	221,957	251,820
Pre-operating Expense	10,500	9,450	8,400	7,350	6,300	5,250	4,200	3,150	2,100	1,050	-
Other Amortized Items	36,400	32,760	29,120	25,480	21,840	18,200	14,560	10,920	7,280	3,640	-
FIXED ASSETS											
Land	2,954	2,954	2,954	2,954	2,954	2,954	2,954	2,954	2,954	2,954	2,954
Process Facilities	160,330	160,330	160,330	160,330	160,330	160,330	160,330	160,330	160,330	160,330	160,330
Off-site Facilities	13,410	13,410	13,410	13,410	13,410	13,410	13,410	13,410	13,410	13,410	13,410
Less: Accumurated Depreciation	-	16,927	33,854	50,781	67,708	84,635	101,562	118,489	135,416	152,343	169,270
Total Fixed Assets	176,694	159,767	142,840	125,913	108,986	92,059	75,132	58,205	41,278	24,351	7,424
TOTAL ASSETS	236,145	233,669	231,714	233,636	230,391	228,734	232,848	237,799	243,849	250,998	259,244
LIABILITIES & NET WORTH											
CURRENT LIABILITIES											
Account Payable	-	13,961	17,451	20,941	20,941	20,941	20,941	20,941	20,941	20,941	20,941
Income Tax Payable	-	-	2,930	7,052	7,907	8,763	9,618	10,210	10,802	11,394	11,985
Current Portion of Loan											
Foreign Loan	15,652	15,652	15,652	15,652	15,652	15,652	15,652	15,652	15,652	15,652	-
Local Loan	12,551	12,551	12,551	8,367	4,184	-	-	-	-	-	-
Total Current Liabilities	28,203	42,164	48,584	52,012	48,684	45,356	46,211	46,803	47,395	47,987	32,926
Foreign Loan	140,868	125,216	109,564	93,912	78,260	62,608	46,956	31,304	15,652	-	-
Local Loan		-	-	-	-	-	-	-	-	-	-
NET WORTH											
Stockholders' Equity	67,074	67,074	67,074	67,074	67,074	67,074	67,074	67,074	67,074	67,074	67,074
Retained Earnings	-	-	(785)	6,492	20,638	36,373	53,696	72,607	92,618	113,728	135,937
Net Income for the year	-	(785)	7,277	14,146	15,735	17,323	18,911	20,011	21,110	22,209	23,307
Total Net Worth	67,074	66,289	73,566	87,712	103,447	120,770	139,681	159,692	180,802	203,011	226,318
TOTAL LIABILITIES & NET WORTH	236,145	233,669	231,714	233,636	230,391	228,734	232,848	237,799	243,849	250,998	259,244

Table 5-4 Projected Income Statement

Utility Center

(1,000 US$)

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
REVENUE										
Sales	39,310	49,202	59,054	59,054	59,054	59,054	59,054	59,054	59,054	59,054
EXPENDITURE										
Cost of Goods Sold	30,905	36,879	43,175	43,090	43,005	42,922	42,837	42,752	42,669	42,584
(GROSS PROFIT ON SALES)	8,405	12,323	15,879	15,964	16,049	16,132	16,217	16,302	16,385	16,470
Operating Expense	2,655	2,831	3,016	3,014	3,011	3,009	3,006	3,004	3,001	2,999
(NET PROFIT FROM OPERATION)	5,750	9,492	12,863	12,950	13,038	13,123	13,211	13,298	13,384	13,471
Financial Charge										
Local Loan	877	877	877	585	292	-	-	-	-	-
Foreign Loan	5,642	5,078	4,514	3,950	3,385	2,821	2,257	1,693	1,128	564
Guarantee Fee	1,198	1,078	959	839	719	599	479	359	240	120
Total Financial Charge	7,717	7,033	6,350	6,350	4,396	3,420	2,736	2,052	1,368	684
NET PROFIT BEFORE TAXES	(1,967)	2,459	6,513	6,600	8,642	9,703	10,475	11,246	12,016	12,787
DEDUCTION & TAX CREDIT										
Pre-operational Expense	(365)	(365)	(365)	(365)	(365)	(365)	(365)	(365)	(365)	(365)
Labor Training Expense	-	-	-	-	-	-	-	-	-	-
Direct Labor Cost	-	-	-	-	-	-	-	-	-	-
Net Operating Loss (carried over)	-	(1,967)	-	-	-	-	-	-	-	-
Total Deduction	(365)	(2,332)	(365)	(365)	(365)	(365)	(365)	(365)	(365)	(365)
TAXABLE INCOME	(2,332)	127	6,148	6,235	8,277	9,338	10,110	10,881	11,651	12,422
PROVISION FOR INCOME TAX	-	44	2,152	2,182	2,897	3,268	3,539	3,808	4,078	4,348
NET PROFIT AFTER TAX	(1,967)	2,415	4,361	4,418	5,745	6,435	6,936	7,438	7,938	8,439

Table 5-5 Projected Cash Flow Statement

Utility Center

(1,000 US$)

	Pre-Operation	1980	1981	1982	1983	1984	1985	1986	1987	1988	1969
CASH RECEIPTS											
Net Income before Tax	-	(1,967)	2,459	6,513	6,600	8,642	9,703	10,475	11,246	12,016	12,787
Add: Depreciation	-	5,910	5,910	5,910	5,910	5,910	5,910	5,910	5,910	5,910	5,910
Amortization	-	1,691	1,691	1,691	1,691	1,691	1,691	1,691	1,691	1,691	1,691
Increase (decrease) in Account Payable	-	3,597	863	916	-	-	-	-	-	-	-
Foreign Loan	74,240	-	-	-	-	-	-	-	-	-	-
Local Loan	4,873	4,873	4,873	3,249	1,624	-	-	-	-	-	-
Stockholders' Equity	31,820	-	-	-	-	-	-	-	-	-	-
Total Receipts	110,933	14,104	15,796	18,279	15,825	16,243	17,304	18,076	18,847	19,617	20,388
CASH DISBURSEMENTS											
Process Facilities	76,210	-	-	-	-	-	-	-	-	-	-
Off-site Facilities	12,440	-	-	-	-	-	-	-	-	-	-
Land	500	-	-	-	-	-	-	-	-	-	-
License & Knowhow Fee	-	-	-	-	-	-	-	-	-	-	-
Pre-operating Expense	3,650	-	-	-	-	-	-	-	-	-	-
Financial Charge	13,260	-	-	-	-	-	-	-	-	-	-
Repayment											
Foreign Loan	-	7,424	7,424	7,424	7,424	7,424	7,424	7,424	7,424	7,424	7,424
Local Loan	-	4,873	4,873	4,873	3,249	1,624	-	-	-	-	-
Income Tax Payment	-	-	-	44	2,152	2,182	2,897	3,268	3,539	3,808	4,078
Increase (decrease) in Account Receivable	-	6,552	1,648	1,642	-	-	-	-	-	-	-
Increase (decrease) in Inventories											
Raw Materials	-	-	-	-	-	-	-	-	-	-	-
Finished Goods	-	-	-	-	-	-	-	-	-	-	-
Total Disbursements	106,060	18,849	13,945	13,983	12,825	11,230	10,321	10,692	10,963	11,232	11,502
NET CASH FLOW	4,873	(4,745)	1,851	4,296	3,000	5,013	6,983	7,384	7,884	8,385	8,886
BEGINNING CASH BALANCE	-	4,873	128	1,979	6,275	9,275	14,288	21,271	28,655	36,539	44,924
ENDING CASH BALANCE	4,873	128	1,979	6,275	9,275	14,288	21,271	28,655	36,539	44,924	53,810

Table 5-6 Projected Balance Sheet

Utility Center

(1,000 US$)

	Pre-Operation	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
ASSETS											
CURRENT ASSETS											
Cash	4,873	128	1,979	6,275	9,275	14,288	21,271	28,655	36,539	44,924	53,810
Account Receivable	-	6,552	8,200	9,842	9,842	9,842	9,842	9,842	9,842	9,842	9,842
Inventories											
Finished Goods	-	-	-	-	-	-	-	-	-	-	-
Raw Materials	-	-	-	-	-	-	-	-	-	-	-
Total Current Assets	4,873	6,680	10,179	16,117	19,117	24,130	31,113	38,497	46,381	54,766	63,652
Pre-operating Expense	3,650	3,285	2,920	2,555	2,190	1,825	1,460	1,095	730	365	-
Other Amortized Items	13,260	11,934	10,608	9,282	7,956	6,630	5,304	3,978	2,652	1,326	-
FIXED ASSETS											
Land	500	500	500	500	500	500	500	500	500	500	500
Process Facilities	76,210	76,210	76,210	76,210	76,210	76,210	76,210	76,210	76,210	76,210	76,210
Off-site Facilities	12,440	12,440	12,440	12,440	12,440	12,440	12,440	12,440	12,440	12,440	12,440
Less: Accumurated Depreciation	-	5,910	11,820	17,730	23,640	29,550	35,460	41,370	47,280	53,190	59,100
Total Fixed Assets	89,150	83,240	77,330	71,420	65,510	59,600	53,690	47,780	41,870	35,960	30,050
TOTAL ASSETS	110,933	105,139	101,037	99,374	94,773	92,185	91,567	91,350	91,633	92,417	93,702
LIABILITIES & NET WORTH											
CURRENT LIABILITIES											
Account Payable	-	3,597	4,460	5,376	5,376	5,376	5,376	5,376	5,376	5,376	5,376
Income Tax Payable	-	-	44	2,152	2,182	2,897	3,268	3,539	3,808	4,078	4,348
Current Portion of Loan											
Foreign Loan	7,424	7,424	7,424	7,424	7,424	7,424	7,424	7,424	7,424	7,424	-
Local Loan	4,873	4,873	4,873	3,249	1,624	-	-	-	-	-	-
Total Current Liabilities	12,297	15,894	16,801	18,201	16,606	15,697	16,068	16,339	16,608	16,878	9,724
Foreign Loan	66,816	59,392	51,968	44,544	37,120	29,696	22,272	14,848	7,424	-	-
Local Loan	-	-	-	-	-	-	-	-	-	-	-
NET WORTH											
Stockholders' Equity	31,820	31,820	31,820	31,820	31,820	31,820	31,820	31,820	31,820	31,820	31,820
Retained Earnings	-	-	(1,967)	448	4,809	9,227	14,972	21,407	28,343	35,781	43,719
Net Income for the year	-	(1,967)	2,415	4,361	4,418	5,745	6,435	6,936	7,438	7,938	8,439
Total Net Worth	31,820	29,853	32,268	36,629	41,047	46,792	53,227	60,163	67,601	75,539	83,978
TOTAL LIABILITIES & NET WORTH	110,933	105,139	101,037	99,374	94,773	92,185	91,567	91,350	91,633	92,417	93,702

Table 5-7 Projected Income Statement

LDPE Plant

(1,000 US$)

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
REVENUE										
Sales	76,524	92,337	108,812	114,810	121,677	129,539	133,421	133,421	133,421	133,421
EXPENDITURE										
Cost of Goods Sold	60,422	71,112	81,878	81,775	81,674	81,582	81,494	81,382	81,257	81,140
(GROSS PROFIT ON SALES)	16,102	21,225	26,934	33,035	40,003	47,957	51,927	52,039	52,164	52,281
Operating Expense	6,738	8,280	9,148	10,288	11,567	13,247	15,349	15,827	15,823	16,299
(NET PROFIT FROM OPERATION)	9,364	12,945	17,786	22,747	28,436	34,710	36,578	36,212	36,341	35,982
Financial Charge										
Local Loan	1,230	1,230	1,230	820	410	-	-	-	-	-
Foreign Loan	6,639	5,975	5,311	4,648	3,984	3,320	2,656	1,992	1,328	664
Guarantee Fee	1,410	1,269	1,128	987	846	705	564	423	282	141
Total Financial Charge	9,279	8,474	7,669	6,455	5,240	4,025	3,220	2,415	1,610	805
NET PROFIT BEFORE TAXES	85	4,471	10,117	16,292	23,196	30,685	33,358	33,797	34,731	35,177
DEDUCTION & TAX CREDIT										
Pre-operational Expense	(613)	(613)	(613)	(613)	(613)	(613)	(613)	(613)	(613)	(613)
Labor Training Expense	-	-	-	-	-	-	-	-	-	-
Direct Labor Cost	(171)	(208)	(226)	(171)	(104)	(31)	-	-	-	-
Net Operating Loss (carried over)	-	-	-	-	-	-	-	-	-	-
Total Deduction	(784)	(821)	(839)	(784)	(717)	(644)	(613)	(613)	(613)	(613)
TAXABLE INCOME	(699)	3,650	9,278	15,508	22,479	30,041	32,745	33,184	34,118	34,564
PROVISION FOR INCOME TAX	-	1,278	3,247	5,428	7,868	10,514	11,461	11,614	11,941	12,097
NET PROFIT AFTER TAX	85	3,193	6,870	10,864	15,328	20,171	21,897	22,183	22,790	23,080

Table 5-8 Projected Cash Flow Statement

LDPE Plant

(1,000 US$)

	Pre-Operation	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
CASH RECEIPTS											
Net Income before Tax	-	85	4,471	10,117	16,292	23,196	30,685	33,358	33,797	34,731	35,177
Add: Depreciation	-	8,818	8,818	8,818	8,818	8,818	8,818	8,818	8,818	8,818	8,818
Amortization	-	3,160	3,160	3,160	3,160	3,160	3,160	3,160	3,160	3,160	3,160
Increase (decrease) in Account Payable	-	8,635	2,158	2,159	-	-	-	-	-	-	-
Foreign Loan	87,360	-	-	-	-	-	-	-	-	-	-
Local Loan	6,832	6,832	6,832	4,555	2,277	-	-	-	-	-	-
Stockholders' Equity	37,445	-	-	-	-	-	-	-	-	-	-
Total Receipts	131,637	27,530	25,439	28,809	30,547	35,174	42,663	45,336	45,775	46,709	47,155
CASH DISBURSEMENTS											
Process Facilities	82,100	-	-	-	-	-	-	-	-	-	-
Off-site Facilities	9,120	-	-	-	-	-	-	-	-	-	-
Land	1,985	-	-	-	-	-	-	-	-	-	-
License & Knowhow Fee	5,960	-	-	-	-	-	-	-	-	-	-
Pre-operating Expense	6,130	-	-	-	-	-	-	-	-	-	-
Financial Charge	19,510	-	-	-	-	-	-	-	-	-	-
Repayment											
Foreign Loan	-	8,736	8,736	8,736	8,736	8,736	8,736	8,736	8,736	8,736	8,736
Local Loan	-	6,832	6,832	6,832	4,555	2,277	-	-	-	-	-
Income Tax Payment	-	-	-	1,278		5,428	7,868	10,514	11,461	11,614	11,941
Increase (decrease) in Account Receivable	-	13,913	2,876	2,995	1,091	1,248	1,430	705	-	-	-
Increase (decrease) in Inventories											
Raw Materials	-	-	-	-	-	-	-	-	-	-	-
Finished Goods	-	-	-	-	-	-	-	-	-	-	-
Total Disbursements	124,805	29,481	18,444	19,841	17,629	17,689	18,034	19,955	20,197	20,350	20,677
NET CASH FLOW	6,832	(1,951)	6,995	8,968	12,918	17,485	24,629	25,381	25,578	26,359	26,478
BEGINNING CASH BALANCE	-	6,832	4,881	11,876	20,844	33,762	51,247	75,876	101,257	126,835	153,194
ENDING CASH BALANCE	6,832	4,881	11,876	20,844	33,762	51,247	75,876	101,257	126,835	153,194	179,672

Table 5-9 Projected Balance Sheet

LDPE Plant

(1,000 US$)

	Pre-Operation	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
ASSETS											
CURRENT ASSETS											
Cash	6,832	4,881	11,876	20,844	33,762	51,247	75,876	101,257	126,835	153,194	179,672
Account Receivable	-	13,913	16,789	19,784	20,875	22,123	23,553	24,258	24,258	24,258	24,258
Inventories											
Finished Goods	-	-	-	-	-	-	-	-	-	-	-
Raw Materials	-	-	-	-	-	-	-	-	-	-	-
Total Current Assets	6,832	18,794	28,665	40,628	54,637	73,370	99,429	125,515	151,093	177,452	203,930
Pre-operating Expense	6,130	5,517	4,904	4,291	3,678	3,065	2,452	1,839	1,226	613	-
Other Amortized Items	25,470	22,923	20,376	17,829	15,282	12,735	10,188	7,641	5,094	2,547	-
FIXED ASSETS											
Land	1,985	1,985	1,985	1,985	1,985	1,985	1,985	1,985	1,985	1,985	1,985
Process Facilities	82,100	82,100	82,100	82,100	82,100	82,100	82,100	82,100	82,100	82,100	82,100
Off-site Facilities	9,120	9,120	9,120	9,120	9,120	9,120	9,120	9,120	9,120	9,120	9,120
Less: Accumurated Depreciation	-	8,818	17,636	26,454	35,272	44,090	52,908	61,726	70,544	79,362	88,180
Total Fixed Assets	93,205	84,387	75,569	66,751	57,933	49,115	40,297	31,479	22,661	13,843	5,025
TOTAL ASSETS	131,637	131,621	129,514	129,499	131,530	138,285	152,366	166,474	180,074	194,455	208,955
LIABILITIES & NET WORTH											
CURRENT LIABILITIES											
Account Payable	-	8,635	10,793	12,952	12,952	12,952	12,952	12,952	12,952	12,952	12,952
Income Tax Payable	-	-	1,278	3,247	5,428	7,868	10,514	11,461	11,614	11,941	12,097
Current Portion of Loan											
Foreign Loan	8,736	8,736	8,736	8,736	8,736	8,736	8,736	8,736	8,736	8,736	-
Local Loan	6,832	6,832	6,832	4,555	2,277	-	-	-	-	-	-
Total Current Liabilities	15,568	24,203	27,639	29,490	29,393	29,556	32,202	33,149	31,302	33,629	25,049
Foreign Loan	78,624	69,888	61,152	52,416	43,680	34,944	26,208	17,472	8,736	-	-
Local Loan	-	-	-	-	-	-	-	-	-	-	-
NET WORTH											
Stockholders' Equity	37,445	37,445	37,445	37,445	37,445	37,445	37,445	37,445	37,445	37,445	37,445
Retained Earnings	-	-	85	3,278	10,148	21,012	36,340	56,511	78,408	100,591	123,381
Net Income for the year	-	85	3,193	6,870	10,864	15,328	20,171	21,897	22,183	22,790	23,080
Total Net Worth	37,445	37,530	40,723	47,593	58,457	73,785	93,956	115,853	138,036	160,826	183,906
TOTAL LIABILITIES & NET WORTH	131,637	131,621	129,514	129,499	131,530	138,285	152,366	166,474	180,074	194,455	208,955

Table 5-10 Projected Income Statement

HDPE Plant

(1,000 US$)

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
REVENUE										
Sales	41,304	50,213	59,406	61,965	64,896	68,251	72,092	72,775	72,775	72,775
EXPENDITURE										
Cost of Goods Sold	34,298	41,810	49,316	49,273	49,232	49,194	49,163	49,114	49,059	49,009
(GROSS PROFIT ON SALES)	7,006	8,403	10,090	12,692	15,664	19,057	22,929	23,661	23,716	23,766
Operating Expense	4,082	4,835	5,221	5,824	6,487	7,344	8,562	8,865	8,863	9,124
(NET PROFIT FROM OPERATION)	2,924	3,568	4,869	6,868	9,177	11,713	14,367	14,796	14,853	14,642
Financial Charge										
Local Loan	720	720	720	480	240	-	-	-	-	-
Foreign Loan	3,205	2,884	2,564	2,243	1,923	1,602	1,282	961	641	320
Guarantee Fee	681	613	545	476	408	340	272	204	136	68
Total Financial Charge	4,606	4,217	3,829	3,199	2,571	1,942	1,554	1,165	777	388
NET PROFIT BEFORE TAXES	(1,682)	(649)	1,040	3,669	6,606	9,771	12,813	13,631	14,076	14,254
DEDUCTION & TAX CREDIT										
Pre-operational Expense	(343)	(343)	(343)	(343)	(343)	(343)	(343)	(343)	(343)	(343)
Labor Training Expense	-	-	-	-	-	-	-	-	-	-
Direct Labor Cost	(100)	(119)	(128)	(100)	(69)	(38)	(5)	-	-	-
Net Operating Loss (carried over)	-	(1,682)	(2,331)	(1,291)	-	-	-	-	-	-
Total Deduction	(443)	(2,144)	(2,802)	(1,734)	(412)	(381)	(348)	(343)	(343)	(343)
TAXABLE INCOME	(2,125)	(2,793)	(1,762)	1,935	6,194	9,390	12,465	13,288	13,733	13,911
PROVISION FOR INCOME TAX	-	-	-	677	2,168	3,287	4,363	4,651	4,807	4,869
NET PROFIT AFTER TAX	(1,682)	(649)	1,040	2,992	4,438	6,484	8,450	8,980	9,269	9,385

Table 5-11 Projected Cash Flow Statement

HDPE Plant

(1,000 US$)

	Pre-Operation	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
CASH RECEIPTS											
Net Income before Tax	-	(1,682)	(649)	1,040	3,669	6,606	9,771	12,813	13,631	14,076	14,254
Add: Depreciation	-	3,858	3,858	3,858	3,858	3,858	3,858	3,858	3,858	3,858	3,858
Amortization	-	1,814	1,814	1,814	1,814	1,814	1,814	1,814	1,814	1,814	1,814
Increase (decrease) in Account Payable	-	4,712	1,178	1,178	-	-	-	-	-	-	-
Foreign Loan	42,170	-	-	-	-	-	-	-	-	-	-
Local Loan	4,000	4,000	4,000	2,667	1,333	-	-	-	-	-	-
Stockholders' Equity	18,075	-	-	-	-	-	-	-	-	-	-
Total Receipts	64,245	12,702	10,201	10,557	10,674	12,278	15,443	18,485	19,303	19,748	19,926
CASH DISBURSEMENTS											
Process Facilities	34,650	-	-	-	-	-	-	-	-	-	-
Off-site Facilities	5,895	-	-	-	-	-	-	-	-	-	-
Land	1,560	-	-	-	-	-	-	-	-	-	-
License & Knowhow Fee	5,060	-	-	-	-	-	-	-	-	-	-
Pre-operating Expense	3,430	-	-	-	-	-	-	-	-	-	-
Financial Charge	9,650	-	-	-	-	-	-	-	-	-	-
Repayment											
Foreign Loan	-	4,217	4,217	4,217	4,217	4,217	4,217	4,217	4,217	4,217	4,217
Local Loan	-	4,000	4,000	4,000	2,667	1,333	-	-	-	-	-
Income Tax Payment	-	-	-	-	-	677	2,168	3,287	4,363	4,651	4,807
Increase (decrease) in Account Receivable	-	6,884	1,485	1,532	427	488	559	640	114	-	-
Increase (decrease) in Inventories											
Raw Materials	-	-	-	-	-	-	-	-	-	-	-
Finished Goods	-	-	-	-	-	-	-	-	-	-	-
Total Disbursements	60,245	15,101	9,702	9,749	7,311	6,715	6,944	8,144	8,694	8,868	9,024
NET CASH FLOW	-	(2,399)	499	808	3,363	5,563	8,499	10,341	10,609	10,880	10,902
BEGINNING CASH BALANCE	-	4,000	1,601	2,100	2,908	6,271	11,834	20,333	30,674	41,283	52,163
ENDING CASH BALANCE	4,000	1,601	2,100	2,908	6,271	11,834	20,333	30,674	41,283	52,163	63,065

Table 5-12 Projected Balance Sheet

HDPE Plant

(1,000 US$)

	Pre-Operation	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
ASSETS											
CURRENT ASSETS											
Cash	4,000	1,601	2,100	2,908	6,271	11,834	20,333	30,674	41,283	52,163	63,065
Account Receivable	-	6,884	8,369	9,901	10,328	10,816	11,375	12,015	12,129	12,129	12,129
Inventories											
Finished Goods	-	-	-	-	-	-	-	-	-	-	-
Raw Materials	-	-	-	-	-	-	-	-	-	-	-
Total Current Assets	4,000	8,485	10,469	12,809	16,599	22,650	31,708	42,689	53,412	64,292	75,194
Pre-operating Expense	3,430	3,087	2,744	2,401	2,058	1,715	1,372	1,029	686	343	-
Other Amortized Items	14,710	13,239	11,768	10,297	8,826	7,355	5,884	4,413	2,942	1,471	-
FIXED ASSETS											
Land	1,560	1,560	1,560	1,560	1,560	1,560	1,560	1,560	1,560	1,560	1,560
Process Facilities	34,650	34,650	34,650	34,650	34,650	34,650	34,650	34,650	34,650	34,650	34,650
Off-site Facilities	5,895	5,895	5,895	5,895	5,895	5,895	5,895	5,895	5,895	5,895	5,895
Less: Accumurated Depreciation	-	3,858	7,716	11,574	15,432	19,290	23,148	27,006	30,864	34,722	38,580
Total Fixed Assets	42,105	38,247	34,389	30,531	26,673	22,815	18,957	15,099	11,241	7,383	3,525
TOTAL ASSETS	64,245	63,058	59,370	56,038	54,156	54,535	57,921	63,230	68,281	73,489	78,719
LIABILITIES & NET WORTH											
CURRENT LIABILITIES											
Account Payable	-	4,712	5,890	7,068	7,068	7,068	7,068	7,068	7,068	7,068	7,068
Income Tax Payable	-	-	-	-	677	2,168	3,287	4,363	4,651	4,807	4,869
Current Portion of Loan											
Foreign Loan	4,217	4,217	4,217	4,217	4,217	4,217	4,217	4,217	4,217	4,217	-
Local Loan	4,000	4,000	4,000	2,667	1,333	-	-	-	-	-	-
Total Current Liabilities	8,217	12,929	14,107	13,952	13,295	13,453	14,572	15,648	15,936	16,092	11,937
Foreign Loan	37,953	33,736	29,519	25,302	21,085	16,868	12,651	8,434	4,217	-	-
Local Loan	-	-	-	-	-	-	-	-	-	-	-
NET WORTH											
Stockholders' Equity	18,075	18,075	18,075	18,075	18,075	18,075	18,075	18,075	18,075	18,075	18,075
Retained Earnings	-	-	(1,682)	(2,331)	(1,291)	1,701	6,139	12,623	21,073	30,053	39,322
Net Income for the year	-	(1,682)	(649)	1,040	2,992	4,438	6,484	8,450	8,980	9,269	9,385
Total Net Worth	18,075	16,393	15,744	16,784	19,776	24,214	30,698	39,148	48,128	57,397	66,782
TOTAL LIABILITIES & NET WORTH	64,245	63,058	59,370	56,038	54,156	54,535	57,921	63,230	68,281	73,489	78,719

Table 5-13 Projected Income Statement

Electrolysis Plant

(1,000 US$)

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
REVENUE										
Sales	14,242	17,802	21,364	21,364	21,364	21,364	21,364	21,364	21,364	21,364
EXPENDITURE										
Cost of Goods Sold	10,309	12,172	14,033	13,999	13,965	13,933	13,900	13,865	13,829	13,794
(GROSS PROFIT ON SALES)	3,933	5,630	7,331	7,365	7,399	7,431	7,464	7,499	7,535	7,570
Operating Expense	1,337	1,516	1,613	1,736	1,861	2,009	2,208	2,257	2,256	2,305
(NET PROFIT FROM OPERATION)	2,596	4,114	5,718	5,629	5,538	5,422	5,256	5,242	5,279	5,265
Financial Charge										
Local Loan	372	372	372	248	124	-	-	-	-	-
Foreign Loan	1,961	1,765	1,569	1,373	1,176	980	784	588	392	196
Guarantee Fee	416	375	333	291	250	208	167	125	83	42
Total Financial Charge	2,749	2,512	2,274	1,912	1,550	1,188	951	713	475	238
NET PROFIT BEFORE TAXES	(153)	1,602	3,444	3,717	3,988	4,234	4,305	4,529	4,804	5,027
DEDUCTION & TAX CREDIT										
Pre-operational Expense	(228)	(228)	(228)	(228)	(228)	(228)	(228)	(228)	(228)	(228)
Labor Training Expense	-	-	-	-	-	-	-	-	-	-
Direct Labor Cost	-	-	-	-	-	-	-	-	-	-
Net Operating Loss (carried over)	-	(153)	-	-	-	-	-	-	-	-
Total Deduction	(228)	(381)	(228)	(228)	(228)	(228)	(228)	(228)	(228)	(228)
TAXABLE INCOME	(381)	1,221	3,216	3,489	3,760	4,006	4,077	4,301	4,576	4,799
PROVISION FOR INCOME TAX	-	427	1,126	1,221	1,316	1,402	1,427	1,505	1,602	1,680
NET PROFIT AFTER TAX	(153)	1,175	2,318	2,496	2,672	2,832	2,878	3,024	3,202	3,347

Table 5-14 Projected Cash Flow Statement

Electrolysis Plant

(1,000 US$)

	Pre-Operation	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
CASH RECEIPTS											
Net Income before Tax	-	(153)	1,602	3,444	3,717	3,988	4,234	4,305	4,529	4,804	5,027
Add: Depreciation	-	2,527	2,527	2,527	2,527	2,527	2,527	2,527	2,527	2,527	2,527
Amortization	-	923	923	923	923	923	923	923	923	923	923
Increase (decrease) in Account Payable	-	1,112	278	278	-	-	-	-	-	-	-
Foreign Loan	25,800	-	-	-	-	-	-	-	-	-	-
Local Loan	2,065	2,065	2,065	1,377	688	-	-	-	-	-	-
Stockholders' Equity	11,065	-	-	-	-	-	-	-	-	-	-
Total Receipts	38,930	6,474	7,395	8,549	7,855	7,438	7,684	7,755	7,979	8,254	8,477
CASH DISBURSEMENTS											
Process Facilities	23,660	-	-	-	-	-	-	-	-	-	-
Off-site Facilities	2,415	-	-	-	-	-	-	-	-	-	-
Land	1,560	-	-	-	-	-	-	-	-	-	-
License & Knowhow Fee	1,810	-	-	-	-	-	-	-	-	-	-
Pre-operating Expense	1,540	-	-	-	-	-	-	-	-	-	-
Financial Charge	5,880	-	-	-	-	-	-	-	-	-	-
Repayment											
Foreign Loan	-	2,580	2,580	2,580	2,580	2,580	2,580	2,580	2,580	2,580	2,580
Local Loan	-	2,065	2,065	2,065	1,377	688	-	-	-	-	-
Income Tax Payment	-	-	-	427	1,126	1,221	1,316	1,402	1,427	1,505	1,602
Increase (decrease) in Account Receivable	-	2,374	593	594	-	-	-	-	-	-	-
Increase (decrease) in Inventories:											
Raw Materials	102	25	26	-	-	-	-	-	-	-	-
Finished Goods	-	-	-	-	-	-	-	-	-	-	-
Total Disbursements	36,967	7,044	5,264	5,666	5,083	4,489	3,896	3,982	4,007	4,085	4,182
NET CASH FLOW	1,963	(570)	2,131	2,883	2,772	2,949	3,788	3,773	3,972	4,169	4,295
BEGINNING CASH BALANCE	-	1,963	1,393	3,524	6,407	9,179	12,128	15,916	19,689	23,661	27,830
ENDING CASH BALANCE	1,963	1,393	3,524	6,407	9,179	12,128	15,916	19,689	23,661	27,830	32,125

