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TENDER SPECIFICATIONS
FOR THE
DESIGN, SUPPLY, ERECTION AND COMMISSIONING
OF THE
LIMA—CALLAO PETROCHEMICAL COMPLEX
IN PERU

VOLUME I
INTRODUCTION AND GENERAL PHILOSOPHY

October 1973
IPROCHIM
BUCHAREST — ROMANIA

TENDER SPECIFICATIONS
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VOLUME I
INTRODUCTION AND GENERAL PHILOSOPHY

This document is prepared for the United Nations Industrial Development Organization acting as Participating and Executing Agency for the United Nations Development Programme (Special Industrial Services)

C O N T E N T S

1. INTRODUCTION

Since new domestic resources of crude oil have been recently discovered in the North - East jungle of Peru, the country's Government has decided to build a petrochemical complex near Lima for the manufacturing of a range of largely used products which may be obtained economically from certain oil fractions starting with their pyrolysis.

Considering the proportions of the complex and the requirements of using the most up-to-date technologies and equipment for the plants of this complex, the Government of Peru has decided to build the complex in cooperation with a foreign company or an ad-hoc-formed partner having a suitable financial and technical capacity.

The present "Tender Specifications" are meant to be used by the companies interested in preparing tenders for the

DESIGN, SUPPLY, ERECTION AND COMMISSIONING OF THE LIMA - CALLAO PETROCHEMICAL COMPLEX IN PERU.

It is made up of four volumes, arranged as follows:

- Volume I: INTRODUCTION AND GENERAL PHILOSOPHY wich contains data and information necessary for the BIDDER to make a general appraisement of the COMPLEX and the conditions of implementation considered by the Peruvian Government (hereafter referred to as GOVERNMENT);

- Volume II: GENERAL SPECIFICATION
  which contains the commercial and legal information and requirements of the GOVERNMENT and instructions for the preparation of tenders;

- Volume III: TECHNICAL SPECIFICATION
  which contains the description of the COMPLEX as a whole, the technical specification of process plants, main utility plants and offsites.

- Volume IV: LOCAL CONDITIONS, DESIGN NORMS AND REQUIREMENTS
  which contains: local data on COMPLEX location, geographic, climatic and geotechnical conditions, utility sources, local material and labour resources and design norms and requirements which shall be observed by the Bidders when preparing the tenders.

Data and information not available at the date of issuing the present "Tender Specifications" or which prove necessary for preparing the tenders can be requested and procured, by the interested companies, from

the " MINISTERIO DE INDUSTRIA Y COMERCIO " Lima, Peru.

2. BRIEF DESCRIPTION OF THE COMPLEX

2.1. Products and Process Plants

The Lima - Callao Petrochemical Complex, planned to be constructed in two stages, will have as a head line:

- a plant producing olefines (ethylene and propylene) by pyrolysis of an oil fraction having a capacity of 75,000 to/y ethylene, in stage I and 100,000 to/y in the final stage and
- a catalytic reforming plant for depentanized naphtha with a processing capacity of 170,000 to/y naphtha,, constructed in stage I.

Directly connected with these two plants, there are provided the following:

- plant for butadiene extraction from C_4 cut of the olefines plant;
- plant for extraction and separation of aromatics from olefines plant and catalytic reforming plant;
- plant for toluene dealkylation

The basic products of the above mentioned plants, namely:

- ethylene
- propylene
- benzene
- o - xylene
- butadiene

will be captively used within the COMPLEX to produce - in relevant process plants - the following intermediate and end products:

	to/y	
	stage I	final stage
- vinyl chloride (VCM)	25,000	50,000
- dodecylbenzene	10,000	10,000
- caprolactum	16,000	16,000
- styrene (including ethyl-benzene)	45,000	45,000
- acrylonitrile	24,000	24,000
- P.V.C. emulsion	5,000	7,500
- P.V.C. suspension	20,000	40,000
- low density polyethylene	22,500	45,000
- high density polyethylene and polypropylene (co-production)	22,500	45,000
- butadiene-styrene rubber (SBR)	20,000	40,000
- polystyrene	10,000	10,000
- ABS co-polymers	4,000	8,000
- maleic anhydride	2,500	2,500
- phthalic anhydride	5,000	5,000

Related to the plants and products of the COMPLEX, the BIDDER has to consider the following:

a/. Plants to produce maleic anhydride and phthalic anhydride will be constructed - within relevant battery limits - by the GOVERNMENT.

Consequently, these plants stand for the subject-matter of the " Tender Specifications " and tenders, only as regards their location, supply of utilities and connection with other plants and units of the COMPLEX:

b/. As butadiene throughput of the COMPLEX can not meet the foreseen outputs of rubber and ABS co-polymers the deficit will be covered by procurement of the required amounts from outside of the COMPLEX;

c/. Temporary shortage of benzene (stage I) does not have to be covered by procurements from outside the COMPLEX since in this stage benzene consuming plants shall function below normal capacities.

d/. The amounts of styrene and acrylonitrile outputs exceeding the requirements of the COMPLEX (for polystyrene and ABS co-polimers) will be used for sale;

e/. By-products of olefines, catalytic reforming, butadiene extraction and aromatics extraction and separation plants will be processed as follows:

- light fraction from catalytic reforming as feedstock for pyrolysis;
- pyrolysis gasoline from the olefines and aromatics separation plants will be returned to a neighbouring refinery for rectification of octane number and, as motor gasoline, for sale;
- fuel gas and fuel oil from the olefines plant will be captively used within the COMPLEX as fuels;
- LPG cut from butadiene extraction will be recycled to refinery for bottling or other uses;

f/. In order to produce high density polyethylene and polypropylene, the BIDDER will provide a common (unique) plant operating alternatively (in campaigns) either on polyethylene or on polypropylene.

The block flow diagrams of the COMPLEX are attached hereto.

2.2. Raw Materials

The following raw materials will be available:

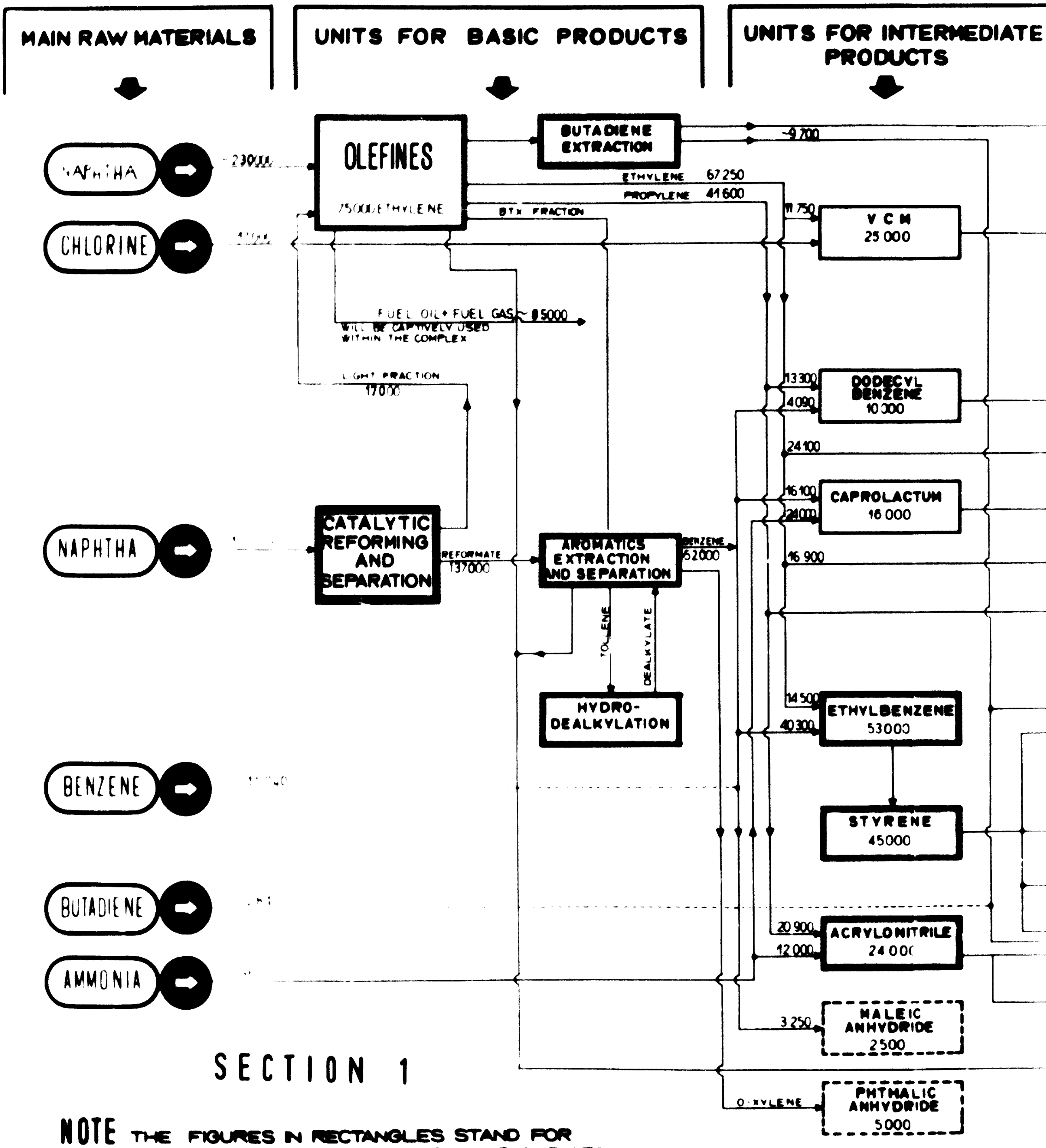
- an oil fraction (naphtha) having the quality specification as indicated in vol. III chap. 1.5.1.
- straight-run depentanized gasoline: :

  density: 0.7519 kg/cu.dm.
  at 15^{0}C and a
  distillation range
  of 83 - 183^{0}C

  uses for catalytic reforming;
- chlorine: In stage I the whole necessary amount shall be brought under gaseous state, by pipes from a neighbouring unit. In the final stage the remained necessary quantity shall be brought under liquid state from great distances.
- liquid ammonia: brought by ship to the Callao-harbour and then transported by pipes to the COMPLEX.

Complete quality specification of raw materials is given in Volume III.

BLOCK FLOW DIAGRAM OF LIMA
FIRST STAGE

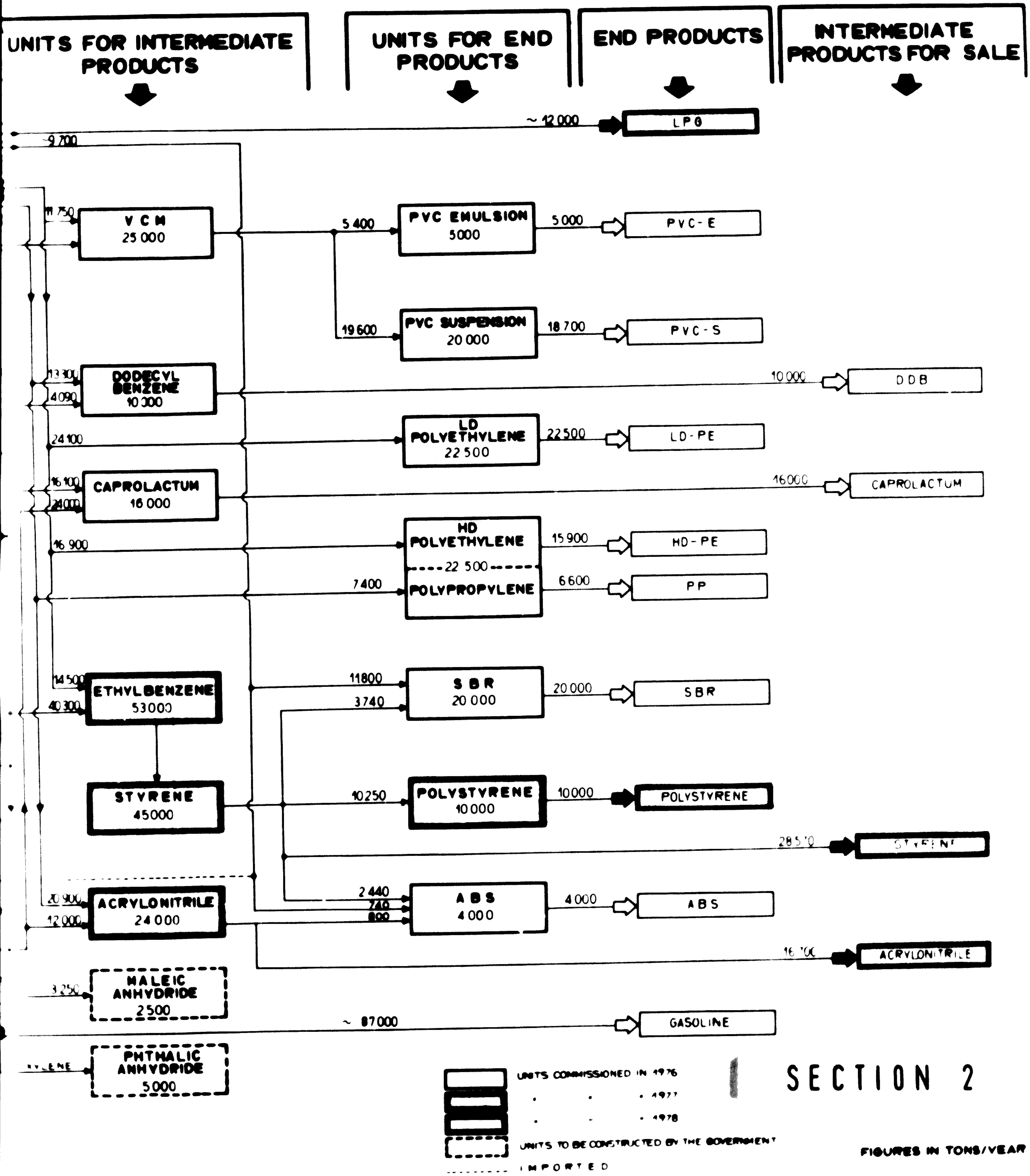


SECTION 1

NOTE THE FIGURES IN RECTANGLES STAND FOR CAPACITIES OF RESPECTIVE PLANTS AND ARE FIRM.

THE FIGURES ON LINES STAND FOR PROVIDED OUTPUTS AND/OR CONSUMPTIONS AND ARE SUBJECT TO MODIFICATIONS.

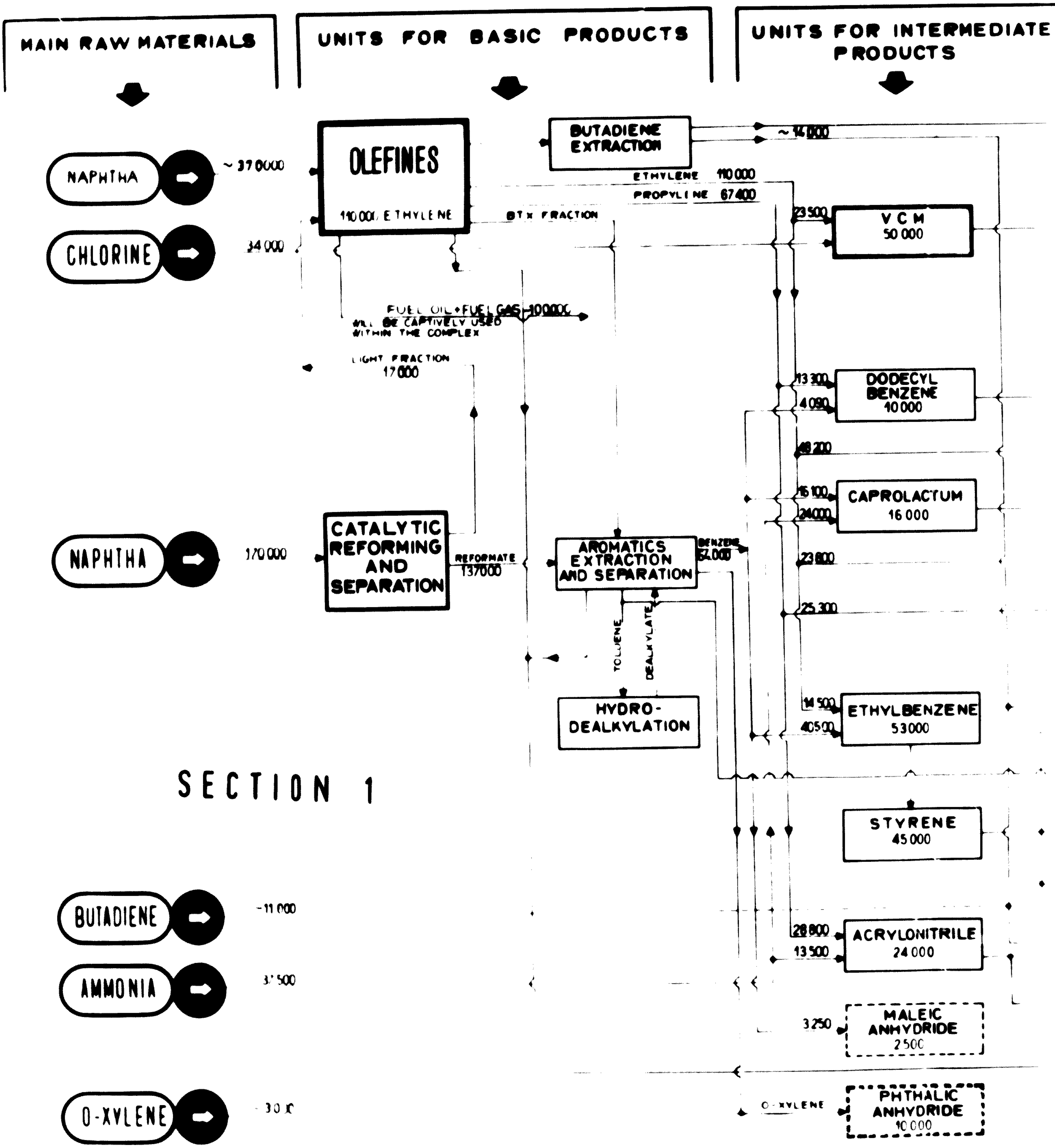
RAM OF LIMA-CALLAO COMPLEX
FIRST STAGE



SECTION 2

FIGURES IN TONS/YEAR

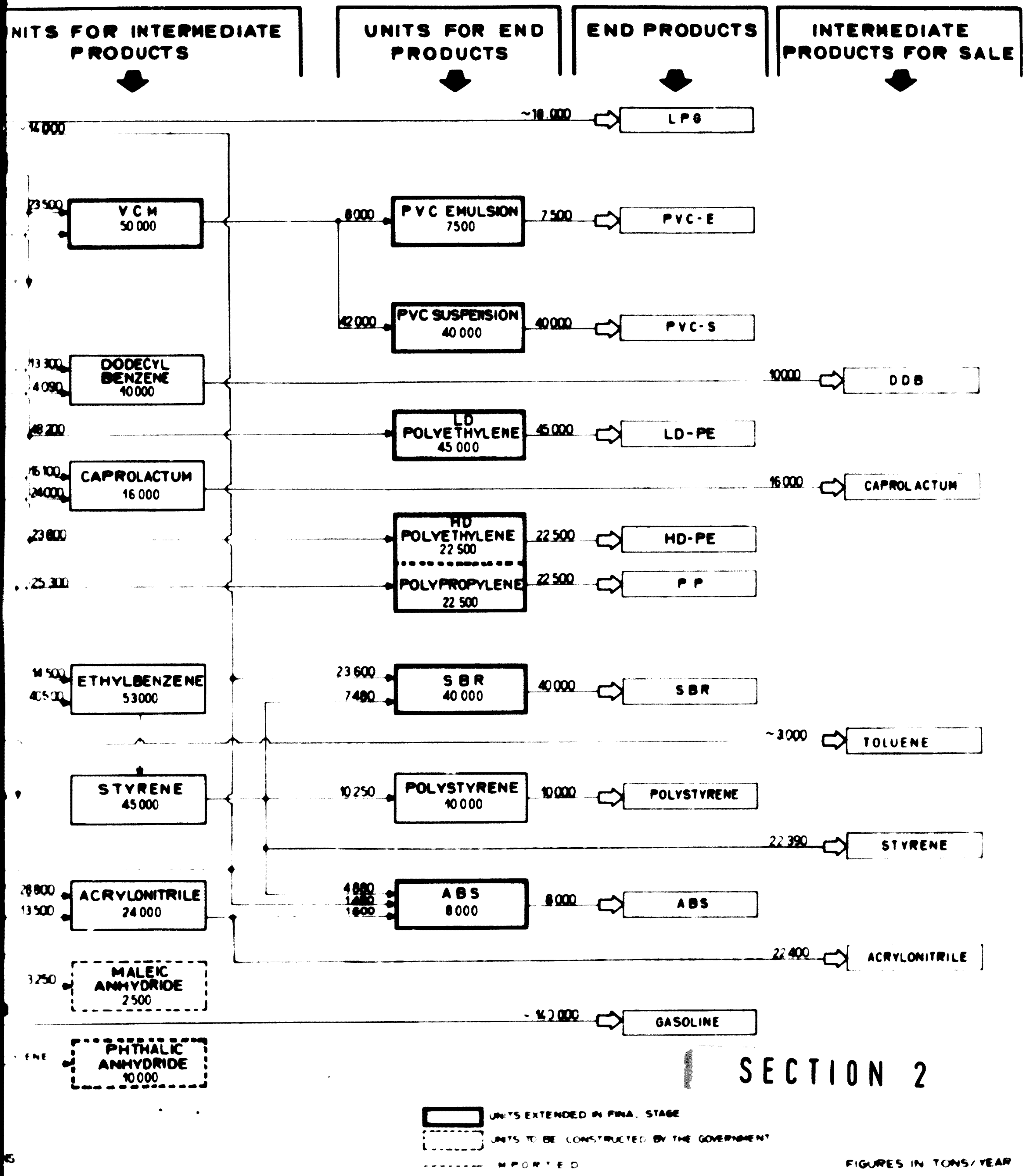
BLOCK FLOW DIAGRAM OF LIMA
FINAL STAGE



NOTE THE FIGURES IN RECTANGLES STAND FOR CAPACITIES OF RESPECTIVE PLANTS AND ARE FIRM.

THE FIGURES ON LINES STAND FOR PROVIDED OUTPUTS AND/OR CONSUMPTIONS AND ARE SUBJECT TO MODIFICATIONS

RAM OF LIMA-CALLAO COMPLEX
FINAL STAGE



SECTION 2

2.3. Location, Geographic and Climatic Data

The Lima-Callao Petrochemical Complex will be located on a site situated on the coast of the Pacific Ocean, at a distance of about 15 Km north of the Callao port and directly connected with the capital of the country. (See enclosed maps).

The climate of the area where the COMPLEX is to be located is characterized by:

- maximum temperature 31°C;
- minimum temperature 8°C;
- medium humidity 85%;
- very low level of rainfalls (24 mm/y)
- moderate wind (max.: 6 m/sec.)

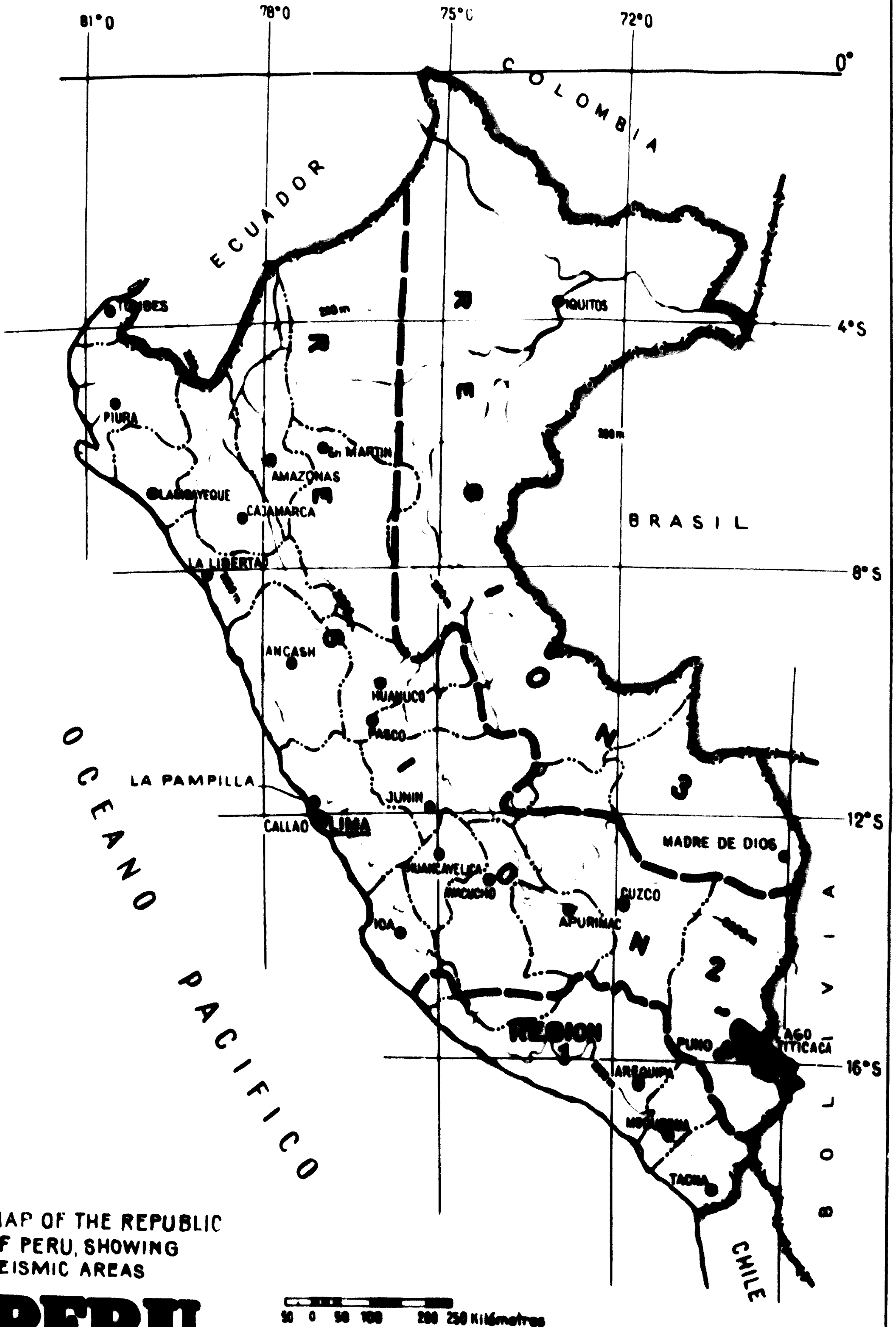
From seismic viewpoint, the location area belongs to the second region of the country with earthquakes having a seismic degree of 8 on the international M.S.K. scale (Mercalli - Cancani, modified).

The site where the COMPLEX is to be located is sandy, looking like a beach, with a maximum altitude of 12 m above the sea level.

Northwards, the COMPLEX will be bordered by the refinery " La Pampilla ", under operation, with which it will co-operate for:

- supply of main raw materials (naphtha for pyrolysis and naphtha for catalytic reforming);
- supply of fuel for the thermoelectric power station;
- processing of some by-products produced by the COMPLEX (gasoline from pyrolysis and catalytic reforming, LPG cut).

APPENDIX I

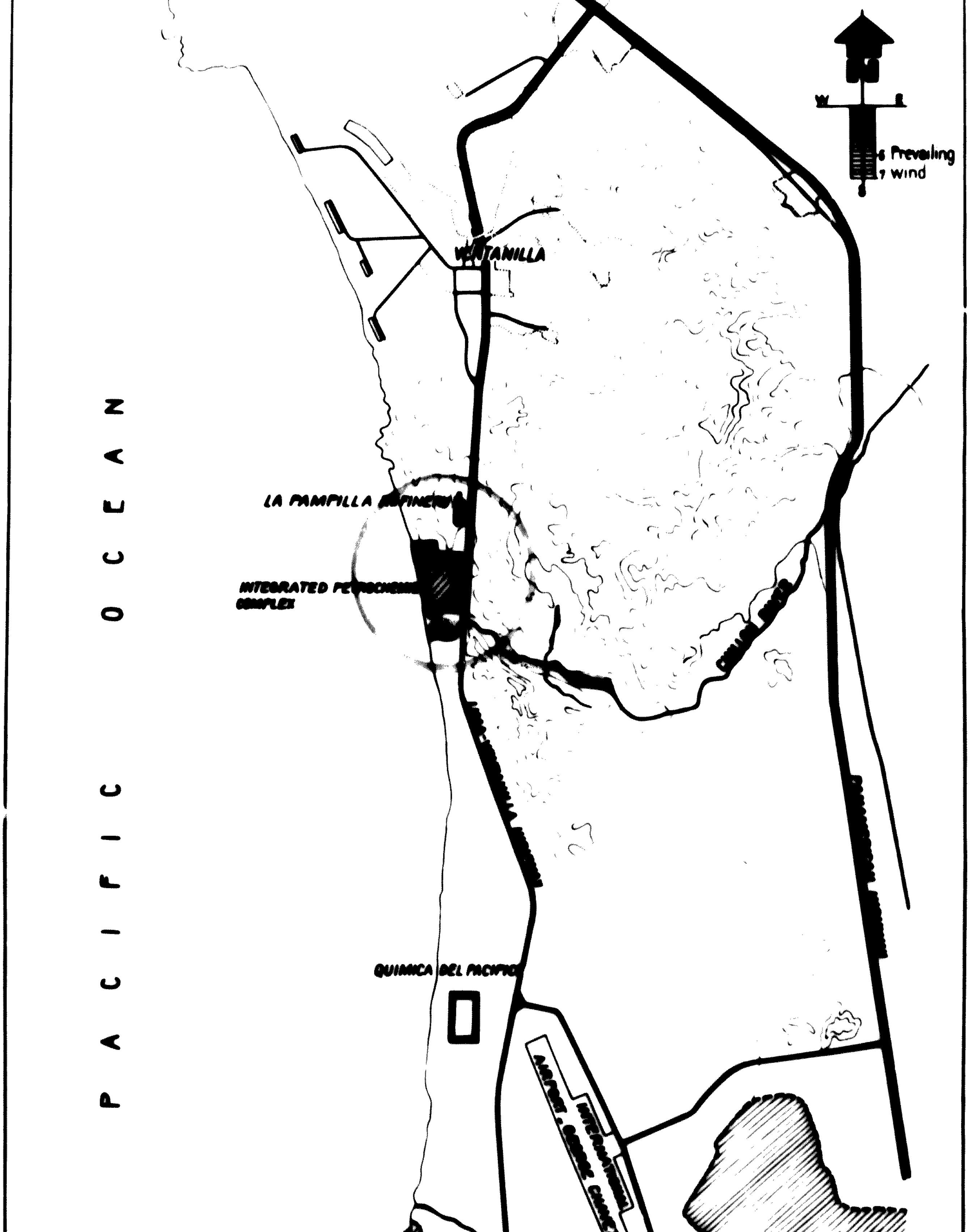


MAP OF THE REPUBLIC OF PERU, SHOWING SEISMIC AREAS

PERU

DWG. Nº 04

APPENDIX II



Prevailing
wind
PACIFIC OCEAN
LA PAMPILLA
INTEGRATED
COMPLEX
QUIMICA DEL PACIFICO
CALLAO HARBOUR
KEY
PAMPILLA REFINERY
INTEGRATED PETROCHEMICAL COMPLEX LIMA-CALLAO PERU
MAP OF COMPLEX AREA
AND SURROUNDINGS
SIGNATURE
DATE

Volume IV contains more detailed data on the location of the COMPLEX.

2.4. Utility Sources

The available, local sources of utilities are the following:

- sea water which might be used as cooling water;
- underground water (in the neighbouring areas of the COMPLEX)
- in limited quantity, which will be used as drinking water and - after adequate treatment - as process water and feed water for boilers.

Details on water sources are given in Volume IV.

All the other utilities required for the operation of the COMPLEX (steam, electric power, water with special quality specification, technical and instrument compressed air, nitrogen, refrigerating agent and other), shall be produced in the relevant plants of the COMPLEX.

2.5. Offsites

Besides process plants mentioned under para 2.1., the COMPLEX shall be provided with all offsites required for operating the COMPLEX under satisfactory conditions, namely:

a/. storehouses for raw and auxiliary materials, intermediate and end products, maintenance facilities and transportation means.

b/. plants to produce and supply utilities, including collecting and treatment of waste waters.

Among the plants to produce utilities, a considerable share is owned by the thermoelectric power station with an estimated capacity of about 40 - 50 M.W. installed power and steam output of about 300 to/hr (except the own consumption of the thermoelectric power station).

The thermoelectric power station of the COMPLEX shall be interconnected, by means of a high voltage transformer unit, with the national power system, under development.

c/. Auxiliary facilities (workshops for maintenance and current repairs, fire-fighting systems, central laboratory social and administration buildings, internal roads and railroads, weak current facilities required for the satisfactory operation of the COMPLEX.

3. GENERAL CONDITIONS OF IMPLEMENTATION CF COMPLEX

The GOVERNMENT intends to construct the Lima-Callao Petrochemical Complex by concluding a contract with a unique Contractor under the following conditions:

a/. Grass roots, lump-sum, turn-key.

b/. Observance of the technical and commercial conditions as indicated in Volume II, III, IV.

c/. Payment in instalments i.e. credit for at least 10 years.

d/. The total price to be divided into two parts, namely:

- one part paid off in the currency proposed by the BIDDER and accepted by the GOVERNMENT.
- one part paid off in soles. (the national currency of Peru).

In order to spare currency, the Bidders shall consider the possibility of using local resources (materials, manpower, building and erecting enterprises from Peru) to the highest extent.

Details on the local resources to be used for the construction of the COMPLEX are given in Volume IV.

4. SCOPE OF THE TENDERS

Any work carried out within the COMPLEX including the fencing and all services implied by the design, supply, erection and commissioning of the Lima - Callao Petrochemical Complex as mentioned in para 2 and 3 represent the object of the tenders.

The GOVERNMENT specifies the following:

a/. The seawater inlet and the channels for the discharge of waste waters (into the ocean) represent the object of the tenders although they are partly outside the COMPLEX.

b/. Special tanks for the transportation of liquid chlorine and ammonia as well as for liquid products which are meant for sale, being part of the COMPLEX inventory, shall be also included in the tenders.

c/. Plants for producing maleic anhydride and phthalic anhydride within the relevant battery limits shall be achieved by the GOVERNMENT of Peru and shall not represent the object of the tenders (although they are included in the COMPLEX).

d/. Any facilities outside the COMPLEX necessary for operating it, namly:

- the railway from the limits of the COMPLEX to the Callao harbour;
- the road connection;

- the pipe for bringing under ground water to the COMPLEX limits.

- the high voltage connection between the national power station and the transformer unit of the COMPLEX (excluding the transformer unit-itself)

- the pipes for bringing raw materials (naphtha chlorine, ammonia) and fuel.

- the connection between the telephone exchange of the COMPLEX and the national telephone system shall also be achieved by the GOVERNMENT, so they are not included in the objet of the tenders.

e/. The tenders shall be prepared for stage I, starting with olefines plant having the commissioning time in 1976; the commissioning time of the other plants and offsites shall be correlated with that of olefines plants.

f/. The plants and offsites mentioned at para 2.5. shall be achieved in stages as long as this method presents significant advantages as regards the initial financial effort without causing an exagerated increase in investments in the final stage.

So, depending on the situation, the achievment of the offsites for the final stage can be considered from the very beginning.

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TENDER SPECIFICATIONS
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DESIGN, SUPPLY, ERECTION AND COMMISSIONING
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IN PERU

VOLUME II
GENERAL SPECIFICATION

October 1973
I P R O C H I M
BUCHAREST — ROMANIA

TENDER SPECIFICATIONS
FOR THE
DESIGN, SUPPLY, ERECTION AND COMMISSIONING
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VOLUME II
GENERAL SPECIFICATION

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C O N T E N T S

Page

INTRODUCTION

This volume deals with the main commercial and legal provisions to be considered by the BIDDER when preparing the tender.

Complete conditions to be provided in the contract shall be defined during the negociations between the BIDDER and the GOVERNMENT, before concluding the contract.

Either along with the tender or during the negociations, the BIDDER shall set forth a contract proposal including all conditions, stipulations and explanations required in compleance with the provisions of the Tender Specifications.

In his contract proposal the BIDDER shall make use, as a guide, of the " Model Form of Conditions of Contract for Process Plants, Suitable for Lump-sum Contracts in the United Kingdom ", issued by "The Institution of Chemical Engineers".

1. DEFINITION OF TERMS

In the Tender Specifications and in documents to be further prepared on the basis of Tender Specifications, the following words and expressions wite have the meanings as herein defined:

- The GOVERNMENT means the Peruvian Government, the partner of contract represented by "Ministerio de Industria y Comercio".

- The BIDER means the firm or company which agrees to prepare and present a tender for the whole COMPLEX under the conditions set forth in the Tender Specifications.

- The CONTRACTOR means the BIDDER whose tender has been accepted by the GOVERNMENT, with whom the GOVERNMENT will place the contract and who become the general supplier.

- The SUBCONTRACTOR means any firm taking over part of CONTRACTOR's obligations, based on a contract concluded with the same.

- COMPLEX means the abbreviated denomination of the Lima - Callao Petrochemical Complex as defined in the Tender Specifications.

- SITE means the areas on which the COMPLEX will be located, the ground provided to construction, erection and other works required as long as the job is being achieved.

- COMPLEX LIMIT means the perimeter of land covering all plants and offsite provided for the COMPLEX and defined in volume III.

- REIMBURSABLE EXPENSES means distinct amounts of money received by the CONTRACTOR from the GOVERNMENT covering expeditures not included in the price of contract.

- PROVISIONAL ACCEPTANCE CERTIFICATE means the written document issued by the GOVERNMENT stating that the relative work has met the contract requirements, excepting mechanical guarantees.