Table 5-15 Projected Balance Sheet

Electrolysis Plant

(1,000 US$)

	Pre-Operation	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
ASSETS											
CURRENT ASSETS											
Cash	1,963	1,393	3,524	6,407	9,179	12,128	15,916	19,689	23,661	27,830	32,125
Account Receivable	-	2,374	2,967	3,561	3,561	3,561	3,561	3,561	3,561	3,561	3,561
Inventories											
Finished Goods	-	-	-	-	-	-	-	-	-	-	-
Raw Materials	102	127	153	153	153	153	153	153	153	153	153
Total Current Assets	2,065	3,894	6,644	10,121	12,893	15,842	19,630	23,403	27,375	31,544	35,839
Pre-operating Expense	1,540	1,386	1,232	1,078	924	770	616	462	308	154	-
Other Amortized Items	7,690	6,921	6,152	5,383	4,614	3,845	3,076	2,307	1,538	769	-
FIXED ASSETS											
Land	1,560	1,560	1,560	1,560	1,560	1,560	1,560	1,560	1,560	1,560	1,560
Process Facilities	23,660	23,660	23,660	23,660	23,660	23,660	23,660	23,660	23,660	23,660	23,660
Off-site Facilities	2,415	2,415	2,415	2,415	2,415	2,415	2,415	2,415	2,415	2,415	2,415
Less: Accumurated Depreciation	-	2,527	5,054	7,581	10,108	12,635	15,162	17,689	20,216	22,743	25,270
Total Fixed Assets	27,635	25,108	22,581	20,054	17,527	15,000	12,473	9,946	7,419	4,892	2,365
TOTAL ASSETS	38,930	37,309	36,609	36,636	35,958	35,457	35,795	36,118	36,640	37,359	38,204
LIABILITIES & NET WORTH											
CURRENT LIABILITIES											
Account Payable	-	1,112	1,390	1,668	1,668	1,668	1,668	1,668	1,668	1,668	1,668
Income Tax Payable	-	-	427	1,126	1,221	1,316	1,402	1,427	1,505	1,602	1,680
Current Portion of Loan											
Foreign Loan	2,580	2,580	2,580	2,580	2,580	2,580	2,580	2,580	2,580	2,580	-
Local Loan	2,065	2,065	2,065	1,377	688	-	-	-	-	-	-
Total Current Liabilities	4,645	5,757	6,462	6,751	6,157	5,564	5,650	5,675	5,753	5,850	3,348
Foreign Loan	23,220	20,640	18,060	15,480	12,900	10,320	7,740	5,160	2,580	-	-
Local Loan	-	-	-	-	-	-	-	-	-	-	-
NET WORTH											
Stockholders' Equity	11,065	11,065	11,065	11,065	11,065	11,065	11,065	11,065	11,065	11,065	11,065
Retained Earnings	-	-	(153)	1,022	3,340	5,836	8,508	11,340	14,218	17,242	20,444
Net Income for the year	-	(153)	1,175	2,318	2,496	2,672	2,832	2,878	3,024	3,202	3,347
Total Net Worth	11,065	10,912	12,087	14,405	16,901	19,573	22,405	25,283	28,307	31,509	34,856
TOTAL LIABILITIES & NET WORTH	38,930	37,309	36,609	36,636	35,958	35,457	35,795	36,118	36,640	37,359	38,204

Table 5-16 Projected Income Statement

VCM Plant

(1,000 US$)

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
REVENUE										
Sales	22,826	28,533	34,239	34,239	34,239	34,239	34,239	34,239	34,239	34,239
EXPENDITURE										
Cost of Goods Sold	18,914	23,004	27,091	27,062	27,034	27,007	26,982	26,951	26,916	26,885
(GROSS PROFIT ON SALES)	3,912	5,529	7,148	7,177	7,205	7,232	7,257	7,288	7,323	7,354
Operating Expense	1,610	2,038	2,261	2,569	2,876	3,246	3,738	3,861	3,860	3,982
(NET PROFIT FROM OPERATION)	2,302	3,491	4,887	4,608	4,329	3,986	3,519	3,427	3,463	3,372
Financial Charge										
Local Loan	382	382	382	255	127	-	-	-	-	-
Foreign Loan	1,815	1,633	1,452	1,270	1,089	907	650	544	363	182
Guarantee Fee	385	347	308	270	231	193	153	116	77	39
Total Financial Charge	2,582	2,362	2,142	1,795	1,447	1,100	803	660	440	221
NET PROFIT BEFORE TAXES	(280)	1,129	2,745	2,813	2,882	2,886	2,716	2,767	3,023	3,151
DEDUCTION & TAX CREDIT										
Pre-operational Expense	(202)	(202)	(202)	(202)	(202)	(202)	(202)	(202)	(202)	(202)
Labor Training Expense	-	-	-	-	-	-	-	-	-	-
Direct Labor Cost	-	-	-	-	-	-	-	-	-	-
Net Operating Loss (carried over)	-	(280)	-	-	-	-	-	-	-	-
Total Deduction	(202)	(482)	(202)	(202)	(202)	(202)	(202)	(202)	(202)	(202)
TAXABLE INCOME	(482)	647	2,543	2,611	2,680	2,684	2,514	2,565	2,821	2,949
PROVISION FOR INCOME TAX	-	226	890	914	939	939	880	898	987	1,032
NET PROFIT AFTER TAX	(280)	903	1,855	1,899	1,944	1,947	1,836	1,869	2,036	2,119

Table 5-17 Projected Cash Flow Statement

VCM Plant

(1,000 US$)

	Pre-Operation	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
CASH RECEIPTS											
Net Income before Tax	-	(280)	1,129	2,745	2,813	2,882	2,886	2,716	2,767	3,023	3,151
Add: Depreciation	-	2,401	2,401	2,401	2,401	2,401	2,401	2,401	2,401	2,401	2,401
Amortization	-	824	824	824	824	824	824	824	824	824	824
Increase (decrease) in Account Payable	-	2,507	626	627	-	-	-	-	-	-	-
Foreign Loan	23,880										
Local Loan	2,124	2,124	2,124	1,416	708	-	-	-	-	-	-
Stockholders' Equity	10,235										
Total Receipts	36,239	7,576	7,104	8,013	6,746	6,107	6,111	5,941	5,992	6,248	6,376
CASH DISBURSEMENTS											
Process Facilities	22,470	-	-	-	-	-	-	-	-	-	-
Off-site Facilities	2,760	-	-	-	-	-	-	-	-	-	-
Land	945	-	-	-	-	-	-	-	-	-	-
License & Knowhow Fee	700	-	-	-	-	-	-	-	-	-	-
Pre-operating Expense	2,020	-	-	-	-	-	-	-	-	-	-
Financial Charge	5,220	-	-	-	-	-	-	-	-	-	-
Repayment											
Foreign Loan	-	2,388	2,388	2,388	2,388	2,388	2,388	2,388	2,388	2,388	2,388
Local Loan	-	2,124	2,124	2,124	1,416	708	-	-	-	-	-
Income Tax Payment	-	-	-	226	890	914	938	939	880	898	987
Increase (decrease) in Account Receivable	-	3,804	952	951	-	-	-	-	-	-	-
Increase (decrease) in Inventories											
Raw Materials	-	-	-	-	-	-	-	-	-	-	-
Finished Goods	-	-	-	-	-	-	-	-	-	-	-
Total Disbursements	34,115	8,316	5,464	5,689	4,694	4,010	3,326	3,327	3,268	3,286	3,375
NET CASH FLOW	2,124	(740)	1,640	2,324	2,052	2,097	2,785	2,614	2,724	2,962	3,001
BEGINNING CASH BALANCE	-		1,384	3,024	5,348	7,400	9,497	12,282	14,896	17,620	20,582
ENDING CASH BALANCE	2,124	1,384	3,024	5,348	7,400	9,497	12,282	14,896	17,620	20,582	23,583

Table 5-18 Projected Balance Sheet

VCM Plant

(1,000 US$)

	Pre-Operation	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
ASSETS											
CURRENT ASSETS											
Cash	2,124	1,384	3,024	5,348	7,400	9,497	12,282	14,896	17,620	20,582	23,583
Account Receivable	-	3,804	4,756	5,707	5,707	5,707	5,707	5,707	5,707	5,707	5,707
Inventories											
Finished Goods	-	-	-	-	-	-	-	-	-	-	-
Raw Materials	-	-	-	-	-	-	-	-	-	-	-
Total Current Assets	2,124	5,188	7,780	11,055	13,107	15,204	17,989	20,603	23,327	26,289	29,290
Pre-operating Expense	2,020	1,818	1,616	1,414	1,212	1,010	808	606	404	202	-
Other Amortized Items	6,220	5,598	4,976	4,354	3,732	3,110	2,488	1,866	1,244	622	-
FIXED ASSETS											
Land	945	945	945	945	945	945	945	945	945	945	945
Process Facilities	22,170	22,170	22,170	22,170	22,170	22,170	22,170	22,170	22,170	22,170	22,170
Off-site Facilities	2,760	2,760	2,760	2,760	2,760	2,760	2,760	2,760	2,760	2,760	2,760
Less: Accumurated Depreciation	-	2,401	4,802	7,203	9,604	12,005	14,406	16,807	19,208	21,609	24,010
Total Fixed Assets	25,875	23,474	21,073	18,672	16,271	13,870	11,469	9,068	6,667	4,266	1,865
TOTAL ASSETS	36,239	36,078	35,445	35,495	34,322	33,194	32,754	32,143	31,642	31,379	31,155
LIABILITIES & NET WORTH											
CURRENT LIABILITIES											
Account Payable	-	2,507	3,133	3,760	3,760	3,760	3,760	3,760	3,760	3,760	3,760
Income Tax Payable	-	-	226	890	914	938	939	880	898	987	1,032
Current Portion of Loan											
Foreign Loan	2,388	2,388	2,388	2,388	2,388	2,388	2,388	2,388	2,388	2,388	-
Local Loan	2,124	2,124	2,124	1,416	708	-	-	-	-	-	-
Total Current Liabilities	4,512	7,019	7,871	8,454	7,770	7,086	7,087	7,028	7,046	7,135	4,792
Foreign Loan	21,492	19,104	16,716	14,328	11,940	9,552	7,164	4,776	2,388	-	-
Local Loan	-	-	-	-	-	-	-	-	-	-	-
NET WORTH											
Stockholders' Equity	10,235	10,235	10,235	10,235	10,235	10,235	10,235	10,235	10,235	10,235	10,235
Retained Earnings	-	-	(280)	623	2,478	4,377	6,321	8,268	10,104	11,973	14,009
Net Income for the year	-	(280)	903	1,855	1,899	1,944	1,947	1,836	1,869	2,036	2,119
Total Net Worth	10,235	9,955	10,858	12,713	14,612	16,556	18,503	20,339	22,208	24,244	26,363
TOTAL LIABILITIES & NET WORTH	36,239	36,078	35,445	35,495	34,322	33,194	32,754	32,143	31,642	31,379	31,155

Table 5-19 Projected Income Statement

PP Plant

(1,000 US$)

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
REVENUE										
Sales	69,432	83,870	98,779	103,245	108,317	111,095	111,095	111,095	111,095	111,095
EXPENDITURE										
Cost of Goods Sold	47,684	57,820	67,946	67,868	67,792	67,720	67,563	67,653	67,466	67,376
(GROSS PROFIT ON SALES)	21,748	26,050	30,833	35,377	40,525	43,375	43,442	43,532	43,629	43,719
Operating Expense	5,808	7,200	7,975	8,983	10,093	11,392	12,991	13,389	13,386	13,784
(NET PROFIT FROM OPERATION)	15,940	18,850	22,858	26,394	30,432	31,983	30,451	30,143	30,243	29,935
Financial Charge										
Local Loan	1,385	1,385	1,385	923	462	-	-	-	-	-
Foreign Loan	5,384	4,845	4,307	3,769	3,230	2,692	2,154	1,615	1,077	538
Guarantee Fee	1,143	1,029	915	800	686	572	457	343	229	114
Total Financial Charge	7,912	7,259	6,607	5,492	4,378	3,264	2,611	1,958	1,306	652
NET PROFIT BEFORE TAXES	8,028	11,591	16,251	20,902	26,054	28,719	27,840	28,185	28,937	29,283
DEDUCTION & TAX CREDIT										
Pre-operational Expense	(491)	(491)	(491)	(491)	(491)	(491)	(491)	(491)	(491)	(491)
Labor Training Expense	-	-	-	-	-	-	-	-	-	-
Direct Labor Cost	(48)	(74)	(89)	(54)	(18)	-	-	-	-	-
Net Operating Loss (carried over)	-	-	-	-	-	-	-	-	-	-
Total Deduction	(539)	(565)	(580)	(545)	(509)	(491)	(491)	(491)	(491)	(491)
TAXABLE INCOME	7,489	11,026	15,671	20,357	25,545	28,228	27,349	27,694	28,446	28,792
PROVISION FOR INCOME TAX	2,621	3,859	5,485	7,125	8,941	9,880	9,572	9,693	9,956	10,077
NET PROFIT AFTER TAX	5,407	7,732	10,766	13,777	17,113	18,839	18,268	18,492	18,981	19,206

Table 5-20 Projected Cash Flow Statement

PP Plant

(1,000 US$)

	Pre-Operation	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
CASH RECEIPTS											
Net Income before Tax		8,028	11,591	16,251	20,902	26,054	28,719	27,840	28,185	28,937	29,283
Add: Depreciation		6,833	6,833	6,833	6,833	6,833	6,833	6,833	6,833	6,833	6,833
Amortization		2,862	2,862	2,862	2,862	2,862	2,862	2,862	2,862	2,862	2,862
Increase (decrease) in Account Payable		6,273	1,569	1,568	-	-	-	-	-	-	-
Foreign Loan	70,840	-	-	-	-	-	-	-	-	-	-
Local Loan	7,694	7,694	7,694	5,129	2,565	-	-	-	-	-	-
Stockholders' Equity	30,350	-	-	-	-	-	-	-	-	-	-
Total Receipts	108,884	31,690	30,549	32,643	33,162	35,749	38,414	37,535	37,880	38,632	38,978
CASH DISBURSEMENTS											
Process Facilities	62,680	-	-	-	-	-	-	-	-	-	-
Off-site Facilities	8,475	-	-	-	-	-	-	-	-	-	-
Land	1,415	-	-	-	-	-	-	-	-	-	-
Licence & Knowhow Fee	7,640	-	-	-	-	-	-	-	-	-	-
Pre-operating Expense	4,910	-	-	-	-	-	-	-	-	-	-
Financial Charge	16,070	-	-	-	-	-	-	-	-	-	-
Repayment											
Foreign Loan	-	7,084	7,084	7,084	7,084	7,084	7,084	7,084	7,084	7,084	7,084
Local Loan	-	7,694	7,694	7,694	5,129	2,565	-	-	-	-	-
Income Tax Payment	-	-	2,621	3,859	5,485	7,125	8,941	9,880	9,572	9,693	9,956
Increase (decrease) in Account Receivable	-	11,572	2,406	2,485	745	845	463	-	-	-	-
Increase (decrease) in Inventories											
Raw Materials	-	-	-	-	-	-	-	-	-	-	-
Finished Goods	-	-	-	-	-	-	-	-	-	-	-
Total Disbursements	101,190	26,350	19,805	21,122	18,443	17,619	16,488	16,964	16,656	16,777	17,040
NET CASH FLOW	7,694	5,340	10,744	11,521	14,719	18,130	21,926	20,571	21,224	21,855	21,938
BEGINNING CASH BALANCE	-	7,694	13,034	23,778	35,299	50,018	68,148	90,074	110,645	131,869	153,724
ENDING CASH BALANCE	7,694	13,034	23,778	35,299	50,018	68,148	90,074	110,645	131,869	153,724	175,662

Table 5-21 Projected Balance Sheet

PP Plant

(1,000 US$)

	Pre-Operation	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
ASSETS											
CURRENT ASSETS											
Cash	7,694	13,034	23,778	35,299	50,018	68,148	90,074	110,645	131,869	153,724	175,662
Account Receivable	-	11,572	13,978	16,463	17,208	18,053	18,516	18,516	18,516	18,516	18,516
Inventories											
Finished Goods	-	-	-	-	-	-	-	-	-	-	-
Raw Materials	-	-	-	-	-	-	-	-	-	-	-
Total Current Assets	7,694	24,606	37,756	51,762	67,226	86,201	108,590	129,161	150,385	172,240	194,178
Pre-operating Expense	4,910	4,419	3,928	3,437	2,946	2,455	1,964	1,473	982	491	-
Other Amortized Items	23,710	21,339	18,968	16,597	14,226	11,855	9,484	7,113	4,742	2,371	-
FIXED ASSETS											
Land	1,415	1,415	1,415	1,415	1,415	1,415	1,415	1,415	1,415	1,415	1,415
Process Facilities	62,680	62,680	62,680	62,680	62,680	62,680	62,680	62,680	62,680	62,680	62,680
Off-site Facilities	8,475	8,475	8,475	8,475	8,475	8,475	8,475	8,475	8,475	8,475	8,475
Less: Accumurated Depreciation	-	6,833	13,666	20,499	27,332	34,165	40,998	47,831	54,664	61,497	68,330
Total Fixed Assets	72,570	65,737	58,904	52,071	45,238	38,405	31,572	24,739	17,906	11,073	4,240
TOTAL ASSETS	108,884	116,101	119,556	123,867	129,636	138,916	151,610	162,486	174,015	186,175	198,418
LIABILITIES & NET WORTH											
CURRENT LIABILITIES											
Account Payable	-	6,273	7,842	9,410	9,410	9,410	9,410	9,410	9,410	9,410	9,410
Income Tax Payable	-	2,621	3,859	5,485	7,125	8,941	9,880	9,572	9,693	9,956	10,077
Current Portion of Loan											
Foreign Loan	7,084	7,084	7,084	7,084	7,084	7,084	7,084	7,084	7,084	7,084	-
Local Loan	7,694	7,694	7,694	5,129	2,565	-	-	-	-	-	-
Total Current Liabilities	14,778	23,672	26,479	27,108	26,184	25,435	26,374	26,066	26,187	26,450	19,487
Foreign Loan	63,756	56,672	49,588	42,504	35,420	28,336	21,252	14,168	7,084	-	-
Local Loan	-	-	-	-	-	-	-	-	-	-	-
NET WORTH											
Stockholders' Equity	30,350	30,350	30,350	30,350	30,350	30,350	30,350	30,350	30,350	30,350	30,350
Retained Earnings	-	-	5,407	13,139	23,905	37,682	54,795	73,634	91,902	110,394	129,375
Net Income for the year	-	5,407	7,732	10,766	13,777	17,113	18,839	18,268	18,492	18,981	19,206
Total Net Worth	30,350	35,757	43,489	54,255	68,032	85,145	103,984	122,252	140,744	159,725	178,931
TOTAL LIABILITIES & NET WORTH	108,884	116,101	119,556	123,867	129,636	138,916	151,610	162,486	174,015	186,175	198,418

5-5 Financial Analysis

5-5-1 Profitability Ratio

The followings are the profitability ratio applicable to the entire complex. Each ratio was computed by the respective accounts of each enterprise, and then the relative items were added together to obtain the total figure for the whole complex.

This procedure has been applied to all the ratio computations and measurements of economic factors.

(1) Rate of return on total assets

a)	1980	4.91%
b)	1985	12.04%
c)	1989	10.21%

(2) Rate of return on stockholders' equity

a)	1980	0.30%
b)	1985	16.35%
c)	1989	11.09%

(3) Net profit margin on sales x Turnover of investment

a)	1980	7.55%
b)	1985	18.52%
c)	1989	15.71%

(4) Payback period

a)	Total investment	5 years 6 months
b)	Equity investment	7 years 6 months

The detailed computations of the above-mentioned ratios for each enterprise are shown in 5-2-5, Part II.

5-5-2 DCF Internal Rate of Return

The internal rate of return (IRR) by the discounted cash flow method for the whole complex is based on the following:

(1) Total capital requirement 16.0%

(2) Paid-in capital 22.5%

The detailed calculations of the discounted cash flow for individual companies are illustrated in 5-2-6, Part II.

5-5-3 Liquidity Ratio

The liquidity ratios applied to the total complex are as follows:

(1) Current ratio

1980	0.75 : 1	(75%)
1985	3.02 : 1	(302%)
1989	7.96 : 1	(796%)

(2) Quick ratio

1980	0.75 : 1	(75%)
1985	3.02 : 1	(302%)
1989	7.96 : 1	(796%)

(3) Number of days' sales in receivables: 67 days

Further details are contained in 5-2-5, Part II.

5-5-4 Solvency Ratio

The following are the solvency ratios employed for the whole complex:

(1) Debt-equity ratio

1980	71 : 29
1985	37 : 63
1989	10 : 90

(2) Debt-service coverage on contractual obligations

1980	0.69 : 1
1985	2.13 : 1
1989	2.84 : 1

Further details are given in 5-2-5, Part II.

5-6 Measurement of Economic Factors

The following economic factors are used by aggregating the relative items to arrive at the total figure for the entire complex. The criteria applied are the same as those used by the Board of Investments (BOI) of the Philippines.

(1) Value added coefficient: 45.12%

(2) Utilizations of indigenous raw materials: 47.51%

(3) Fixed assets per worker: US$252,780

(4) Fixed assets per peso wage/salary: US$63.01

(5) Fixed assets/value added: 1.12

(6) Foreign exchange benefit/cost ratio: 307.67%

(7) Foreign exchange benefit/imported raw material ratio: 510.32%

Refer to 5-2-6, Part II regarding the calculated economic factors for individual companies.

5-7 Foreign Exchange Balance

Total foreign exchange earnings and savings of this complex during ten (10) operating years, i.e., from 1980 to 1989, is US$527,313,000. (Table 5-41 in 5-2, Part II for the details of the foreign exchange balance)

5-8 Break-even Analyses

The break-even analyses on the whole complex for the years 1982, 1985, and 1989 are as shown in Figs. 5-1 through 5-3.

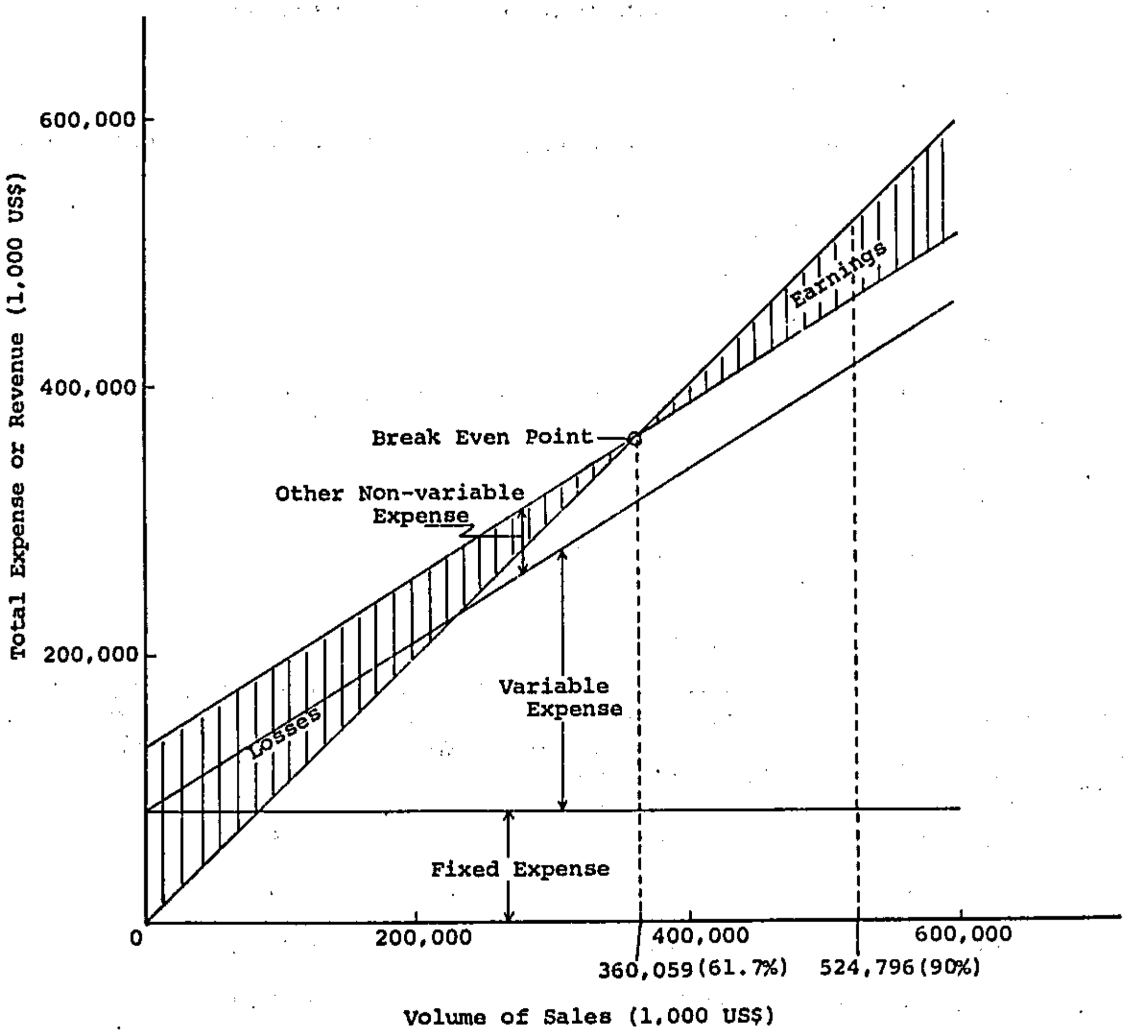

Fig. 5-1 Break-even Chart

Whole Complex (1982)

(Operation at 90% of Rated Capacity)

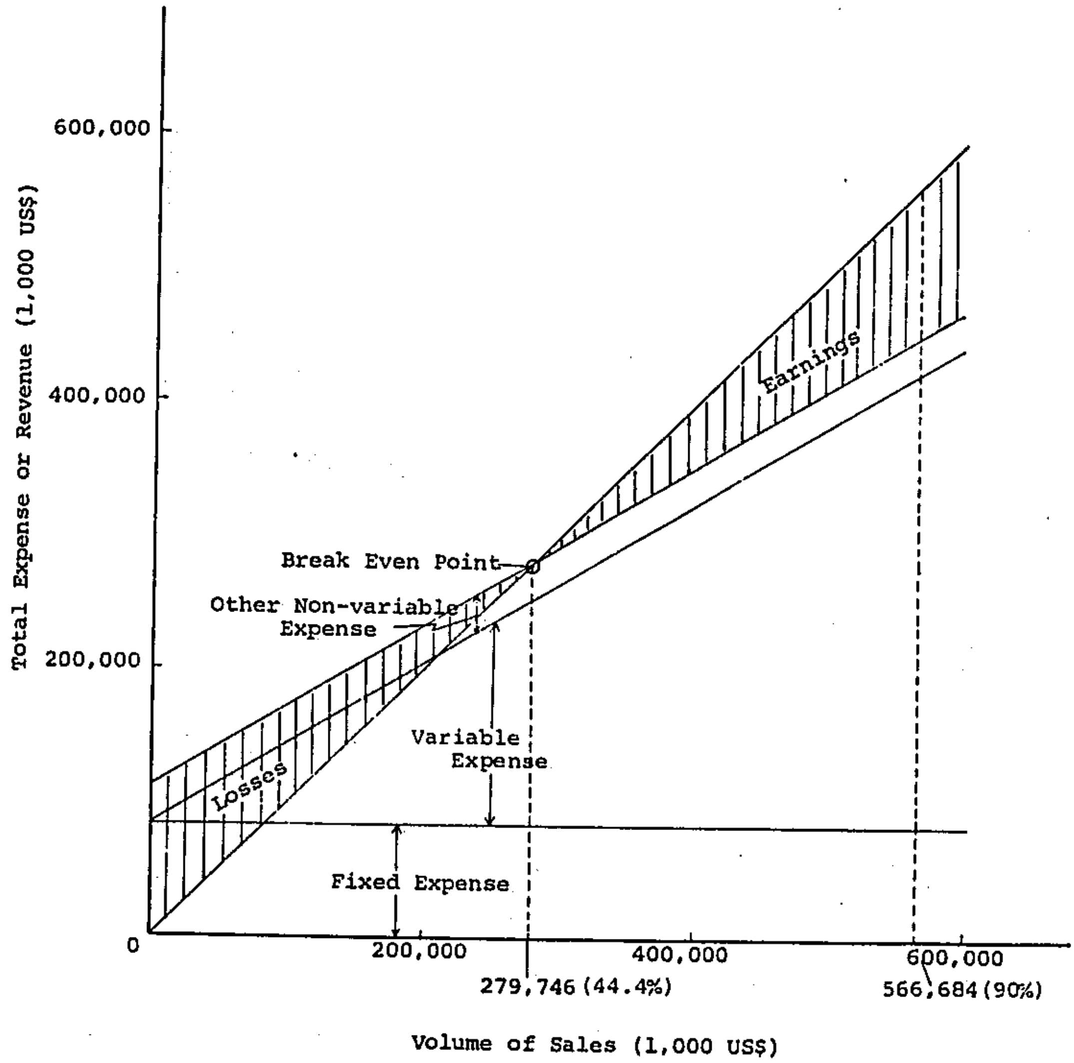

Fig. 5-2 **Break-even Chart**

Whole Complex (1985)

(Operation at 90% of Rated Capacity)

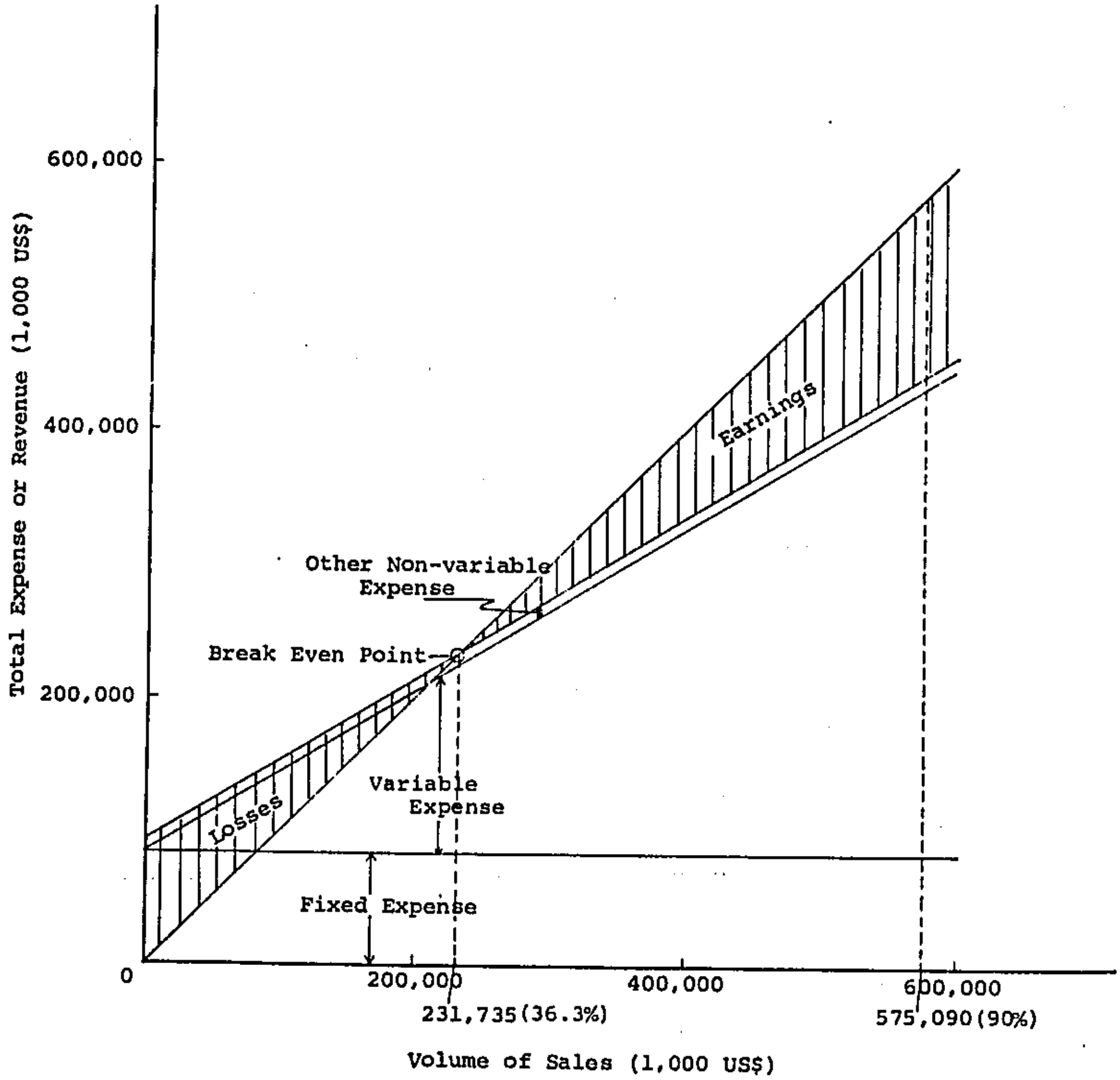

Fig. 5-3 Break-even Chart
Whole Complex (1989)
(Operation at 90% of Rated Capacity)

The margin for safety in the respective years is calculated as follows:

(a) 1982 : $1 - \frac{360,059}{524,796} = 0.314$

(b) 1985 : $1 - \frac{279,746}{566,684} = 0.506$

(c) 1989 : $1 - \frac{231,735}{575,090} = 0.597$

Further, the respective operational rates at the break-even point are as follows:

(a) 1982 : 61.7%

(b) 1985 : 44.4%

(c) 1989 : 36.3%

5-9 General Financial Evaluation

The general financial evaluation of the entire complex based on the outcome of the financial statements regarding the financial analysis is as follows:

The project plans and financial analysis in this study are based on many assumptions, and in addition many questionable points seem to have been present in the accuracy of the estimated investment amounts. Therefore, the following should not be taken as a final evaluation of this project.