- FINAL ACCEPTANCE CERTIFICATE means the written document through which the GOVERNMENT certifies the fulfilment by the CONTRACTOR of his obligations under the contract.

2. TENDER SCOPE

2.1. The tender to be prepared and submitted to the GOVERNMENT will have the following object and scope:

THE DESIGN, SUPPLY, ERECTION AND COMMISSIONING OF THE LIMA - CALLAO PETROCHEMICAL COMPLEX IN PERU

under the conditions stipulated by the Tender Specifications.

The tender will be prepared for stage I of COMPLEX construction taking also into account the development planned for the final stage and the indications given in Volume III.

2.2. The Lima - Callao Petrochemical Complex shall be constructed on " grass roots/lump sum/turn key " basis by a single CONTRACTOR.

So, the submitted proposals shall refer to the COMPLEX, seen as an assembly, no matter whether the chosen CONTRACTOR will place or not contracts with hereafter named Subcontractors for partial performance of his obligations.

3. DETERMINATION AND PRESENTATION OF TENDERS

3.1. The heading of tenders prepared on the basis of the Tender Specifications will be the following:

" TENDER FOR THE DESIGN, SUPPLY, ERECTION AND COMMISSIONING OF THE LIMA CALLAO PETROCHEMICAL COMPLEX IN PERU".

3.2. Tenders and the entire correspondence will be submitted to:

" Ministerio de Industria y Comercio, Lima, Peru".

3.3. Tenders shall be written in English, as only the English version will have validity.

3.4. Tenders will be issued in 10 copies.

3.5. Tenders and further projects and drawings shall be prepared relying an International System of Units (weights and measures) - SI.

3.6. BIDDER is requested to set the date until which his proposal will remain in force, time which is understood to be at least within 6 months after the submission of the tender.

4. ELIGIBILITY OF BIDDER

4.1. The BIDDER shall submit adequate evidence ilustrating his experience in the field of services granted by him with a reference list of similar works performed elswhere.

4.2. The BIDDER shall also submit adequate information concerning his experience in erecting plants in South America.

4.3. The BIDDER shall indicate in the tender the licences standing for the basis of his tender, the plants erected by the same, the subcontractors selected to participate in the erection of the COMPLEX as well as the plants constructed by them, similar to the offered ones.

For each plant, the followings have to be set forth: name of the client, location, annual capacity, process used, commissioning date, specifying also the plants which may be visited by the representatives of GOVERNMENT.

4.4. The BIDDER shall submit references as to his financial status and possibilities to guarantee the fulfilment of financial obligations under the contract.

For this, due references produced by one or more reputed financing companies ought to be presented.

4.5. Certified copies of documents attesting the setting up the company and its field of activity shall be enclosed to the tender.

5. GOVERNMENT'S RESPONSIBILITIES

5.1. The GOVERNMENT shall provide the BIDDER, at the latter's request, with further information besides this included in the Tender Specifications. The GOVERNMENT is responsible for the accuracy of data made available.

The GOVERNMENT is also responsible for the accuracy of data and information communicated to the CONTRACTOR, subject to the stipulations of the contract.

5.2. The GOVERNMENT shall make arrangements to facilitate during the proposal preparation, all deemed contact with local companies in Peru, for the BIDDER to collect information on local sources able to help him with the COMPLEX carrying out.

5.3. The GOVERNMENT shall put at the CONTRACTOR's disposal the surface area to be covered by the COMPLEX, within 30 days at the latest before starting any preparatory works on SITE.

5.4. The GOVERNMENT shall made available to the CONTRACTOR all licenses, permits and approvals deemed for the construction of the COMPLEX, before any starting of works on the SITE.

5.5. During the execution of works on SITE, the GOVERNMENT will provide - at SITE limits - the supply of water and electric power in the quantities requested by the CONTRACTOR.

5.6. The GOVERNMENT shall ensure, by its representatives, the checking and review of drawings submitted by the CONTRACTOR as specified under item 7.8.1. in this volume, at the dates stipulated by the contract.

5.7. The GOVERNMENT shall provide sending - at the terms stipulated by the contract - of the personnel to be trained by the CONTRACTOR.

5.8. The GOVERNMENT shall provide, at the commissioning term of each plant within the COMPLEX, the operating personnel according to the contract, providing that - until producing the PROVISIONAL ACCEPTANCE CERTIFICATE - all responsability for the running of plants remains with the CONTRACTOR.

5.9. The GOVERNMENT shall provide, at the COMPLEX LIMIT, the following basic utilities:

- underground water in the amount required to produce drinking water and treated water (process water and steam boiler feed water); likewise, the GOVERNMENT shall provide the pipe line supplying water up to the COMPLEX LIMIT.

Underground water quality is indicated in volume IV.

- electric power from the national power system as (partial) spare for failures occurring in the COMPLEX thermal power station and for start-up; the GOVERNMENT shall provide high voltage connection line between the national network (mains) and the connection transformer post of the COMPLEX.

5.10. During COMPLEX commissioning, the GOVERNMENT shall provide, at COMPLEX LIMIT, raw material supply in quantities and of qualities defined by the contract excepting chemicals and catalysts which have to be provided by the CONTRACTOR for at least one year after the completion of guarantee test-runs.

5.11. The GOVERNMENT shall provide the connection with Lima - Ventanilla highway at the COMPLEX LIMIT point.

All other works and supplies required for the construction of COMPLEX and performance of guarantees under the contract fall in the category "CONTRACTOR's", responsabilities and have to be considered when working out the tender.

6. BIDDER'S RESPONSABILITIES

6.1. The BIDDER shall prepare his tender in accordance with the conditions of the present specifications.

6.2. When the BIDDER cannot entirely accepted the main conditions or requirements laid down in the Tender Specifications or when doubting the conformity of his suggestions with the provisions of the Tender Specifications, he must notify the GOVERNMENT thereof within one month from the receipt of enquiry in view of clearing up questionable points.

6.3. The BIDDER can provide in the tender - as alternative to the provisions in the Tender Specifications - some other alternatives he deems more advantageous, showing their profitability and inffluence on the offered prices. Anyhow, capacity modifications as to the marketable products are not permitted.

6.4. When preparing the contract proposal, the BIDDER shall use, as a guide, the "Model Form of Conditions of Contract for Process Plants, suitable for Lump - sum Contracts in the United Kingdom" issued by "The Institition of Chemical Engineers".

6.5. The BIDDER shall consider that the Contract to be concluded is governed by and in compliance with the laws and regulations valid in Peru at that time.

6.6. The BIDDER shall undertake to perform all works render all services required for the erection and operation of the COMPLEX to meet the performance guarantees under the contract excepting those works the completion of which remains with the GOVERNMENT (see Section 5).

The main works and services that are the responsabilities of the CONTRACTOR whose fulfilment is at the BIDDER'S charge are shown in Section 7.

6.7. The BIDDER shall consider, when preparing the tender, the use to the greatest extent of materials and services available in Peru.

Information on these local resources is given in Volume IV.

Before preparing the tender, the BIDDER shall thoroughly investigate the local market in Peru so as to be aware of the possiblities existing at that date as well as of the purchase prices.

The BIDDER shall indicate in the tender all types of equipment, materials and services assumed to be used from Peru reserves and list in the local companies intended to act as SUBCONTRACTORS.

6.8. As long as the tenders are being studied, BIDDER shall send his representatives to Lima, or receive at his headquarters the authorized representatives of the GOVERNMENT in view of discussing and making clear all technical and comercial aspects.

6.9. The BIDDER shall facilitate arrangements for the GOVERNMENT's representatives to visit the plants specified in the proposal, at a convenient time, prior to the contract coming into force.

7. WORKS AND SERVICES

This section deals with the main works and services that are at the CONTRACTOR's charge which have to be considered when preparing the tender.

The detailed specification of works and services offered will be included in the tender.

The list of works and services is not restrictive, the CONTRACTOR following to perform any other works and services which are or will turn out to be necessary for the execution, completion and satisfactory operation of the COMPLEX and for performance of guarantees under the contract even if not purposely set forth in the tender and the contract.

7.1. Preliminary Activity regarding Local Conditions Investigation

The Contractor shall visit and thoroughly investigate the SITE and its surroundings in order to collect direct information on: nature of soil, existing transportation and communication means, handling and storage facilities in Callao port, local material resources, available labour and services as well as information of a kind to make possible a good organization and developing of the SITE future activity in connection with 'he contract scope.

7.2. <u>Basic Design</u>

The CONTRACTOR shall workout all designs necessary for the construction of the COMPLEX, namely:

- Basic design.
- Detalied design.
- Electrical engineering.
- Detailed instrumentation design.
- Civil engineering.

As for as the basic design is concerned the BIDDER shall consider the following:

a/. BIDDER shall mention in the tender the firms selected to workout the basic design, with a good renown in the relative field and mentioned in the contract.

b/. CONTRACTOR is not allowed to change the firms indicated in the tender and provided in the contract without the written consent of the GOVERNMENT.

c/. As for as civil engineering is concerned, the BIDDER shall resort to the greatest extend to the specialized Peruvian firms.

d/. At certain design stages and for some parts of designs, the CONTRACTOR must get the approval of the GOVERNMENT by submitting for review the documentation under item 7.7.1.

7.3. Co - ordination and Management

The CONTRACTOR shall conduct and co-ordinate the entire activity of execution and commissioning of the COMPLEX before the performance test-runs and issuing of PROVISIONAL ACCEPTANCE CERTIFICATE for each plant, mainly following:

- the co-ordination of designs worked-out by various subcontracting companies;

- execution in due time and in good conditions of all works and services;

- suitable planning and observance of partial terms based on work programmes innitially prepared and afterwards detailed and updated;

- rapid elucidation and operative resolving of problems risen during the development of the contract;

- fulfilment of the SUBCONTRACTORS' obligations;

- fulfilment of conditions for commissioning and performance of process test-runs.

7.4. SITE preparation

7.4.1. The CONTRACTOR is entirely responsible for the preparation and provision of the SITE with technical devices and provisional facilities required for the execution, in satisfactory conditions and at the terms stipulated, of all works to be performed on SITE till the commissioning of the COMPLEX and performance of the contract guarantees.

7.4.2. Before starting the works on SITE, the CONTRACTOR shall provide the enclosure of the surface area included in the COMPLEX LIMIT and shall ensure the security of all civil-works, materials and equipment belonging to the COMPLEX.

7.4.3. Within the COMPLEX provisional works, the CONTRACTOR shall provide:

- access roads;
- parking platforms for the cars of CONTRACTOR's personnel;
- fuel storages;
- material warehouses and storages;
- workshops for the maintenance and repair of construction equipment;
- workshops and platforms for fabrication of precast elements;
- networks for the distribution of utilities and

- provisional sewage within the SITE;
- fire fighting facilities;
- offices and sanitary groups for the personnel working on the SITE;
- canteen;
- barrack camp for workers;

as well as any other temporary works necessary for the proper development of works on the SITE.

7.4.4. Provisional facilities and storages for construction materials shall be located by the CONTRACTOR on the surface areas provided for the extension of plants at the final stage, that are available during stage I.

If this is the case, the CONTRACTOR may also make use of surface areas provided for sports ground.

7.4.5. The CONTRACTOR, during the activity period on the SITE, may use some of the final facilities of the COMPLEX, i.e. internal roads, warehouses, concrete platforms (built with priority) under the following conditions:

- not to disturb the commissioning of the COMPLEX by the temporary use of the said facilities;

- to make remedies to the damaged works temporarily used and to hand them over in good conditions.

7.4.6. For the accomodation of personnel working on SITE, the CONTRACTOR shall also consider the existing capacities in Lima and Ventanilla.

The transportation of personnel in these towns shall be provided by the CONTRACTOR by resorting to local specialized companies.

7.5. Equipment and Material Supply

The CONTRACTOR shall supply all equipment and materials necessary for the construction and satisfactory operation of the COMPLEX, as set forth in Volume III, as well as for the performance of guarantees under the contract.

The BIDDER shall prepare a detailed specification of equipment and materials as underlined under item 16, stating that the specification is not restrictive and that any equipment and materials deemed necessary for the satisfactory operation of the COMPLEX and for performance of guarantees shall be supplied by the CONTRACTOR against no extra-payment.

Supply shall also include:

a/. Spare parts for a 2 - year operation; the tender shall include a detailed specification of spare parts to be delivered at least 2 months before commissioning of relative plants.

b/. Catalysts and chemicals for one year of operation.

These have also to be delivered within 2 months before commissioning the related plant.

All activities mentioned below and other that may turn out to be necessary associated with the equipment and material supplies belong to CONTRACTOR's responsabilities.

7.5.1. **Purchase and Procurement**

Procurement of materials and equipment will be made from the best vendors in the field on competitive terms of bidding.

The GOVERNMENT reserve the right to participate - for the major equipment and as far as the personnel is available - in producing and evaluating enquiries and negotiating with relevant vendors and in making a decision concerning the final selection of bids on which basis the CONTRACTOR is to place the orders.

7.5.2. **Shipment and Inspection**

The CONTRACTOR will be held responsible for all shipment and inspection both at vendors shops and at SITE of all materials and equipment.

The CONTRACTOR shall forward to the GOVERNMENT a copy of dispatching and inspection documents and inform it of any problems encountered with regard to the quality and quantity of relative deliveries.

Quality certificates prepared by equipment and material suppliers with the CONTRACTOR's signature shall be part of the technical documentation made available to the SITE by the CONTRACTOR.

The GOVERNMENT reserves the right to control, through its representatives any delivery, either at vendors shops or at SITE, by additional tests performed at its own expense.

Inspection carried by GOVERNMENT's representatives shall nor relieve the CONTRACTOR from any of his responsabilities and liabilities as stipulated in the contract.

7.5.3. Transportation, Unloading, Storage

The CONTRACTOR shall be held responsible for the sea and inland transportation up to the SITE of all deliveries.

Materials and equipment will be transported at CONTRACTOR's risk; he shall carry all negociations with shipping companies and shall take all necessary steps to prevent loss or damages.

The CONTRACTOR shall store all equipment and materials in good preservation conditions and not exposed to hazard.

The CONTRACTOR shall insure equipment and materials during transportation.

Insurance cost shall be included in the total price.

7.6. Civil Works and Erection

All civil and erection works within the COMPLEX LIMIT, including enclosures and those implying sea water intake and pipeline and collecting trench for water effluents (although outside the teritorial limit of the COMPLEX) belong to the responsabilities of the CONTRACTOR.

Related to civil and erection works, the BIDDER shall consider, besides technical requirements set forth in Volume III and IV, the following general provisions:

7.6.1. CONTRACTOR's Facilities

The CONTRACTOR will be granted the possibility to build, on SITE, offices, material yards and temporary work-shops.

7.6.2. Access to SITE

The GOVERNMENT shall have the right of free access to SITE both for its representatives and the representatives of local authorities involved in the development of works on SITE.

The CONTRACTOR shall make available offices for the permanent representatives of the GOVERNMENT during the execution of works on SITE.

7.6.3. Construction and Erection Equipment

The CONTRACTOR shall provide necessary equipment and collateral work for construction and erection.

Equipment used and collateral work will remain the property of the CONTRACTOR and profitably reused by him when no longer necessary on SITE.

They can become the property of the GOVERNMENT following an agreement between parties and against payment of a sum mutually agreed at relevant time.

7.6.4. Labour

For the execution of works, the CONTRACTOR shall employ, as far as possible, local skilled and unskilled labour. Engagement and payment of the staff shall comply with the Peruvian laws.

If necessary, the CONTRACTOR shall provide due housing for the labour employed in temporary barracks as well as other facilities required for the satisfactory progress of works. The CONTRACTOR shall also provide for the observance of labour protection regulations in Peru; when such regulations are missing, the CONTRACTOR shall use and observe - with GOVERNMENT's approval - norms ruling in his own country with respect to the job to be performed on SITE.

7.6.5. <u>Compliance with Laws and Regulations on SITE</u>

The CONTRACTOR shall, in the execution and performance of works on SITE, comply with any and all applicable local laws and regulations.

During the execution of works on SITE, the CONTRACTOR shall at all times keep free from obstruction all public roads, footpaths and open space in the vicinity of the SITE, and shall perform the works in such a manner as not to interfere with the traffic or any such roads, footpaths or free space.

Any damages, costs, charges, whatsoever arising out of or in relation to obstructions caused by him in contravention of this clause will be at the CONTRACTOR's charge.

CONTRACTOR shall at all times take proper precautions as he may deem necessary or expedient to present accidents.

CONTRACTOR will be responsible for providing coverage for routine first aid requirements.

The CONTRACTOR shall conform in all respects to the local laws, regulations and sanitary authorities, with regard to the medical services prescriptions to be granted to the personnel working on SITE.

7.6.6. Insurance

The CONTRACTOR shall procure and maintain insurance of the COMPLEX covering all risks of direct physical loss or damage to the COMPLEX or any part thereof, completed or in progress.

The CONTRACTOR shall provide and maintain insurance to cover employees of the CONTRACTOR, whether permanent or temporary.

The CONTRACTOR shall cause all such insurance to be maintained in full force and effect from the beginning of works on SITE until the signing of PROVISIONAL ACCEPTANCE CERTIFICATE.

Insurance cost will be included in the total price of the contract.

7.6.7. Clearance of the SITE on Completion

Upon completion of works, the CONTRACTOR shall clear away and remove from the SITE all surplus materials and rubbish, and transport outside all construction and erection materials no longer used.

The CONTRACTOR shall leave the whole COMPLEX clean and free of materials and auxiliary facilities of any kind, to the satisfaction of the GOVERNMENT.

7.7. Documentation Submission to the GOVERNMENT

7.7.1. Documentation for Approval

The following documentation will be submitted by the CONTRACTOR to the GOVERNMENT's representatives.

- Documentation requested by the GOVERNMENT for the construction of the COMPLEX to be licensed. The content of this documentation shall be defined when the contract is placed.
- Process flow sheets of each process plant of the COMPLEX.
- Hook - up drawings.
- Equipment arrangement drawings for each process plant location.
- Plot plan showing all process plants, utility plants and offsites.
- Utility networks drawings.
- Electric one-line diagrams.
- Equipment data sheets indicating potential vendors for main equipment.

Some of the above mentioned documentation can be discussed and approved during the negociations preceeding the conclusion of the contract, without any further approval.

The approval given by the representatives of the GOVERNMENT does not relieve the CONTRACTOR from any of his obligations.

7.7.2. Final Documentation

This documentation shall include all drawings, information, data and calculations requested by the GOVERNMENT for:

- getting perfect knowledge of all plants and works belonging to the COMPLEX;
- plant start-up, operation and shut-down, under various circunstances;
- current maintenance and repair of equipment and plants as an assembly.