5-9-1 Profit Rate

(1) Rate of return on total assets

The rate of return on total assets of this project is attains a 10% level of higher in the fourth year after operation, and 12.04% in the sixth year, thereafter showing a gradual fall. The instances of similar enterprises in Japan generally show a level between 8% and 9% depending on capital structures. Therefore, the rate of this complex can readily be deemed satisfactory.

(2) Rate of return on stockholders' equity

Higher figures for this rate is more desirable for the purpose of maintaining viability of the enterprise during recession. The analysis of this project indicates an increase in the rate of return on stockholders' equity up to the fifth year after commencing operation, and a downtrend in the sixth year onwards. The fall is due to the conspicuous annual increase in the rate of return on stockholders' equity caused by the increase in the retained earnings, and does not constitute any instability.

(3) Payback period

The payback period for the entire investment and equity investment seems a little too long.

(4) Internal rate of return by discounted cash flow method

The standard value, in this project, for IRR assessment seems to be 12.0 - 13.0% (against total capital requirement). The 16% rate of this project seems to be a fair value to base on when making an investment decision, when compared to other investment opportunities.

(5) The capital cost in this project consists of a 7.6% interest p.a. for the long-term foreign loan and an 18% interest p.a. for the short-term local loan. The net average interest rate for the loans calculated by the weighted average according to the amounts of loans is 10.12%. Comparison of this average interest rate with the rate of return on total assets and the rate of return on stockholders' equity indicates that the interest rate is exceeded by the rate of return on total assets in the second year onwards, and by the rate of return on stockholders' equity in the third year onwards.

There is no other enterprise in the Philippines suitable for comparison with this project regarding the rate of return on total assets and the rate of return on stockholders' equity. Therefore, examples of representative Japanese petrochemical industry corporations are given as follows:

Rate of return on total assets: between 10% and 11%
Rate of return on stockholders' equity: between 12% and 13%

As far as these two rates are concerned, this project appears to be satisfactory.
For the entire Japanese chemical industry, the corresponding rates are as follows:

Rate of return on total assets: between 8% and 9%
Rate of return on stockholders' equity: approximately 26%

5-9-2 Liquidity Ratio

(1) Current ratio

The desirable liquidity ratio for an enterprise in general is considered to be 2:1 (200%) or higher. In the manufacturing enterprises, in which the ratio of imported raw materials to their production costs is high, the usual standard is between 1.4:1 and 1.6:1 (140% - 160%). In the case of this project, the ratio is 140% or lower up to the third year after commencing the operation; however, 200% or higher is attainable during and after the fifth year.

Therefore, this project seems to have sufficient solvency for short-term obligations.

(2) Acid test or quick ratio

In this financial analysis, the acid test results are almost equal to the liquidity ratio, as the current asset classification in this study is not detailed.

(3) Number of days' sales in receivables

It is difficult to readily decide the number of days' sales in receivables as it differs according to the business activities and demand/supply conditions. As this complex provides 67 days for the sales in receivables and 106 days for procurement in payables, a relatively favorable number of days' sales in receivables is maintained. However, the question of the solvency of the drawer of bills received is not taken into account.

5-9-3 Repayment Capacity Rate (Solvency Rate)

(1) Equity investment rate

As no assumption is made in the financial projection of this project, all the profits will be reserved. Therefore, the equity investment ratio in 1989 (tenth year after the commencement) will be 10:90. Generally, the rate ranges from 70:30 to 60:40, yet it is desirable that the equity investment rate higher. A further study is necessary together with the profit projection when implementing a more detailed financial projection.

(2) Solvency ratio

A solvency ratio of 100% or higher normally signifies solvent. As the ratio of this project exceeds 100% in and after the second year, no solvency problem seems to exist.

5-9-4 General Evaluation

This project involves some questionable points during three years after the operation commencement. In a long-term view, however, this project seems to possess the potentialities for growing into a sound operation, although the financial position is not necessarily excellent.

PART II

ADDITIONAL INFORMATION

PART II

ADDITIONAL INFORMATION

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CHAPTER 1. PROJECT DESCRIPTION

CHAPTER 1. PROJECT DESCRIPTION

CONTENTS

TABLES AND ILLUSTRATIONS

1. Project Description

1-1 Plant Site

Plant site for the petrochemical industry, the selection of which will greatly affect the economy, shall be carefully scrutinized taking into consideration factors such as the availability, cost, quality and accessibility of all the goods and services needed, the raw materials, supplies, fuel, power, water, land, labor, housing, transportation, etc. These elements have to be investigated not only for one but for other alternative locations.

Since the major objective of this pre-feasibility study is to justify the establishment of a petrochemical complex in the Philippines for commercial and national benefit, the project site is tentatively nominated for Rosario, Cavite wherein the Filoil Refinery is situated. An overall study has been conducted in the plant site.

At the stage of the implementation of the project, eventual location shall be determined after conducting detailed site surveys on other candidate sites such as Bataan, Batangas, etc.

Rosario, Cavite is located in Luzon Island and is about 30km south from Manila area, which makes the site very advantageous in various aspects.

1-1-1 Land

In Rosario, Cavite, there exists a large area of land available for the petrochemical industry. The land is now owned by Filoil Refinery and available land is about 240 hectares. The major part of the land is now utilized for paddy field and already partly sold to other petrochemical companies at the price of 7 to 10 pesos per square meter which is far below the current price of the land in the same area.

1-1-2 Transportation

The proximity of the candidate site to the existing market area is considered the most favorable condition. The distance to the market area is only 30km, and in the market, more than 90 per cent of the domestic users are located. Further, the road conditions between the market and the site will be improved in the future under the present urbanization proposal plan. In addition to these promising factors, the presence of intermediate stock points will allow direct distribution of products to customers.

1-1-3 Labor

As the site is not far from Manila, skilled labor forces from the city is considered to be the possible manpower resources, while manual labor will be available from the province of Cavite itself.

1-1-4 Harbor Facilities

The existing port facilities at the plant site of Rosario, Cavite is not in a big scale as to introduce a large tanker or deliver a large quantity of products. They only have a jetty for delivery of refined products such as fuel oil, kerosene, etc. In the Area, there exists a PS plant and the introduction of monomer as raw materials is also made through the pipeline from the jetty. Crude oil for Filoil Refinery is being received at off-shore from the jetty via the submarine pipeline. If a new harbor is constructed, there is a possibly that this will be filled with sand since the river beside the proposed plant site brings a huge quantity of sand from the upper stream.

The existing port facilities of the Filoil Refinery are given below:

(1) Seaberth for 45,000 to 60,000DWT tankers

Location:	4km off shore from Rosario, Cavite. Bearing of the centerline of the seaberth is N 65E.
Facilities:	Two(2) lines of 10" x 255' submarine pipeline. There are six(6) mooring buoys in the mooring area and (5) other buoys are located inside the berthing area.
Draft:	Approximately 50' 0" at high tide and 45' 0" at low tide.

(2) Barge wharf for local loading barges

Location:	Approximately 2,980' off the shore of Rosario, Cavite with bearing at centerline of the 90' x 30' Pier "T" Hea of N 47° 11'E.
Draft:	2.4m to 3.0m at MLL Water level.

1-1-5 Availability of Utilities

(1) Electric power

At present, PNOC is receiving electric power supply from MERALCO through 34.5kv lines extended from a substation in Manila. As this is a single line transmission, the supply sometimes becomes unreliable. The stability of supply is also affected at times by the extent of present domestic electric power consumption.

However, by the year 1980, dual circuit of 110kv or 230kv will be installed by MERALCO including a transmission line from Las Pinas which is very close geographically to the candidate plant site, thereby, improving the power supply stability. MERALCO also has certain expansion plans, so that the available supply capacity will be sufficient for the operation of the petrochemical complex in the future.

This being the circumstance, it is estimated that the required amount of electrical power supply will be made available from either NPC or MERALCO or from both.

Electric power generation within the complex will be conducted by using a start-up boiler as a backup supply source for critical equipment.

(2) Water supply

The following are sources of water supply:

(a) River water

The water flowing from the river beside the proposed plant site has a high salt content. Therefore, this water cannot be used as BFW, or as process water. The water in the upstream of the river is presently used for irrigation. Thus, it may also be difficult to make use of the water as the cooling water for the plant.

(b) Well water

At present, Filoil has three deep wells as water supply sources for the refinery. The available water quantity from these wells is about 800 to 1,000GPM per well.

These drilled wells are approximately 1,000 feet deep and submarine water pumps are set at about 120 feet below the water level. For the proposed petrochemical complex, the required amount of water may be obtained by drilling six of such wells. However, the accurate amount of the water requirement must be determined on the basis of detailed operation diagram of the complex including such factors as the required amount of electric power which may be made available from NPC/MERALCO.

(c) Sea water

Due to luck of assurance on the available quantity of the well water, the sea water will be used as cooling water as much as possible. The intake and the exhaust points of the water will be studied by the Consultants by taking the sea-depth into consideration.

Sea water can be used as cooling water for the ethylene plant. Problems of sea water utilization at the candidate site may be caused by the shallowness of the sea in this area, and the wide variation in the intake water temperature will be affected by weather conditions.

The maximum temperature of the sea-bed in this area is estimated to be 32°C.

1-1-6 Feedstock Supply

In Rosario, Cavite, there is a refinery with a capacity of 30,000BPSD which can be the supplier of ethylene feedstock to the proposed petrochemical complex.

However, the existing refinery's capacity will be only sufficient for 160,000MTA - 170,000MTA ethylene production. To cover the expected ethylene production rate, the refinery shall be expanded to meet the feedstock requirement which is possible by an in-depth study of the refinery.

1-1-7 Meteorological conditions

(1) Atmospheric temperature

(a) Highest temperature: 34°C
Lowest temperature: 22°C
Mean temperature: 28°C

(b) Monthly changes : refer to attached Fig. 1-1.

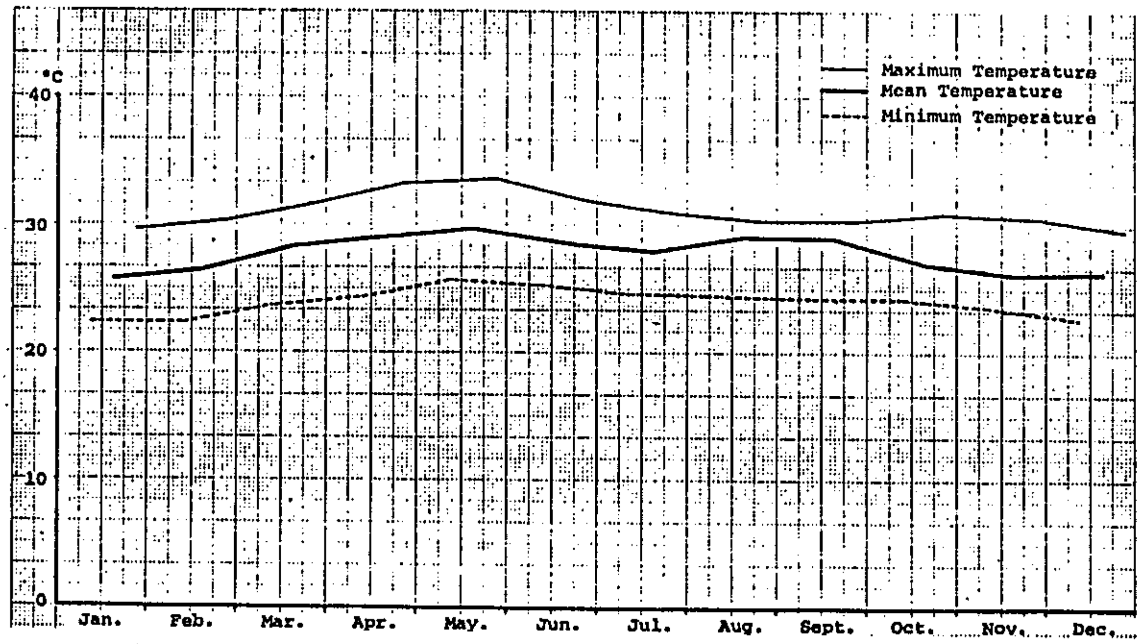


Fig. 1-1 Monthly Temperature

(2) Wind

(a) Wind direction:

Prevailing winds from February to May - SE
June to September - SW
October to January- NE

Refer to Fig. 1-2.

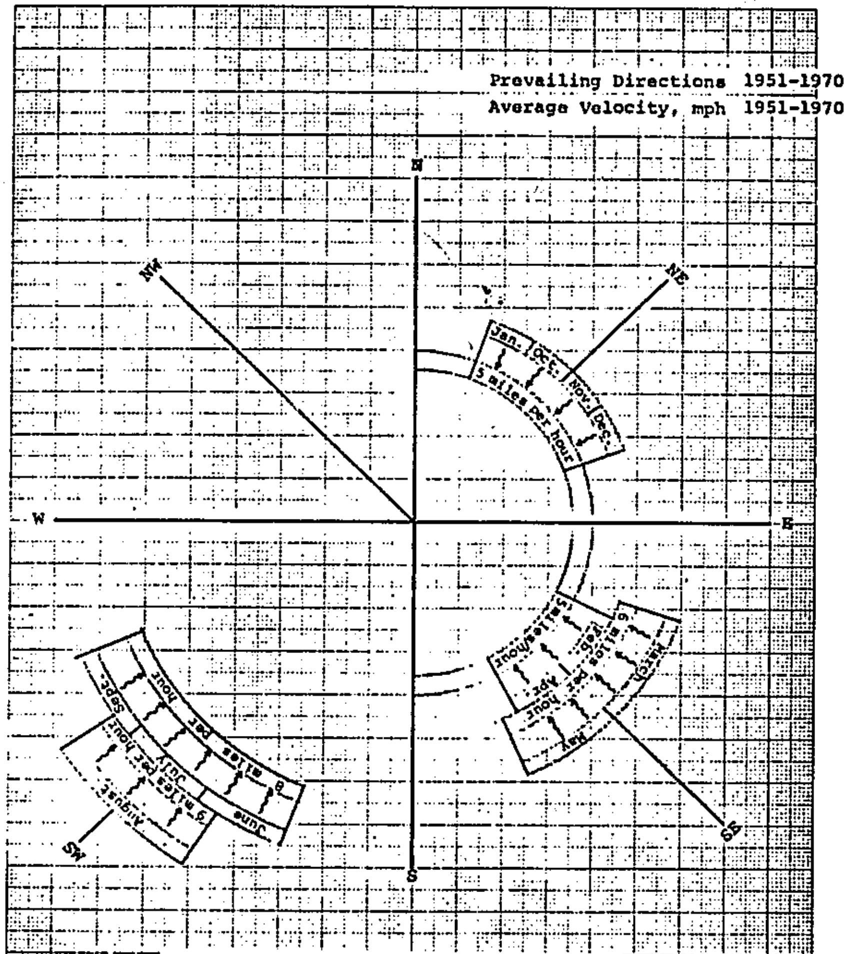


Fig. 1-2 Prevailing Wind Directions

Manila

(Based on Data from Bureau of Weather)

(b) Hourly velocities of 38 or more knots have been recorded during July, August, and September when the southwest monsoon prevails. Typhoons and severe tropical storms occur frequently from May to December. However, the majority of these storms pass the northern part of Luzon.

Structural design wind pressures for various height

49 psf below 30'
50 psf above 30' but below 49'
60 psf above 50' but below 99'
75 psf above 100'

(3) Typhoon

(a) Frequency as per attached sheet

(b) Typhoons and severe tropical storms occur frequently from May to December. Sometimes, this delays the handling of crude oil and products at the jetty for about one week to ten days. However, the majority of these storms pass the north of Luzon.

(4) Relative humidity

(a) Max. rel. humidity: 96% at around 28°C
Min. rel. humidity: 50% at around 28°C

(b) See Fig. 1-3 for monthly average relative humidity curve during the past several years.

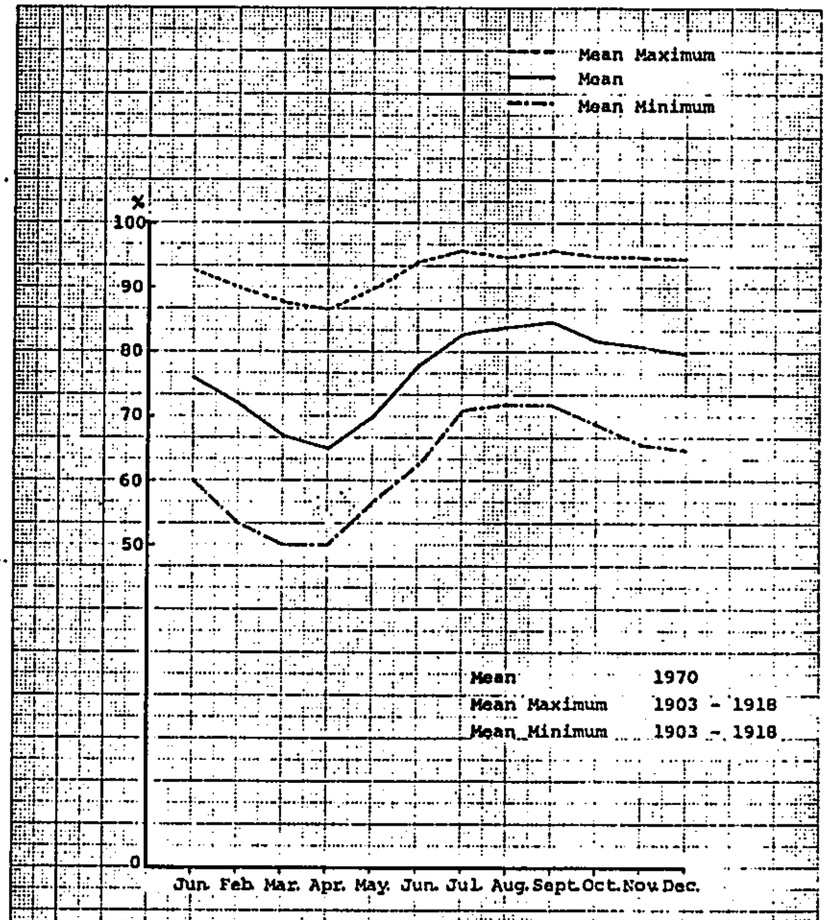


Fig. 1-3 Percentage of Relative Humidity

(Based on Data from Bureau of Weather)

(5) Rainfall

(a) Max. rainfall: 2" per hour

(b) Details as per attached Fig. 1-4.

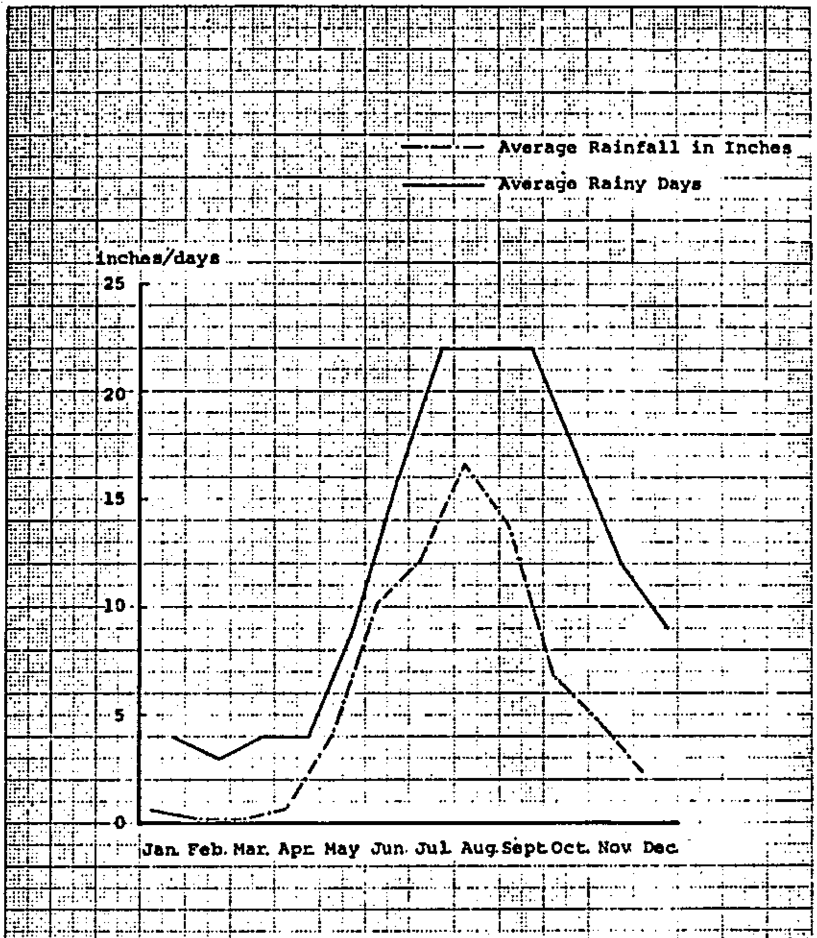


Fig. 1-4 Rainfall Record

(Based on Data from Bureau of Weather)
1951 - 1970

(6) Flood: None

(7) Earthquake

(a) The earthquakes in this area vary between I and X on the Rossi-Forrel Scale.

(b) Seismic factor: 0.1

(8) Tides

The diurnal range of the tide in the area is about 3-1/2 feet.

(9) Currents

The tidal currents in Manila Bay are generally weak.

1-1-8 Geological Conditions

The refinery site is divided into two (2) distinct areas defined by "Marine Benches" which are characterized by underlying contrasting rocks with various lithological and physical properties.

The area north of or below the marine bench is made up of sediments such as clays, sand and gravel with an occasional thin veneer of decomposed and disintegrated tuff.

The area south of or above the marine bench shows a thick column of tuff which is strongly and regularly bedded.

(1) Soil bearing capacity

(a) For foundations of tanks and other minor structures north of or below the marine bench ..... 2 to 2-1/2 tons/sq.ft.

(b) For tanks and other minor structures resting on tuff south of or above the marine bench ..... 5 to 6 tons/sq.ft.

(c) For critical structures and installations where sellements or movements of the foundation are important factors, and which are founded on tuff and located south of or above the marine bench ... . 2-1/2 to 3-1/2 tons/sq.ft. or 27 tons/m^2

(2) Elevation of ground water table : 1.2 m below existing grade

1-1-9 Conditions

Hard layer sounding data : less than 1 m depth
Site elevation from the sea level : 5.4 m

Present information indicates that no difficult foundation problems will be encountered and that there appears to be no need for the consideration of pile foundations for equipment.

1-2 General Layout

The layout is classified into two kinds:

(1) Overall layout

This is a layout for the process units, utility facilities, warehouses, administration offices, maintenance shops, main roads, etc.

(2) Unit layout

This is a layout for the process equipments, namely: towers, heat exchangers, reactor drums, etc., control rooms, and other buildings inside the battery limit of the plant.

In this study, only the overall layout will be planned, and the unit layout will be discussed at the time of the detailed engineering study. A preliminary overall layout is shown in Fig. 1-5.

1-2-1 Overall Layout

In this study, the overall layout is made by taking into account the following items:

(1) General

(a) The manufacturing plants are separated from other facilities like the general service facilities, for general security and safety.

(b) Most of the general service facilities are located adjacent to the public road for the convenience of carrying out daily functions and other related outside activities.

(2) Utility distribution

(a) Electric power

1) Purchased power-receiving station and primary substation are located at the boundary of the complex while the utility plant which includes the power distribution station is located very near the receiving station and the primary substation so that the extra-high tension cable inside the complex will be as short as possible for safety and economy.

2) The LDPE plant and the electrolysis plant which require a large amount of power are located as near as possible to the utility plant.

(b) Steam

The Olefin plant which require high-pressure steam (120 kg/cm^2) is located adjacent to the utility plant.

1) Utility piping

The plant layout is taken into consideration to make the utility piping as short as possible.

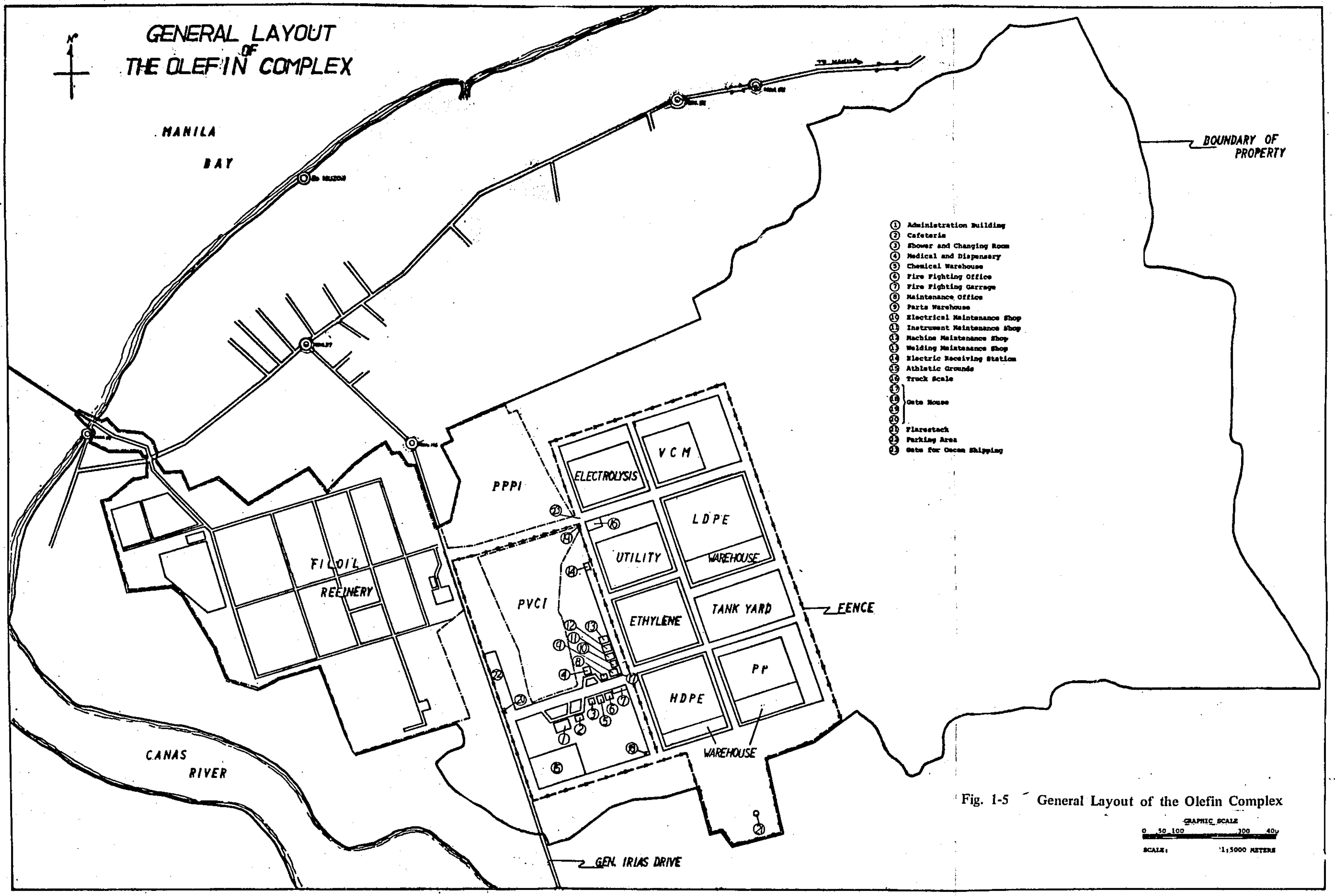


Fig. 1-5 General Layout of the Olefin Complex

(c) Storage, warehouse and shipping

1) The product warehouse of each plant is located adjacent to its battery limit and storage tanks are generally laid out near the battery limit of the plant.

2) Resin products will be shipped from warehouses by trucks and lorries, so the roads are laid out for convenient and smooth shipping.

(d) Correlation between the plants

1) All the plants except the electrolysis plant will be supplied raw materials from the olefin plant.

On the other hand, the plants which will be supplied ethylene gas are located more nearly to the olefin plant than the plant which will be supplied propylene liquid from the viewpoint of economical piping.

2) The VCM plant is located adjacent to the Electrolysis plant to make the chlorine gas supply piping short.