To meet the above mentioned requirements, the CONTRACTOR shall put at the GOVERNMENT's disposal the following:

a/. Execution drawings of all works to be performed on SITE, namely for:

- ground levelling and COMPLEX fencing;
- equipment layout, pipes, fittings and valves for all process plants, utilities and storages, including isometric diagrams for piping;
- process and utility networks;
- piperacks and pipe supports;
- sewage;
- internal roads and railways;
- civil works and facilities, including also static and dynamic calculations, equipment foundation

drawings and specifications of construction materials;

- electric transforming connection and distribution stations;
- electric distribution networks (one-line diagrams);
- control panels of all plants;
- weak current facilities;
- fire - fighting systems;
- external lighting facilities;
- insulations and paintings.

b/. Plot plan showing the final location in plan coordinates, of all plants and offsites belonging to the COMPLEX:

c/. Complete flow sheets of all process and utility plants, including all equipment, instruments, pipe and operating parameters.

d/. Detailed description of all processes indicating the influence of operating parameters on the running and results of the referred process.

e/. Instrument hook - up drawings showing also compressed-air and electric power supply.

f/. Equipment and instrument specifications of each plant.

g/. Material balance for each separate plant and for the COMPLEX as a whole.

h/. Utility consumptions and specific parameters for each plant.

i/. General utility balance of the whole COMPLEX, justifying the capacities adopted for utility plants.

j/. Flow rates and composition of effluents (waste water off-gases), of each plant.

k/. Machine book for catalogue equipment (compressors, pumps, turbines, etc.).

l/. Technical drawings for the rest of equipment.

m/. Vessel book for pressure vessels including also pressure test certificate.

n/. Indications related to equipment and plants maintenance and repairs.

o/. Operating manual of each process and utility plant, including:

- detailed instructions for operating the plant under all circumstances (start-up, normal running, normal shut-down, emergency shut-down);
- instructions for fire-fighting labour protection and safety technique.

p/. Process plant models.

7.8. **Training of GOVERNMENT's Personnel**

7.8.1. The CONTRACTOR shall ensure the training of the GOVERNMENT's personnel at his headquarter as well as within plants similar to those provided in the COMPLEX.

The aim of this training is to initiate the GOVERNMENT's personnel in the design of such plants so as to become familiarized with the proper operation and maintenance of the plants.

The so trained personnel of the GOVERNMENT together with CONTRACTOR's specialists shall have, in turn, to train, in Peru, the remaining personnel of the GOVERNMENT necessary for the COMPLEX start - up and running.

7.8.2. The BIDDER shall state in the tender:

- the manner and factories in which personnel training is to be performed;

- the number and skill degrees of personnel to be trained, split by plants;

- training duration;

- number of CONTRACTOR's specialists and the duration of their stay in Peru, in view of ensuring the training of GOVERNMENT's personnel up to the FINAL ACCEPTANCE;

- training cost to be included in the total price, for which the GOVERNMENT shall work-out a calculation estimation including personnel travelling expenses.

7.9. <u>Technical Assistance</u>

Until carrying out performance and guarantee test runs and producing the PROVISIONAL ACCEPTANCE CERTIFICATE, the CONTRACTOR shall conduct and supervise all activities performed on SITE and within the COMPLEX.

For this, the CONTRACTOR shall provide the necessary personnel whose payment shall be included in the total price.

After the PROVISIONAL ACCEPTANCE CERTIFICATE signing, the responsability of put in operation plants will be passed over to the GOVERNMENT's staff.

The GOVERNMENT reserves the right to ask the CONTRACTOR - who agrees to - for granting technical assistance for one year (from the PROVISIONAL ACCEPTANCE date of each plant), both for plant operation and possible interventions occuring in this period of time.

Technical assistance shall be granted, at GOVERNMENT request, for a period defined by the GOVERNMENT and by CONTRACTOR's specialists, i.e. engineers, formen and highly skilled workers.

Payment for technical assistance shall be separately made by the GOVERNMENT in compliance with tariff rates (terms) set forth in the tender.

7.10. Test - Runs, Start - up and Guarantee Performance Test Runs.

The CONTRACTOR shall carry the following test runs for each of the completed plants, individually:

7.10.1. Mechanical Tests

These tests shall include, but not to limited to the following:

a/. Stuffing-boxes inspection and checking of lubricators on pumps, compressors and couplings.

b/. Checking of lubricating systems of compressors.

c/. Checking of all lines by washing, steaming, blowing.

d/. Hydraulic and / or pneumatic testing of pressure vessels and connecting pipes.

e/. Adjustment and control of all safety valves.

f/. Shortly running of compressors and pumps with the alignment and couplings inspection.

g/. Machine running - in.

h/. Changing of blinds, installation of orifice plates and small filters (strainers) on pipes.

i/. Filling of instruments with adequate fluids and calibration of instruments.

j/. Thermocouple connection and checking out.

k/. Drying out of all furnace refractories and reactor linings.

l/. Testing of electrical systems.

m/. Filling of the equipment with catalysts and adequate packing.

n/. Drying out and plant purging.

o/. Preparation state of protection equipment.

Afterwards there shall be performed inert fluid handling tests (cold and hot tests where possible), at the temperatures and pressures provided for the operation.

The CONTRACTOR shall, during this period, assume the responsibility for such alterations, repairs and replacements as may be needed to place all equipment in proper working order.

7.10.2. <u>Process Test - Runs</u>

During process test-runs, feedstock will be charged in and plants started-up and kept running until reaching a continuous, stable operation under the conditions and with the results close to those stipulated in the design and the contract.

For the performance of process test-runs, the GOVERNMENT shall put at the CONTRACTOR's disposal auxiliary personnel required, raw and auxiliary materials as well as utilities provided by the GOVERNMENT at COMPLEX LIMIT (see Section 5. 9.).

The CONTRACTOR, shall conduct process test-runs by means of his skilled personnel and shall assume full responsibility for the way of carrying them.

Process test runs are aimed at revealing what are the optimum operating conditions and establishing the values of magnitude with an influence on the process run and results.

Any remedies, alterations or adjustments which will prove to be necessary for the satisfactory operation of plant and for meeting the guarantees under the contract shall be made by the CONTRACTOR at his own expense at terms stipulated by the contract.

The CONTRACTOR shall be responsible for updating the entire documentation handed over according to the results from and / or remarks made on during process test-runs.

7.10.3. Performance Tests (Guarantee Test Runs)

Performance tests shall be carried according to the provisions and methods stipulated by the contract, being aimed at demonstrating if met the guarantees under the contract.

The BIDDER shall indicate in the tender specific methods to be used for guarantee test-runs.

The duration of such performance tests shall be of minimum 72 hours continuous operation. The plants shall be kept operating till an adequate product amount is accumulated of the kind to be used as charge materials to other units within the COMPLEX for process test-runs to be made in, one after an another.

Performance test may be repeated if necessary until reaching the results complying with the guarantees.

The BIDDER shall set forth in the tender "limit terms" assumed for completion of performance tests.

8. TIME SCHEDULE

8.1. The BIDDER shall work-out a detailed time schedule indicating the period of fulfilment of all activities implied by COMPLEX setting up, from the date of contract's coming into force until the FINAL ACCEPTANCE.

8.2. The BIDDER shall specifically indicate terms for:

- drawing transmittals for GOVERNMENT's approval;
- beginning and completion of deliveries;
- beginning of works on SITE;
- execution of civil - works;
- performance of erection;
- transmittal of final documentation;
- performance of mechanical tests;
- performance of process tests;
- performance guarantee test runs.

8.3. The BIDDER shall state the date when the GOVERNMENT ought to put the SITE at his disposal as well as the terms at which the GOVERNMENT is expected to fulfil the other obligations under section 5.

8.4. The time schedule shall be worked out under the form of har chart. At the contract conclusion, the CONTRACTOR shall put at GOVERNMENT's disposal Perth diagramme (Critical Path Method), so that the GOVERNEMNT should follow the progress of works and the intermediate terms if observed.

9. PRICE

9.1. The tender shall indicate the total price of works, supplies and services rendered for the Design, Supply, Erection and Commissioning of the Petrochemical Complex Lima - Callao, as defined under these Tender Specifications and on "grass roots'/ lump sum / turn - key" basis.

9.2. Total price which after the conclusion of the contract shall be a fixed price will be calculated and expressed in a currency at BIDDER's option, deducting the sum - also indicated in the tender - which would be paid in local currency (soles) at the official rate of exchange valid at the date of making the payment.

In view of reducing the amount payable in foreign currency, the BIDDER shall consider the use of local means and resources to the greatest extent.

9.3. The BIDDER shall prepare a detailed analysis (break-down) of the total price, under the form of a table showing the main components of price and at least the following:

a/. The price of each, process and utility plant including final treating plant of waste water, split as follows :

- licence and Know-how;
- engineering;
- equipment aand materials;
- instrumentation;

- construction and erection;
- utility network within battery limit;
- chemicals and catalysts;
- spare parts;
- other costs within plant battery limit.

b/. Price of each storage, split as follows:

- equipment and materials;
- instrumentation;
- construction and erection;
- utility networks within storage limit;
- other costs.

c/. Price of utility distribution networks and sewage up to the battery limit of each plant.

d/. Price of offsites, split by main categories: workshops, central laboratory, social - administration buildings, weak current facilities, internal roads, internal rail roads, fencing, external lighting, etc.

e/. Price of other facilities of the COMPLEX: trucks, lorries, cisterns for the transportation of liquefied gases, protection equipment, etc.

f/. Other costs split by main items: basic design of the COMPLEX (not included under a), GOVERNMENT's personnel training, travelling expenses, etc.

9.4. In connection with licence cost, the BIDDER shall state whether price in the tender covers only the offered plants or is final, i.e. whether and under wich conditions the GOVERNMENT can use the offered process for later projects.

9.5. The total price will include and cover all costs, expenditures, expenses, (profit included) on the CONTRACTOR's account excepting REIMBURSABLE EXPENSES and presumable additional expenditures which could appear after concluding the contract from faults not imputable to the CONTRACTOR.

REIMBURSABLE EXPENSES shall not be included in the total price specified in the tender as they refer to only expenses depending on current settlements which cannot be negociated.

REIMBURSABLE EXPENSES cover:

- port charges;

- duties and taxes imposed by the Peruvian GOVERNMENT;

- inland transportation in Peru;

- customs clearance and storage taxes thereof.

The stipulated value of REIMBURSABLE EXPENSES shall be quoted in the tender.

9.7. Only the following can be deemed as causes leading to the total price supplementing after concluding the contract:

a/. natural calamities to the extent affect the cost of project;

b/. the issuing, after the date of the contract, of laws, regulations or other provisions having the force and effect of laws in Peru, that will cause the CONTRACTOR's additional expenses in implementation of the COMPLEX;

c/. modifications and completion of works, requested by the GOVERNMENT in addition to the provisions of contract;

d/. inaccurate information given by the GOVERNMENT which implies an increase in CONTRACTOR's expenses.

9.8. "Royalties" to be paid by the GOVERNMENT after COMPLEX commissioning shall be quoted apart, specifying:

- quantum;
- payable currency;
- terms and instalments.

9.9 The tender will have separately quoted - the tariff (payment conditions) for CONTRACTOR's specialists granting technical assistance as per item 7.9.

10. PAYMENT CONDITIONS

The BIDDER shall present in the tender detailed payment conditions, considering the following basic requirements on behalf of the GOVERNMENT :

10.1. The GOVERNMENT agrees with the payment of an approximate 5% advance from the amount of price to be paid in foreign currency at the date of contract's coming into force.

10.2. For the rest of money to be paid in foreign currency, the GOVERNMENT requests credit for at least 10 years, i.e. a scheduled payment by half-year instalments including also interest rates on the money advanced.

10.3. The BIDDER shall define the conditions of granting credits, mainly specifying:

a/. term of credit opening;

b/. interest;

c/. interest rate flow estimated date;

d/. if special guarantees are claimed by GOVERNMENT as to the credit reimbursement;

e/. instalments and terms of credit reimbursement;

g/. other crediting conditions.

The GOVERNMENT requests that the time to start credit reimbursement and interest rate flow should be connected to the starting of marketable output.

10.4. The GOVERNMENT is interested in covering part of the price to be paid on foreign currency against selling of products available for export in Peru.

The BIDDER shall quote in the tender the quantum suggested for this way of payment, the selection of products and other conditions are to be defined during talks preceeding the conclusion of contract.

10.5. Price share to be paid in local currency (soles) will be made proportionally to the performed amount of works, supplies and services, against invoices monthly released by the CONTRACTOR and endorsed by the representatives of the GOVERNMENT within 30 days from the date of invoice presented.

10.6. The payment of REIMBUR ABLE EXPENSES will be made as soon as they are produced against submission of due documents by the CONTRACTOR and endorsed by the representatives of the GOVERNMENT within 60 days from the dispatch of relevant documents.

10.7. Other conditions and detailed formalities related to the payments are to be set forth in the contract.

11. GUARANTEES.

Guarantees specified thereinafter stand for minimum guarantees claimed by the GOVERNMENT.

11.1. Mechanical Guarantees

Mechanical guarantees are referring to all works within the COMPLEX, namely: process plants, utility plants, storages and warehouses, offsites, process and utility networks.

11.1.1. The BIDDER will guarantee that materials used for execution and the works performance itself shall be faultlees and in compliance with the requirements of Tender Specifications and relevant designs.

11.1.2. The BIDDER shall guarantee that within one year elapsed from the signing of PROVISIONAL ACCEPTANCE CERTIFICATE, he will provide, repair or change, immediately and at his own expense, any equipment, materials and workmanship found to be defective.

As to the equipment, materials and portions of works to be changed or remade, CONTRACTOR's obligations will be understood from the date of change or remake.

11.1.3. The BIDDER shall guarantee that all materials and equipment to be used for the COMPLEX erection will be new and procured by him only from reputed suppliers, and thoroughly suitable to the revelant application foreseen.

11.2. Performance Guarantees

Performance guarantees cover two categories:

a/. Absolute guarantees which by all means must be met, so that the CONTRACTOR is allowed to alter or change at his own expense equipment or / and materials if he feels they are obstructing fulfilment of said guarantees.

b/. Other guarantees, i.e. guarantees that are subject to penalties by the CONTRACTOR, if failed.

11.2.1. Process Plants Guarantees

a/. Absolute Guarantees

- Maximum capacity assumed for each process plant as well as the minimum capacity assumed for a process plant to satisfactorily operate in accordance with the requirements set forth in Volume III.

The BIDDER will guarantee both capacities per day and per year, based in general on an operation of 330 days/year.

- Specific raw material consumption (per ton of product) for each process plant. Specific consumptions thereto with respect to certain raw material qualities to be specified in detail in compliance with the requirements set forth in Volume III.

- End-product quality produced by each process plant in compliance with the requirements set forth in Volume III.

- Life of catalysts used in the plants of the COMPLEX.

- Composition of waste water to be discharged into the ocean, according to the requirements set forth in Volume III.

- Quantity and composition of offgasses released to the atmosphere which have to correspond to sanitary norms relative to the atmosphere pollution control in the CONTRACTOR's country.

b/. <u>Other Guarantees</u>

- Consumptions of auxiliary materials and chemicals for each process plant.

- Quality and quantity of by - products to be rendered valuable.

- Specific consumption of utilities (cooling water, steam, electric power, instrument air, inert gas, compressed air, fuel recovered condensate), for each process plant.

BIDDER shall also guarantee maximum consumptions per hour of each utility and process plant.

Within the guarantees related to utility consumptions, an increase in certain consumptions can be accepted if this can be compensated for - within the same plant - by a decrease in other utility consumptions. This can be considered, provided that the total utility requirements within the COMPLEX should be met by relevant plants provided by the CONTRACTOR.

11.2.2. Utility Plants Guarantees

a/. Absolute Guarantees

- Capacity.

BIDDER shall guarantee the capacity of each utility plant (per day and year) and meeting of the COMPLEX requirements thereby.

- Quality of utilities produced.

BIDDER shall guarantee the quality of utilities produced, their compliance with the consuming plants requirements.

b/. Other Guarantees

Maximum specific per hour consumption of utilities for each plant.

For some consumptions, it can be accepted that an increase against valued compensation with other consumptions in the same plant should be made, provided that the total consumption of each utility produced in the COMPLEX be assured.

11.2.3. Guarantees for the whole COMPLEX

a/. Absolute Guarantees

BIDDER shall guarantee that all plants and facilities covered by the COMPLEX will operate in such a close dependence that the COMPLEX may provide all products at the ratings and of qualities stated in the Tender Specifications and stipulated by the contract.

BIDDER shall guarantee that the performed jobs are complete or that any work or endowment if proved to be necessary for the normal running of the COMPLEX and meeting of the guarantees under the contract - whether provided or not in the tender and the contract - will be performed with no extra cost incurred by the CONTRACTOR.

12. ACCEPTANCE

12.1. Provisional Acceptance

Each plant or auxiliary facility ready for start-up or commissioning may be accepted independently by the GOVERNMENT's representatives in the presence of CONTRACTOR's delegates, when a PROVISIONAL ACCEPTANCE CERTIFICATE is prepared.

PROVISIONAL ACCEPTANCE CERTIFICATE is the proof that the GOVERNMENT finds the contract terms to have been fulfilled as to the plant therein, except mechanical guarantees.

For the PROVISIONAL ACCEPTANCE may be released the following conditions are necessary:

a/. For process and utility plants: successful completion of performance tests;

b/. For other plants and auxiliary facilities: satisfactory running during acceptance tests and meeting of the general and specific guarantees under the contract.

c/. For "hidden works" the GOVERNMENT reserves the right to check during the progress of works the fulfilment of provisions under the contract and relevant projects.

Related to the above there will be prepared control programmes, mutually agreable both to the representatives of the GOVERNMENT and the CONTRACTOR.

12.2. Final Acceptance

Final aceeptance will certfy that the examination of the obligations of the CONTRACTOR assumed under the contract was satisfactory, which will be written down in FINAL ACCEPTANCE CERTIFICATE.

So, the Final Acceptance is conditioned by:

- provisional accceptance of all plants and auxiliary works covered by the COMPLEX;

- fulfilment of mechanical guarantees which means that the CONTRACTOR has made all remedies believed necessary within the period provided for mechanical guarantees.

Detailed procedures related to provisional and final acceptance and issuing of relevant documents shall be set forth in the contract.

13. PENALTIES

The BIDDER shall specify penalties - a sum deducted from the contract price - he deems acceptable for the following:

13.1. Delays in commissioning and failure to meet absolute guarantees as per 11.2.1.a, 11.2.2.a, and 11.2.3.

13.2. Failure to meet "other guarantees" as per items 11.2.1.b, and 11.2.2.b.

For the exceeded specific consumptions of chemicals and utilities, the BIDDER may suggest as penalty a sum at least equal to the extra consumption value covering a period of 5 (five) years.

13.3. Delays in the documentation transmittals.

14. PATENTS AND OTHER PROTECTED RIGHTS.

BIDDER shall outline in his tender that the GOVERNMENT by the fact of accepting the tender is by all means protected against claims and proceedings on account of infringement of protected rights (patents, know - how, trade-mark, etc).

If, however, such cases are encountered, the CONTRACTOR shall indemnify GOVERNMENT from and against all claims, costs, charges and expenses incurred in connection with this infringement or resulting therefrom.

15. SELECTION OF TENDERS

15.1. The tenders shall be considered in connection with the GOVERNMENT's requirements with a particular regard to the following:

a/. Technical level of offered plants and quality of products and relevant operating costs;

b/. total price;

c/. use extend of local resources in Peru (materials labour) with the price share to be paid in soles;

d/. payment conditions (duration of credit, interest countertrade).

e/. guarantees;

f/. BIDDER's experience.