1-3 Utility Facilities

The utility balance and requirement of the complex are shown in Tables 1-1 and 1-2 respectively. According to the utility balance, the utility facilities are designed as follows:

Table 1-1 Utility Balance

	Unit	Process	Electric Boiler	Sea Water	Well Water	Demi. Water	B. F. Water	I. A.	Inert	P. A.	Others	Total
Electric Power	kw/hr	59,542	-19,788	3,398	366	110	28	757	2,231	371	1,485	48,500
Steam HP	t/hr	6.7	-6.7									
MP	t/hr	194	-194									
LP	t/hr	-10.3				0.4		0.2	0.9		8.8	0
Total	t/hr											207
Well W. & P. W.	m^3/hr	1,105	0.8		13	155.2		4	16	2	104	1,400
Sea Water	m^3/hr	11,325										11,325
Demi. Water	m^3/hr	22.1					110.8					132.9
B. F. Water	m^3/hr	7.5	200.7									208.2
I. A.	Nm^3/hr	4,832	200			50	50		50			5,182
Inert	Nm^3/hr	4,119										4,119
Oxygen	Nm^3/hr	719										719
Plant Air	Nm^3/hr	2,326									274	2,600
Steam Condensate	t/hr	-99.3					99.3					
Fuel	MMKcal/hr	209.6	160.0									

Table 1-2 Utility Requirements

(operational rate 100%)

Plant	Unit	Ethylene	LDPE	HDPE	PP	VCM	Electrol-ysis	Sub-Total	Refinery	Total
Plant Capacity	t/y	201,000	110,000	60,000	90,000	55,000	32,300			
Electric Power	kw	2,231	20,625	5,813	10,688	1,500	13,405	54,262	5,280	59,542
Steam HP	t/hr	6.7	-	-	-	-	-	6.7	-	6.7
MP	t/hr	4.7	13.8	52.5	61.9	6.0	14.1	153	41	194
LP	t/hr	-	-	-	-	5.5	3.2	8.7	-19	-10.3
Total	t/hr							168.4		168.4
C. W. Make up	m^3/hr	-	138	203	304	85	73	803	96	899
Sea Water	m^3/hr	11,325	-	-	-	-	-	11,325	-	11,325
Process Water	m^3/hr	-	13.8	15	56.3	7.5	-	92.6	113	205.6
Demineralized Water	m^3/hr	-	-	-	11.3	10.0	0.8	22.1	-	22.1
Boiler Feed Water	m^3/hr	7.5	-	-	-	-	-	7.5	-	7.5
Instrument Air	Nm^3/hr	1,340	1,238	338	506	200	1,100	4,732	100	4,832
Inert Gas	Nm^3/hr	200	1,100	750	1,688	300	81	4,119	-	4,119
Oxygen	Nm^3/hr	-	-	-	-	719	-	719	-	719
Plant Air	Nm^3/hr	1,876	-	-	-	450	-	2,326	-	2,326
Fuel Gas	MMKcal/hr	168.5	-	-	-	8.0	-	176.5	-	176.5
Fuel Oil	MMKcal/hr	33.1	-	-	-	-	-	33.1	(48.7)*	81.8*
Steam Condensate	t/hr	-	-6.9	-26.3	-31.0	-5.8	-9.3	-79.3	-20	-99.3

Note: * Either fuel gas or fuel oil is utilizable for the refinery heaters.

1-3-1 Electric Power

Required capacity of electric power is 48,500 KWH.

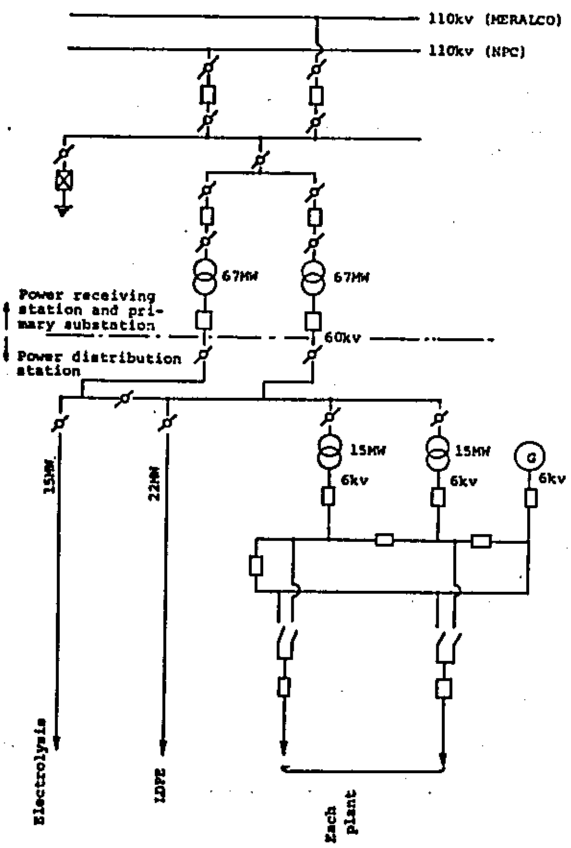


Fig. 1-6 Electric Power Single Line Diagram

The electric single line diagram is shown in Fig. 1-6. As has been stipulated in 1-1-5 of this report, the supply of electric power from MERALCO or NPC is estimated to be adequate in 1980 both in quantity and in quality.

Therefore, the complex has two power supply sources: one is purchased from the electric company and the other is supplied from the electric generating plant within the complex.

The purchased power is received at 110kv or 230kv and voltage is transformed to 60kv at the primary substation.

Two 67 MW (110 or 230kv-60kv) transformers will be installed at the primary substation wherein one transformer will supply power to the electrolysis plant while the other will supply power to the other plants.

Because the electrolysis plant will use a large amount of power and thus, will require a large-scale direct current supply system, this may disturb the power systems of other plants connected to the same transformer. But when one of these transformers gets out of function, it is possible to supply all of the power required in the complex from the other transformer.

After the 60kv power is supplied to the primary substation, this will in turn be supplied to the LDPE plant and then, to the distribution station. However, at the distribution station, the 60kv power's voltage will be transformed to 6kv and supplied to each plant.

As for the power generated in the power plant, it is considered to be more reliable than the purchased power, so the former shall be supplied to the ethylene and the utility plants which require more reliable operation compared to the down-flow plants.

So, if the power plant gets out of function, the feed source will be switched instantly to the purchased power without plant shutdown.

1-3-2 Steam Generating System

Required capacity: HP Steam 6.7t/h MP Steam 194t/h LP Steam 8.7t/h.

The specifications of the steam generating plant will be assessed on the basis of the following considerations:

(1) The specification which will generate high pressure steam at the time of the ethylene plant start-up.

(2) The required amount of high, medium and low pressure steam during the normal operation.

Considering the above items, the system designed is shown in Fig. 1-7.

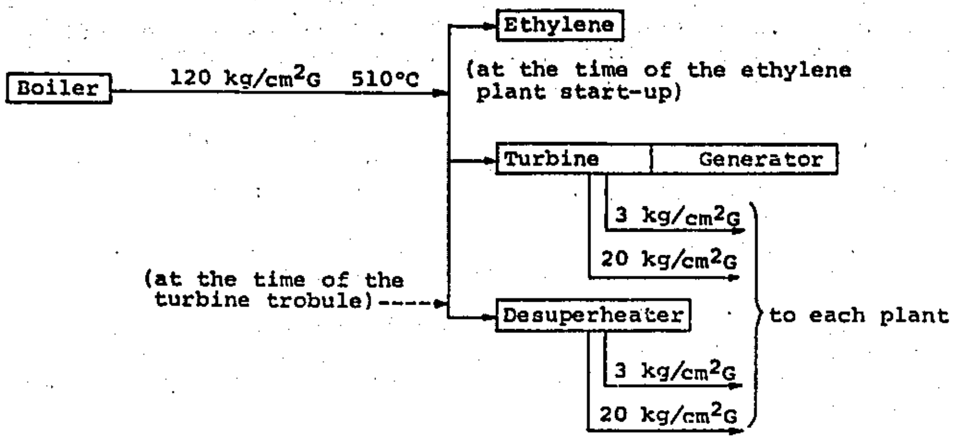


Fig. 1-7 Steam Generating System

The ethylene plant will require steam of 120 kg/cm^2 and 510°C, and required capacity will be 90-100 tons/hour at the plant start-up.

According to the steam specification of the ethylene plant, the boiler is designed to generate steam of 120 kg/cm2G and 510°C, and the boiler capacity is determined to be 200 tons/hour considering the total required amount of the complex in the normal operation.

The MP steam and LP steam will be extracted from the turbine of the electric generating system feeded the HP (120 kg/cm2G, 510°C) steam.

In case of turbine trouble, the MP and LP steam will be generated through the desuperheater.

1-3-3 Water Supply System

(1) Fresh industrial water source

As a result of the site survey, it can be concluded that it is very difficult to use river water and utilization of well water is preferable.

The required capacity of well water is 1,400 m^3/hr.

Well water will be used for the following purposes:

(a) Plant cooling water (for make up)

In the process plant, cooling water will be recycled by cooling towers, but about 5% loss of total capacity will be necessary.

For this aim, well water will be directly used without special treating system.

(b) Process water

Well water will be used directly for this purpose.

(c) Demineralized water

Through the softener system, raw water will become demineralized water and in turn, used for the boiler feed water.

(d) Boiler feed water

Boiler feed water will constitute of demineralized water and steam condensate made by the high polisher system. In turn, this will be used for the boilers of the steam generating plant and the quench boiler of the ethylene plant.

The basic data of the well water is as follows:

(a) Well capacity: 1,000 gpm/well

(b) Well water temperature: 30°C (max)

(c) Analysis data: See the Table 1-3

Table 1-3 Well Water Analysis

	(Parts per Million)
Phenolphthalein alkalinity as $CaCO_3$	Nil
Methyl orange alkalinity as $CaCO_3$	250
Total hardness as $CaCO_3$	124
Silica as SiO_2	36
Calcium	46
Magnesium	2
Chlorides as Cl	14
Sulfates as SO_4	25
pH	7.1
Iron as Fe	1
Bicarbonates as HCO_3	305
Normal carbonates as CO_3	Nil
Total Solids	580
Appearance on ignition	White
Color	Nil
Odor	Nil

Remarks: Bacteriological tests with NIST show that the water is potable. Sample taken and analyzed on March 30, 1974.

(d) System: See Fig. 1-8

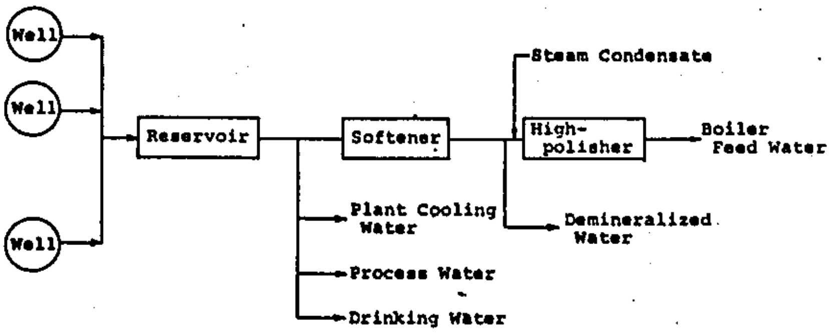


Fig. 1-8 Well Water Supply System

1-3-4 Compressed Air System

The compressed air system diagram is shown in Fig. 1-9.

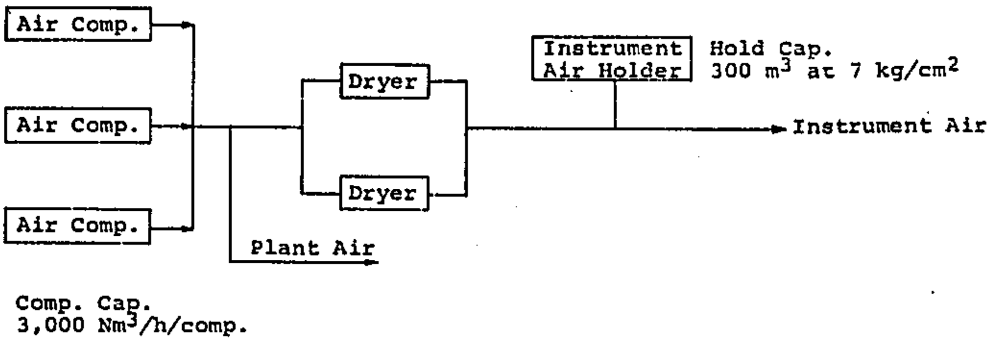


Fig. 1-9 Compressed Air System

The compressed air will be used for the plant air and the instrument air.

(1) Plant air

This air will be mainly used for the furnace decoking in the ethylene and the VCM plants.

The specification of the air is as follows:

(a) Pressure: 7 kg/cm^2G

(b) Temperature: Ambient temp.

(2) Instrument air

This air will be used for the operation of the pneumatic instrument.

The capacity of the air is estimated based on the supposition that all plants in the complex are equipped with the pneumatic instrument system.

The specification of the air is as follows:

(a) Pressure: 7 kg/cm^{2}G at the discharge of the dryer

(b) Temperature: Ambient temp.

(c) Dew point: -20°C at 7 kg/cm^{2}G

1-3-5 Air Separation System

Nitrogen and oxygen gases will be produced from the air separation unit.

The system diagram is shown in Fig. 1-10.

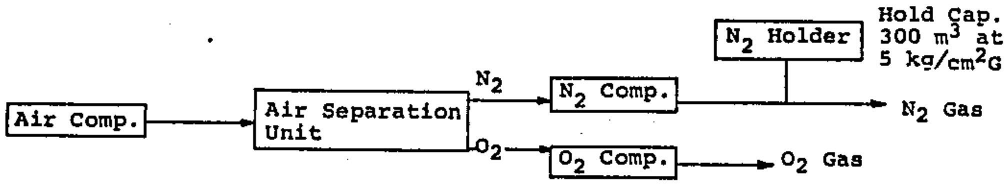


Fig. 1-10 Air Separation System

(1) Nitrogen

Nitrogen will be used for the transportation of the resin plant's powder and for the seal of tanks.

The specification of the nitrogen is as follows:

(a) Pressure: 5 kg/cm^{2}G

(b) Temperature: Ambient temp.

(2) Oxygen

Oxygen will be used for the VCM plant.

The specification of the oxygen is as follows:

(a) Pressure: 5 kg/cm^{2}G

(b) Temperature: Ambient temp.

1-3-6 Fuel

Fuel gas and fuel oil will be mainly used for the cracking furnace of the ethylene plant and for the boiler of the steam generating plant.

Fuel gases such as residue gas, C_4s and C_5s as well as fuel oil are by-products of the ethylene plant.

The required fuel will mostly constitute of the above-mentioned sulfur-free gases and will partly consist of the sulfur-contained fuel oil produced by the refinery.

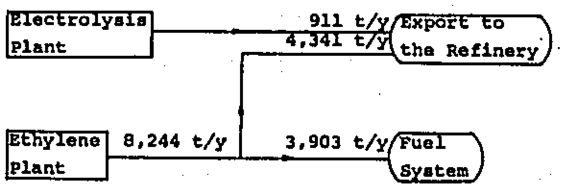
To evaluate the supply ability of fuel from the ethylene plant, the hydrogen balance in the complex is estimated by accounting the consumption for desulfurization in the refinery, and production of hydrogen in both the electrolysis plant and the ethylene plant. Table 1-4 shows that the residual hydrogen, approximately 4,000 t/y, is utilizable for fuel. Strictly speaking, a comparatively small amount of hydrogen is consumed for the process uses, such as hydrogenation of acetylene and methyle-acetylene in the ethylene plant, etc. However, these consumptions are not counted in this paper.

Table 1-4 Hydrogen Balance in the Olefin Complex

(Base Case, Operational Rate 100%)

Supply of H_2	
H_2 from the Electrolysis Plant (@100 Mol%)	911 t/y
H_2 from the Ethylene Plant (@95 Mol%)	8,244 t/y
Demand of H_2	
Desulfurization in the Refinery* (38,000 B/SD)	
@100 Mol%	911 t/y
@95 Mol%	4,341 t/y
Hydrogenation in the Olefin Complex	-
Balance	
H_2 from the Electrolysis Plant	0 t/y
H_2 from the Ethylene Plant	3,903 t/y

Scheme of H_2 Balance



Note: * 157,000 Nm^3/d @100 Mol%

The potentiality of fuel supply from the ethylene plant in the base case complex, 200,000 t/y ethylene production, is shown in Table 1-5. The hydrogen, and methan-rich gas must be consumed in the complex due to the difficulties in gas transportation. The C_3's, C_4's fractions, and the cracked fuel oil can be exported from the complex as the fuel for house cooking, as a raw material for butadiene extraction, and as a feedstock for production of carbon black, respectively. They are also utilizable as low sulfur fuel in the complex. The fuel gas requirements in the complex is mainly for the pyrolysis furnaces in the olefin plant, because of the easiness in the combustion operation which is especially necessary for the stringent control of thermal cracking.

Table 1-5 Fuel Balance in the Olefin Complex

(Base Case, Operational Rate 100%)

Supply from the Ethylene Plant

	(t/y)	(MMkcal/y)
H_2 (@95%)	3,903	92,111
CH_4	92,867	1,114,404
C_3,s; LPG and Residual $C_3^=$	13,578	151,123
C_4,s	72,956	795,220
Fuel Gas Total		2,152,958
Cracked Fuel Oil	74,967	749,670
Total		2,902,628

Demand in the Olefin Complex and the Refinery

	(MMkcal/hr)	(MMkcal/y)
Process Requirements as Fuel Gas	176.5	1,397,880
Process Requirements as Fuel Gas or Oil	33.1	262,150
Utility Boiler	160.0	1,267,200
Total Olefin Complex	369.6	2,927,230
Refinery Heaters*	48.7	385,655
Total	418.3	3,312,885

Note: * 105 t/d as LPG

More than 90% of necessary the super high pressure steam, 120-140 atg., which is consumed to compress the cracked gases and refrigerants in the ethylene plant is recovered in the transfer line heat exchangers, and is superheated in the superheater boiler. Either oil or gas can be utilized for the firing of superheater boiler, utility boilers, and heaters in the refinery.

Therefore, appropriate allocation of fuel should be provided by taking into account the possibility of selling the fuel fractions by-produced in the ethylene plant. If the pollution control of air is necessiated, fuels produced in the complex and imported fuel oil from the refinery should be combined adequately to maintain the total sulfur content of fuel under regulated standards.

At present, the above-mentioned conditions are not fixed. Therefore, the cases of the maximum and minimum utilization of the imported fuel oil are provided in Figs. 1-11 and 1-12.

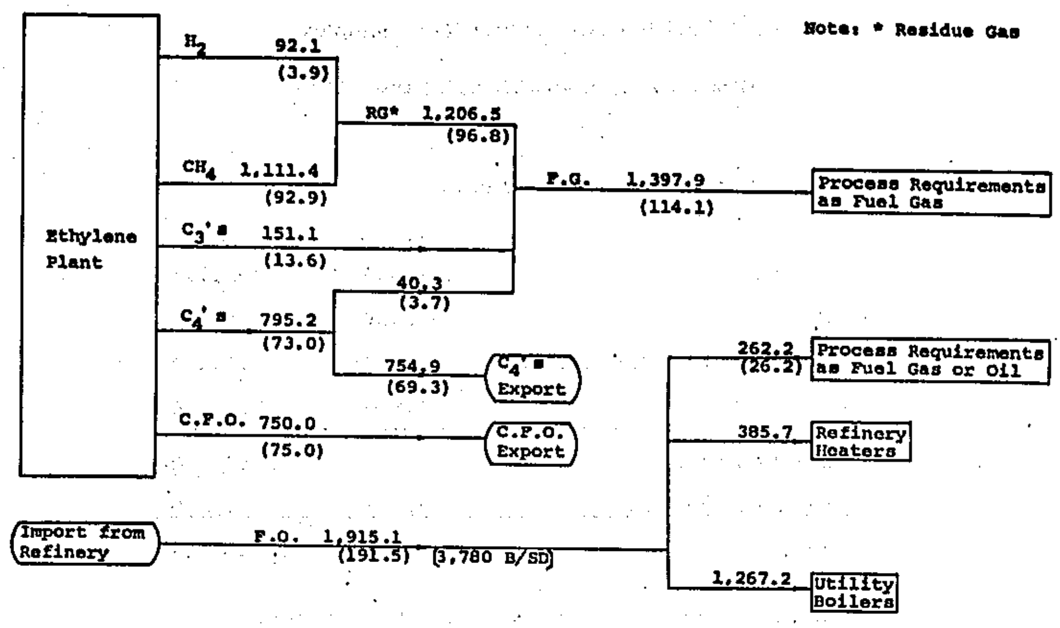
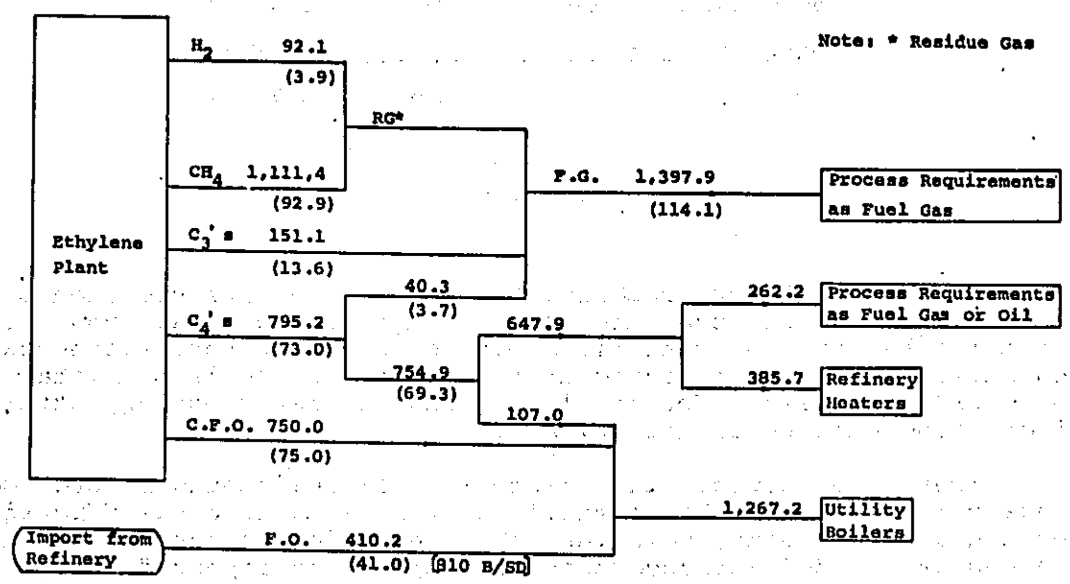


Fig. 1-11 Fuel Balance of the Olefin Complex
(Maximum Utilization of Fuel Oil: Case 1)

Unit: 10^3MMkcal/y / (10^3t/y)



Unit: 10^3MMkcal/y / (10^3t/y)

Fig. 1-12 Fuel Balance of the Olefin Complex
(Minimum Utilization of Fuel Oil)

In addition to the fuel requirements in normal operation, approximately 80 MMKcal/hr of fuel is necessary for the start-up boiler which is installed in the ethylene plant or is integrated in the utility center at the time of start-up.

1-4 General Service Facility

1-4-1 Scope

The scope of general service facilities is as follows:

(1) Administration office

In this complex, there will be several companies, but the administration office building is designed to include all the offices of the manufacturing companies. This building will also provide conference rooms, telecommunication rooms and other utility areas for common use.

(2) Maintenance facilities

The above-given facilities will be commonly used by the maintenance engineers of each plant. Moreover, the maintenance office is provided for the maintenance shops' engineers as well as for other common service maintenance workers.

The scope of maintenance facilities is as follows:

(a) Maintenance office

(b) Machine shop

(c) Welding shop

(d) Instrument shop

(e) Electrical shop

(3) Fire fighting facilities

(4) Welfare facilities

The scope of the facilities is as follows:

(a) Cafeteria

(b) Shower and change rooms

(c) Medical and dispensary

(d) Athletic facilities

There was an agreement between the Consultants and PNOC that other facilities are unnecessary such as the employees' housing accommodation and gymnasium.

(5) Parts and chemical warehouses

(6) Roads

(7) Fence

(8) Parking area

(9) Lighting

(10) Piping

Piping between the plants is for raw materials, products and utilities transportation.

1-4-2 Design Basis

(1) Administration office

(a) Capacity of accommodation

1) For manufacturing company

Factory managers (all); Directors (all); Superintendents (all); Supervisors, Operators and Clerks (belong to the administration dept.)

2) For general service company

Factory manager, Director, Superintendent, Supervisors, Operators and Clerks (belong to the administration dept.)

(b) Total office area: 1,400 m^2

(c) Number of conference room: 18

(d) Total conference room area: 400 m^2

(e) Total floor area of the building: 2,200 m^2

(f) Number of story: 2

(g) Construction: Reinforced concrete with air conditioning

(2) Maintenance facilities

(a) Maintenance office

1) Capacity of accommodation:

(Director, Superintendents, Supervisors, Operators and Clerks belong to the maintenance dept. of General Service company.)

2) Total floor area: 350 m^2

3) Number of story: 1

4) Construction: Reinforced concrete with air conditioning

(b) Machine shop

1) Total floor area: 600 m^2

2) Number of story: 1

3) Construction: Steel structure

(c) Welding shop

1) Total floor area: 600 m^2

2) Number of story: 1

3) Construction: Steel structure

(d) Instrument shop

1) Total floor area: 600 m^2

2) Number of story: 1

3) Construction: Steel structure

(e) Electrical shop

1) Total floor area: 400 m^2

2) Number of story: 1

3) Construction: Steel structure

(3) Fire fighting facilities

(a) Office

1) Capacity of accommodation:

Director, Superintendents, Supervisors, Operators and Clerks belong to the safety and environment dept. of General Service Company.

2) Total floor area: 400 m^2

3) Number of story: 1

4) Construction: Reinforced concrete with air conditioning

(b) Trucks and cars

1) Fire truck (chemical): 2

2) Fire truck: 3

3) Ambulance: 1

4) Wagon truck: 2

5) Jeep: 3

(c) Fire water pump

1) Pump capacity: 3,000 m^3

2) Pump head: 150 m

3) Driver: Diesel engine

4) Quantity: 2

(4) Welfare facilities

(a) Cafeteria

1) Number of seats: 200

2) Total floor area: 500 m^2

3) Number of story: 1

4) Construction: Reinforced concrete with air conditioning

(b) Shower and change room

1) Number of lockers: 950

2) Number of showers: 10

3) Total floor area: 400 m^2

4) Number of story: 1

5) Construction: Reinforced concrete

(c) Medical and dispensary

1) Total floor area: 400 m^2

2) Number of story: 1

3) Construction: Reinforced concrete with air conditioning

(d) Athletic facilities

1) Basketball court: 2

2) Tennis court: 4

(5) Parts and chemical warehouse

(a) Parts warehouse

1) Total floor area: 1,500 m^2

2) Number of story: 2

3) Construction: Steel structure

(b) Chemical warehouse

1) Total floor area: 500 m^2

2) Number of story: 1

3) Construction: Steel structure

(6) Road

(a) Width of main road: 20 m

(b) Width of sub-road: 10 m

(c) Paving: Asphalt

(7) Fence

(a) Material: Lower part=concrete
Upper part=steel wire net

(b) Total height: 3 m

(8) Parking Area

(a) Total area: for 150 cars

(b) Paving: Asphalt

(9) Lighting

Mercury lamp will be prepared for:

(a) 10m width road: 250W x 30m pitch (one side)

(b) 20m width road: 400W x 30m pitch (both side)

(10) Piping

The size and length of the piping are estimated based upon the material and utility balance as well as the plant layout.

The result of the estimation of the main piping is shown in Table 1-6.

Table 1-6 Main Piping

1. Utility

Used for	Material	Size	Length
HP Steam	Carbon Steel	1½"	300 m
	"	6"	300 m
MP Steam	"	8"	900 m
	"	12"	1,000 m
LP Steam	"	8"	900 m
Sea Water	"	2,000 mm	3,000 m
Well Water	"	2"	800 m
	"	8"	900 m
	"	14"	8,000 m
Demi. Water	"	3"	900 m
Boiler Feed Water	"	2"	300 m
Instrument Air	"	6"	900 m
	"	1"	700 m
Plant Air	"	2"	900 m
Nitrogen	"	6"	900 m
Oxygen	Stainless Steel	3"	300 m

2. Raw Material and Product

Ethylene	Carbon Steel	3"	400 m
	"	4"	600 m
	"	6"	400 m
	"	8"	400 m
Propylene	"	3"	300 m
Fuel Oil	"	2"	900 m
Pyrolisis Gasoline	"	4"	900 m
Naphtha	"	14"	900 m

3. Waste Water

Industrial Water (Oily)	Concrete	600 mm	2,700 m
" (Non-oily)	Ditch		
Sea Water	Carbon Steel	2,000 mm	3,000 m

4. Pipe Rack

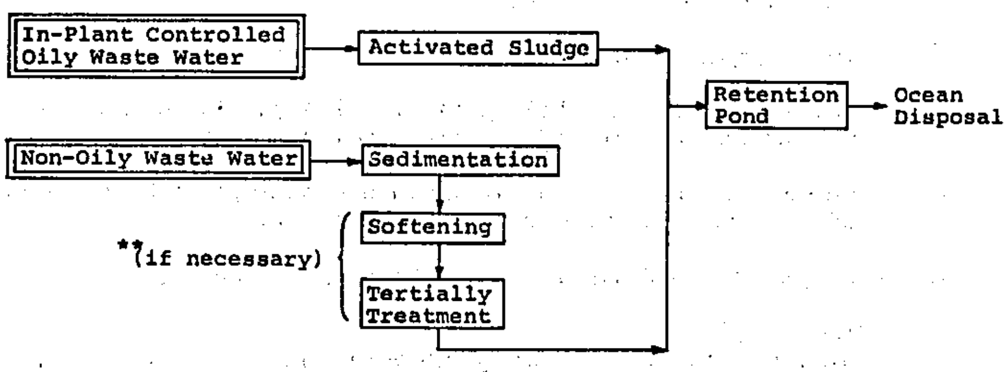
Main Pipe Rack	900 m
Sub Pipe Rack	1,200 m

1-5 Pollution Control

The "Pollution Control Law" in the Philippines which was enacted by the National Water and Air Pollution Commission will be revised by the end of this year. Basically, the fulfillment of each required item of the revised law should be achieved in this pre-feasibility study as far as the subject of pollution control is concerned. However, at this stage, in view of the unavailability of the revised law, pollution control will be preliminarily defined in this study as follows:

1-5-1 Water Pollution Control

The "Pollution Control Law" currently in force does not specify the quality standard of the waste water. According to the information given by the members of the commission, it has been made clear that the waste water quality standard will be gradually specified from now onward. Thus, the waste water treatment system for the complex will be planned as shown in Fig. 1-13.



** This treating system depends on the specification of inhibitors added to cooling water.

Fig. 1-13 Waste Water Total Treating System

The specification of in-plant controlled oily waste water is shown in Table 1-7.

Table 1-7 Specification of Waste Water
(at outlet of plant oil separator)

	Ethylene	HDPE	PP	LDPE	PVC VCM	Electrolysis	Utility
Flow Rate (t/hr)	25	50	80	35	6	3	20
Temperature (°C)	35	80	70-72	29	50-60	25	25
PH	6-9	13	6-9	7	6-8	6-8	7
Oil (ppm)	10	1	1	1	<5	1	1
SS (ppm)	10	200	50	9	<50	<10	50
COD (ppm)	200	20	50	10	150-200	<5	20
Ti (g/l)		0.015	0.005				
Al (g/l)		0.03	0.01				
Plant Capacity (t/y)	201,000	60,000	90,000	110,000	55,000	32,300(as Cl)	

(1) Activated sludge

The activated sludge process is a continuous system where biological growth is mixed with waste water, aerated, and followed by a biological sludge separation step. A portion of the concentrated sludge is then recycled and mixed with additional waste. This process has been applied very effectively in the treatment of refinery and petrochemical waste waters.