15.2. The BIDDER reserves the right of selecting the most advantageous tender and rejecting any tender which, in his opinion, would not meet the requirements contemplated by the GOVERNMENT.

The GOVERNMENT is not obliged to give reason for rejection of any tender submitted.

15.3. The BIDDER whose tenders have not been accepted by the GOVERNMENT are not entitled to claim charges, costs or expenses in respect thereof, or any indemnification incurred in connection thereto, before and after the tender submission.

16. INFORMATION TO BE INCLUDED IN THE TENDER.

16.1. Commercial Side

This plant of tender shall cover:

a/. Tender scope enounced to correspond to the Tender Specifications.

b/. BIDDER's experience (see Section 4).

c/. Listing of works and services offered (see item 7) with the mention that this list is subject to additions and that the BIDDER assumes the responsibility to fulfil all works and services necessary for the construction and commissioning of the COMPLEX as well as for the determination of the guarantees under the contract, except the works and services standing for the obligations of the GOVERNMENT (under section 5).

d/. Time schedule (see Section 8)

e/. Total price and price breakdown as per requirements under Section 9

f/. Payment conditions (see item 10)

g/. Guarantees (see Section 11)

h/. Penalties (see Section 13)

i/. Patents and other protected rights (see Section 14) j/. Any other data and information considered by the BIDDER as being necessary for the evaluation of his tender and / or are to stand for the Special Conditions to the Contract.

16.2. Technical Side

This part will cover:

a/. General description of the COMPLE` as conceived by the BIDDER complying with the conditions in the Tender Specifications.

b/. Plot plan of the COMPLEX.

c/. Process block diagram of the whole COMPLEX.

d/. General material balance of the whole COMPLEX.

e/. General utility balance of the whole COMPLEX.

f/. Ceneral endowment for the COMPLEX (trucks, special waggons, etc.).

g/. Total personnel estimated for the COMPLEX, split per categories of skills.

h/. Specification of documentation to be delivered to the GOVERNMENT (see item 7.8).

i/. Information on process and utility plants consisting of:

- plant capacity (annual and per hour), duration of continuous operation; planned running shut-downs;
- description of procedure and process offered;
- principle flow diagram;

- data on instrumentation;

- types of products achievable therein (as the case may be).

- complete quality specification of products with the methods for determination of various characteristics;

- specific consumption of raw and auxiliary materials and relevant quality characteristics;

- specific and hourly consumptions (minimum and maximum values) of utilities, relative parameters included;

- by-products; quantities, characteristics, possibilities of turning to account;

- waste water; quantity, composition, local treating facility provided, composition after local treatment;

- offgases; quantities, composition and methods foreseen for atmosphere pollution control;

- labour protection and fire - fighting regulations;

- equipment specification with at least the following references: design and vendor (for major equipment) nominal performances, main construction materials, number off (indicating stand-by's);

- instrument specification, indicating the design and maker;

- specification of erection materials (pipes, fittings, etc.) per categories of construction materials;

- spare parts specification;
- data relative to extent and type of constructions in relevant plants: type, main sizes, main construction materials, finishings;
- required operating personnel, within the battery limit grouped by category of skills and shifs.

j/. Information on tank yards for liquids, i.e.

- number and capacity of tanks in each tank yard;
- storage duration of each product;
- construction materials of tanks;
- pumping stations and relevant equipment specifi - cation;
- loading and unloading platforms provided for;
- auxiliary labour;

k/. Information on warehouses, mentioning:

- design and main sizes;
- storage capacity;
- construction materials;
- auxiliary labour;
- mechanical devices for tranportationn, piling and handling.

l/. Information on process and utility networks, covering for each individual system:

- general diagram;
- piping, (laid on piperacks, above or underground;

- type and construction materials;

Electrical distribution diagrams will show transformer stations of 6/0.4 KV as well as electrical distribution stations of 6 KV and 0.4 KV.

m/. Information on offsites, namely:

- specification of offsites;

- detailed description of each work - stating from case to case - type, main sizes, construction materials, finishing, equipment provided and any other characteristics necessary for their estimation;

- estimated labour requirements broken down on each auxiliary facility.

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TENDER SPECIFICATIONS
FOR THE
DESIGN, SUPPLY, ERECTION AND COMMISSIONING
OF THE
LIMA—CALLAO PETROCHEMICAL COMPLEX
IN PERU

VOLUME III
TECHNICAL SPECIFICATION

October 1973

I P R O C H I M

BUCHAREST — ROMANIA

TENDER SPECIFICATIONS
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This document in prepared for the United Nations Industrial Development Organization acting as Participating and Executing Agency for the United Nations Development Programme
(Special Industrial Services)

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1. COMPLEX DESCRIPTION

1.1. GENERALS

Lima - Callao Petrochemical Complex is to produce chemical products of great use, namely: polyvinyl chloride (suspension and emulsion), polyethylene (high and low density), styrene - butadiene rubber, ABS co-polymers, polystyrene, caprolactum, dodecylbenzene, acrylonitrile, phthalic and maleic anhydride, which can be efficiently produced by using a petroleum cut as basic raw material.

The first process stage of the COMPLEX will consist of an olefine plant, based on steam cracking of the petroleum cut, which produces ethylene, propylene, butadiene, benzene, o-xylene, herein after referred to as basic products.

The raw material for the olefine plant will be naphtha having the quality specification given under item 1.5.

In view of obtaining the above mentioned basic products, the olefine plant shall be completed by a plant for hydrogenation of the pyrolysis gasoline followed by a butadiene extraction and separation plant and an aromatics separation plant.

For increasing benzene and o-xylene outputs of the COMPLEX, the GOVERNMENT has also provided a plant for catalytic reforming of primary distillation (depentanized) naphtha as well as a plant to produce benzene by dealkylating the toluene resulting from the olefine and catalytic reforming plants.

The aromatics separation plant will process aromatic concentrates, both from the olefine and the catalytic reforming plants.

The other raw materials (besides the basic products from the olefine plant) required for producing intermediate and end products will be acquired from outside the COMPLEX.

This category also includes certain amounts of butadiene and o-xylene to the extent to which the production cannot meet the relevant cunsumption.

By-products of the COMPLEX, similar to the refinery products (pyrolysis gasoline, L.P.G. cut) will be supplied to the neighbouring refinery, " La Pampilla ", wherefrom the COMPLEX will be fed with some of the raw materials and fuels required.

As the COMPLEX will be built on a grass roots basis and the co-operation with other companies as regards utility supply is not possible, the COMPLEX has to be provided with plants for producing all utilities required.

Data and conditions related to utilities are given under item 1.7.

The GOVERNMENT intends to erect the COMPLEX in two stages, namely:

- Stage I : all plants for basic, intermediate and end products at the capacities indicated under item 1.3. as well as storages for raw materials, intermediate and end products ;

utility plants process and utility networks, relevant offsites.

Plants belonging to stage I will be commissioned within the period 1976 - 1977 ;

- Final Stage : production capacities of the plants will reach figures under item 1.3., either by expansion (supplementing) of the plants from stage I or by building new plants. Auxiliary facilities and offsites of the COMPLEX are to be increased accordingly to meet final capacities of plants. Completion term of the final stage has not been defined yet.

1.2. PRODUCTS

1.2.1. Basic Products

Product Denomination	Quantity, to/year Stage I	Final stage
1	2	3
- ethylene	75,000	100,000
- propylene	42,000	54,000
- butadiene	10,000 approx.	14,000 approx.
- benzene	52,000 approx.	64,000 approx.
- o-xylene	5,000 approx.	6,200 approx.

Figures related to quantities of butadiene, benzene and o-xylene are approximate figures. They shall be finally defined by the BIDDER according to the performances of the offered plants and shall be indicated in the relevant tender.

1.2.2. Intermediate Products

Product Denomination	Quantity, to/year Stage I	Final stage
1	2	3
- vinyl chloride monomer	25,000	50,000
- dodecylbenzene	10,000	10,000
- caprolactum	16,000	16,000

1	2	3
- ethyl-benzene	53,000	53,000
- styrene	45,000	45,000
- acrylonitrile	24,000	24,000
- maleic anhydride	2,500	2,500
- phthalic anhydride	5,000	10,000

1.2.3. End Products

Product Denomination	Quantity, to/year Stage I	Final stage
1	2	3
- PVC-suspension	20,000	40,000
- PVC-emulsion	5,000	7,500
- LD-polyethylene	22,500	45,000
- HD-polyethylene + polypropylene	22,500	45,000
- SBR	20,000	40,000
- ABS	4,000	8,000
- polystyrene	10,000	10,000

1.2.4. By-Products

Product Denomination	Quantity, to/year Stage I	Final stage
1	2	3
- pyrolysis and catalytic reforming gasoline	90,000 approx.	140,000 approx.

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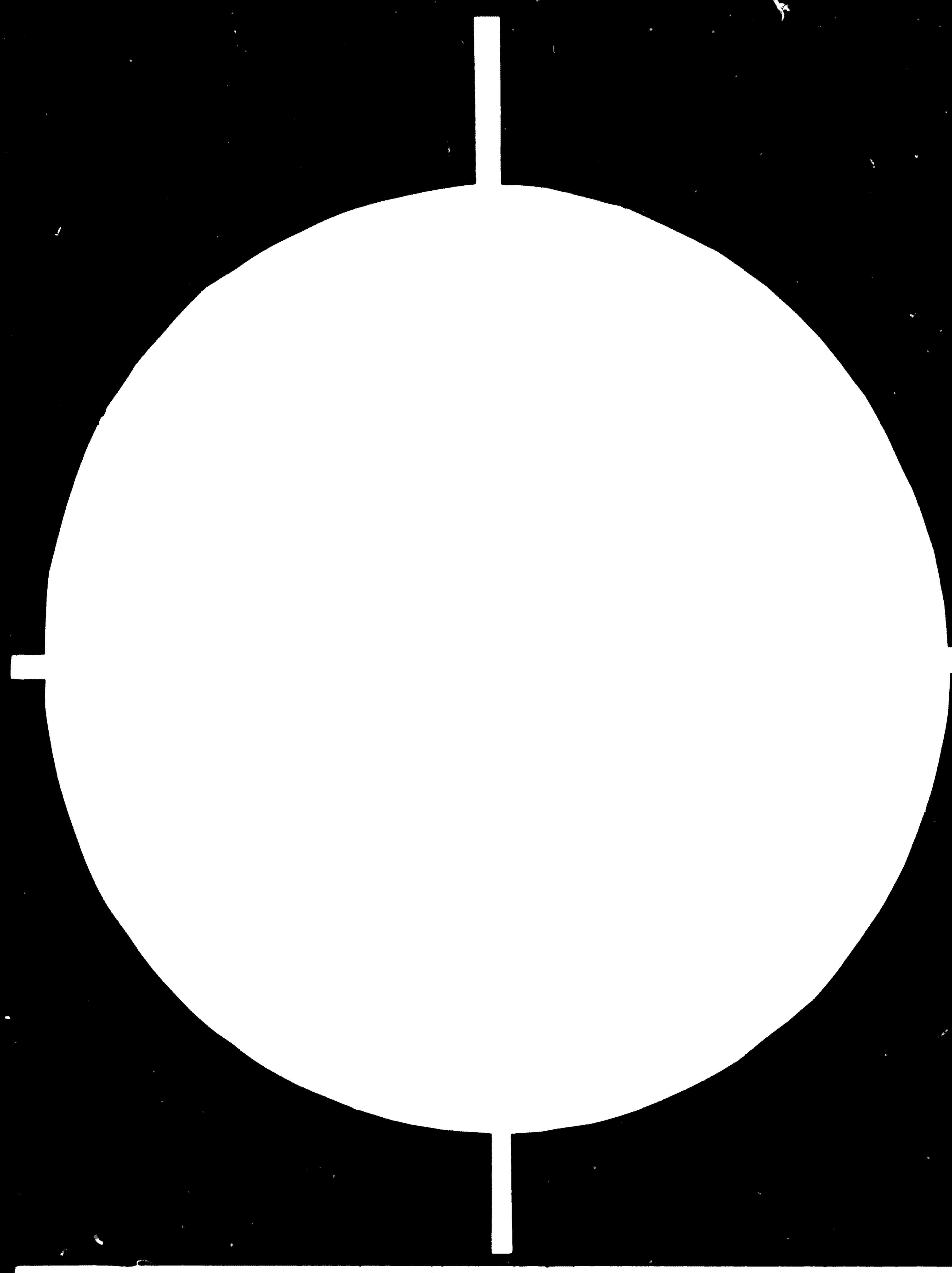

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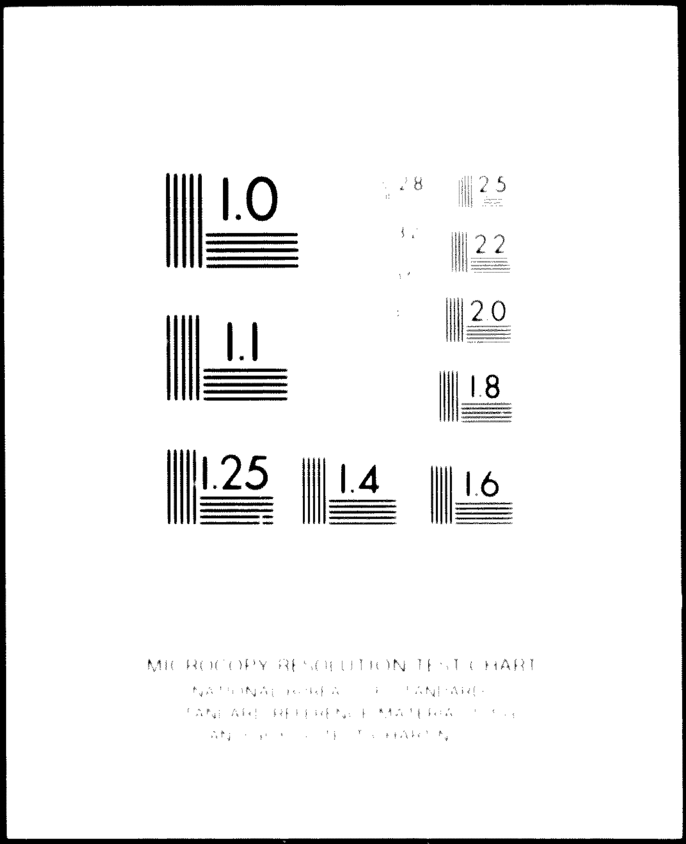

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1	2	3
- L.P.G. (from butadiene extraction)	12,000 approx.	28,000 approx.
- other products		

The figures for gasoline and L.P.G. are approximate figures. The BIDDER will define these amounts and specify other by-products, indicating relevant quantities accordingly.

1.3. PROCESS PLANTS

In view of producing basic, intermediate and end products foreseen by the GOVERNMENT, the COMPLEX will be provided with the relevant process units, namely:

Plant Denomination	Stage I: Capacity to/year	Stage I: Commissioning year	Final stage to/year
1	2	3	4
1. Olefine plant	75,000 ethylene	1976	110,000 ethylene
2. Catalytic reforming plant	170,000 feed	1977	As in Stage I
3. Aromatic extraction and separation plant	180,000 feed approx.	1977	As in Stage I
4. Toluene dealkylation plant	36,500 feed approx.	1977	As in Stage I
5. Butadiene extraction plant	14,000 butadiene approx.	1978	As in Stage I
6. VCM plant	25,000	1976	50,000
7. Dodecylbenzene plant	10,000	1976	As in Stage I
8. Caprolactum plant	16,000	1976	As in Stage I
9. Ethylbenzene plant	53,000	1977	As in Stage I
10. Styrene plant	45,000	1977	As in Stage I

1	2	3	4
11. Acrylonitrile plant	24,000	1977	As in Stage I
12. PVC suspension plant	20,000	1976	40,000
13. PVC emulsion plant	5,000	1976	7,500
14. LD polyethylene plant	22,500	1976	45,000
15. HD-polyethylene + polypropylene plant	22,500	1976	45,000
16. SBR plant	20,000	1976	40,000
17. ABS plant	4,000	1976	8,000
18. Polystyrene plant	10,000	1977	As in Stage I
19. Maleic anhydride plant	2,500	-	As in Stage I
20. Phthalic anhydride plant	5,000		10,000

Figures related to the capacities of the plants for aromatics extraction and separation, toluene dealkylation and butadiene extraction are only approximate figures. The accurate capacities of these plants will be defined by the BIDDER (and will be indicated in the tender) depending on the following :

- BTX cut from the olefine plant (corresponding to the output of the final stage);
- reformate from the catalytic reforming plant;
- C_4 cut from the olefine plant (corresponding to the output of the final stage);

- toluene from the aromatics separation plant, so that the maximum possible outputs of benzene, o-xylene and butadiene may be reached.

The maleic anhydride plant and phthalic anhydride plant - both to be commissioned in 1976 - will belong to the COMPLEX but do not stand for the subject matter of the Tender Specifications an they are to be erected by the GOVERNMENT.

As far as these plants are concerned, the BIDDER will provide only the utility supply at the battery limit, location within the plot plan of the COMPLEX and relevant offsites.

Detailed data and technical conditions required for preparing the tenders for the process plants standing for the subject matter of the Tender Specifications are provided under the technical specifications, item 2.

The process plants producing chemically impure waste waters which have to undergo specific treatments before entering the final treating plant, will be provided - within the relevant battery limit - with the suitable plants for proper locat treatment of the waste waters.

1.4. BLOCK FLOW DIAGRAM

1.4.1. The enclosed flow diagrams of stage I and the final stage show the planned process plants (relevant capacities included), the distribution of the raw materials and basic and intermediate products within the COMPLEX as well as, the amounts of selling products obtained.

The capacities of the process plants planned for the final stage are balanced, provided certain amounts of butadiene and o-xylene are imported.

Several inconsistencies may be noticed at stage I, namely :

a/. VCM-plant capacity is a little lower than the requirements of PVC-suspension and PVC-emulsion plants.

The total output of PVC, suspension and emulsion, will be limited in stage I to the available quantity of VCM;

b/. Propylene output is lower than the total propylene requirements of the consuming plants. These plants will run, in stage I, below designed capacity ;

c/. Actual output of the benzene producing plants does not meet the consumer requirements in stage I. Consumer units have to operate, in stage I, below designed capacity ;

d/. The output of C_4 - and BTX-cuts from the olefine plant is lower than the requirements of the plants for butadiene extraction, aromatics extraction and separation, toluene dealkylation, the capacities of which are the same in stage I, and in the final stage.

Consequently, these plants have to run, in stage I, at a capacity below the designed capacity.

By accepting this situation, the GOVERNMENT has considered the advantages granted by the erection of the relevant plants in a single stage considering their relatively small capacities.

1.4.2. The BIDDER has to introduce in the tender a block flow diagram for stage I, complying with the firm capacities under item 1.3. and defining the outputs of the plants for aromatics extraction and separation, toluene dealkylation, butadiene extraction.

The quantities and break down of the raw materials and basic and intermediate products will be also specified by the BIDDER in the block flow diagram, along with the by-products: pyrolysis gasoline, gasoline from catalytic reforming (from aromatics extraction and separation respectively), LPG-cut and others.

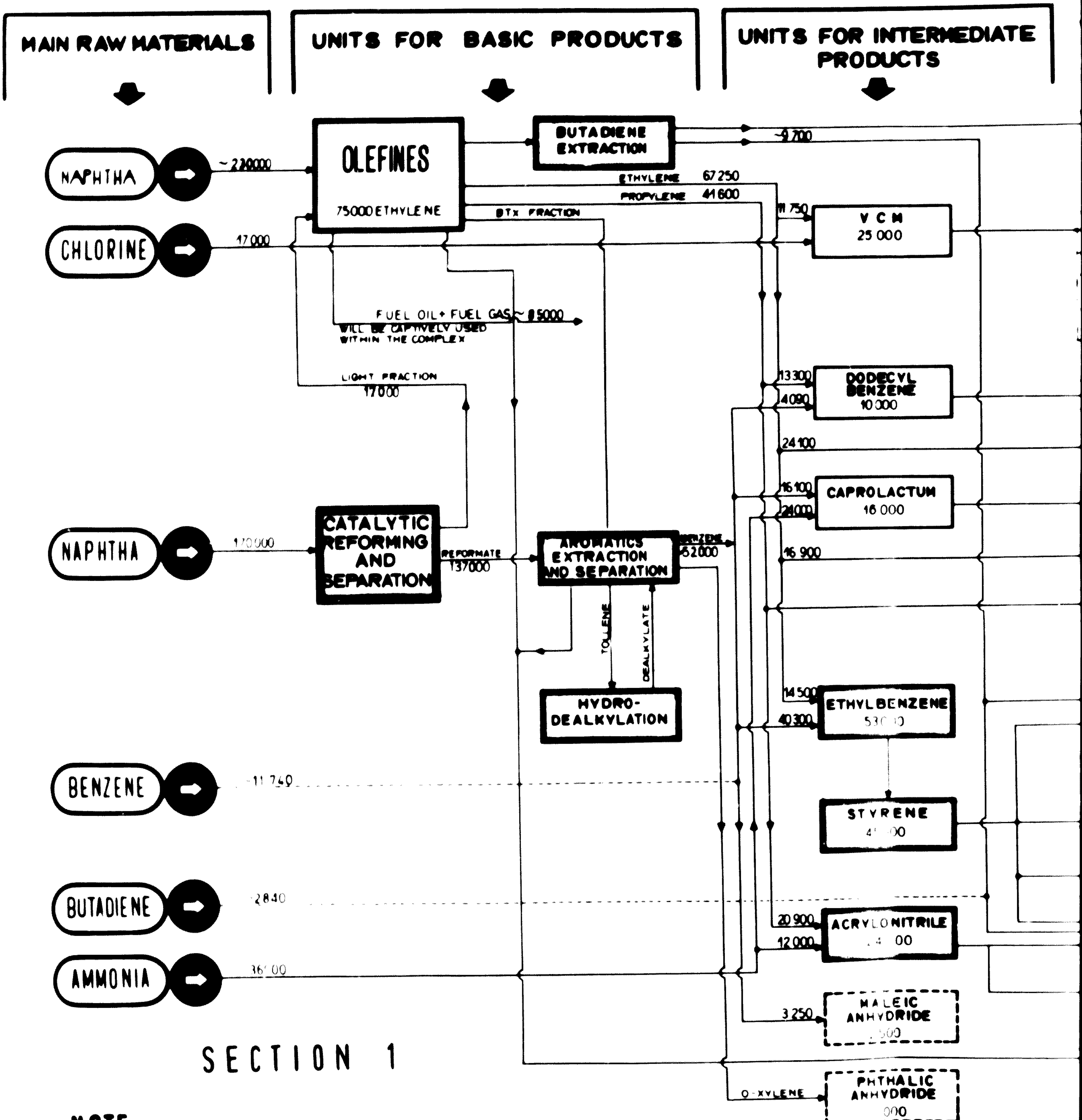
When working out the block flow diagram and materials balance, the BIDDER has to consider the following :

- Pyrolysis gasoline and gasoline from the aromatics extraction will be returned to the refinery " La Pampilla " for standardization and sale;

- LPG-cut from butadiene extraction will be returned to the refinery for use or bottling;
- VCM and ethyl-benzene will be captively used within the COMPLEX, i.e.: VCM for PVC-suspension and PVC-emulsion whereas ethyl-benzene for styrene production;
- Acrylonitrile and styrene will be partly used within the COMPLEX, namely: acrylonitrile for ABS co-polymers production whereas styrene for ABS co-polymers production, polystyrene and SBR.

  The available amounts of acrylonitrile and styrene will be used for sale;
- Dodecylbenzene and caprolactum shall not be used within the COMPLEX, but meant to sale.

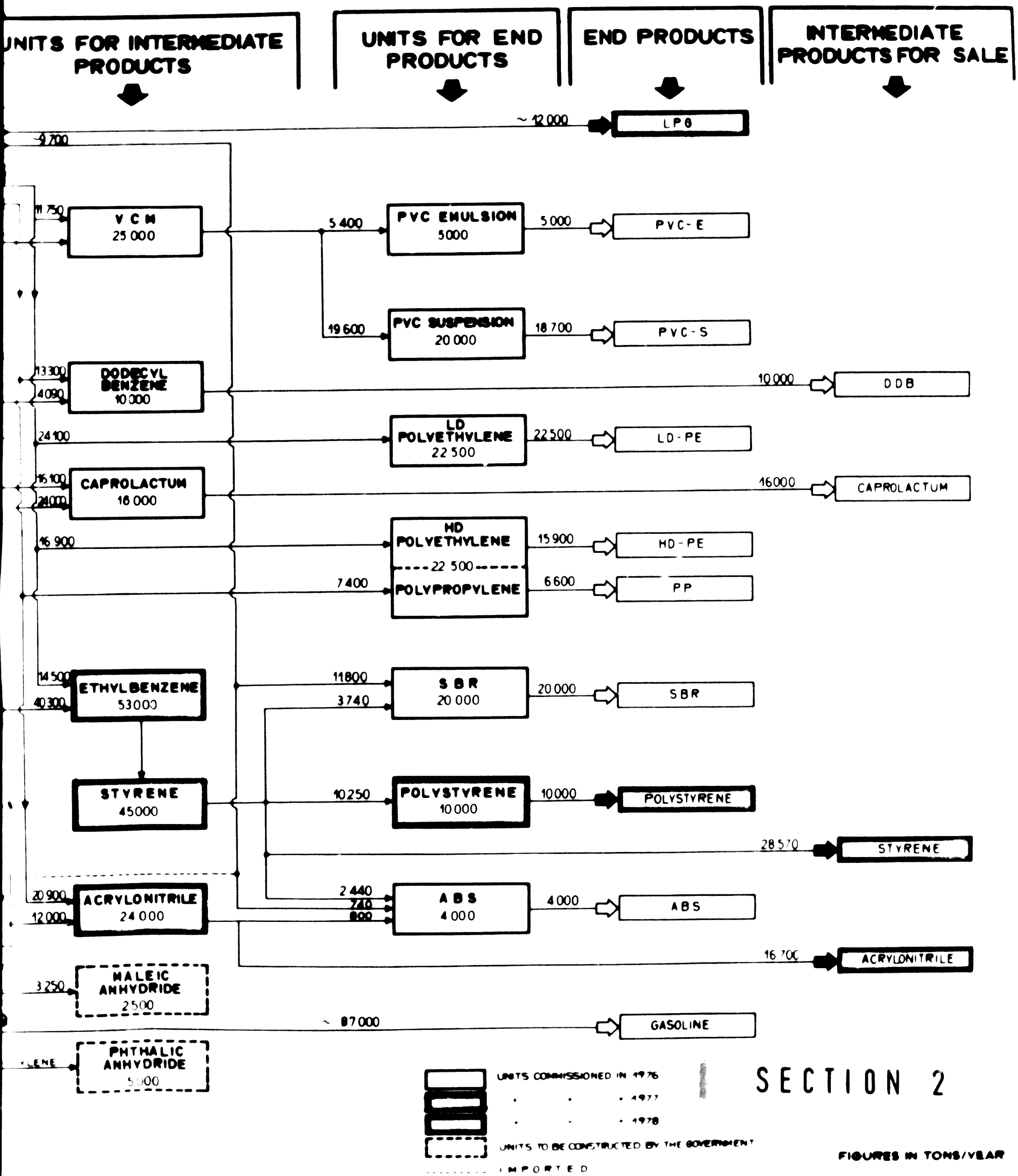
BLOCK FLOW DIAGRAM OF LIMA - FIRST STAGE



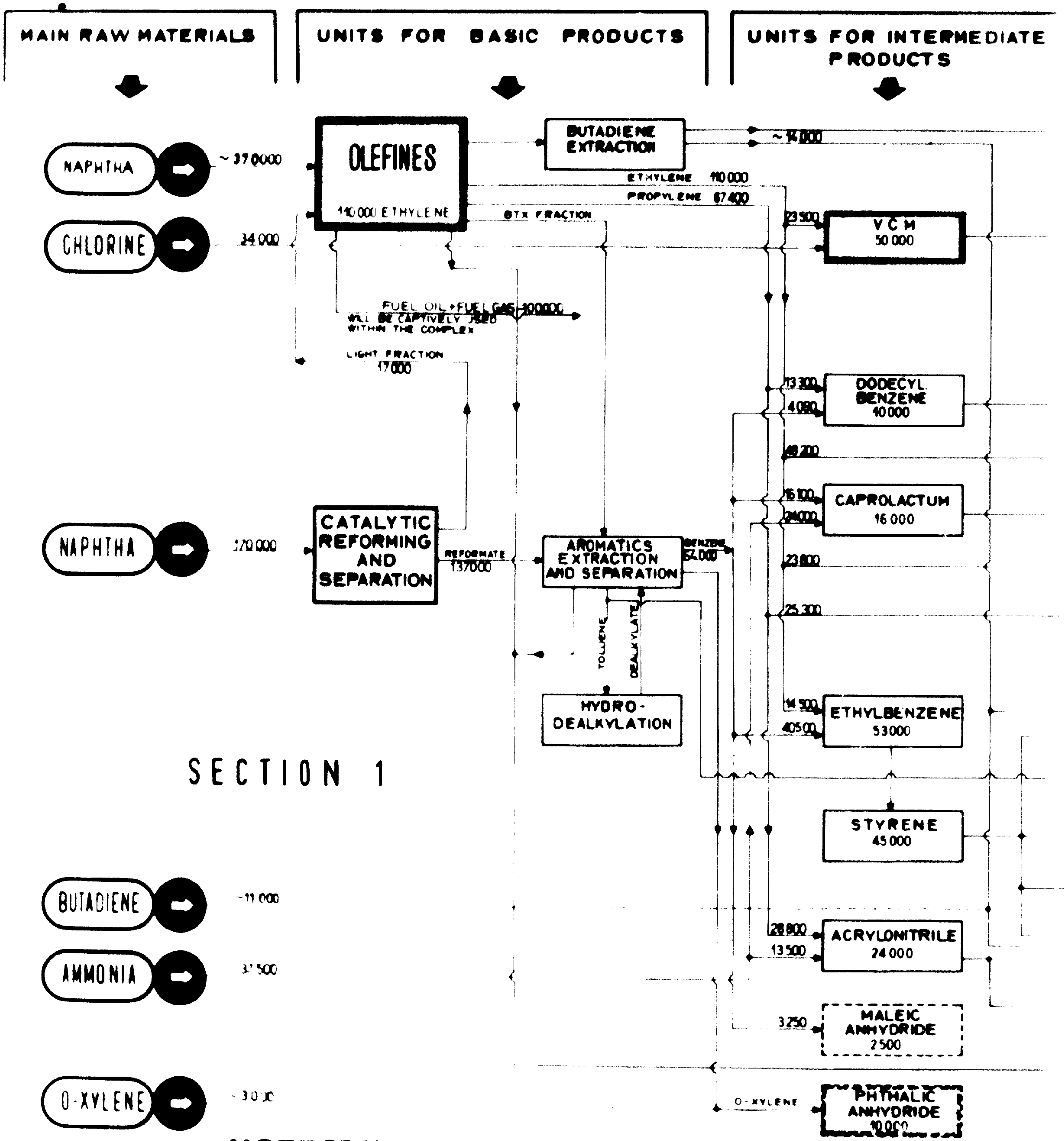
NOTE THE FIGURES IN RECTANGLES STAND FOR CAPACITIES OF RESPECTIVE PLANTS AND ARE FIRM.

THE FIGURES ON LINIES STAND FOR PROVIDED OUTPUTS AND/OR CONSUMPTIONS AND ARE SUBJECT TO MODIFICATIONS

RAM OF LIMA-CALLAO COMPLEX
FIRST STAGE



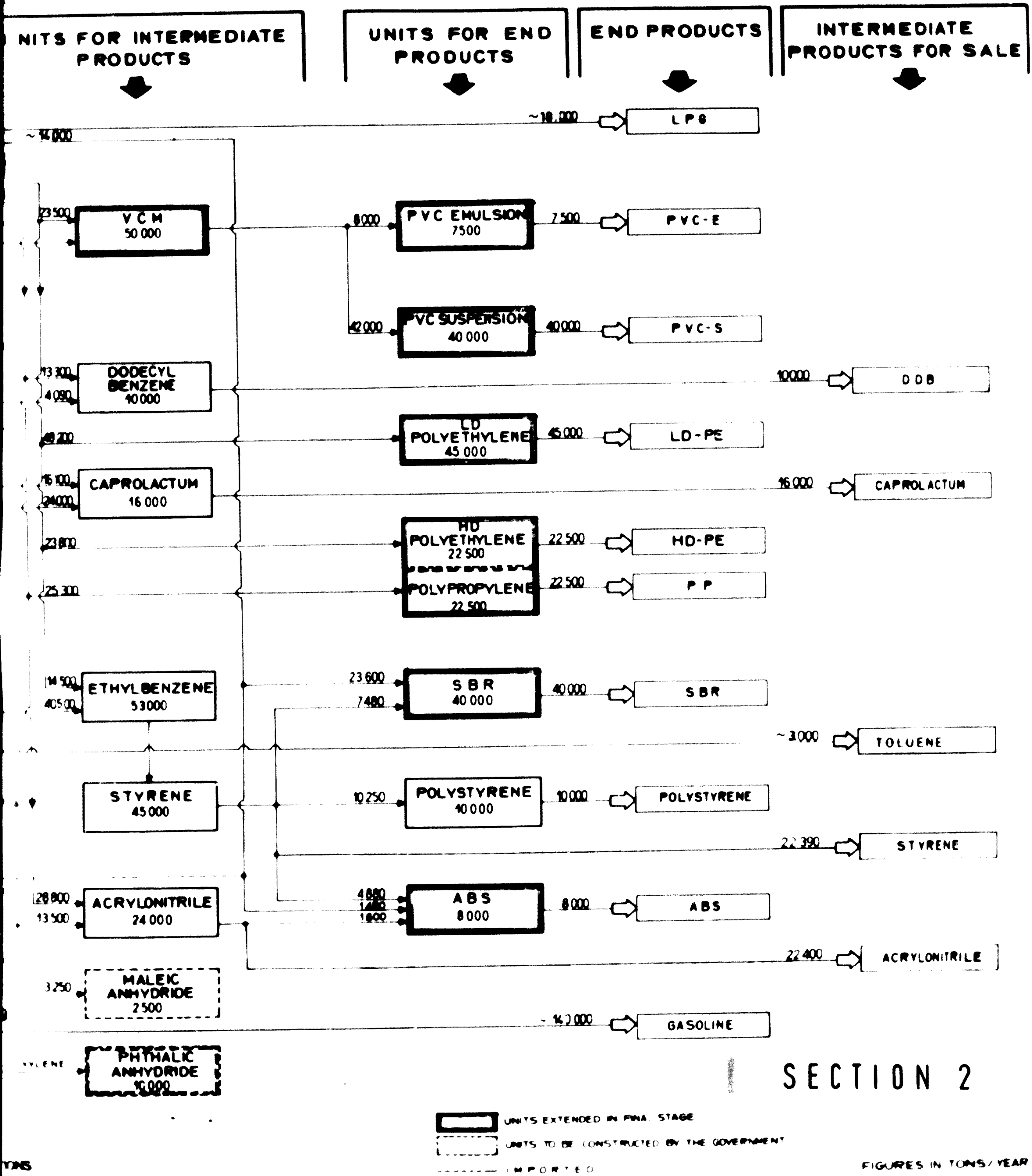
BLOCK FLOW DIAGRAM OF LIMA
FINAL STAGE



NOTE THE FIGURES IN RECTANGLES STAND FOR CAPACITIES OF RESPECTIVE PLANTS AND ARE FIRM.

THE FIGURES ON LINES STAND FOR PROVIDED OUTPUTS AND/OR CONSUMPTIONS AND ARE SUBJECT TO MODIFICATIONS

RAM OF LIMA-CALLAO COMPLEX
FINAL STAGE



SECTION 2

1.5. RAW MATERIALS

When preparing the tender, the BIDDER has to consider the following main raw materials available:

1.5.1. Naphtha for pyrolysis

Naphtha having the following quality specification shall be used as raw material for the olefine plant:

- distillation range	106^{o} - 310^{o} F (41^{o} - 155^{o} C)
- specific gravity	0.69
- paraffins Vol. %	83
- naphthenes Vol. %	14
- aromatics Vol. %	3

1.5.2. Naphtha for catalytic reforming

As raw material for the catalytic reforming the BIDDER will consider the primary distillation naphtha, depentanized fraction, having the following quality specification:

	Total Fraction	Depentanized Fraction
L.V. % of total fraction		92.9
Sulphur, total, ppm	7.2	
Total, chlorides, ppm	< 1	
Total nitrogen, ppm	0.1 ± 0.1	
Lead, ppb	< 20	
Copper, ppb	< 1	
Arsenic, ppb	< 1	

A.P.I. Gravity at 15.5°C	58.9	56.7
Sp. Gravity at 15.5°C	0.7432	0.7519
Distillation (ASTM D 86)		
I.B.P., °C	55	83
5 %	67.5	94
10 %	76	98
20 %	95.5	103
30 %	103	107.5
40 %	110	113
50 %	116.5	119
60 %	123	125.5
70 %	129	131.5
80 %	138	141
90 %	152	153.5
95 %	164.5	165
E.P. °C	182.5	182.5
% Recovered	98.0	99.0
% Bottoms	1.0	1.0
% Loss	1.0	

Converted from °F

Fraction and Component Analysis :

Composition (Liquid Volume %)

Propane	0.1
Isobutane	0.5
Normal butane	1.3
Isopentane	2.9
Normal pentane	2.3
Depentanizer bottoms	92.9

PONA Analysis of Depentanizer Bottoms

Paraffin Fractions :	L.V. %
I.B.P. - 83°C	9.0

83 - 108°C	10.6
108 - 134°C	10.6
134 - E.P.	10.4
Naphthene Fractions:	
Cyclopentane	0.3
Methylcyclopentane	2.6
Cyclohexane	2.3
Total C_7 naphthenes	14.6
Total C_8 naphthenes	13.9
Total C_9^+ naphthenes	21.1
Aromatics Fractions:	
Benzene	0.3
Toluene	0.6
Total C_8 aromatics	2.1
Total C_9^+ aromatics	1.6

1.5.3. Liquid Ammonia

Liquid ammonia with the following quality specification:

- concentration	min.	95.5 % wt.
- evaporation residue	max.	6,000 ppm wt.