The design of an activated sludge system is based on the production and maintenance of an environment for micro-organisms so that their growth and activity will be near optimal as possible. These parameters include temperature, hydrogen ion concentration, and nutrient availability as well as the following considerations:

(a) the organic loading in terms of BOD applied per day per unit wt. of biological solids,

(b) the BOD removal kinetics of the specific petrochemical waste water,

(c) the oxygen requirements of the system,

(d) the quantity of biological sludge produced including the accumulation of primary sludge, and

(e) the stability of the biological sludge and the ease of gravity liquids-solids separation.

(2) The main process of in-plant waste water control

(a) Olefin plant
(Waste caustic treating process: Figs. 1-14-1 and 1-14-2)

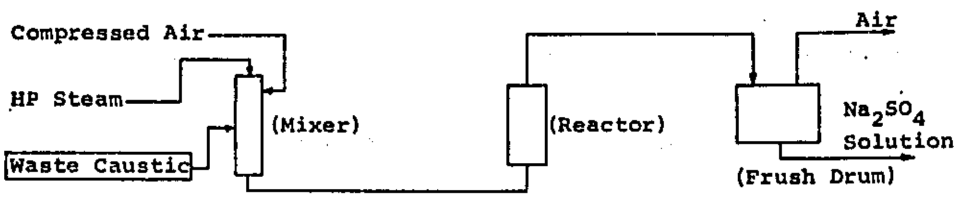


Fig. 1-14-1 Chemical Reaction Treating System

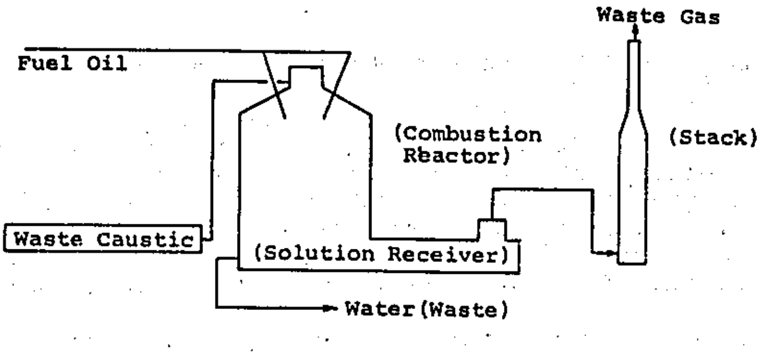
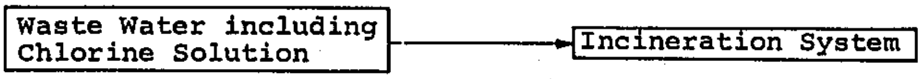
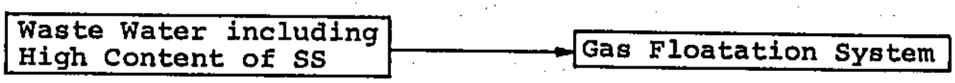


Fig. 1-14-2 Waste Solution Combustion Treating System

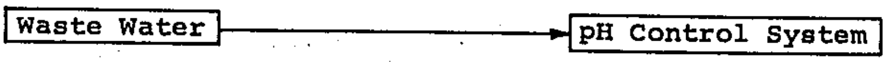
(b) VCM plant



(c) HDPE plant



(d) Electrolysis plant



1-5-2 Air Pollution Control

The main sources of air pollution in this complex will be as follows:

(a) SO_x and NO_x from the steam generating plant

(b) Reaction waste gas from the VCM plant

(c) Cl_2 gas from the electrolysis plant (only in cases of start-up and trouble)

The treating system of the above pollution sources is as follows:

(a) SO_x and NO_x from the steam generating plant

The Pollution Commission envisages a plant that will regulate the NO_x and SO_x contents on a much stricter standard than the present regulation.
At present, however, the sulfur contents of fuel oil is allowed to a maximum of 4%, in spite of the regulated level of 1.5%. This relaxation has been practiced recently because of the oil crisis.

This being the case, it is highly difficult to pin-point a target figure for the year 1980. Therefore, the air pollution control facilities for the SO_x and NO_x will not be included in the scope of this study.

(b) Reaction waste gas from the VCM plant

The waste gas will be treated by the incinerator of the VCM plant.

(c) Cl_2 gas from the electrolysis plant

Only during plant start-up and plant trouble instances will there be Cl_2 waste gas.
This will be treated by the caustic washing system of the plant.

1-5-3 Pollution Control for Other Wastes

The main wastes, except waters and gases in the complex, and their treating system will be as follows:

(a) Waste (low) polymer in the LDPE, HDPE and PP plant

The waste polymer will be treated as shown in Fig. 1-15.

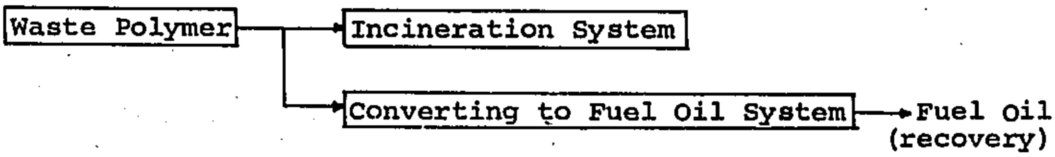


Fig. 1-15 Waste Polymer Treating System

(b) Sludges in the activated sludge plant

The sludges will be treated by the incineration system.

1-6 Raw Material and Product Storage

1-6-1 Storage Capacity

The storage capacity for raw materials and resins for the down-flow plants should be minimized as much as possible. Thus, in view of the above, the storage capacity is determined as follows:

(1) Raw materials for the down-flow plants

Storage capacity = 10 days

Storage tanks, especially for ethylene and propylene will be rather expensive so in order to economize, capacity should be decreased.

Storage capacity depends mainly on the shut-down duration policy of the ethylene and the down-stream plants.

The shut-down duration required will be 35 to 40 days in case of the ethylene plant, while most of the down-stream plants will need 25 to 30 days. Therefore, the difference of 10 days will be taken as the ethylene and propylene storage capacity formulation basis.

The storage capacity of other materials is determined to be same as that of ethylene and propylene.

(a)	Ethylen:	6,100 tons
(b)	Propylene:	3,000 tons
(c)	Chlorine:	1,000 tons
(d)	VCM:	1,700 tons
(e)	Salt:	1,450 tons

(2) Product resins

Storage capacity = 50 days

The storage capacity for resins varies depending on the number of grades of resins and the distance of transportation. The higher the number of grades, the longer will be the manufacturing cycle of the same grade, and the larger will be the storage capacity. Accordingly, as the transportation distance becomes farther, the storage capacity will have to be larger.

However, at present, 95% of the plastics processing makers are operating in or around Manila City. Therefore, it seems unnecessary to provide a storage capacity as large as that of Japan. (In Japan, a normal storage capacity covers a period of three months including storage of stock points.)

Considering the present status of resin makers and processing makers in the Philippines, "50 days" is taken as the reasonable storage capacity of product resins wherein this will be stored in the complex's warehouses.

Storage capacity of each resin is as follows:

(a) HDPE: 9,100 tons

(b) LDPE: 16,700 tons

(c) PP: 13,700 tons

(3) Other products

Storage capacity = 10 days (generally)

The only main product included in this category is caustic soda.

1-6-2 Design Data

(1) Storage tank

(a) Ethylene tank: Dome type, 5,500 kl x 2
holding up at -104°C, atmospheric pressure

(b) Propylene tank: Dome type, 5,000 kl x 1
holding up at -55°C, atmospheric pressure

(c) Chlorine tank: Spherical type, 700 kl x 1
holding up at -15°C, 2 kg/cm^2G

(d) VCM tank: Spherical type, 1,900 kl x 1
holding up at atomospheric temperature, 5.5 kg/cm^2G

(2) Resins warehouse

(a) Total floor area:

1) HDPE: 9,100 m^2

2) LDPE: 17,000 m^2

3) PP: 14,000 m^2

Note: The capacity of one bag is 25 kg.
The capacity of one pallet is 40 bags = 1 ton.
The pallets are piled up in 3 stages.

(b) Number of story: 1

(c) Construction: Reinforced concrete

(3) Salt storage

(a) Total floor area: 500 m^2

1-7 Construction and Test Operation Schedule

1-7-1 Construction Period

The construction period after contract of each plant is as follows:

(a) Utility plant: 2.5 years

(b) Other plant: 3.5 years

1-7-2 Time Schedule (Ref. Table 1-8)

	Time of contract	*Time of mechanical completion	Time of commercial operation
(a) Utility plant	May '76	Nov. '78	Feb. '79
(b) Other plant	Sept.'75	Feb. '79	Jul. '79

* The dry test operation shall be finished at the time of mechanical completion.

1-7-3 Test Operation (oil running)

(a) The test operation of the utility plant will be finished completely prior to the start of the olefin plant test operation.

(b) The test operation of the olefin and electrolysis plant will be started at the same time. After one month of the olefin plant's test operation has begun, the test operation of HDPE, LDPE, VCM and PP plants will be started.

As for the PP plant, its test operation will be possibly started at the same time as the olefin plant test operation.

(c) Three months will be required for the olefin plant test operation.

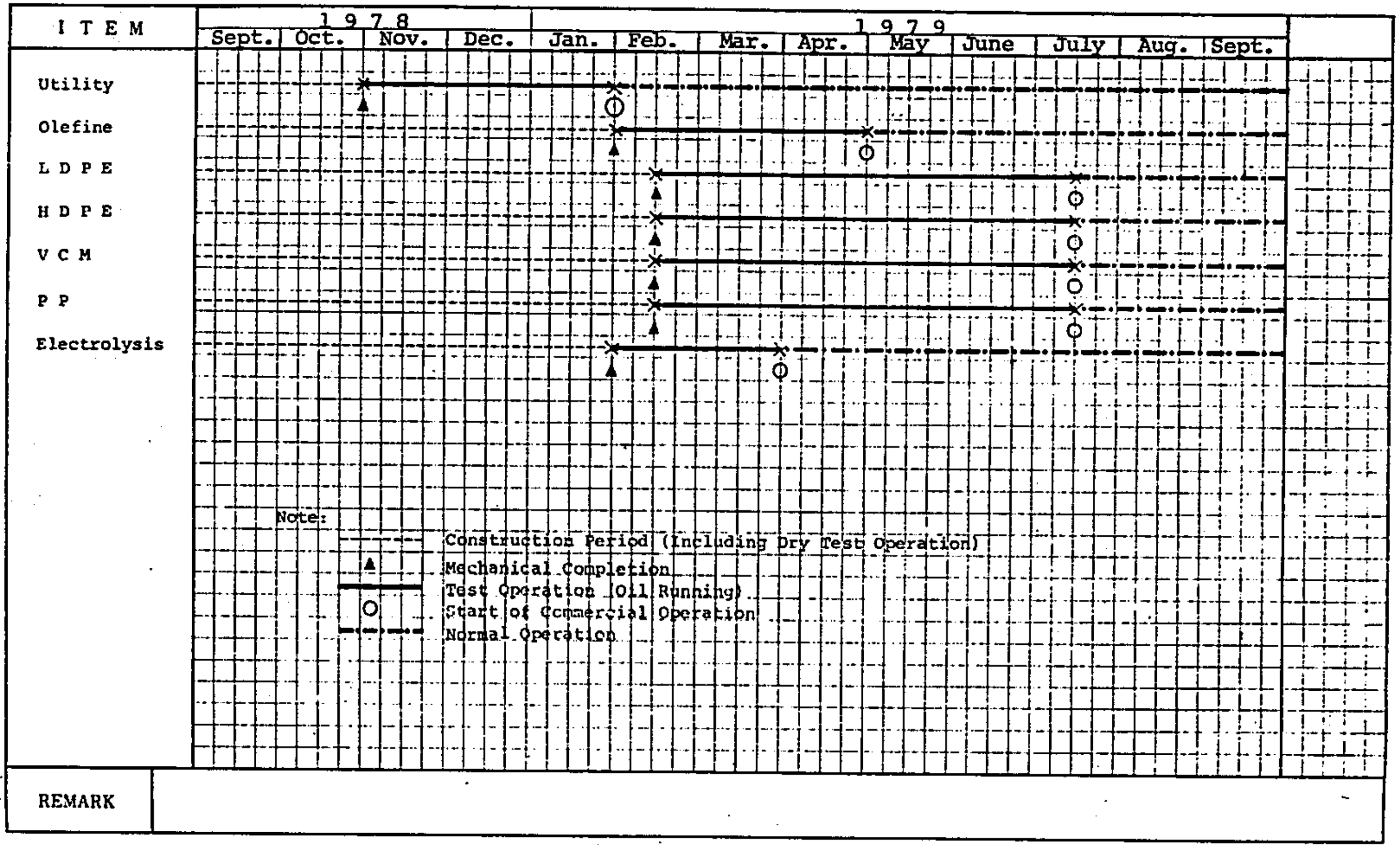
(d) Minimum five months will be required for the test operation of each polymer plant.

(e) Two months will be required for the test operation of the electrolysis plant.

PROJECT:

Table 1-8 Time Schedule

DATE:
BY:
REV:



1-8 Organization

1-8-1 Basic Way of Thinking Underlying the Organizational Structure

The form of organization described herein was developed in accordance with the ideas and opinions of both the Consultants and PNOC.

(1) The olefin plant, the utility plant and other common facilities serving as the vital core of the petrochemical complex will be managed through 100% capital investment by PNOC. Intermediate products from the olefin plant as well as various utilities from the utility plant will be supplied to the downstream plants.

(2) The downstream plants will be managed by private individual firms. The complex will not provide a research nor a technological development sub-organization for the purpose of developing and/or improving the requisite know-how since it will adopt the latest technical skills.

(3) The departments and divisions to be instituted in each of the production plants are formulated after referring to the current organizational structure of Filoil Refinery.

On the basis of the above, we have constructed the personnel requirement for normal operation of each plant, as shown in Figs. 1-16, 1-17, and Table 1-9.

1-8-2 Manufacturing Plants

The complex comprises seven production plants, namely Olefin, HDPE, PP, LDPE, VCM, Electrolysis and Utility plants. As shown in Fig. 1-16, each of these plants will be organized under a factory manager down to departmental and divisional levels. The departments will be in three categories, namely: Technical Administration & Maintenance, Production, and Administration Departments.

(1) Technical Administration & Maintenance Department

This department will have three divisions: Technical Administration, Laboratory, and Maintenance Divisions.

(a) Technical Administration Division

The division's major responsibility will be to resolve the technical problems encountered in running the manufacturing process and to institute technical improvements, etc.

(b) Laboratory Division

This division will mainly concern itself with various types of analysis and tests for process management.

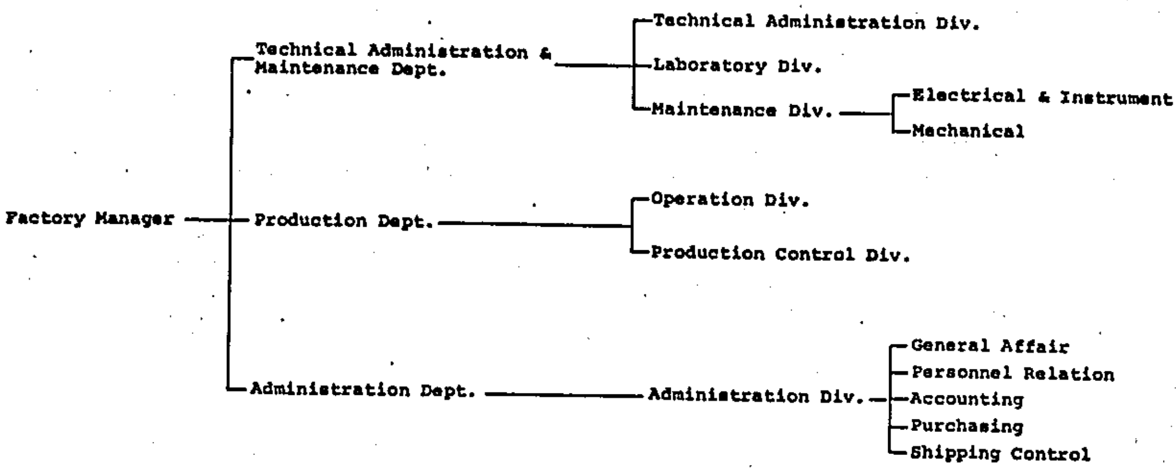


Fig. 1-16 Organization Chart for Process Plant Company

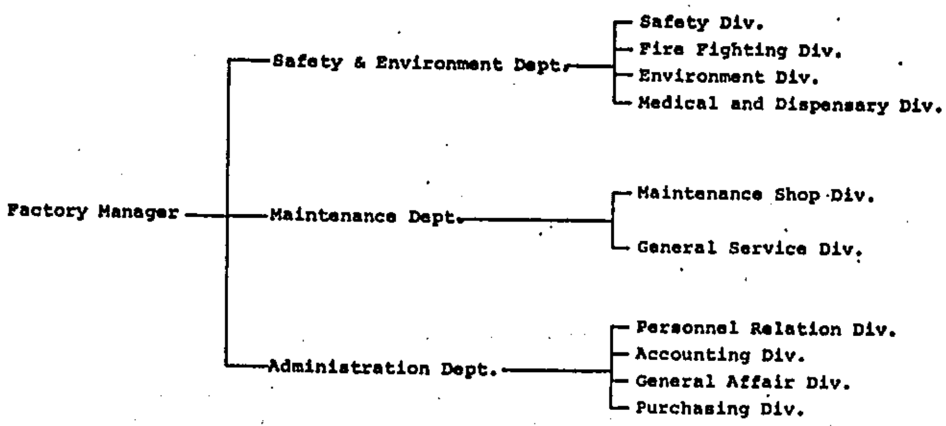


Fig. 1-17 Organization Chart for General Service Company

Table 1-9 Required Number of Personnel

	Factory Manager	Director	Super-intendent	Super-visor	Operator	Clerk	Laborer
Olefin Plant							
Production Dept.	1	1	2	5	70	2	
Tech. Admi. & Maint. Dept.		1	3	4	43	4	
Administration Dept.		1	1	3	14	12	
Sub-total	1	3	6	12	127	18	
Utility Plant							
Production Dept.	1	1	2	6	65	2	
Tech. Admi. & Maint. Dept.		1	3	7	39	4	
Administration Dept.		1	1	3	14	12	
Sub-total	1	3	6	16	118	18	
LDPE Plant							
Production Dept.	1	1	1	5	60	2	
Tech. Admi. & Maint. Dept.		1	3	4	50	4	
Administration Dept.		1	1	3	9	12	20
Sub-total	1	3	5	12	119	18	20
HDPE Plant							
Production Dept.	1	1	1	5	31	2	
Tech. Admi. & Maint. Dept.		1	3	4	33	4	
Administration Dept.		1	1	2	9	12	20
Sub-total	1	3	5	11	73	18	20
PP Plant							
Production Dept.	1	1	1	5	52	2	
Tech. Admi. & Maint. Dept.		1	3	4	29	4	
Administration Dept.		1	1	2	9	12	32
Sub-total	1	3	5	11	90	18	32
VCM Plant							
Production Dept.	1	1	1	5	26	2	
Tech. Admi. & Maint. Dept.		1	3	4	22	4	
Administration Dept.		1	1	2	7	12	
Sub-total	1	3	5	11	58	18	
Electrolysis Plant							
Production Dept.	1	1	1	5	27	2	
Tech. Admi. & Maint. Dept.		1	3	4	18	4	
Administration Dept.		1	1	2	12	12	
Sub-total	1	3	5	11	57	18	
General Service Co.							
Safety Dept.	1	1	4	7	62	15	
Maintenance Shop Dept.		1	2	5	30	5	30
Administration Dept.		1	4	4	15	20	
Sub-total	1	3	10	16	107	40	30
Grand Total	8	24	47	100	759	166	102

(Factory Manager through Clerk: 1,104)

(c) Maintenance Division

This division will consists of mechanical, electrical and instrument engineers who will carry out maintenance of the equipment and instruments of the plant.

Thus, large machine tools, welding machines, measuring instruments, etc., which are considered to be more practically utilized when commonly used by each plant, will be under the responsibility of the maintenance shops of the General Service Facilities. The maintenance shops will be staffed by engineers exclusively selected for this purpose.

(2) Production Department

This department will consist of the Operation and Production Control Divisions.

(a) Operation Division

This division will be responsible for plant operation and safety.

(b) Production Control Division

This division will prepare plant operation schedules in accordance with the feedstock supply and product shipment schedules.

(3) Administration Department

This department will have under its supervision the Administration Division staffed by personnel in charge of General Affairs, Personnel Relations, Accounting, Purchasing and Shipping Control. All staff members belonging to Administration Department will be housed in the Administration Office Building, which is also a part of General Services Facilities.

1-8-3 General Service Facilities

As shown in Fig. 1-17, the organization of the General Service Facilities will comprise three departments: Safety & Environment, Maintenance and Administration Departments.

(1) Safety & Enviornment Department

The department will have four divisions.

(a) Safety Control Division

This division will be responsible for compliance by the complex as a whole with various safety regulations, establishment of safety standards, carrying out safety inspections, providing guidance and training for safety etc.

(b) Fire Fighting Division

This division will be responsible not only for extinguishing a fire when it occurs within the complex, but also for maintenance of the fire fighting facilities, etc.

(c) Environment Division

This division will be responsible for carrying out technical planning as well as guidance and surveillance for the control of environmental pollution due to waste water or gas, wastes, noise, etc. occuring at or emitted from all the plants, in addition to operation and maintenance of pollution control treatment facilities.

(d) Medical and Dispensary Division

This division will be responsible for managing the physical condition and health of plant employees and for providing emergency medical treatment.

(2) Maintenance Department

This department supervises the following divisions:

(a) Maintenance Shop Division

This division will manage the Welding, Machine, Instrument and Electrical Shops, which will be commonly utilized by the various plants. Engineers of each shop are required to operate the equipments installed.

(b) General Service Division

This division will be in charge of maintenance of all facilities belonging to General Service Facilities, excluding the maintenance shops. For example, maintenance of the Administration Office Building will be included as one of the duties of the General Service Division.

(3) Administration Department

This department will consist of General Affairs, Personnel Relations, Purchasing and Accounting Divisons.

CHAPTER 2. REVAMPING PLAN OF FILOIL REFINERY

CHAPTER 2. REVAMPING PLAN OF FILOIL REFINERY

CONTENTS

TABLES AND ILLUSTRATIONS

2. Revamping Plan of Filoil Refinery

2-1 Introduction

This report is prepared as part of a pre-feasibility study for the development of the petrochemical industry in the Philippines.

In this study, it is presupposed that Rosario, Cavite, is selected as the site for a petrochemical complex, and Filoil Refinery will supply feedstock to the petrochemical complex.

JGC has conducted the study for the refinery expansion to meet the requirements of a petrochemical complex.

2-2 Summary and Recommendation

(1) Summary

(a) Crude capacity of the Filoil Refinery will be increased from present 30,000 BPSD to a maximum of 57,400 BPSD by adapting the existing FCC main column to a new crude unit.

(b) An atmospheric residue hydrodesulfurization unit is necessary to produce fuel oil with a sulfur content of 1.5 wt%.

(c) The replacement of trays with high-efficiency packing will increase the capacity of the existing vacuum column up to 11,000 BPSD.

(2) Recommendation

The recent development of SO_2 removal techniques from stack effluent should be taken into consideration before the decision is made regarding the construction of a hydrodesulfurization unit for heavy oil fractions.

2-3 Expansion of Crude Processing Capacity

To maximize the crude throughput of the Filoil Refinery by modifications of the existing plants, studies were made on the following three alternatives.

Alternative 1: Construction of a new topping unit by adaptation of the existing FCC main column

Alternative 2: Combination of the existing topping unit and the existing vacuum flasher

Alternative 3: Addition of pre-flash tower to the existing topping unit

These studies presupposed the following conditions.

(1) Crude: Kuwait

(2) Cut range of products

Products	Cut Range TBP (°F)
LSR	C_5-235
Naphtha	235-380
Kerosene	380-480
Gas Oil	480-650 (or 690)
Residue	650+ (or 690+)

A summary of the studies on revamping of the crude system is shown in Table 2-1.

Alternative 1 will give the maximum crude throughput of 57,400 BPSD in total.

Table 2-1 Summary of Crude Unit Revamping Study

	Alternative 1	Alternative 2	Alternative 3
Possible capacity (BPSD)	57,400 (Existing 30,000 New 27,400)	46,500	34,600
Equipment to be modified	FCC main column modified to new crude column	Existing crude column Existing vacuum column	LSR stabilizer Existing crude charge heater
New equipment to be added	LSR stabilizer Crude charge heater Heat exchangers Desalter	LSR stabilizer Crude charge heater Heat exchangers Desalter	Pre-flash tower

According to the agreement between PNOC and the Consultants, the preliminary design work was carried out for Alternative 1, while the conceptual study was made on Alternatives 2 and 3.

Following are details of each alternative.

2-3-1 Alternative 1: Construction of a New Topping Unit by Adoption of the Existing FCC Main Column

(1) Process design for the new crude unit

The variable and operating conditions for the new topping unit were determined to get maximum crude throughput.

(a) The operating pressure of the topping column was set at 26.8 psig at the overhead receiver to reduce vapor load.

(b) Highly efficient "Perform Contact Tray" is introduced as tower internal.

(c) Duty of gas oil reflux was maximized while duties of overhead reflux and kerosene reflux were reduced. This sacrificed the sharp separation of each fraction, which is not an essential requirement for petrochemical feedstocks.

(d) Steam is injected only to the bottom of crude column, eliminating steam injection to the strippers for each fraction.

(e) Cut point for atmospheric residue was set at 650°F plus to keep the temperature of transfer line outlet below 700°F. By doing this, the crude throughput was increased to 27,400 BPSD from 22,600 BPSD with the cut point of 690°F plus.

(2) Modification of existing equipment

The following modifications are to be made to improve efficiency.

(a) In modifying the existing FCC main column to the new crude column, the trays are to be replaced with "Perform Contact Trays", the number of plates being 28.

(b) Existing overhead receiver of FCC main column can be used for the new crude unit.

(c) Strippers for the light cycle oil and the heavy cycle oil of the existing FCC unit are to be used as strippers for naphtha and kerosene, respectively. These strippers are to be used only for keeping residence time of each product. The existing trays are to be removed.

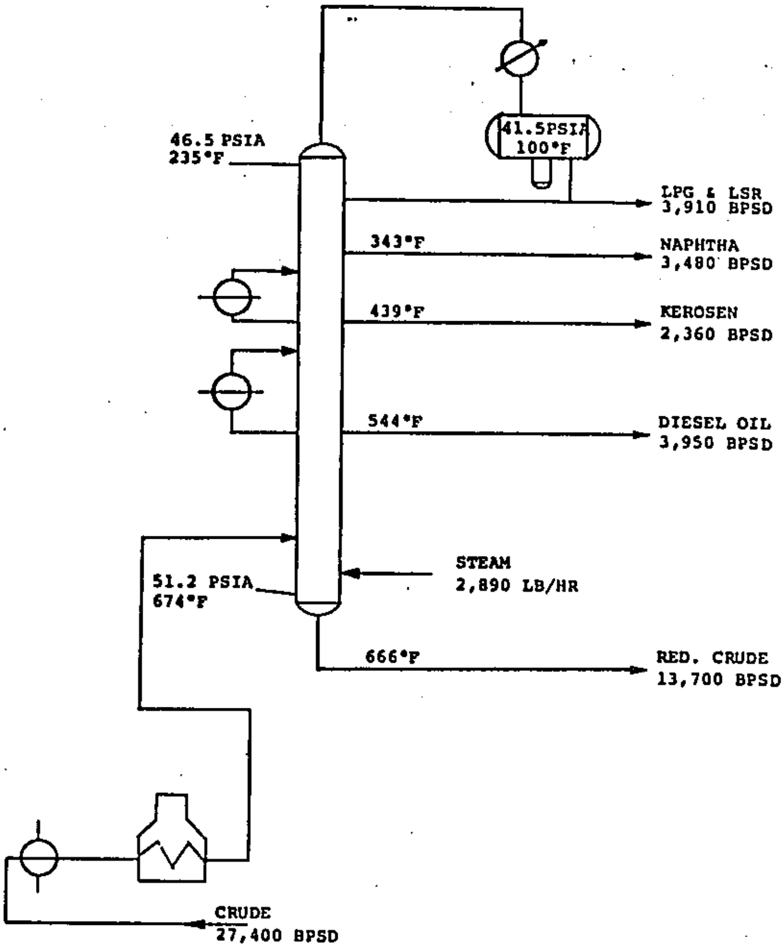
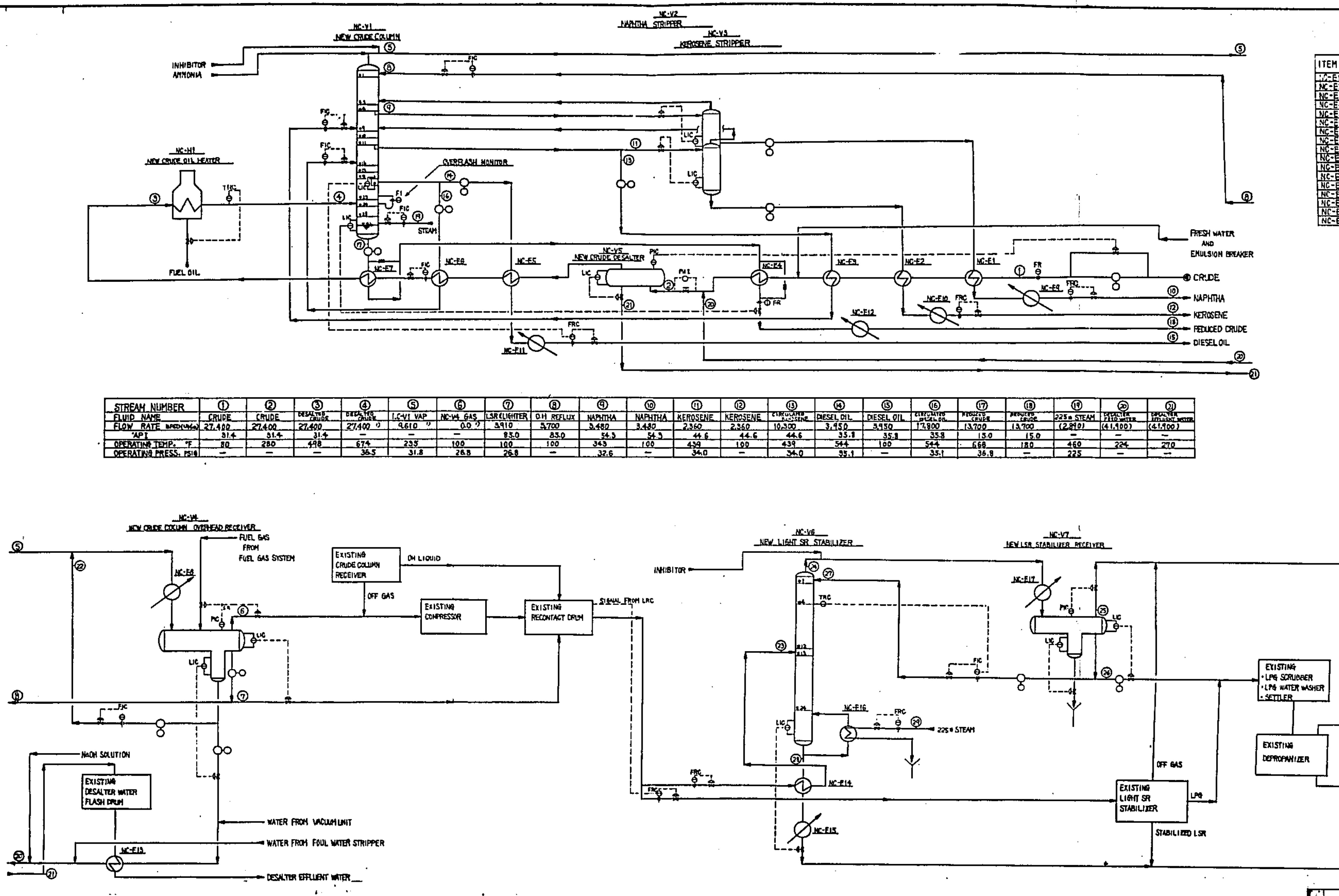


Fig. 2-1 Process Flow Diagram for New Topping Unit (Alternative 1)

Table 2-2 Estimated Yields and Properties for New Crude Unit (Alternative 1)

Description	Crude	Off Gas	LPG	Light SR	Naphtha	Kerosene	Diesel Oil	Reduced* Crude
TBP Cut Point: °F	-	C_2-	C_3, C_4	C_5-235	235-380	380-480	480-650	650-
Yield: vol % on crude	100.0	1.3	1.9	11.1	12.7	8.6	14.4	50.0
Flow Rate: BPSD	27,400	350	520	3,040	3,480	2,360	3,950	13,700
Gravity: °API	31.4	-	120	76.0	54.3	44.6	35.8	15.0
Sp. Gr., 60°F/60°F	0.869	(MW=42.9)	0.563	0.682	0.762	0.804	0.846	0.966
Sulfur: wt %	2.56	-	-	0.03	0.057	0.35	1.37	4.04
Hydrocarbon Type : vol %								
Parafines	-	-	-	81.7	60.2	Saturates	Saturates	-
Monocyclo-Parafines	-	-	-	15.8	24.0	81.0	70.5	-
Bicyclo-Parafines	-	-	-	0.0	0.8	Aromatics	Aromatics	-
Aromatics	-	-	-	2.5	15.0	19.0	29.5	-
Vap. Press., REID: lb	7.1	-	90	7.6	-	-	-	-
Viscosity: CS	14.8@77°F	-	-	-	-	2.0@70°F	3.8@100°F	1.100@100°F
	9.8@100°F	-	-	-	-	1.5@100°F	1.4@210°F	44@210°F
Flash, P-M: °F	Below 60	-	-	-	-	140	230	390
Pour Point: °F	-5	-	-	-	-	Below -40	15	64
ASTM: °F								
0%	-	-	-	-	181	215	270	-
5%	-	-	-	-	252	348	432	-
10%	-	-	-	-	269	365	458	-
30%	-	-	-	147	305	412	527	-
50%	-	-	-	168	329	441	565	-
70%	-	-	-	200	354	469	664	-
90%	-	-	-	245	397	511	659	-
95%	-	-	-	264	420	529	680	-
100%	-	-	-	304	458	565	720	-

* Light component below TBP cut point is 5.5 vol%.



ITEM NO	MMBTU/H	AREA: FT
NC-E1	5.41	1,040
NC-E2	4.71	900
NC-E3	7.80	620
NC-E4	18.0	3,380
NC-E5	6.45	2,380
NC-E6	20.0	3,570
NC-E7	21.4	4,780
NC-E8	23.6	6,760
NC-E9	0.13	290
NC-E10	0.87	620
NC-E11	4.63	1,920
NC-E12	16.3	3,380
NC-E13	2.85	820
NC-E14	2.33	590
NC-E15	0.91	520
NC-E16	4.68	410
NC-E17	3.67	2,390

STREAM NUMBER	①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩	⑪
FLUID NAME	CRUDE	CRUDE	DESALTED CRUDE	DESALTED CRUDE	NC-V1 VAP	NC-V4 GAS	LSR&LIGHTER	OH REFLUX	NAPHTHA	NAPHTHA	KEROSENE
FLOW RATE BPSD(LB/Hr)	27,400	27,400	27,400	27,400 1)	9,610 1)	0.0 1)	3,910	5,700	3,480	3,480	2,360
°API	31.4	31.4	31.4	—	—	—	85.0	85.0	54.3	54.3	44.6
OPERATING TEMP. °F	80	280	498	674	235	100	100	100	343	100	439
OPERATING PRESS. PSIG	—	—	—	36.5	31.8	26.8	26.8	—	32.6	—	34.0

STREAM NUMBER	⑫	⑬	⑭	⑮	⑯	⑰	⑱	⑲	⑳	㉑
FLUID NAME	KEROSENE	CIRCULATED KEROSENE	DIESEL OIL	DIESEL OIL	CIRCULATED DIESEL OIL	REDUCED CRUDE	REDUCED CRUDE	225# STEAM	DESALTER FEED WATER	DESALTER EFFLUENT WATER
FLOW RATE BPSD(LB/Hr)	2,360	10,300	3,950	3,950	17,800	13,700	13,700	(2,890)	(41,900)	(41,900)
°API	44.6	44.6	35.8	35.8	35.8	15.0	15.0	—	—	—
OPERATING TEMP. °F	100	439	544	100	544	668	180	460	224	270
OPERATING PRESS. PSIG	—	34.0	35.1	—	35.1	36.8	—	225	—	—

STREAM NUMBER	㉒	㉓	㉔	㉕	㉖	㉗	㉘	㉙
FLUID NAME	CIRCULATED WATER	LSR&LIGHTER	NC-V6 VAP	NC-V7 GAS	LPG&LIGHTER	REFLUX	LIGHT SR	225# STEAM
FLOW RATE BPSD(LB/Hr)	(2,160)	3,910	3,010 1)	250 1)	620	2,140	3,040	(3,780)
°API	—	85.0	—	—	126	—	76.0	—
OPERATING TEMP. °F	100	200	142	100	100	100	264	460
OPERATING PRESS. PSIG	31.8	127	125	120	—	125	190	225

NOTE
1) LIQUID BASE

JAPAN GASOLINE CO., LTD.

Fig. 2-2 PROCESS AND FLAGGED FLOW SHEET

FILOIL REFINERY CORPORATION

6-MAY-1975

DWG NO. -B

Fig. 2-2 Process and Flagged Flow Sheet for New Crude Unit (Alternative 1)

(3) Addition of equipment

The following new equipment items are to be added and their dimensions were determined as a result of the process design.

i) Crude desalter

ii) Light straightrun stabilizer

iii) Crude charge heater

iv) All heat exchangers

v) All pumps

Because there is no space around the existing FCC area, all new equipment except pumps should be installed in a new area across the Avenue E.

(4) Estimation of capital requirements for new crude unit

Cost estimation was made by the following procedure:

(a) Investment for a completely new crude unit of 27,400 BPSD was estimated to be US$6.00 million.

(b) Costs of the unnecessary equipments available in the existing FCC unit were deducted from the above figure.

Then, costs of incremental items given below were added:

i) Modification of existing equipment

ii) Replacement of trays

iii) Piping work

iv) Removing pumps, racks, and other unnecessary items.

The resultant figure was US$6.42 million, which is higher than the cost of acquiring a completely new unit of the same capacity. This may be caused by rather high incremental costs of longer distanced - piping work.

However, the difference is less than 10%, so that it is difficult to state definitely whether the completely new crude unit is more economical than the modified one.

Table 2-3 Performance of New Crude Charge Heater

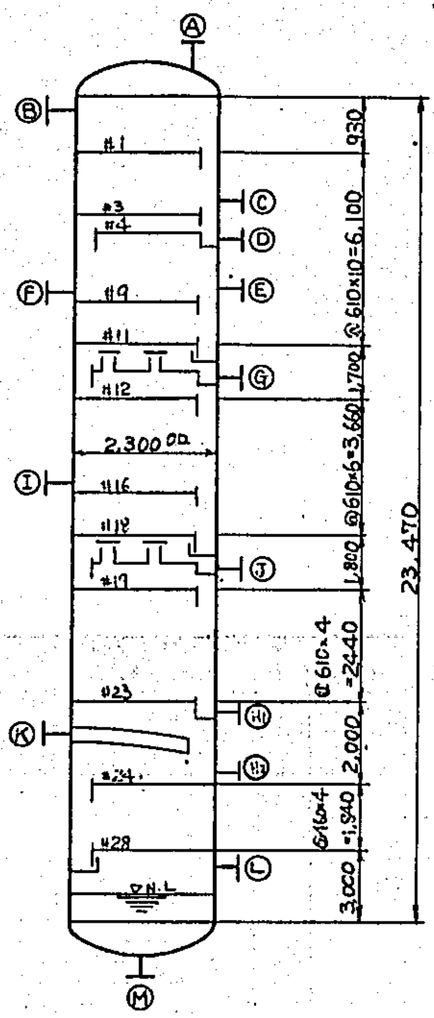
Flow Rate	BPSD	27,400
Inlet Temperature	°F	498
Outlet Temperature	°F	674
Outlet Pressure	Psig	36.5
Heat Absorbed	10^6BTU/hr	60.1
Vaporized (Outlet)	wt%	42.3

Table 2-4 Heat Exchangers Summary for New Crude Unit

Item No.	Service	Surface Area per Shell(ft^2) x No. of Shells
E- 1	Crude-naphtha exchanger	1,040 x 1
E- 2	Crude-kerosene exchanger	800 x 1
E- 3	Crude-circuit kerosene exchanger	620 x 1
E- 4	Crude-cold RCD exchanger	3,380 x 1
E- 5	Desalted crude-gas oil exchanger	1,690 x 2
E- 6	Desalted crude-circuit gas oil exchanger	3,570 x 1
E- 7	Desalted crude-hot RCD exchanger	2,390 x 2
E- 8	Crude column condenser	3,380 x 2
E- 9	Naphtha cooler	290 x 1
E-10	Kerosene cooler	620 x 1
E-11	Gas oil cooler	1,920 x 1
E-12	Reduced crude cooler	3,380 x 1
E-13	Desalted water exchanger	410 x 2
E-14	LSR stabilizer feed exchanger	290 x 2
E-15	LSR stabilizer bottom cooler	620 x 1
E-16	LSR stabilizer reboiler	410 x 1
E-17	LSR stabilizer condenser	2,390 x 1

SKELETON OF VESSEL

SIZE 23,470^H x 2,300^O.D. [m/m] QUANTITY 1



NOZZLES & MANHOLES				
MARK	NO.	SIZE	RATING/ FACING	SERVICE
A	1	—	—	[illegible]
B	1	—	—	[illegible]
C	1	—	—	[illegible]
D	1	—	—	[illegible]
E	1	—	—	[illegible]
F	1	—	—	[illegible]
G	1	—	—	[illegible]
H1-2	1	—	—	[illegible]
I	1	—	—	[illegible]
J	1	—	—	[illegible]
K	1	—	—	FEED
L	1	—	—	[illegible]
M	1	—	—	[illegible]

Thickness given for heads are minimum.

Elliptical heads : 2 to 1 ratio.

Field test : gauge at juncture of bottom head and shell.

Corrosion allowances and total thicknesses include any cladding or applied alloy lining.

Wind
Seismic Factor } Where governs

NOTE MODIFIED FCC MAIN COLUMN.

UNIT NEW CRUDE UNIT

NAME OF VESSEL NEW CRUDE COLUMN NC-V1 (F-V10)

JOB CODE 3 - 8833 - 0 - 5 -

DATE 2 - May - '75 SHEET NO

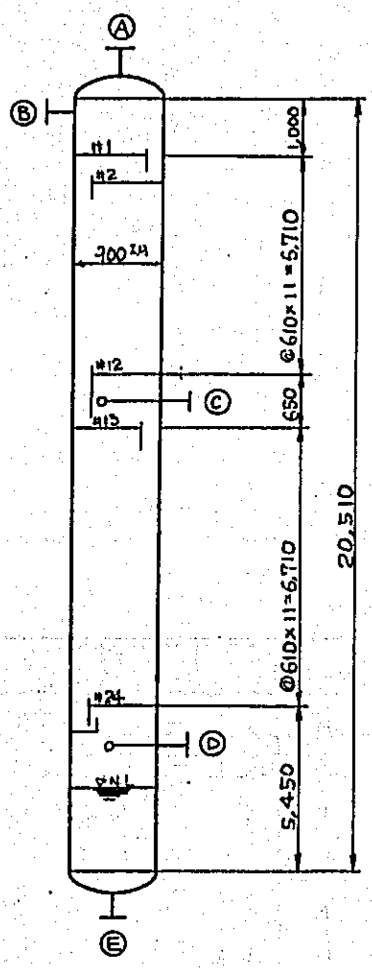
PREP'D CHK'D APP'D

REV.

Fig. 2-3 Skeleton of Modified Crude Column NC-V1

SKELETON OF VESSEL

SIZE 20,510^{H} × 900^{ID} [mm] QUANTITY 1



MARK	NO.	SIZE	RATING/ FACING	SERVICE
A	1	—	—	[illegible]
B	1	—	—	[illegible]
C	1	—	—	FEED
D	1	—	—	[illegible]
E	1	—	—	[illegible]

NOZZLES & MANHOLES

NOTE

Thickness given for heads are minimum.
Elliptical heads : 2 to 1 ratio.
Field test : gauge at juncture of bottom head and shell.
Corrosion allowances and total thicknesses include any cladding or applied alloy lining.
Wind
Seismic Factor } Where governs

UNIT NEW CRUDE UNIT

NAME OF VESSEL NEW LSR STABILIZER NC-V6

JOB CODE 0-8833-0-0-[illegible]

DATE 2-May-'75 SHEET NO.

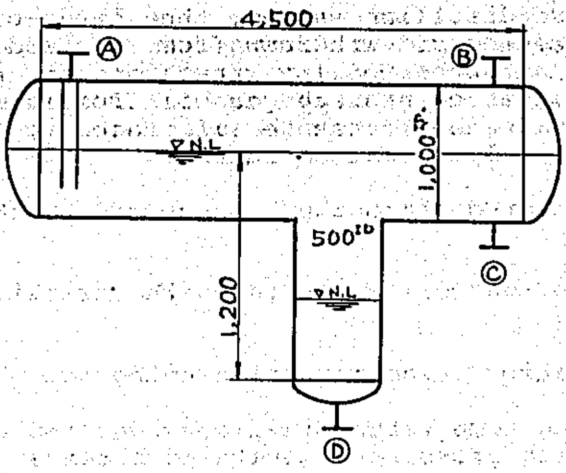
PREP'D [illegible] CHK'D [illegible] APP'D [illegible]

REV.

Fig. 2-4 Skeleton of New LSR Stabilizer NC-V6

SKELETON OF VESSEL

SIZE 4,500 L × 1,000 ID QUANTITY 1
[mm]



ACCESSORIES APPLIED BY FABRICATOR

INSULATION CLIPS

NOZZLES & MANHOLES

MARK	NO.	SIZE	RATING/ FACING	SERVICE
A	1	—	—	[illegible]
B	1	—	—	VAP. [illegible]
C	1	—	—	LIQ. OIL
D	1	—	—	WATER

Thickness given for heads are minimum.
Elliptical heads 2 to 1 ratio.
Field test : gauge at juncture of bottom head and shell.
Corrosion allowances and total thicknesses include any cladding or applied alloy lining.
Wind
Seismic Factor } Where governs

NOTE

UNIT NEW CRUDE UNIT
SERVICE NEW LSR STABILIZER RECEIVER
NC-V7

JOB CODE 0-8833-0-5-

DATE 2-May-'75 SHEET NO.
PREP'D [illegible] CHK'D S.O. APP'D [illegible]
REV.

Fig. 2-5 Skeleton of New LSR Stabilizer Receiver NC-V7

2-3-2 Alternative 2: Combination of the Existing Crude Column and Vacuum Flasher

The existing crude column and vacuum flasher are combined to make a new crude distilling system with an increased crude throughput of 46,500 BPSD.

In the new crude distilling system, the lower-boiling products such as naphtha and kerosene are withdrawn from the side of the modified crude column and higher boiling fractions are charged to the modified vacuum flasher to separate gas oil from atmospheric residue. The vacuum charge heater can be eliminated by feeding atmospheric residue directly to vacuum flasher.

The increase of crude throughput is caused by the reduction of vapor load by:

(a) Charging gas oil fraction to the existing vacuum column

(b) Eliminating steam injection to bottom

(c) Lowering temperature in flash zone and thus raising operating pressure of overhead receiver up to 45psig.

Necessary modifications are as follows:

(d) Adding a new crude heater

(e) Replacing the trays in external reflux section of the existing crude column with "Perform Contact Tray"

(f) Addition of some heat exchangers

(g) Replacement of trays in the existing vacuum flasher with highly-efficient packing.

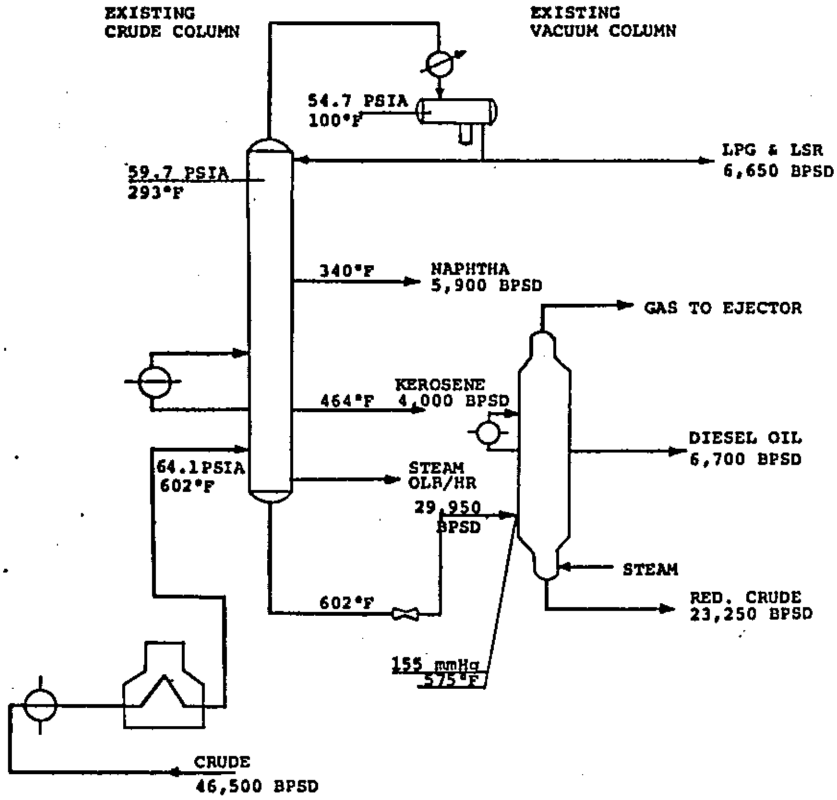


Fig. 2-6 Process Flow Diagram for New Topping Unit (Alternative 2)

2-3-3 Alternative 3: Addition of a Pre-flash Tower to the Existing Topping Unit

Addition of a new pre-flash tower will increase crude throughput from 30,000 BPSD to 34,600 BPSD.

In the new crude distilling system, the lowest boiling products (LPG, LSR, and small portion of naphtha) are vaporized in the new pre-flash tower and fed to the upper section of the existing crude column.

Heavier fractions which are not vaporized in the pre-flash tower are charged to the existing crude column through the crude charge heater.

In this Alternative 3, the increase of crude throughput is smaller than the other two alternatives, because the operating pressure in the column is kept lower to avoid the increase of temperature at the heater outlet.

The following modifications are necessary:

(a) Modifying some heat exchangers to avoid increased pressure drop

(b) Addition of pre-flash tower level control valve in the crude line on the upstream of pre-flash tower.

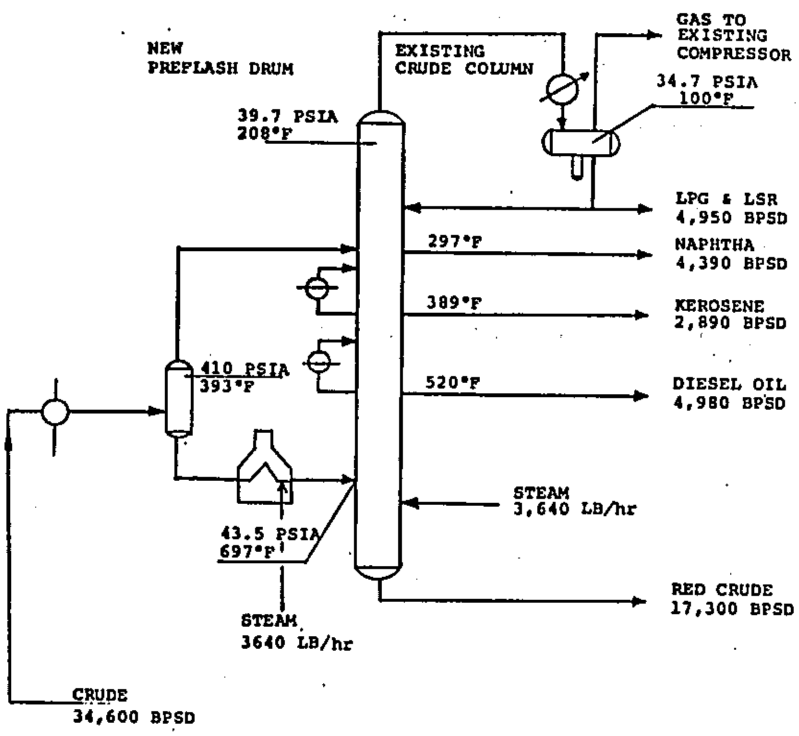


Fig. 2-7 Process Flow Diagram for Alternative 3

2-4 Modification of the Existing Vacuum Flasher

The capacity of the vacuum flasher will increased from present 8,000 BPSD to about 11,000 BPSD, by introducing highly efficient packings in place of existing column internals.

The increase of the throughput becomes possible for the following reasons. The replacement of the internals will lower the pressure in the flash zone by reducing the pressure loss between the column overhead and the flash zone to about 18mmHg. This markedly reduce the steam injected to the charge heater with purposes of lowering the partial pressure of hydrocarbons and of avoiding the coking within the heater. Thus, vapor load in the vacuum is reduced and the throughput increased.

The new operating conditions for the vacuum column are as follows:

Table 2-5 Proposed Operating Conditions for Modification of the Existing Vacuum Flasher

Vacuum column	
Overhead pressure	25mmHg
Flash zone pressure	43mmHg
Overhead temperature	110°F
Flash zone temperature	750°F
Steam injection to heater	1,100 lb/hr
Steam injection to vacuum bottom	700 lb/hr
Ejector suction conditions	

		Original design	After modification
Steam	lb/hr	5,400	1,800
Hydrocarbon	lb/hr	400	400
Pressure	mmHg	20	20
Temperature	°F	110	110

As a result of this modification, steam consumption of the vacuum column will decrease despite the increase of the throughput.

Table 2-6 Reduction of Steam Consumption Resulting from Modification

Item		Original design	After modification
To vacuum heater	lb/hr	900	1,100
To vacuum bottom	lb/hr	4,500	700
To ejectors	lb/hr	9,500	5,900
Total		14,900	7,700

Table 2-7 Products Summary for the Modified Vacuum Flasher

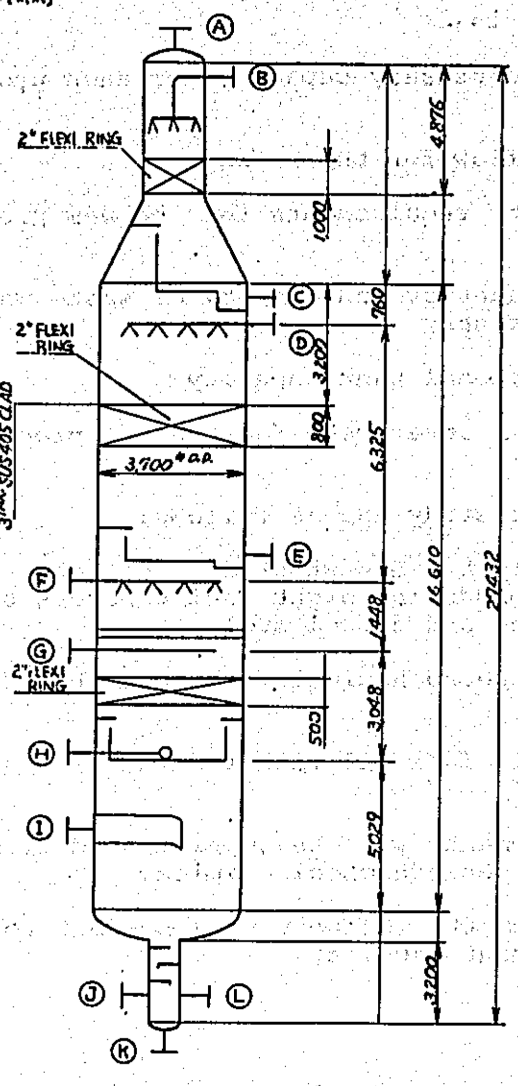
Estimated Yields and Properties

Properties	VC Charge	Off Gas	LVGO	HVGO	LVGO&HVGO	Slop Wax	VC Bottoms
TBP Cut Point: °F	650+	-	650-750	750-1,065	650-1,065	1,065-1,090	1,090+
Vol % on Charge	100.0	0.5 *1)	18.2	42.3	60.5	3.0	36.0
Vol % on Crude	50.0	0.3 *1)	9.1	21.1	30.2	1.5	18.0
Flow Rate: BPSD	11,000	60 *1)	2,000	4,650	6,650	330	3,960
Flow Rate: lb/hr	153,800	400	25,900	62,800	88,700	4,600	60,100
API Gravity: °API	15.0	-	27.7	21.3	23.1	15.5	4.4
Sp. Gr., 60°F/60°F	0.966	MW=31	0.889	0.926	0.915	0.963	1.041
Sulfur: wt %	4.04	22 *2)	2.42	2.85	2.72	4.49	5.62
Flash Point, P-M: °F	390	-	350	440	420	>550 *3)	>600 *3)
Pour Point: °F	64	-	58	102	97	130	135
Con. Carbon: wt %	9.4	None	< 0.1	0.55	0.42	5.0	24.6
Metals : ppm wt.							
Vanadium	56	None	< 0.1	0.25	0.21	4.6	130
Nickel	13	None	< 0.1	0.15	0.14	2.4	42
Pene. 77°F, 100G, 5Sec	-	-	-	-	-	-	60

*1) Liquid Base
*2) H_2S Gas in Off Gas
*3) COC

SKELETON OF VESSEL

SIZE (mm)
TOP 4876×1720 ID
UPPER 3200×3700 ID
LOWER 13410×3700 ID
DROP LEG 3200×1250 ID
QUANTITY 1



NOZZLES & MANHOLES				
MARK	NO.	SIZE	RATING FACING	SERVICE
A	1	—	—	[illegible]
B	1	—	—	[illegible]
C	1	—	—	[illegible]
D	1	—	—	[illegible]
E	1	—	—	HVGO [illegible]
F	1	—	—	HVGO [illegible]
G	1	—	—	SLOP WAX [illegible]
H	1	—	—	SLOP WAX [illegible]
I	1	—	—	FEED
J	1	—	—	STEAM [illegible]
K	1	—	—	V.R. [illegible]
L	1	—	—	V.R. RESID [illegible]

NOTE SEE UOP PRESSURE VESSEL SUMMARY No. 1200, SHEET 4~5/7.

Thickness given for heads are minimum.
Elliptical heads : 2 to 1 ratio.
Field test : gauge at juncture of bottom head and shell.
Corrosion allowances and total thicknesses include any cladding or applied alloy lining.
Wind
Seismic Factor } Where governs

UNIT VACUUM UNIT
NAME OF VESSEL VACUUM COLUMN

JOB CODE 0 - 8 3 2 - 0 - 5 - [illegible]
DATE 2-May-'75 SHEET NO.
PREPD [illegible] CHK'D [illegible] APP'D [illegible]
REV.

Fig. 2-8 Skeleton of the Existing Vacuum Flasher for Modification

2-5 The Configuration of the Refinery for Supply of Petrochemical Feedstocks and Low-sulfur Fuel Oil

To meet requirements from the proposed petrochemical complex, the rearrangement of Filoil Refinery was studied.

The purpose of this study is:

(a) To determine the necessary capacity for each process unit

(b) To make material flow for the refinery

(c) To estimate utility requirements for the new process units

(d) To estimate the quantity and quality of waste water from the whole refinery

(e) To determine additional tank capacity

(f) To estimate capital investment for the new process units.

The basic premises for the study are as follows:

(1) Filoil Refinery will supply the feedstock for the petrochemical complex without producing hight fuel products such as motor gasoline, kerosene and diesel fuel.

(2) The sulfur content of the petrochemical feedstock should be below 0.25 wt%.

(3) Filoil Refinery will supply fuel oil with 1.5 wt% of sulfur.

(4) Additional utility requirements will be supplemented from the utility center of the petrochemical complex.

(5) Discharged waste water from the refinery will be sent to the central waste-water treatment facility.

2-5-1 Process Units

The foregoing design study has shown that the crude processing capacity of Filoil Refinery can be increased to 57,400 BPSD by adopting the existing FCC main column to a new topping unit.

Processing of 57,400 BPSD Kuwait crude can provide enough feedstock for a 300,000 t/y ethylene plant. However, annual production of 200,000 tons of ethylene is being proposed for the initial stage.

This means that processing of approximately 38,000 BPSD of Kuwait crude will suffice for the petrochemical feedstock. Therefore, processing units other than the topping unit is planned in accordance with 38,000 BPSD crude processing rate to minimize the initial investment.

Table 2-8 Fractions Summary for 38,000 BPSD - Kuwait Crude

	TBP Cut Range (°F)	Yields (vol %)	Flow Rate (BPSD)	Sulfur Content (wt%)
Whole Naphtha	C_5 - 380	23.8	9,040	0.035
Kerosene	380 - 450	8.6	3,270	0.35
Gas Oil	480 - 650	14.4	5,470	1.37
Atmospheric Residue	650+	50.0	19,000	4.04

(1) Preparation of petrochemical feedstock

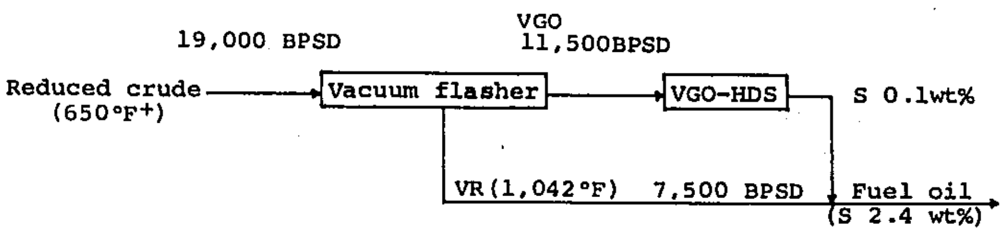
To meet the sulfur limitation of 0.25wt% for the feedstock, kerosene is to be desulfurized by the existing 5,000 BPSD middle distillate unifining unit. The remaining desulfurizing capacity could be utilized to desulfurize 1,380 BPSD of gas oil. Therefore, a new gas oil hydrodesulfurization unit of 4,090 BPSD is needed.