1.5.4. Chlorine

Gaseous chlorine with the following quality characteristics :

- concentration	97 % vol.
- carbon dioxide	0.4 % vol.
- hydrogen	1.0 % vol.
- moisture	50.0 ppm vol.
- air	balance

Liquid chlorine with a minimum concentration of 99.9 % vol.

In stage I, the entire required amount of chlorine (about 170,000 to/year) will be supplied under gaseous state, by neighbouring enterprise by means of a pipeline.

In the final stage, the additional required amount wil' be supplied, under liquid state, from great distances.

1.5.5. Natrium Hydroxide

Natrium hydroxide, solution having the following quality:

- total alkalinity, as Na_2O	38.1	% wt.
- NaOH content	48	% wt.
- Na_2CO_3 content	0.5	% wt.
- Fe	0.005	% wt.

1.5.6. Sulphuric Acid

Sulphuric acid of the following grade:

- total acid (as H_2SO_4)	min.	95	% wt.
- density at 20^oC	min.	1.834	gr/ml.
Impurities :			
- As	max.	30	ppm
- Chlorides (as Cl^-)	max.	20	ppm
- Fe	max.	150	ppm
- Heavy metals (as Pb)	max.	50	ppm
- Nitrates (as NO_3)	max.	10	ppm
- Oxidizing or reductive agents (as SO_2)	max.	40	ppm
- Calcination residue	max.	500	ppm

1.5.7. <u>Butadiene</u>

Butadiene, as extra amount provided from outside the COMPLEX shall meet the grade indicated by the BIDDER

1.6 STORAGES AND WAREHOUSES FOR RAW MATERIALS, FUELS, INTERMEDIATE AND END PRODUCTS, AUXILIARY AND MAINTENANCE MATERIALS

In view of meeting storage requirements of the COMPLEX, the BIDDER shall provide

- tank yards for liquid products,
- warehouses for solid products,
- warehouses for spare equipment and materials, spare parts, etc.

1.6.1. Tank yards for liquid products, namely :

- raw and auxiliary materials,
- intermediate and end products;
- fuel

will be arranged and sized in compliance with data and requirements listed in the technical specification under item 3.1.

" Day " tanks of process plants as well as tanks for utilities (water of various grades, nitrogen compressed air) will be provided within the relevant plants.

Tank yards for liquid products will be provided with loading/unloading platforms for products leaving or entering the COMPLEX

1.6.2. Warehouses for products and materials, namely:

- raw and auxiliary materials;

intermediate and end products;

maintenance materials and others

will be arra[illegible] d and sizes according to the data and requirements given in the technical specification under item 3.2.

1.7. UTILITY SOURCES AND PLANTS

1.7.1. Available Sources :

a/. Water

In the COMPLEX area, the following water sources are available :

- sea water;
- underground water;
- surface water from the rivers: Chillon (flowing into the ocean in the close neighbourhood of the COMPLEX) and Rimac (at about 15 Km. south of the COMPLEX).

Detailed data on these water sources are given in Volume IV chap. 5.

By considering these data, the GOVERNMENT concludes that :

- sea water stands for the only economic source of cooling water and feed water for the internal fire fighting systems;
- underground water, in limited quantities can meet the requirements of drinking water, feed water for the steam boilers and process water, adequate to the respective application;
- surface water cannot be considered, since the Chillon river has relatively low and extremely variable flow rates, sometimes reaching zero in winter time; the water of the Rimac river is highly contaminated by the discharge of waste waters from Lima. The use of the waters of these rivers would imply

considerable work and investments for normalizing the flow rates and for water treatment which is not planned by the GOVERNMENT for the present.

Facilities for collecting and supplying underground water (under natural state) up to the COMPLEX limits are provided by the GOVERNMENT.

All other works aimed at providing water necessary to the COMPLEX will be included in the tender.

For this purpose, the BIDDER will provide equipment, adequate control apparata and piping required for recovering condensated water to the greatest extent.

The BIDDER shall consider and adopt air cooling whenever it is more efficient than sea-water cooling.

If - however - considering the disadvantages of sea water and data related to the Chillon and Rimac rivers - the BIDDER reaches the conclusion that the use of the water from these rivers would be more efficient than that of sea water, the BIDDER is entitled to work out an alternative of supply with surface water, showing the advantages which may be obtained.

b/. Electric Power

Considering planned developments of the national power system in Peru, a part of the power required by the COMPLEX could be obtained from this electric power system.

Certain reasons explained in the technical specification for the thermo - power station (item 4.1.) lead to the conclusion that it would be efficient and economic to produce the entire quantity of electric power required by the COMPLEX within a thermo - power station belonging to the COMPLEX.

Consequently, the national power system will be used as a partial spare power for failures of the COMPLEX thermo-power station as well as for the start-up period.

The high voltage connection line from the national electric network up to the incoming point into the connecting transformer station of the COMPLEX, will be provided by the GOVERNMENT, excluding the transformer station which has to be included in the tender (see technical specification under item 4.2.).

1.7.2. Utility Plants

The COMPLEX shall be provided with all the plants producing utilities required for the operation of the process plants (steam, electric power, nitrogen, technical and instrument compressed air, refrigerating agent, facilities for natural water treatment in view of reaching the conditions required by the process plants as well as the plants for waste water treatment for disposal into the ocean.

Consequently, the BIDDER has to provide and include in the tender:

- the thermo - power station producing steam and electric power;

- the electric connecting station between the COMPLEX and the national electric system ;
- the sea water collecting and treating plant;
- the underground water treating plant ;
- the nitrogen, oxygen and instrument compressed air plant ;
- the control refrigeration unit;
- the final waste water treating plant.

These plants are not limited to the above mentioned. The BIDDER may provide and include into the tender any other utility plants required for the satisfactory operation of the COMPLEX.

Detailed data and requirements as well as reference outputs for each plant for producing (treating) utilities are included in the technical specifications under item 4.

The final capacities of the utility plants will be defined by the BIDDER based on the general utility balance which shall be presented in the tender.

The BIDDER shall generally consider the capacities required for stage I providing also the possibility of further development - under the most economic conditions and without any interruption of the COMPLEX activity - to the capacities of the final stage.

The BIDDER is entitled to suggest from the very beginning the achievement of some equipment of parts of the plants for the final stage if he considers that such solutions are reasonable and lead to considerable savings for the final stage.

For instance: the buffer tanks for liquid nitrogen, the oxygen gas holder, the reagent unit of the final waste water treating plant and others can be sized from the beginning at the capacity of the final stage.

In this way a considerable ground saving (by avoiding equipment doubling) and an easy operation are achieved.

For all circumstances, the BIDDER shall specify in the tender the way each plant is planned to be expanded for the final stage.

1.8. PROCESS AND UTILITY NETWORKS.

The BIDDER shall provide and include in the tender:

a/. Pipes for transportation of some materials, auxiliary materials ans end - products between the process plants and between these and the storages.

b/. Pipes for transportation (distribution) of the utilities and fuels from the sources to the consuming plants and pipes for condensate water collecting and recovery.

The location of the process and utility pipes (on piperacks above ground or in ducts) will be suggested by BIDDER considering also the requirements specified in Volume IV, item 6.5. and will be shown in the tender.

c/. Trenches for waste water discharge including the collecting duct for disposal into the ocean complying with the requirements of Volume IV, item 6.7.

Sizing of the networks from the above items a, b and c shall be made from the very beginning for the final stage in order to avoid the replacement or doubling of these networks and the relevant desadvantages in the final stage. Only the connections to the plants of the final stage are excepted.

d/. Electric distribution networks including also the 6/0.4 Kv transformer units and the 6 and 0.4 Kv distribution units.

Related to the above mentioned, the BIDDER has to consider the requirements from Volume IV, item 6.6.

As far as the stages are concerned, the BIDDER shall consider the following requirements :

- the transformer and distribution units will be sized (equipped) for stage I providing the possibility of enlarging them, in the final stage, in an economic way and without interrupting the activity for the COMPLEX;

- cables shall be provided only for stage I.

1.9. OFFSITES

The BIDDER shall provide all offsite. required for the satisfactory operation of the COMPLEX.

The BIDDER will include but not limit to the following:

a/. Fire Fighting System

b/. Central workshops for :

- current repairs and maintenance of equipment;
- current repairs and maintenance of electric facilities and equipment;
- current repairs and maintenance of instruments;
- maintenance of transportation vehicles;
- maintenance of urbane public works.

c/. Central laboratory for raw materials and end product control as well as research works aimed at improving the processes.

Current analyses for process control will be performed in the laboratories of the process units, in each plant or group of plants, the BIDDER providing all necessary equipment.

d/. Weak current facilities (telephony, intercommunication system, telex, radio-relays, clock-systems).

e/. External lighting.

f/. Administration buildings consisting in :

- offices for administrative services and assembly rooms;

- labour protection office;
- first aid and medical assistance room;
- canteen with dining room.

g/. Social groups consisting in:

- sanitary groups;
- smoking room;
- laundries for protective clothes;

h/. Bus parking platforms.

i/. Places for rest, recreative and sportive activities, club, sports grounds.

j/. Internal roads and walks for pedestrians.

k/. Internal railroads.

l/. Enclosures, access gates and relevant facilities.

m/. Fire-station house.

Detailed requirements related to the main offsites are given in the technical specification under item 5.

For all offsites, the BIDDER shall specify in the tender sufficient qualitative and quantitative data on the basis of which the GOVERNMENT will compare and estimate relevant solutions suggested by the BIDDER and, after concluding the contract, will check if the CONTRACTOR has fulfilled his obligations concerning this category of works.

This provision refers to both offsites with or without technical specifications in the Tender Specifications.

1.10. MISCELLANEOUS

The BIDDER shall provide and include in the tender all equipment required for the operation of the COMPLEX, which has to belong to the COMPLEX inventory and which is not included in the works and supplier under items 1.3; 1.6; 1.7 and 1.8 mentioned abo .

In the scope of these supplies the following are included:

a/. Transportation means (cars, special tank truck or tank cars, switch locomotive, fork lifts) for the transport within the COMPLEX as well as for the transport of the products requiring special transportation means.

b/. Equipment and materials for labour protection.

c/. Computers, typewriten, reproducing machines.

d/. Any other equipment or device which the BIDDER, based on his own experience, considers necessary for the satisfactory operation of the COMPLEX.

1.11. LOCATION

The COMPLEX area is located along the coast of the Pacific Ocean at about 15 Km north of Lima and the Callao port. Northwards the COMPLEX will be bordered by the refinery, " La Pampilla " (after being enlarged)

Detailed data related to location (geographic position, relief and geological structure, climatic and seismic data, ways and means of communication, natural utility sources, etc) are given in Volume IV, item 1,2,3,4 and 5.

The site is grass root with no other existing or further use.

The available surface area is of about 130 ha, meeting the location requirements of all plants and offsites provided within the COMPLEX in the final stage, as described in Volume IV under item 3.2.

This section also deals with the principles and requirements to be considered when working out the final plot plan.

The final plot plan is to be analised and proposed by the CONTRACTOR and approved by the GOVERNMENT (according to the provisions under 7.8.1.).

All alternatives have to include further extensions planned for the final stage.

The BIDDER shall enclose to the tender a tentative plot plan, which may be Appendix VII, from Volum IV if the BIDDER agrees to it

2. TECHNICAL SPECIFICATIONS FOR THE PROCESS PLANTS

2.1. OLEFINE PLANT

(Pyrolysis Gasoline Hydrogenation Included)

2.1.1. Capacity

a/. Ethylene : stage I : 75,000 to/y

stage II: 110,000 to/y

The plant shall contiuously operate for 330 days/year at the guaranteed throughput of each stage and also at a reduced output down to about 55,000 to/y ethylene in stage I.

As far as scheduling is concerned, the following are to be specified:

- the achievement of the final capacity shall be made under conditions as economic as possible, by installing additional equipment (e.g. pyrolysis furnaces, compressors, etc.) and/or by sizing from the very beginning certain equipment (or units) for the final capacity (e.g. product separation and purification unit, gasoline hydrogenation unit);

- the BIDDER has to specify properly the way in which it is envisaged to reach final capacities and respectively the additional equipment required for this purpose as well as the possibility of including them within the plant.

The price of this equipment and, generally, of all additional works for reaching the final capacity shall be separately specified in the tender.

Time period between stages I and II will be of 3 - 5 years.

b/. Propylene

Under satisfactory operating conditions the propylene output shall be about 62% as compared to ethylene.

If this ratio can not be satisfactorily reached, the BIDDER has to specify limit propylene outputs which can be reached under various working conditions (see item 2.1.4.g too).

c/. By - Products

- Hydrogen;
- C_4 - cut;
- BTX - cut;
- Pyrolysis gasoline;
- Fuel gases which shall be used as fuel for the furnaces from the pyrolysis unit;
- Fuel oil which shall be entirely used within the COMPLEX;
- Other by-products and wastes for which the BIDDER shall provide facilities for their processing neutralization or disposal.

For all by-products, the BIDDER shall specify, in the tender, their relevant amounts.

2.1.2. <u>Product Quality</u>

a/. Ethylene

- concentration	min.	99.9	% vol
- methane+ethane+ propane+propylene +nitrogen	max.	1,000	ppm vol
- propylene	max.	20	ppm vol
- acetylene	max.	5	ppm vol
- hydrogen	max.	10	ppm vol
- nitrogen	max.	20	ppm vol

- oxygen	max.	5[x]	ppm vol
- carbon monoxide	max.	2[x]	ppm vol
- carbon dioxide	max.	5[x]	ppm vol
- methanol	max.	5[x]	ppm vol
- acetone	max.	2[x]	ppm vol
- water	max.	5[x]	ppm vol
- total sulphur	max.	3[x]	ppm wt
- ammonia	max.	5[x]	ppm
- NO_x	max.	5[x]	ppm
	max.	20	ppm vol

adequate to be used for producing HD-polyethylene, LD-polyethylene, VCM, ethyl-benzene.

Temperature at battery limit : max. 20^{o} C

Pressure min. 16 ats.

b/. Propylene

- concentration	min.	99.5	% vol
- ethylene	max.	25	ppm vol
- ethane	max.	250	ppm vol
- propane	max.	0.5	% vol
- nitrogen + methane	max.	300	ppm vol
- water	max.	10	ppm vol
- hydrogen	max.	10	ppm vol
- alenes	max.	10	ppm vol
- acetylenes	max.	5	ppm vol
- butylenes	max.	20	ppm vol
- butadiene	max.	10	ppm vol
- carbon monoxide	max.	1	ppm vol
- carbon dioxide	max.	5	ppm vol
- oxygen	max.	5	ppm vol
- sulphur	max.	3	ppm wt
- alenes + acetylenes butylenes + butadiene	max.	20	ppm

adequate for producing : polypropylene, acrylonitrile, propylene tetramer.

Pressure at plant battery limit: min. 16 ats

Temperature at plant battery limit: max. 30^{o} C.

c/. Hydrogen

- concentration	min.	95	% vol
- water	max.	10	ppm vol
- oxygen	max.	10	ppm vol
- $CO + CO_2$	max.	10	ppm vol
- methane + ethane + nitrogen	max.	5	ppm vol
- nitrogen	max.	1	ppm vol

Pressure at plant battery limit: min. 20 ats

d/. C_4 - cut

Informative composition of C_4-cut is the following:

- C_3 hydrocarbons	2	%
- C_5 hydrocarbons	2	% wt
- C_4 hydrocarbons	96	% wt

Complete composition shall be specified in the tender.

Pressure at plant battery limit: approx. 5 ats.

Temperature at plant battery limit: max. 30^{o} C.

e/. BTX - cut

- benzene		39-45	% wt
- toluene		25-31	% wt
- C_8 aromatics		15-17	% wt
- bromine number	max.	1 gr/100 gr.	
- diene number	max.	0.1	% wt.
- total sulphur	max.	1	ppm wt
- existing gums	max.	1	mgr/100 ml

adequate for aromatics extraction.

The BIDDER has to specify also the content of benzene, toluene, ortho-, meta- and para-xylenes, ethyl-benzene.

f/. Pyrolysis Gasoline

- potential gums	max.	3 mgr./100 ml
- induction period	min.	480 min
- dienes number	max.	3 % wt

Other charateristics, chemical composition, isoprene content and octane number have to be specified by the BIDDER.

g/. Fuel Gases, Fuel Oil and Other By-Products and Wastes

Their characteristics and processing possibilities have to be specified in the tender.

The above mentioned specifications of quality, pressure and temperature for ethylene, propylene, hydrogen and BTX-cut shall be compared by the BIDDER with the requirements of the plants to use these products.

In case of some discrepancies, the BIDDER shall change accordingly the quality of the olefine plant products as well as the conditions of their supply (pressure, temperature) at battery limits of the relevant plant.

2.1.3. Raw Materials

a/. Naphtha covering the required amount and having the following characteristics:

- Distillation range			106 - 310 ^{o}F
			(41 - 155 ^{o}C)
- Specific gravity			0.69
- Paraffins	vol	%	83
- Naphthenes	vol	%	14
- Aromatics	vol	%	3

b/. C_3 - C_4 - cut produced by the catalytic reforming. Quantity and characteristics of this have to be specified by the BIDDER in the tender for the catalitytic reforming plant. (See item 2.2. in this Volume).

2.1.4. Process

Steam cracking of naphtha specified under para 2.1.3., followed by ethylene and propylene separation and purification by rectification carried at low temperatures.

The plant shall mainly consist of the following units:

- pyrolysis, quench and steam generation;
- compression and treatment;
- acetylene removal and drying;
- ethylene separation;
- propylene separation;
- by-products separation;
- pyrolysis gasoline hydrogenation;
- refrigeration.

Pyrolysis gasoline is to be processed by catalytic hydrogenation for using it as motor gasoline.

The BIDDER has to provide equipment for BTX - cut separation and deep hydrogenation of this cut in view of using it as feedstock for aromatics extraction.

When preparing the tender, the BIDDER shall consider that:

a/. Obtained ethane and propane should be captively used, within the olefine plant, as feedstock for pyrolysis;

b/. Spare pyrolysis furnaces should be provide so that an emergency or systematic shut-down of the pyrolysis furnaces (e.g. for decoking processes) should not damage the ethylene and propylene output;

c/. All spare powers have to be recovered as much as possible (e.g. heat of pyrolysis gases, heat of fuel gases from the pyrolysis furnaces);

d/. Turbocompressors have to be actuated by steam turbines;

e/. Half of the ethylene output should be reached at a pressure of about 16 ats (pressure corresponding to the ethylene column or to the last step of the ethylene compressor) whereas the remaining percentage of 50 % to be reached at the pressures corresponding to intermediate compression steps which have to bo specified in the tender.