(2) Production of low sulfur fuel oil

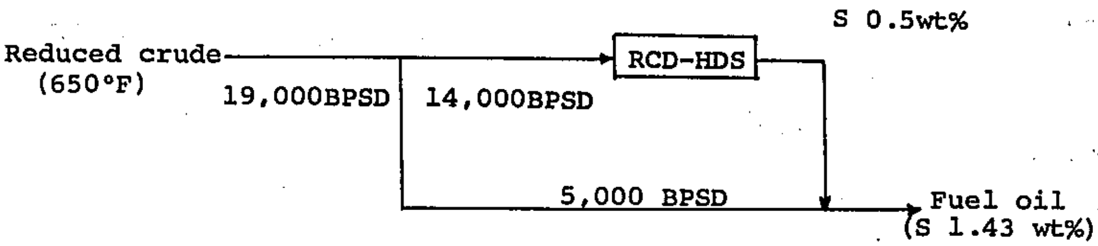
To reduce sulfur content of fuel oil, two alternatives will be considered. In the Alternative 1 (indirect desulfurization route), VGO is desulfurized to 0.1wt%S and is blended with vacuum residue. This route gives fuel oil with a sulfur content of 2.4 wt%.

To reduce the sulfur content to 1.5 wt%. Alternative 2 (direct desulfurization route) is required, wherein a part of atmospheric residue is desulfurized to 0.5 wt%, and blended with the rest of the residue to give fuel oil the required sulfur content.

Alternative 1: VGO Hydrodesulfurization Route



Alternative 2: Reduced Crude Hydrodesulfurization Route



(3) Additional processing units

A 3,910 BPSD hydrotreating unit is necessary to refine the cracked gasoline from the olefin complex which is to be utilized as motor gasoline blendstock. The existing reforming unit and gasoline sweetening unit will become unnecessary.

148,000 Nm3/D of hydrogen from the olefin complex is not sufficient to cover the total hydrogen requirement of the modified refinery. Therefore, the balance of hydrogen must be supplied by a new hydrogen unit making use of butane from the refinery as feedstock. To recover hydrogen sulfide from hydrodesulfurization units, an amine treating system is required. The recovered hydrogen sulfide is to be fed to a new sulfur plant.

Fuel requirement of the refinery will be met by off-gases from the process units and LPG. C_3-LPG from the olefin complex could supplement the required fuel.

Table 2-9 Proposed Refinery Configuration

(unit: BPSD)

Unit	Existing	Case 1	Case 2
Atmospheric Distillation	30,000	57,400	57,400
Kerosene HDS	5,000	5,000	5,000
LGO HDS	-	4,090	4,090
VGO HDS	-	11,500	-
Atmospheric Residue HDS	-	-	14,000
Cracked Gasoline HT	-	3,910	3,910
Amine Treating	-	60 t/d	81 t/d
Sulfur Production with tail gas Treating	-	60 t/d	81 t/d
Hydorgen	-	102,000 Nm^3/d	260,000 Nm^3/d

The proposed material flows for 38,000 BPSD crude processing rate are made in accordance with the above-mentioned planning.

(4) Discussion on fuel oil desulfurization

As afore-mentioned, VGO hydrodesulfurization route will give only 2.4wt%-sulfur fuel oil, and to meet the required sulfur content below 1.5wt%, the direct hydrodesulfurization route becomes necessary.

Here, recent development of SO_2 removal techniques from stack effluent should be taken into consideration in selecting the means of controlling sulfur oxide emission.

The table below shows the economic comparison of various desulfurization processes.

Table 2-10 Operating Cost of Desulfurization Processes

Basis (1) Kuwait atmospheric residue
(2) Sulfur content 4.04 wt %
(3) Capacity 19,000 BPSD

Process	Atmospheric Residue Hydrodesulfurization	SO_2 Removal Process (Limestone)
Plant Capacity	19,000 BPSD	as flue gas 820,000 Nm^3/hr x 2
Sulfur in Product	0.3 wt %	0.2 wt %
Investment Cost (million US$)	48.4*	26.7
Operating Cost (US$/bbl)	3.88	2.95

* includes hydrogen plant and sulfur plant

From the comparison of the costs, SO_2 removal from stack effluent is likely to compete with direct hydrodesulfurization of fuel oil. If import of low-sulfur crude is possible, needs for fuel oil desulfurization will decrease. Thus, there are many uncertain factors to be considered in selecting means of reducing sulfur oxides emissions.

Therefore, it is not safe to definitely recommend adopting the residual oil hydrodesulfurization unit for the new process flow of Filoil Refinery at present.

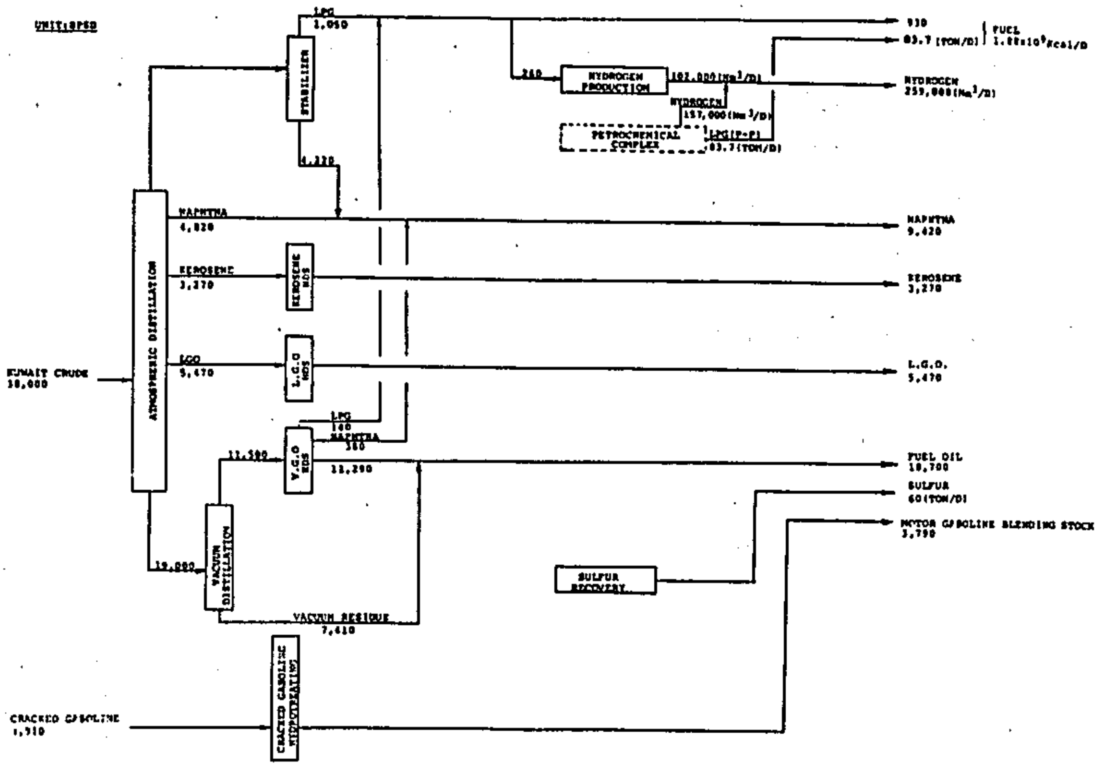


Fig. 2-9 Proposed Material Flow at Crude Processing Rate of 38,000 BPSD (VGO-HDS Case)

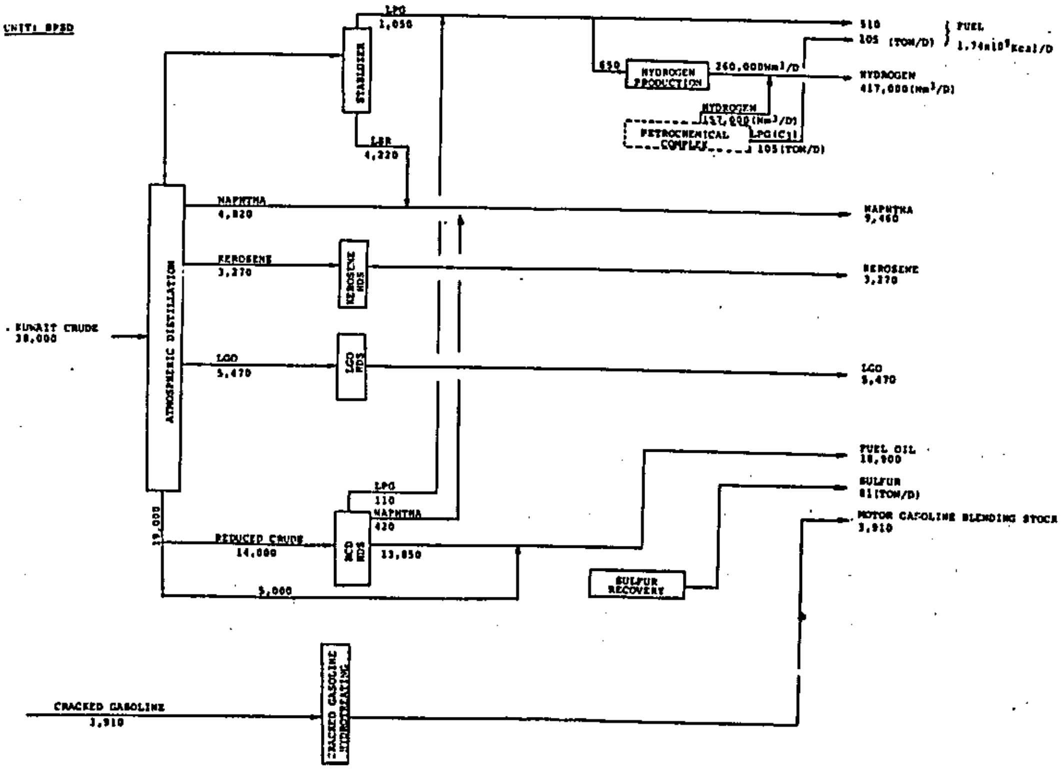


Fig. 2-10 Proposed Material Flow at Crude Processing Rate of 38,000 BPSD (RCD-HDS Case)

2-5-2 Utility Requirements

Utility consumption for new plants are estimated based on the following conditions.

(1) Process plants consume 30 kg and 4.5 kg/cm^2 steam.

(2) Pumps and compressors are driven only by motors.

(3) For process cooling, water circulation is adopted without air cooler.

Table 2-11 Utility Requirements for New Plants (VGO-HDS Case)

Item	Capacity	Elec. Power	Steam		Cond.	Loss	Cooling Water	BFW	Ind. Water	Fuel
	BPSD	kw	21 kg/cm^2G	4.5 kg/cm^2G	t/hr	t/hr	t/hr	t/hr	t/hr	10^6 Kcal/hr
Topping	27,400	634	-3.0	-	-	+3.0	1,780	-	-	17.2
Gas Oil, HDS	4,090	280	-	-	-	0	176	-	3.9	4.9
Vacuum Dist	17,700	389	-5.0	-3.0	-	+13.0	915	-	12.9	18.2
VGO HDS	11,500	1,200	-2.0	-	-	+4.0	740	2.0	11.5	15.0
Hydrogen	102,000 Nm^3/d	97	+2.7	-	-	+6.3	132	9.1	5.6	8.5
Amine Treat		11	-	-2.0	-	+2.0	100	-	-	-
Sulfer	60 t/d	225	-	+5.9	-	+3.0	-	8.9	2.2	-
Tail Gas Treat		33	-	+0.7	-	+0.7	243	0.7	2.2	1.0
Cracked Gaso. HD	3,910	49	-3.0	-	-	+3.0	86	-	9.1	-
Sour Water Strip		15	-	-4.5	+4.1	+0.4	52	-	-	-
Sub-total		2,933	-10.3	-2.9	+4.1	+35.4	4,224	20.7	47.4	64.8
Cooling Tower		1,140							211.2	
Boiler Feed									21.8	
Total		4,073	-10.3	-2.9	+4.1	+35.4			280.4	64.8

Table 2-12 Utility Requirements for New Plants (RCD-HDS Case)

Item	Capacity	Elec. Power	Steam		Cond.	Loss	Cooling Water	BFW	Ind. Water	Fuel
			21	4.5						
	BPSD	kw	kg/cm^{2}G	kg/cm^{2}G	t/hr	t/hr	t/hr	t/hr	t/hr	10^6 Kcal/hr
Topping	27,400	634	-3.0	-	-	+3.0	1,780	-	-	17.2
Gas Oil, HDS	4,090	280	-	-	-	-	176	-	3.1	4.9
At. Res. HDS	14,000	7,458	-	-	-	-	1,954	-	30.3	18.4
Hydrogen	260,000 Nm^3/d	248	-7.0	-	-	+16.3	337	23.2	14.2	21.6
Amine Treat		11	-	-2.0	-	+2.0	100	-	-	-
Sulfur	81 t/d	304	-	+8.0	-	+4.0	-	12.0	3.0	-
Tail Gas Treat		44	-	+1.0	-	+1.0	328	1.0	3.0	1.3
Cracked Gaso. HD	3,910	49	-3.0	-	-	+3.0	-	-	-	-
Sour Water Strip.		21	-	-6.2	+5.6	+0.6	71	-	12.4	-
Sub-total		9,049	-13.0	+0.8	+5.6	+29.9	4,746	36.2	66.0	63.4
Cooling Water		1,281							273.3	
Boiler									38.1	
Total		10,330	-13.0	+0.8	+5.6	+29.9			341.4	63.4

Note: + Indicates quantity generated,
- indicates quantity used.

2-5-3 Discharged Waste Water

Waste water from process plants is treated in a new sour water stripper, and the refreshed water is fed to the crude desalters. This will reduce water consumption.

Effluent water from the desalters is sent to proposed central water treatment system of the olefin complex.

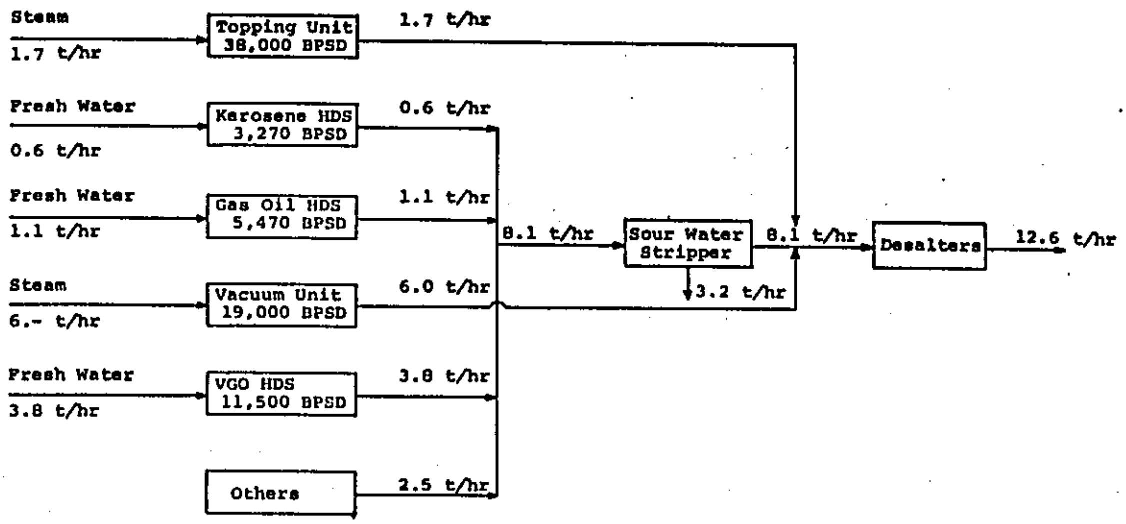


Fig. 2-11 Discharged Waste Water Balance (VGO-HDS Case)

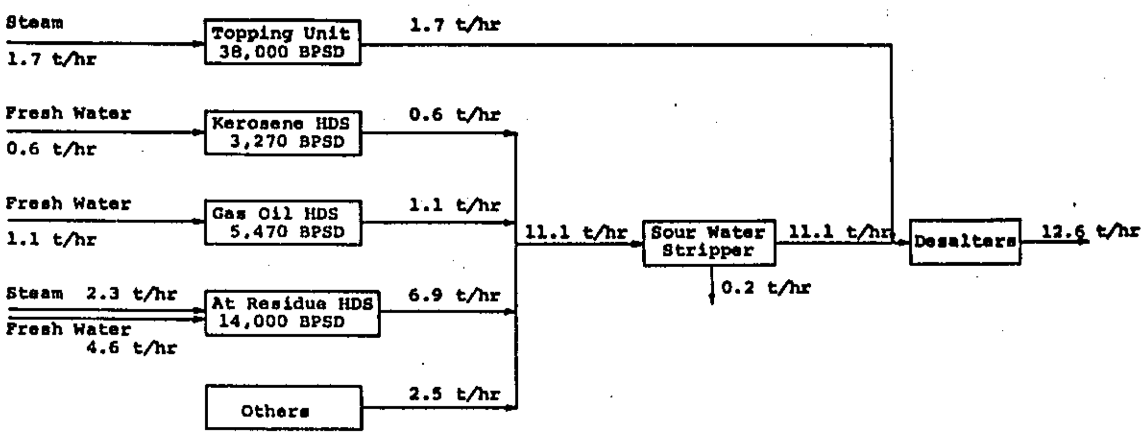


Fig. 2-12 Discharged Waste Water Balance (RCD-HDS Case)

The characteristics of effluent water from the crude desalter is estimated as follows:

COD 65 ppm

H_2S 2 ppm

$NH4^+$ 10 ppm

Quantity of storm water, is estimated below on the basis of maximum rainfall of 50 mm in Manila.

Table 2-13 Quantity and Characteristics for Steam Water

	Flowrate (tons/hr)	Contaminents (ppm)			
		Oil	BOD	COD	SS
Oily Effluent	9,400	50	10	10	30
Non-oily Effluent	1,970	-	10	10	10

2-5-4 Tankage

New tankage is proposed on the basis of a crude processing rate of 38,000 BPSD and owner's intention on oil stock piling rate (39 days for crude, 33 days for products) but 40 days is proposed for the storage capacity of cracked gasoline in accordance with the period of shutdown maintenance of the ethylene plant. (assumed 35 days) and 10 days is proposed for treated cracked gasoline as intermediate products.

Table 2-14 Proposed Tankage

Tank Capacity bbl

	Required	Existing	Additional
Crude	1,482,000	1,100,000	382,000
Naphtha	298,320	349,000	-
Kerosene	107,910	96,000	11,910
Gas Oil	180,510	161,000	19,510
Fuel Oil	627,000	512,500	140,000
Cracked Gasoline	156,400	0	156,400
Treated Cracked Gasoline	39,100	0	39,100

Size and number of the new tanks are determined below in consideration of process operability and existing tankage.

Table 2-15 New Tanks to be Added

	Case 1	Case 2
Crude	500,000 bbl x 1	500,000 bbl x 1
Kerosene	15,000 bbl x 1	15,000 bbl x 1
Gas Oil	20,000 bbl x 1	20,000 bbl x 1
Vacuum Gas Oil	40,000 bbl x 1	-
Vacuum Residue	20,000 bbl x 1	-
Atmospheric Residue	60,000 bbl x 1	60,000 bbl x 1
Cracked Gasoline	100,000 bbl x 2	100,000 bbl x 2
Treated Cracked Gasoline	20,000 bbl x 2	20,000 bbl x 2

2-5-5 Capital Requirements for Expansion

Investment cost for new process units is estimated an order-of-magnitude basis.

Table 2-16 Capital Requirements for New Process Plants

(Unit: Million US$)

Item	Capacity	Case 1 (VGO-HDS Case)	Case 2 (RCD-HDS Case)
* Crude Distillation	27,400 BPSD	6.42	6.42
Vacuum Distillation	17,700 BPSD	7.02	-
* Gas Oil HDS	4,090 BPSD	2.56	2.56
VGO HDS	11,500 BPSD	9.62	-
* Cracked Gasoline Hydrotrating	3,910 BPSD	2.85	2.85
Atmospheric Residue HDS	14,000 BPSD	-	30.97
Hydrogen Production		3.73	6.68
Sulfur Production		4.61	5.52
Hydrogen Sulfide Washing		0.70	0.70
* Sour Water Stripper		0.85	0.85
Sub-total		38.36	56.55
Royally and Initial Catalyst Charge		1.96	1,06
Total		40.32	57.61

If fuel oil desulfurization system is eliminated from the process flow of the refinery, only those process units with an asterisk (*) are necessary and the required investment will be reduced to US$12.68 million.

Fig. 2-13-1 Proposed General Refinery Layout

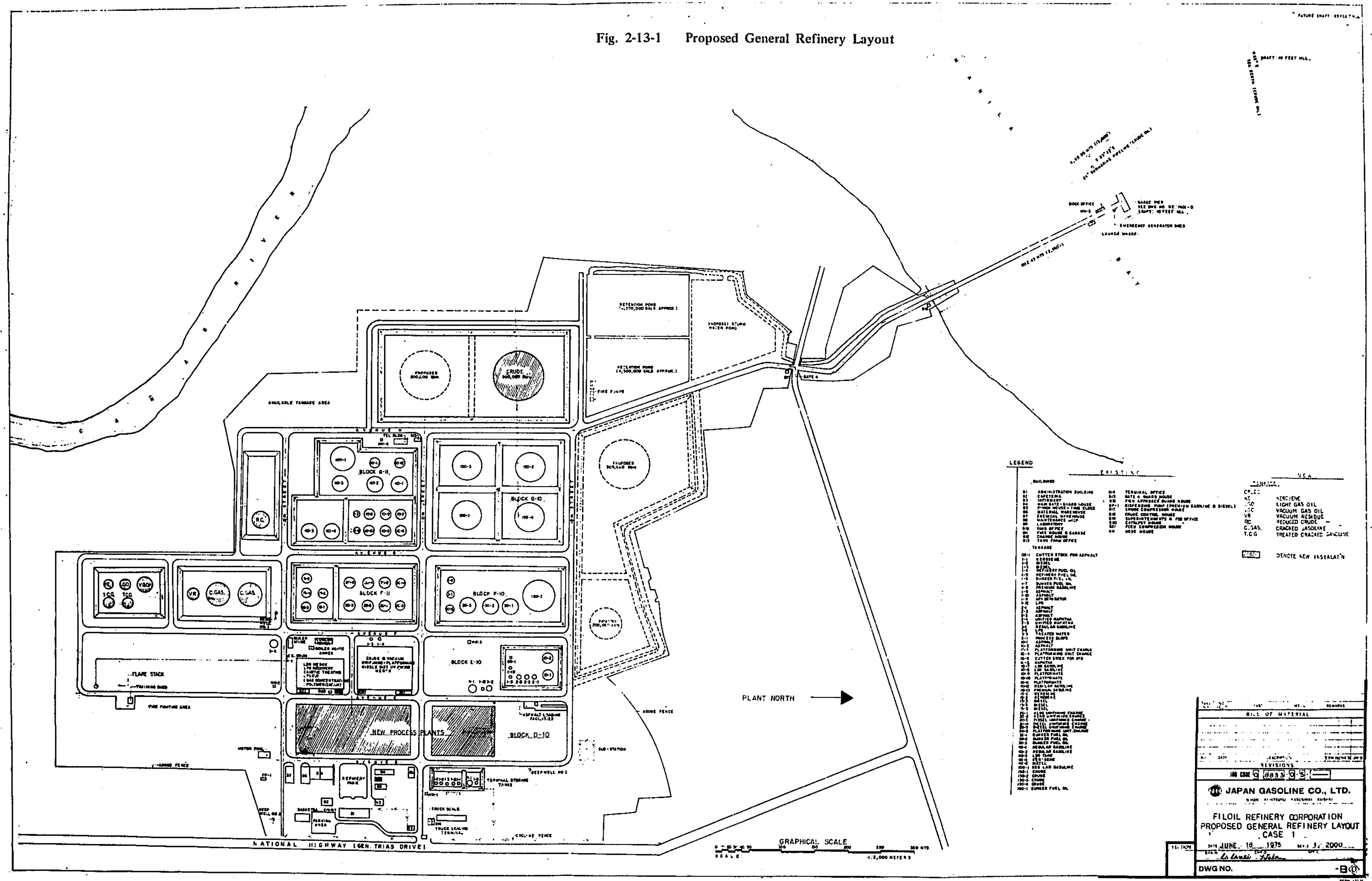
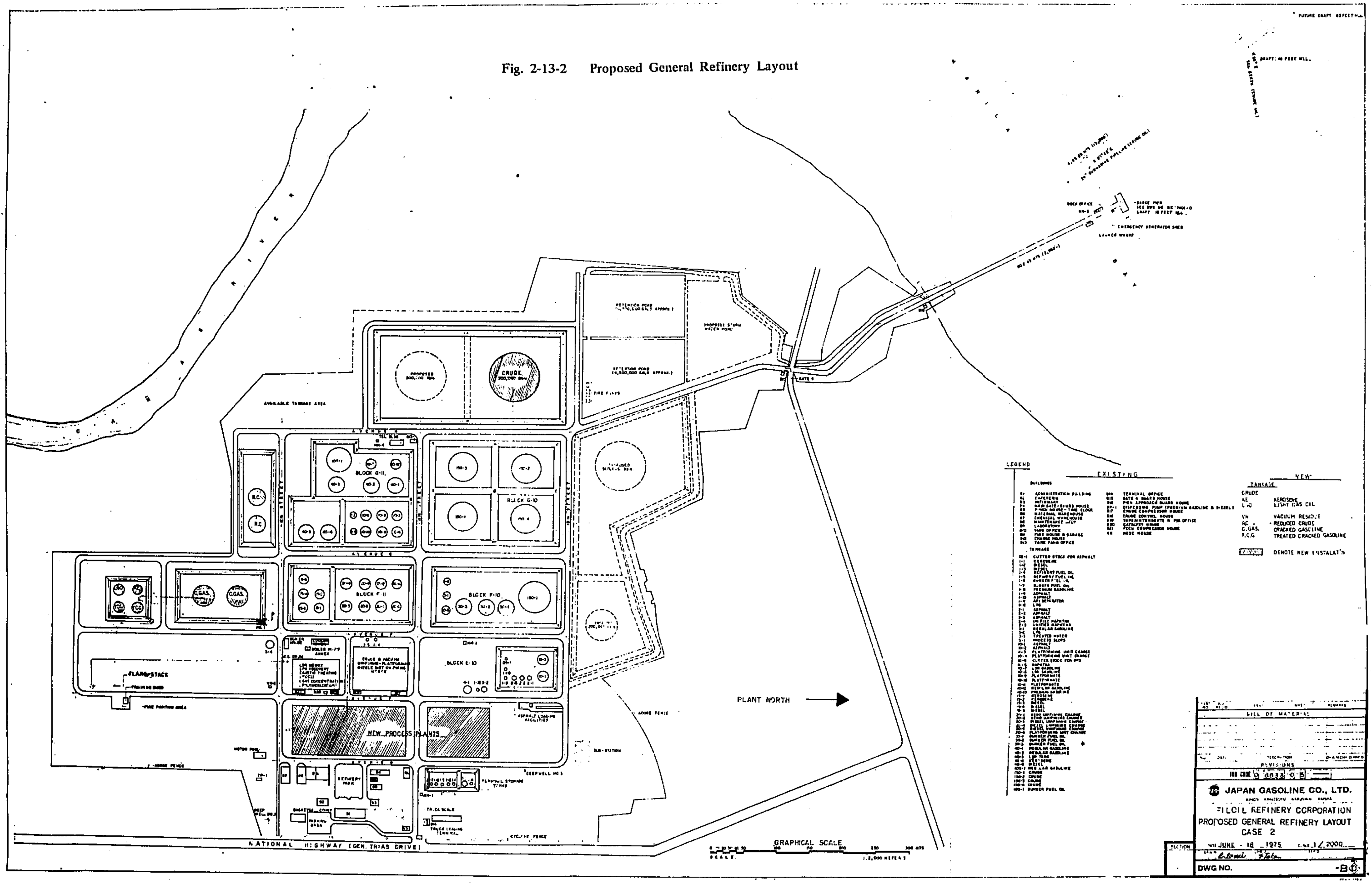


Fig. 2-13-2 Proposed General Refinery Layout



CHAPTER 3. DEVELOPMENT OF PETROCHEMICAL INDUSTRY

CHAPTER 3. DEVELOPMENT OF PETROCHEMICAL INDUSTRY

CONTENTS

TABLES AND ILLUSTRATIONS

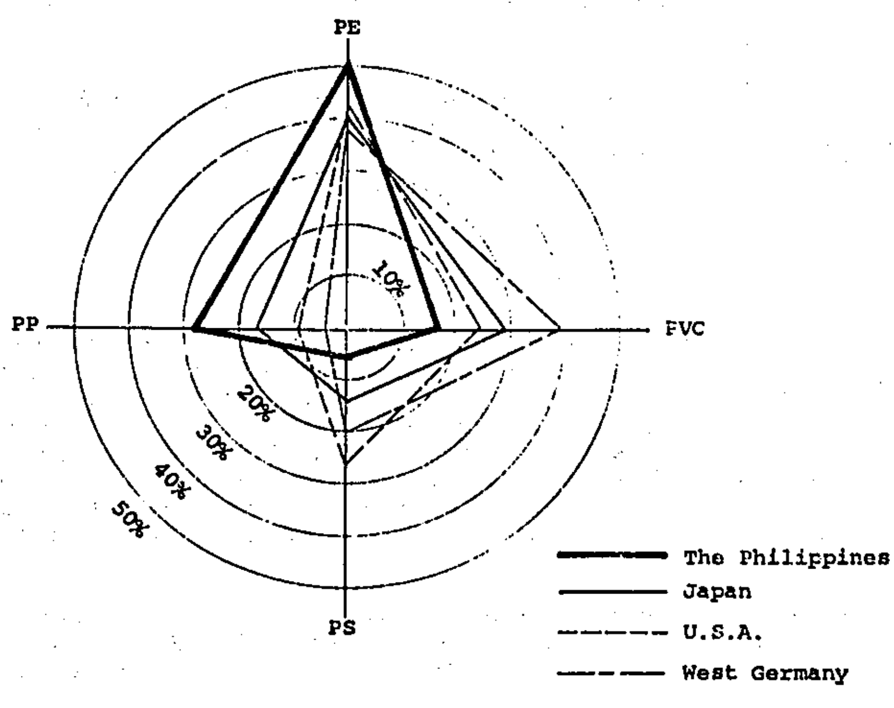
3. Development of Petrochemical Industry

3-1 Expansion of Plastics Demand

The plastics industries in the Philippines appear to be in a rapid developmental stage. Accordingly, the current plastic demand structures, as described in Section (3), 2-1-4, Part I, generally tend to concentrate on specified application fields. However, such application fields may diversify in the future as the modernization of the society will have been promoted.

Fig. 3-1 illustrates a comparsion with other countries of demand structures of various kinds of major plastic products. It is apparently known that the Philippines' plastic demand structure is greatly inclined towards PE and PP. This is due to the fact that PE has been mostly utilized for general packaging material and monofilament, and PP for woven bags; all of these items have been used in the production of agricultural goods most contributing to the economic development of the Philippines.

Plastic demands as the primary industry related materials may continually increase. However, in the future, as the industrialization progresses resulting in a well arranged infra-structure and the promotion of urban development, other uses such as industrial material fields, and civil construction fields may increase. This may indicate an increase in the future use of PS and PVC in comparison with polyolefins.



Source: Table 2-15, Part I

Fig. 3-1 International Comparison of Resinwise Demand Structure (1972)

3-1-1 LDPE

Demand structure of LDPE film and LDPE laminated paper at present is almost the same as in Japan and the demand increase may be expected as the growth of related industry continues. Tables 3-1 and 3-2 indicate the present demand structure in the Philippines:

Table 3-1 Demand Structure of LDPE Film (1973)

General packaging use 75% (1½ mil)	Foodstuff packaging 20%	Fruits, fishes Vegetables Refrigerated foodstuffs
	Non-foodstuff packaging 80%	Pharmaceuticals, shirts, agricultural use*, sugar subdividing packaging
Heavy packaging use 25% (3 mil)	Drum lining	Glue, chemicals
	Woven bag lining	Fertilizers

* Inclusive of banana growing film of ½ mil
Source: Modern Manufacturing Co., Ltd.
Product Packaging Corp.

Table 3-2 Demand Structure of LDPE Laminated Paper (1973)

LDPE/cellophane LDPE/cellophane/aluminium	35%	
LDPE/pouch paper	65%	
General packaging (powder detergents and others)		65%
Foodstuff packaging (snack)		20 - 25%
Pharmaceuticals (LDPE/cellophane/aluminium)		10 - 15%

Source: Cygnus Industries, Inc.

A blend of LDPE and HDPE is being utilized for injection molded household wares. The main purpose of blending LDPE with HDPE is that HDPE has so far been more expensive than either LDPE or PP and the cost reduction was desired. A secondary effect of this blending is the improvement of crack resistance of the HDPE molded articles. However, in comparison with the use of PP, this practice of using LDPE may greatly grow in fields which inherently require LDPE such as Tupperware, as the price is reduced in the future, and as the molding method improves.

Except for squeeze containers such as those used for mayonnaise, LDPE containers are molded from a blend of LDPE and HDPE, so that the demand in this particular field may not be very great in the future.

Conceivable new demands for LDPE in the Philippines are electric wire and electric cable. PVC sheathed electric wire is mainly used for power driving; LDPE sheathed electric wire is ordinarily used for communication cables, the production of which requires a very sophisticated technique called LDPE cross-linking. Incidentally the LDPE used for electric wire in Japan during 1972 was 62,000 tons, signifying 8% of all national demands for LDPE.

3-1-2 HDPE

Demand for HDPE monofilament shares 60% of the entire HDPE demand in the Philippines; the breakdown of monofilament usage is given in Table 3-3.

Table 3-3 Demand Structure for HDPE Monofilament (1973)

	Production capacity t/y	
Rope	7,000	for fishing & livestock shipping
Fishing net	3,600	
Mosquito net, etc.	400	

Source: Manila Plastic Products, Arrow Plastic Industries Corp., Philippine Synthetic Products, Inc.

Production capacity given in the above Table 3-3 is merely an estimation, but actually it seems to be much greater and considerable surplus capacity exists except for demand recession in 1974.

Most injection molded articles of HDPE are household plastic goods. Besides this, there is a crate for San Miguel beer bottles; the material for the crate is imported from Hoechst of West Germany an estimated 2,000 tons in 1972, and 3,000 tons in 1973, which correspond to approximately 20% of the entire HDPE demands. For a further development of HDPE demand in the future, it is necessary to stimulate the demand for agricultural crates along with diversification of home use items.

Blow molded containers made from HDPE are mainly utilized for packaging detergents and shampoo. Philippine Manufacturing Industries are producing special containers for motor oil and brake oil using HDPE. The demand for HDPE-made blow containers remains low, but in the future as the related industries grow, the demand will steadily continue to increase.

Woven bags are being produced from PP flat yarn. Three mil LDPE film is used for inside lining of PP woven bags of fertilizers and refined sugar which need protection against moisture. Woven bags made from HDPE flat yarn are not used at present in the Philippines because such bags are very slippery thus making them difficult to stack.

However, woven bags made from HDPE flat yarn laminated with LDPE are not slippery when stacked and the manufacturing process for sewing is simplified resulting in a cheaper cost. Therefore, this particular field is promising in the future.

With the plastic price increase of late, the film thickness has been decreased to ½mil. However, HDPE film still maintains the rigidity permitting it to be used in various fields. Demand ratio for HDPE film is not very high in Japan, yet it shared in 1972 a 7% national demand for HDPE.

3-1-3 PP

Woven bag popularity in the Philippines, especially those made from PP flat yarn, is indeed eye-catching, having netted PP consumption of an estimated 10,000 tons in 1973. However, in percentage, the demand increase in this particular field is only approximately 10% at the highest, thus for a further demand increase of PP another field development is required.

The usage on which a future prospect lies is an injection molded article. In Japan the domestic PP demand of said injection molded articles are more than 40%, of this 1/3 is for various kinds of crates, about 1/3 is for automobile and electrical parts, and the remaining 1/3 is for home use articles.

Production of PP films in Philippines is mainly based on the blown film molding which seems to be aiming at the substitution for LDPE which, since about 1972 has been in short supply.

For reference, Table 3-4 exhibits the distribution status in Japan of PP film production methods. This table shows that the production of blown film is gradually diminishing and is being replaced by flat film and biaxially oriented flat film, which have inherent characteristics of PP film.

Table 3-4 PP Film Distribution in Japan by Production Method

		Blown film	Flat film	Biaxially oriented flat film	Total
1970	(tons)	30,000	34,000	24,000	88,000
	(%)	34	39	27	100
1971	(tons)	30,000	36,700	41,700	108,400
	(%)	28	34	38	100
1972	(tons)	28,000	41,000	42,000	111,000
	(%)	25	37	38	100
1973	(tons)	28,000	41,600	47,000	116,600
	(%)	24	36	40	100

Source : J.P.P. Report No.106

Application fields, for both non-oriented and oriented films, are mostly for the automatic packaging of foodstuffs and textile products.

3-1-4 PS

Demand structure for GP and HI are almost the same in both the Philippines and Japan, and it seems that the demand in this particular field may continue to increase as the related industries continue to develop.

Current demand ratios for styrene-series plastics in the Philippines' according to Mr. Kataoka, Vice President of PPPI are:

GP	38%
HI	47
FS	15

Demand ratios of Japan in 1972 are:

GP, HI	51%
FS	17
AS	5
ABS	27

Comparison of the figures for the Philippines and Japan indicate a smaller demand in the Philippines for FS. FS is currently being directed for heat insulation purposes (Cebu Styropor Corp.) and also for other general construction material. A further demand could be stimulated for foamed film and sheet as sale of refrigerated and pre-packaged foodstuffs at the super-market continues to increase.

In regard to the industrial parts made of GP and HI, it is found that quite a wide scope of products are being produced in the Philippines, most of them being directed to parts for electrical products (Plastimer Industrial Corp.). Parts for automobils and motorcycles are produced on a smaller scale so that these are not yet being made in the Philippines. However, in Japan, most of these vehicular parts are molded with ABS resin, and the demand for GP and HI are rather dependent on the production status of the home-use electrical appliances.

3-1-5 PVC

More than 80% of PVC demand in the Philippines are for soft quality PVC, of which about 50 - 60% are directed for imitation leather which is made into various products such as furniture, handbags, chemical shoes, etc. Since these are generally durable consumer goods, their introduction into the market is comparatively easy. Said field will go on expanding as the disposable personal income keeps on augmenting.

The increase in PVC demands are dependent on the increase of demand for hard PVC products such as pipes, flat sheets, corrugated sheets and packaging sheets, etc.

Eighty-five percent of PVC pipes in the Philippines are tubes for home electric wiring. Even in the field of tubes for an electric wire, a considerably large demand is expected if PVC is ever directed to the cover of communication cables. In this field steel pipe (GI pipe) is presently being used (Freeman Incorporated).

In the future, however, water supply pipe and pipings for the chemical plants seem promising as major uses for PVC pipes.

Hard sheet for packaging use and blow molded bottles are currently spreading into the market; said fields are expected to expand as the related industries grow.

3-2 Market Problems and Resolving Measures

In the present surveys, after interviewing employees of about 30 plastic processing companies, several major problems were selected for analysis.

3-2-1 Promotion of Plastic Processing Industry in Regions

By nature, plastic industries are consumer-area-directed industries. Production in these consumption areas, except for some producers' goods (capital goods)such as film, leather, pipes which can be mass produced, results in cheaper transport costs and will enable the obtainment of man power at a lower wage rate.

Our surveys on the territorial demand of general consumer goods of plastics in the Philippines revealed the following distributions - Luson 50%, Visaya 30%, and Mindanao 20%. However, about 95% of the molding industries are concentrated in and around Manila City. Several reasons for this concentration are a poor supply of electric power and too small of a demand for a variety of products in the rural areas.

(1) Electric power condition

Most of the plastic molders working in Cebu City have complained about frequent power failure during production, resulting in poor production efficiency.

To generate an adequate supply of electicity, a factory must make an investment comparable to or more than the molding facilities. However, if there is a long depreciation period for the generator, the cost could be cheaper than purchasing the power from outside. A problem faced by the plastics processors is the administration of maintenance which in the absence of a suitable engineer could not be competently accomplished.

One method to settle this problem is the establishment of an industrial complex in major local cities and the possessing of common utilities.

(2) Distribution structure

Plastic product distribution system in the Philippines is a mixture of direct sales and sales through agents. The representative examples are shown in Figs. 3-2 through 3-8.

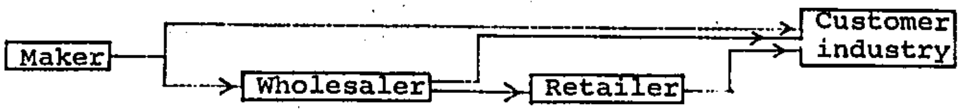


Fig. 3-2 LDPE Film, LDPE Laminated Paper

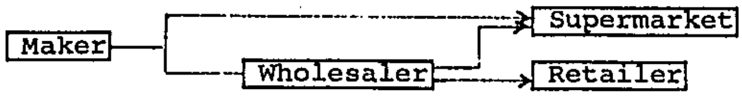


Fig. 3-3 Household Wares

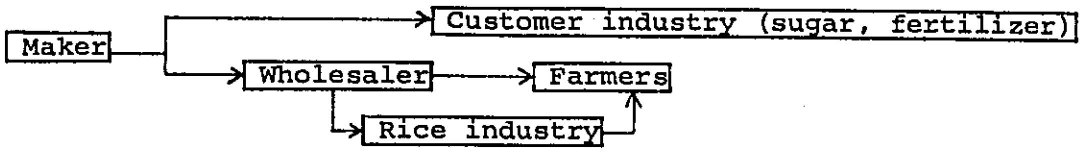


Fig. 3-4 Woven Bag

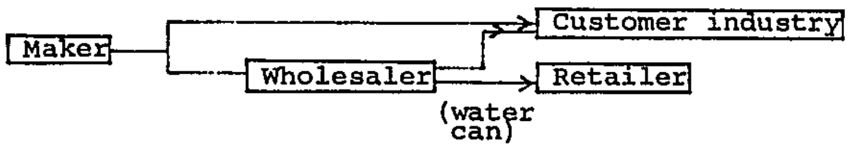


Fig. 3-5 Packaging and Blow Bottle

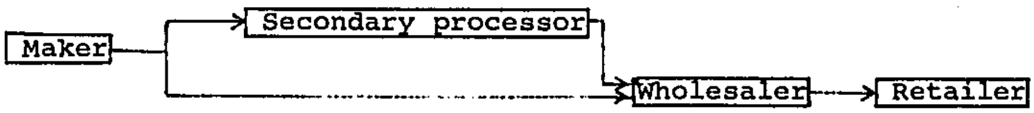


Fig. 3-6 Calendered Sheet

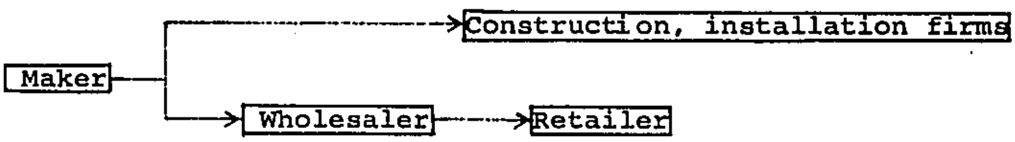


Fig. 3-7 PVC Pipe

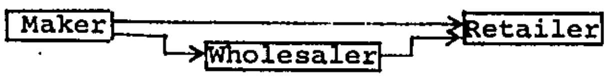


Fig. 3-8 Footware

Summarizing the above distribution systems, no matter whether they are either foreign capital owned or domestic capital owned ones, capital goods are directly sold, and general consumer goods are channeled through the agents or wholesalers.

In the case of houshold goods, the margin for the wholesalers is 3%, the same for the supermarkets in Manila City is about 20~40%, and 20% for the retailers.

As the goods are distributed further out into rural areas, they must pass through many retailers. Thus the final retail price is considerably higher than the initial retail price.

Payments are usually made based on a 30-day time period, while there are some payment terms of 90 days, during which period the monetary interest shall have to be borne by the seller so that the operation funds of the molders are generally large.

Establishing molding compaines in local areas not only reduces the transportation costs but also simplifies the distribution system stimulating the sales of the consumer goods.

3-2-2 Quality Problems

Plastic processors of the Philippines are currently bipolarized. Large-scale processors have their own mold making plant with the quality control media for the molded article. Small-scale ones can compete with large-scale firms because of the smaller general administration costs. On the other hand, smaller firms are falling behind in technical progress and market development. Moreover, as the smaller firms tend to buy cheaper molds, the quality often becomes questionable.

Nevertheless, large-scale makers also have quality problems with molded articles which require precision as in industrial parts. The main cause of this type of problem is that electric appliance makers run by foreign capital are mostly importing parts for a further knock-down procedure so that they tend to give only a short delivery period with cheaper unit prices in their order issue to domestic molders (Perma Plastic Products, Inc.). Production lot is also small which makes molding condition control difficult and which requires skilled workers, thus resulting in higher costs.

On the other hand, the mold production cost in the Philippines is rather high with a longer delivery period. Accordingly, for the purpose of meeting the delivery promise for the product as required by an assembler, the importation of molds from Hong Kong becomes inevitable.

Assemblers usually do not employ any engineers specializing in the design of molds, usually the mold manufacturers are responsible for the mold disign (Plastimer Industrial Corp.).

(1) Mold

Roland J. Rossi, an expert for the mold and dye design of UNIDO, conducted surveys on molds in the Philippines for a period of 5 months beginning in January 1973.

As was stated in his survey report, the majority of powerful mold manufacturing companies have their own molding plant. Such mold manufacturing companies are considered to possess machinery capable of producing their own high quality molds. However, the mold production technique is ever-advancing so that to make a good quality mold in a shorter period, it is mandatory to find excellent designers and skilled workers and to constantly try to make a quality improvement. To do so, the development of an expert mold making firm is the specific countermeasure.

Progress of plastics industries depend solely on the development of the applications fields and supply of many molds for short periods. Of course it should be taken for granted that the most important technical assets for the mold maker is technical know-how of mold production. The development of technical skill in plastic industries in the Philippines depends on the dissemination of high-quality molds by fully qualified and experienced mold makers. Individual molders preferably should stand on said basis and develop their own special techniques.

(2) Good coordination with the demand-giving industries

Of the demand-giving industries for a plastic molded article, the electric appliances manufacturing industry mostly requires precision with the greatest quantity demands. Electric appliances manufacturing industry, in principle, achieves lower costs by making a local procurement of the necessary parts. Accrodingly, it is necessary to pay close attention to the development of the plastic industry.

The molders should try to produce reliable articles for the electrical appliance makers, this, however, will only be made possible through a close joint collaboration between the electrical appliance makers (as order issuing party) and molders (order receiving party).

For example, Union Plastic Co. in Bangkok, Thailand is an expert manufacturer of electrical parts which meet all the rigorous quality standards. This was achieved through its own efforts and the Union Plastic Co. now serves as a competant consultant for its customers.

Administrative measures by the government in the development of industrial parts manufactures include:

(a) Giving good instructions and guidance to the assemblers so that they could increase the procurement ratio in the Philippines.

(b) Standardizing each part of the assembly line for the improvement of production efficiency.

3-2-3 Other Problems

(1) Export competition strength by the plastic products

Exports of plastic products from the Philippines in the years of 1973 and 1974 are given in Table 3-5:

Table 3-5 Export of Plastics Products in the Philippines

(Unit : tons)

		1973	1974
899-11.03	Plastic Tape, pressure sensitive	2	40
899-11.04	Bags	565	267
899-11.07	Beads and spangles	-	1
899-11.08	Sheets cut to shape other than rectangular	157	72
899-11.09	Articles made with plastics	690	428
899-11.11	Hygienic, medical and surgical articles	5	429
899-11.13	Tiles	-	9
899-11.15	Pipes, tubes and fittings	156	31
899-11.18	Bottle caps	26	2
899-11.19	PVC waterstops and waterseals	6	13
899-11.32	Table and kitchen utensils	39	552

Source : Trade Statistics in the Philippines

Products made from PVC calender sheet (Sunta Rubberized Ind. Corp.), chemical shoes (Rubber World Inc.), etc., are also exported. Woven bags were also exported to Japan, Indonesia and the Middle East, but in view of the high materials cost, the export competitiveness was lost (ITEMCOP). Woven vegetable bags shipped to Australia and New Zealand are especially in high demand, but the selling price of such woven bags are 35% higher than those made in Korea and Formosa, resulting in competition failure (Arrow Plastic Industries Corp.).

Materials cost ratio sharing in the production cost of plastic items is 65% for the woven bags having a longer production process, and about 75% for film and blow bottles having a shorter process. The ratio was about 50% when the materials costs were cheaper prior to the oil crisis. Accordingly, the high price of raw materials now prevailing is suppressing the processing cost.

Low competition power in comparison with that of Korea and Formosa is not due to the processing cost but is due to the raw materials cost. This indicates that if in the future the plastic raw materials are ever made available at a reasonable price from the home market, plastic products will have a good export competition strength.

(2) Acceleration of the substitute for imports

Imports of plastic products into the Philippines during 1973 and 1974 are given in Table 3-6. The entire quantity itself is not a large amount, but it should be pointed out that imports of over 3,000 tons were made even during the 1974 recession and will continue to increase. On the contrary, however, such imports should be replaced by domestic production and the finished products should be made available for export.

Table 3-6 Import of Plastics Products in the Philippines

(Unit : tons)

		1973	1974
599-01.25	Plastic veneer film or sheets	295	85
599-01.33	Plastic sheets and sheetings in soft, pliable foam	17	224
599-01.36	Extruded sheets, calendered rigid sheetings	33	205
899-11.03	Plastic tape, pressure sensitive	163	174
899-11.04	Bags	32	183
899-11.05	Laminated extruded and synthetic structural materials with or without fillers	211	344
899-11.07	Beads and spangles	42	84
899-11.07	Sheets, cut to shape other than rectangular	-	3
899-11.09	Articles made of plastics	264	415
899-11.11	Hygienic, medical and surgical articles	323	1,104
899-11.13	Tiles	1	18
899-11.15	Pipes, tubes and fittings	37	85
899-11.16	Wire screen	-	4
899-11.17	Reflective sheeting	1	38
899-11.18	Bottle caps	8	22
899-11.19	PVC waterstops and waterseals	-	2
899-11.21	Program tapes	8	7

Source : Trade Statistics in the Philippines

Also with reference to the PVC now being produced in the home market, attention should be given to the fact that special materials such as the compounds for electric wire are still being imported; moreover, a certain grade of PS was imported in large amounts during 1974.

The replacement of all of these imported materials with those products that are natively produced at as early a date as possible is necessary for the development of the plastic industry in the Philippines.

3-3 Various Measures for the Development of the Plastic Industry

Since the oil crsis, the demand for plastic industries has been strictly curtailed due to the high cost of raw materials. However, the plastics are indispensable materials as the basic industrial materials for the economic development of a nation. Therefore, in order to achieve the healthy growth of said industries, the government is recommended to put several measures into effect.

3-3-1 Reçommendation for the Establishment of a National Polymer Research Institute

(1) Purpose

The purpose of said National Polymer Research Institute aims at the development of the plastics industry through required R&Ds by the following activities:

(a) Standardization - Test and research for plastic materials and plastic products

(b) Design - Further research for improvement of plastic product design

(c) Education - Education, training of those engineers and technicians engaged in plastics industry

(d) Management guidance - Management improvement for plastics makers

(e) Research - Research requested by petrochemical and plastics processing firms, and development research concerning the production techniques for plastics and plastic articles for the Institute's own purposes

(f) Collection of information and its distribution

a. Collection of technical data and arrangement of patent news

b. Collection of related books and magazines on the polymer production and marketing for consumer use

c. Publication of own magazines

(2) Concept of the National Polymer Research Institute

Three alternatives are conceivable for the subject matter.

(a) A concept focusing on the development of the plastics market

This concept utilizes development research of the above in order to achieve greater market expansion for the plastics materials to be domestically produced in the future. Accordingly, a cooperative venture with the customers who require a great quantity of plastic products is the major task of this proposed National Polymer Research Institute. Examples of these customers are: automobile makers, electric appliance makers, the Electric Wire Industry Association and the Agricultural Institute.

In order to carry out the above requirements, research facilities instruments and a large number of skilled engineers are required, resulting in the need for a great deal of funds.

Moreover, these types of market development are usually carried out by the individual plastics materials makers as one of their technical services. Thus the kind of products to be chosen by the government institute shall be limited to the following items:

a. Required materials for the government ventures

For example, telephone cables, military supplies, etc.

b. Development of a product requiring a huge amount of funds which could not be borne by private industries

For example, new polymerization techniques applications for irrigation systems, aqua products promotional systems, materials for the development of a cold chain, etc.

c. Common items

For example, plastics waste disposal systems, etc.

(b) A concept emphasizing administrative guidance

This concept emphasizes technical managerial guidance along with financial administration for the purpose of promoting healthy development of the petrochemical industry.

Most of the medium and smaller sized molding companies do not own testing and research facilities; thus the determination of quality of product is rather difficult. Moreover, in general these molding factories lack developing capability, personnel, and good channels for obtaining required information. Accordingly, major tasks under said concept of the National Polymer Research Institute are as follows:

- Analytical services - Analysis of foodstuff packaging materials inclusive of the toxicity.
- Physical properties measurement services - Structural analysis of polymers and mechanical strength measurements.
- Trial mold making services - Trial making of a product, and the performance measurements, etc.
- Information services - Technical information and new product information, etc.
- Product development services - Guidance on new polymer synthesis, product design and molding techniques, etc.
- Training of technicians - Education and on-the-job training, etc.

In order to effectively, achieve all of the above functions the following are required:

a. Preparation of standard specifications for plastic materials and products.

b. Carrying out of basic research

In addition, long-term reports from fully qualified and experienced experts of more highly developed countries are also essential.

3-3-2 Establishment of Industrial Complexes

The objectives of systematically constructing an industrial complex are to ensure functional production activities for the industry, and to secure healthy living environmental conditions without pollution and with confort for the residents in the community. Hurried urbanization by disorderly industrialization without proper substantialization of commercial, residential, and industrial land utilization will create confusion in the two major functions of a city, i.e., the function as the place of production, and the place of living.

Therefore, a systematic establishment of an industrial complex must be implemented to induce industrialization while eliminating damages caused by the progress of industrialization at the cost of deteriorating the living environmental conditions.

Along with the increase in the level of income of the people by the growth of national economy, the consumption will thereby be activated in general, and in particular, the consumption of industrial products such as durable consumers' goods will be remarkably stimulated. Thus, the industrial production activities will be expanded, thereby making it difficult to absorb the demand increase for the industrial products by running only the existing production facilities. This will therefore necessary to undertake facility expansion.

Also, along with a prompt transfer of scientific technology to the industry, development of new production activities becomes more conspicuous, thereby creating a demand for the establishment of industrial complexes in order to effectively promote these production activities.

During the early stage of industrialization, the following phenomena are usually noted:

(1) The land ownership and land leasing rights are not necessarily clarified, and even clearly defined, the amount of the land available at reasonable costs is limited.

(2) The infrastructures such as electrical power supply, water supply, communications facilities, industrial road systems, etc. are not substantial.

An industrial complex will alleviate such basic shortcomings, and will give a considerable extent of incentive to the industrial investment introduction.

On the part of the government, it seems necessary that the authorities are invested with the rights to utilize the necessary lands for industrial complexes, and also to submit such lands to the invited incoming industry. By doing so, the complication of the administrative proceedings, which takes place if the land is owned by private parties, will be eliminated. The government should also provide middle and small-scale industries with the necessary lands which they lack.

If a single private enterprise were to substantialize the infrastructures such as mentioned above, and to effect new investments thereto, a large amount of fund will be necessary, and at the same time, a considerable extent of risk will be present on the part of such an enterprise. In order to alleviate such difficulties, it seems necessary that the governmental authorities select the lands, install the necessary infrastructures and then to submit the lands for use by the private industries.

The establishment of industrial complexes to gain the merits of integration seems highly necessary particularly for developing countries. The merits of integration signify such advantages as the convenience in transactions, the substantialization of social capital such as roads, port facilities, etc., the easiness in collecting information, procurement of high quality labor force, etc.

3-3-3 Benefits Obtainable by Constructing an Industrial Complex

(1) The merits of integration become available along with the progress in the related industries by effective combination of various types of activites.

(2) Because of the substantialization of the systems of transportation, advantages will become available in the transportation of raw materials and products.

(3) By incorporating vocational training centers, etc. inside the complex as part of the complex facilities for the education of workers, the quality of the labor force will be improved.

(4) Effective inventory control and storage will become possible.

(5) The investment opportunities will be expanded along with the reinforcement of the industrial foundation by the establishment of an industrial complex. In order to attain this objective, the governmental authorities should act as an intermediary organization to introduce both domestic and foreign investment, or extend favorable provisions in the systems of taxation.

(6) By the expansion of well situated and satisfactorily organized industrial complex, the cost of infrastructures for the industry will be minimized.

(7) It is possible to establish export-oriented industries within such an industrial complex. This policy is the so-called export industrial complex, within the framework of which, a certain percentage of the products turned out within the complex is allocated for compulsory exportation.

3-3-4 Export Industrial Complex and Favorable Treatments

For the development of industrial complex orientation towards exports, export finance, business tax, corporation tax, exemption therefrom, etc. should be given special consideration. Further incentives or privileges should also be given to the suppliers of natively produced raw materials and parts directed to export markets. The following special measures are conceivable:

(1) Measures concerning taxation

Any and all the imported articles coming into an industrial complex shall be completely free from the existing laws and regulations of customs and any other domestic laws and regulations. Business taxes and fixed assets taxes shall be exempted for a certain period of time.

(2) Lending of a land lot

Either lend at a cheaper rate or make some subsidy on land lot purchases for export ventures.

(3) Conducting all the export procedures at one place by simplifying and integrating the export/import authorities.

(4) Giving special treatment on export finance

(5) Making supplies for industrial water and power available at a lower rate.

(6) Unifying warehouse, storage system and transportation media, operations; achieving efficient management of raw materials distribution and cargo loading and handling.

(7) Making constructed houses available for local workers at a lower rental rate.

(8) Making lower rate construction loans available for a longer refund period at the vicinity of plant.

(9) Preferentially giving an increased foreign currency allocation for capital goods and importation of raw materials.

(10) Establishing an export promotion center

Providing information about foreign market and domestic exporters, trade fair openings both at home and abroad, standardization of products, quality inspection and guarantees.

3-3-5 Financial Policy

Funds required for development activities are being managed through loans from a central bank, and direct investment or assistance from overseas concerns. In view of the recent diversification and the high level of industrial developments, the amount of developmental funds required is increasing, thus for most business ventures such funds are increasingly difficult to obtain. Therefore, mobilization of private finances both from overseas and home concerns is essential, even though the current industrial financial organizations lack efficient organizations, the stock market is immature and channels between savings and investments are still developing. Under these circumstances, therefore, it is essential to firmly establish a modernized industrial funds supply system.

The medium and smaller-sized plastics industries should especially pay attention to the following measures to help assist their healthy growth:

(1) Improvement of the government-related medium and smaller-scale financial organizations

(2) Facilities modernization fund system

(3) Facilities lending system

(4) Special loan system for the logistics system modernization

Make financing available for the business ventures contributing to the modernization of logistics or distribution system such as construction of a distribution and collection centers.

(5) Credit compensation system

3-4 Related Industries

Except refineries, plants to produce raw materials and auxiliary materials for the petrochemical industry are electrolysis plants that produce chlorine and caustic soda, and air separation plants that supply nitrogen and oxygen.

The attached tables are provided by BOI of the Philippines. Table 3-7 shows predictions of the industrial demand for caustic soda, and Table 3-8 shows the existing plant capacities of caustic production in the Philippines. Table 3-9 shows predictions of the oxygen and nitrogen demand in the Greater Manila area, and Table 3-10 shows the existing plant capacities of oxygen production in the Greater Manila area.

Table 3-7 Application Use-wise Demand Forecast of Caustic Soda

(ton)

Industry	1974	1975	1976	1977
Soap & Detergents	22,904	25,194	27,713	30,484
Pulp & Paper	22,009	23,494	24,000	24,506
Textile	12,088	12,738	13,388	14,039
Mining	5,250	10,500	10,500	10,500
Oil	862	903	944	985
Silicate	641	647	702	729
M S G	9,331	11,197	13,436	16,123
Power Plants	1,631	1,631	1,631	1,631
Petroleum	390	413	437	460
Total	75,106	86,717	92,751	99,457

Table 3-8 Demand Forecast for Oxygen and Nitrogen in Greater Manila Area

('000 cylinders)*

	Oxy Gas.	Nitrogen
1974	1,805	345
1975	1,975	1,335
1976	2,150	1,690
1977	2,355	2,050
1978	2,570	2,255
1979	2,810	2,480
1980	3,060	2,725

* Cylinders are standard 200 cu. ft.

Table 3-9 Petrochemical Related Industries in the Philippines

Caustic Soda

Annual Rated Plant Capacity (t/y)	Name of Firm	Location
22,000	International Chemical	Guiguinto, Bulacan
7,500	Mabuhay Vinyl Corporation	Iligan
5,000	Superior Gas & Equipment Company	Mandaluyong, Rizal
15,000	Resins Incorporated	Pasig, Rizal
1,000	Bataan Pulp and Paper Mills	Samal, Bataan
1,800	Compana de Cellulosa de Filipinas	Negros Occidental
5,000	Paper Industries Corporation of the Philippines	Bislig, Surigao del Sur
4,500	Union Chemicals	Pasig, Rizal
61,800	Total	

Table 3-10 Petrochemical Related Industries in the Philippines

Oxygen (Greater Manila Area)

Plant Capacity		Name of Firm	Location
1,600	cylinders/d	National Industrial Gases Corp.	Greater Manila
1,200	"	Pacific Oxygen & Acetylene Co.	"
750	"	Industrial Co.	"
600	"	Superior Gas & Equipment Co.	"
450	"	Overseas Gas Corp.	"
450	"	Acme Gas Corp.	"
240	"	Oceanic Air Products, Inc.	"
120	"	Dynamic Air Products	"
800	"	Others	"
6,210	cylinders/d	Total	

Note: Cylinders/d - 200 cu. ft. per day