Flow rates corresponding to this intermediate pressure have to be defined by the BIDDER.

A tank of 1,000 cu.m for liquid ethylene should be provided outside the battery limit but connected in process with the refrigeration unit within the ethylene plant;

g/. The plant shall operate either " on ethylene " or " on propylene " allowing for a switch-over, under the widest possible limits (to be specified in the tender), of the ratio between produced ethylene and propylene.

2.1.5. Fuel

The BIDDER shall first consider off gases and fuel oil from the pyrolysis plant. As make-up and for meeting start-up requirements, the BIDDER may rely on fuel gases from the neighbouring refineries having the characteristics listed below as follows:

H_2 (+ inerts)	56	% molar
C_1	22.5	% molar
C_2	14.5	% molar
C_3	6	% molar
$iC_4 + nC_4$	1	% molar

Pressure : 2 atm. approximately.

Heating power : 7,000 Kcal/N cu.m approximately.

2.2. CATALYTIC REFORMING PLANT

2.2.1. Capacity

The plant has to process 170,000 to/year feedstock and to operate continuously for 330 days/year.

The BIDDER has to specify the amounts of obtained end-products corresponding to the feedstock and raw material quality characteristics.

The plant has to be capable of operating satisfactorily at 75 % of the design capacity too.

2.2.2. Product Quality

a/. Aromatic Reformate

The approximate composition is the following:

- benzene	4 - 5	% wt
- toluene	19 - 20	% wt
- o-xylene	5 - 6	% wt
- C_8 aromatics	19 - 20	% wt
- C_9^+ aromatics	32 - 33	% wt
- non-aromatics	17 - 18	% wt

The accurate composition and other characteristics shall be defined by the BIDDER.

b/. Hydrogen rich gas

The quality specification shall be defined by the BIDDER. This gas shall be partly used in the toluene dealkylation plant and the excces shall be sent to the fuel gas network of the COMPLEX.

c/. $C_1 - C_2$ fuel gases

Quality specification shall be indicated by the BIDDER. These gases shall be fed into the fuel gas network of the COMPLEX.

d/. C_3 C_4 Cut (L.P.G.)

The BIDDER has to specify the composition of this cut. This cut shall be used as feedstok for pyrolysis.

2.2.3. Raw Materials

Naphtha dependentanized cut with the following characteristics :

	Total Fraction	Depentanized Fraction
L.V. % of total fraction		92.5
Sulphur, total, ppm	7.2	
Total, Chlorides, ppm	1	
Total Nitrogen, ppm	0.2 ± 0.1	
Lead, ppb	20	
Copper, ppb	1	
Arsenic, ppb	1	
A.P.I. Gravity 15.5 °C	58.9	56.7
Sp. Gravity at 15.5 °C	0.7432	0.7519
Distilation (ASTM-D-86)		
I.B.P., °C	55	83
5 %	67.5	94

10 %	76	98
20 %	95.5	103
30 %	103	107.5
40 %	110	113
50 %	116.5	119
60 %	123	125.5
70 %	129	131.5
80 %	138	141
90 %	152	153.5
95 %	164.5	165
E.P., °C	182.5	182.5
% Recovered	98.0	99.0
% Bottoms	1.0	1.0
% Loss	1.0	

Converted from °F

Fractionation Component Analysis :

Composition (Liquid Volume %)

- Propane	0.1
- Izobutane	0.5
- Normal Butane	1.3
- Isopentane	2.9
- Normal Pentane	2.3
- Dependanizer Bottoms	92.9

PONA analysis of Depentanizer bottoms :

Paraffin Fractions :	L.V. %
I.B.P. - 83°C	9.0
83 - 108°C	10.6
108 - 134°C	10.6
134°C - E.P.	10.4

Naphthene Fractions

Cyclopentane	0.3
Methylcyclopentane	2.6
Cyclohexane	2.3
Total C_7 Naphthenes	14.6
Total C_8 Naphthenes	13.9
Total C_9 + Naphthenes	21.0

Aromatics Fractions

Benzene	0.3
Toluene	0.6
Total C_8 Aromatics	2.1
Total C_9 + Aromatics	1.5

2.2.4. Process

Catalytic reforming at low or mean pressure of naphha with bimetal catalyst, leading to a maximum yield of aromatic reformate.

Aromatic reformate processing is carried together with BTX cut from the pyrolysis plant, in a common plant (see Technical Specification, item 2.3).

2.3. AROMATICS EXTRACTION AND SEPARATION PLANT

2.3.1. Capacity :

The plant should be capable of processing the aromatic reformate produced by the catalytic reforming plant as well as BTX cut produced by the olefine plant in quantities corresponding to the final stage, namely:

- from the olefine plant : about 80,000 to/year (BTX-cut)
- for catalytic reforming : about 140,000 to/year (reformate).

Accurate quantities of these cuts are to be defined by the BIDDER.

The plant should be capable of working continuously for 330 days/year.

Aromatics separation unit shall be sized for processing in addition about 43,000 to/year mixture rich in benzene with about 65 % benzene produced by the toluene dealkylation plant. (The accurate quantity and composition of this mixture shall be defined by the BIDDER).

The plant shall satisfactorily run at a lower capacity down to 70 % of the design capacity too.

2.3.2. Product Quality

a/. Benzene, nitration grade as per ASTM D - 835-50 :

- concentration	min.	99.9 %
- melting point	min.	5.5 ^{o}C
- total sulphur	max.	0.5 ppm
- thiofuran (expressed as total sulphur)	max.	0.5 ppm
- bromine number	max.	1 ppm
- specific gravity at 15.5 ^{o} C :		0.882 - 0.886
- distillation range		96 % distilled within the range of 0.4 ^{o} C (including the temperature of 80.1 ^{o} C)

b/. Toluene, nitration grade as per ASTM D 841-50

- specific gravity at 15.5 ^{o} C :	0.8690 - 0.8730
- colour :	not darker than a solution of 0.0030 g of. $K_2Cr_2O_7$ in 1 liter of water;
- range of distillation at 700 mm. Hg. for any sample:	not more than 1 ^{o}C, including the temperature of 110.6 ^{o}C.
- paraffines :	not more than 1.5 % vol.
- acid wash colour :	not darker than no.2 colour standard.
- acidity :	no free acid; that is, no evidence of acidity;
- sulphur compounds:	free of H_2S and SO_2;
- copper corrosion :	copper strip shall not show iridescence nor a gray or black deposit or discolouration.

c/. O-oxylene, nitration grade, as per ASTM D-843-67

- concentration	min.	96 % wt

ortho meta paraxylene, ethyl benzene and toluene content (total)	min.	98.5	% wt
non aromatics, benzene, C_9 aromatics and higher aromatics (total)	max.	1.5	% wt
non aromatics	max.	0.5	% wt
free acids		nil	
evaporation residue	max.	20	ppm wt
soluble metallic matter	max.	2	ppm wt

adequate to produce phthalic anhydride.

d/. By-products

The BIDDER has to specify the amounts and quality characteristics of by-products as well as methods for rendering them valuable.

Quality characteristics mentioned above for benzene, toluene and o-xylene shall be compared by the BIDDER with the requirements of the consuming plants within the COMPLEX. In case of discrepancies, the BIDDER shall change accordinly the quality of the products of the aromatics extraction plant.

2.3.3. Raw Materials

a/. Aromatic Reformate

Aromatic reformate composition is indicated at item 2. under 2.2.c.

b/. BTX-Cut from pyrolysis

BTX-cut composition is indicated at item 2 under 2.1.2.e.

c/. Mixture rich in benzene from toluene dealkylation.

2.3.4. Process

The process consists in extraction with selective solvents (diethylene glycol + triethylene glycol, sulpholane or N-methyl pyrrolidone) for an advanced recovery of benzene, toluene and xylenes.

Aromatics extraction is to be followed by the separation process by rectification of benzene, toluene and o-xylene. The other aromatic components (meta - and paraxylenes, ethyl-benzene and C_9 aromatics) will not be separated.

2.4. TOLUENE DEALKYLATION PLANT

2.4.1. Capacity

The plant shall process the entire amount of toluene produced by the COMPLEX in the final stage (from the olefine and catalytic reforming plants and aromatics separation plant respectively) .

The estimated quantity is of 43,000 to/year toluene. The accurate figure shall be defined by the BIDDER.

The plant should be capable to run satisfactorily even at a lower capacity down to 75 % of the planned design capacity .

2.4.2. Product Quality

a/. The tender has to specify the composition of the product with a rich benzene content, produced by the offered plant.

b/. By-products, Wastes

The BIDDER has to define the characteristics of by-products and wastes (fuel gases, heavy aromatics, etc.) .

2.4.3. Raw Materials

a/. Toluene, nitration grade, as per ASTM D 841-66 (see Technical Specification 2.3., 2.3.2.b.).

b/. Hydrogen, from the olefine plant, meeting the quality indicated under item 2., 2.1.2.c; or from the catalytic reforming plant.

2.4.4. Process

The process consists in catalytic toluene dealkylation to benzene in the presence of hydrogen.

Separation and purification of benzene produced by the reaction is performed in the aromatics extraction and separation plant which has to be properly sized (see Technical Specification 2.3.).

The BIDDER shall also provide the most complete recovery of waste heat from the reactant preheating furnace.

Fuel gases released from the process, shall be fed into the fuel gas network of the COMPLEX.

2.5. BUTADIENE EXTRACTION PLANT

2.5.1. Capacity

The plant has to be capable to operate continuously 330 days/year and to process the C_4-cut produced in the olefine plant in a quantity corresponding to the final stage.

The estimated quantity of C_4-cut is of 42,000 to/year approximately.

The accurate amount of this cut shall be indicated by the BIDDER.

The BIDDER also has to define and specify in the tender the capacity of the plant expressed as to/year butadiene as well as the relevant amounts of by-products.

2 5.2. Product Quality

a/. Butadiene

- concentration	min	99	% wt
- acetylenes (vinyl-acetylene included)	max.	200	ppm wt
- sulphur (H_2S)	max.	10	ppm wt
- non-volatile matter	max.	0.1	% wt
- inhibitor (T.B.C.)		100-200	ppm wt

adequate to produce SBR and ABS.

b/. By-products

- Butene - Cut

The tender has to specify the characteristics as well as the processing possibilities.

- Butane - Butene Cut (Off-gas)

The characteristics of this cut shall be specified in the tender. For use or bottling, the relevant cut shall be sent to the neighbouring refinery.

The above mentioned quality characteristics of butadiene have to be compared with those specified by the licensors of the plants of SBR and ABS rubber. In case of discrepancies the BIDDER shall change the quality characteristics of the butadiene resulting from the aromatics extraction and separation plant.

2.5.3. <u>Raw Materials</u>

C_4-cut produced in the olefine plant.

Quality characteristics of this cut shall be defined by the BIDDER.

2.5.4. <u>Process</u>

The process consists in extractive distillation with selective solvent, N-methyl pirrolidone, dimethyl phormamide or acetonitrile.

The process making use of acetonitrile shall be preferred by the BIDDER because the product is available within the COMPLEX as a by-product of the acrylonitrile plant.

The BIDDER shall provide:

a/. The solvent regeneration plant within the plant's battery limit;

b/. Necessary steps to prevent the formation of polymers during distillation as well as any emergency, considering the special danger owed to the acetylene compounds;

c/. End-product inhibition.

2.6. VINYL CHLORIDE PLANT

(Dichloroethane Process Included)

2.6.1. Capacity

Vinyl Chloride:	stage I	: 25,000 to/year
	final stage	: 50,000 to/year

The plant shall be capable of running 330 days/year.

During stage I, the BIDDER has to consider the most economic possibilities of development for the final stage.

The BIDDER has to consider the opportunity of realizing, even during the first stage, auxiliary facilities (e.g. refrigeration units, catalyst plants, etc.) at their final capacity.

By-products: the amounts of by-products resulting from the process shall be specified by the BIDDER.

2.6.2. Product Quality

a/. Vinyl Chloride

- concentration	min.	99.95	% wt
- acidity (as HCl)	max.	0.5	ppm wt
- acetylene compounds	max.	1	ppm wt
- aldehydes	max.	10	ppm wt
- butadiene	max.	5	ppm wt
- iron	max.	0.5	ppm wt
- water	max.	70	ppm wt

- chlorinated
  compounds max. 40 ppm wt

adequate to be used for suspension or emulsion polymerization.

b/. By-products

Quality specification and possible processings are to be provided in the tender.

The above mentioned quality conditions of vinyl chloride are to be compared with those requested for the PVC-suspension and PVC-emulsion plants which will make use of this product and change them accordingly, if necessary.

2.6.3. Raw materials

a/. Ethylene from the olefine plant having the characteristics specified under item 2.1.2.a.

b/. Gaseous Chlorine, having the following composition:

- concentration Cl_2	97.0	% vol
- carbon dioxide	0.4	% vol
- hydrogen	1	% vol
- moisture	50	ppm
- air	balance	

reaching a quantity of about 17,000 to/year

c/. Liquid Chlorine with a concentration of minimum 99.9 % as a balance quantity for the final stage.

2.6.4. Process

The process consists in dichloroethane cracking at high pressure, followed by vinyl chloride separation and purification.

Dichloroethane is to be produced both by direct chlorination of ethylene and by oxychlorination (with air or oxygen) using the entire amount of hydrochloric acid from dichloroethane cracking.

Provided that the oxychlorination process with oxygen is used, the BIDDER shall make provisions for producing the required oxygen within the COMPLEX (see Technical Specification under 4.6.) .

The BIDDER shall provide (within battery limit), catalyst plant as well as auxiliary facilities specific to the suggested process (e.g. refrigeration units).

Unreacted ethylene shall be returned to the ethylene plant, purification unit, in order to be recovered.

The plant should be capable of performing purification of vinyl chloride recovered and recycled from the polymerization units up to the conditions listed under 2.6.2.a.

2.7. DODECYLBENZENE PLANT

2.7.1. Capacity :

Dodecylbenzene : 10,000 to/year

The plant has to operate continuously 330 days/year at the designed capacity or below design capacity down to 75 % of it.

Annual amounts of by-products resulting from the process have to be specified, by the BIDDER.

2.7.2. Product Quality

a/. Dodecylbenzene for detergents :

- specific gravity at 15.5^{o} C :	0.871 - 0.875
- boiling range, ^{o}C	256 - 300
- sulphonation degree	min. 98 %
- Saybolt colour	+ 30

b/. By-products

Light Alkylate :

- specific gravity	0.822
- boiling range, ^{o}C	100 - 275

Heavy Alkylate :

- specific gravity	0.940
- boiling range, ^{o}C	over 325

2.7.3. Raw Materials

a/. Propylene from the olefine plant having the quality characteristics as listed in Technical Specification 2.1. (under 2.1.2.b.).

b/. Benzene, with quality as provided under item 2.3.2.a.

2.7.4. Process

The plant will consist of two main units, namely :

a/. Production of propylene tetramer (dodecene) by catalytic polimerization of propylene in a continuous system, within column-type reactors.

b/. Benzene alkylation with propylene tetramer in the presence of catalysts, hydrofluoric acid being preferred.

The BIDDER has to suggest methods for processing by-products.

2.8 CAPROLACTUM PLANT

2.8.1. Capacity

a/. Caprolactum : 16,000 to/year

The plant has to operate continuously 330 days/year at design capacity or below design capacity down to 75 % of it.

b/. Ammonium sulphate (by-product).

Annual output is to be specified in the tender.

2.8.2. Product Quality

a/ Caprolactum

- aspect	white crystals	
- colour (40-50 % solution)	max.	5 units APHA
- water content	max.	0.05 % wt
- melting point	min.	$68.8^{o}C$
- volatile alkalies	max.	5 ppm
- acidity	nil	
- alkalinity	max.	0.02 mg/kg
- permanganate index: (3 % solution)	min.	10,000 sec.

adequate for producing fibres.

b/. Ammonium sulphate (by-product)

- moisture	max.	0.1 %
- nitrogen	min.	21.0 %
- free sulphuric acid	max.	0.02 %

2.8.3. Raw Materials

a/. Benzene having the quality characteristics as listed under item 2.3.2.a.

b/. Hydrogen produced in the olefine plant and having the quality characteristics as listed under item 2.1.2.c.

c/. Ammonia having the following quality :

- concentration	min.	99.95 % wt
- evaporation residue	max.	5,000 ppm wt

d/. Natrium Hydroxide - solution having the following quality characteristics :

- total alkalinity, as Na_2O	38.1 % wt
- NaOH content	48 % wt
- Na_2CO_3 content	0.5 % wt
- Fe	0.005 % wt

e/. Other Raw Materials

These raw materials and their minimum quality requirements shall be defined in the tender.

2.8.4. **Process**

The process based on benzene has the following alternatives :

- conventional process (with an increased production of ammonium sulphate);
- process leading to a reduced production of ammonium sulphate.

Preference is given to the latter process (with a reduced amount of ammonium sulphate), consisting of the following main stages :

production of cyclohexane by benzene hydrogenation;

production of cyclohexane by cyclohexane oxidation followed by saponification and purification;

- production of hydroxilamine by hydrogenation of ammonia oxides (direct process) .

- production of cyclohexane from cyclohexanone and hydroxilamine;

- production of caprolactum by cyclohexanone oxime transposition;

- caprolactum purification.

The tender shall also contain auxiliary plants (ammonium sulphate crystallization, waste incineration, etc.) .

2.9. ETHYL - BENZENE PLANT

2.9.1. Capacity

a/. Ethyl-benzene : 53,000 to/year approximately

The plant's output has to cover the ethyl-benzene requirements of the styrene plant with a capacity of 45,000 to/year.

Consequently, the accurate capacity shall be defined by the BIDDER in accordance with the consumption of a the styrene plant.

The plant shall have to run continuously for 330 days/year at design capacity or below design capacity down to 75 % of it.

b/. Polyalkylbenzene

Annual output which has to be as small as possible, shall be specified by the BIDDER.

2.9.2. Product Quality

a/. Ethyl-benzene

- concentration	min.	99.6	% wt
- benzene + toluene	max.	0.3	% wt
- diethyl-benzene + isopropyl-benzene	max.	40	ppm wt
- chlorine	max.	5	ppm wt

suitable to be used producing styrene meant to polystyrene production.

b/. Polyalkylbenzene

Quality characteristics as well as possible applications shall be specified in the tender.

2.9.3. Raw Materials

a/. Ethylene having the quality characteristics as listed under item 2.1.2.a.

b/. Benzene, nitration grade as per ASTM D - 835-50 (see item 2.3.2.c.)

2.9.4. Process

The process consists in benzene alkylation with concentrated ethylene in the presence of a catalyst, in a neutral (Alkar process) on acid (aluminium chloride process) medium.

For increasing the ethyl-benzene ratio, the BIDDER shall provide a reactor for transalkylation of heavy products.

When using the aluminium chloride process, provisions should be made for the neutralization and purification of acid waste water in order to recover hydrocarbons (by stripping) and to partially reuse water for washing purposes.

As the plant is located in the neighbourhood of a styrene plant the BIDDER has to consider that the obtained polyalkyl-benzene will be used in the styrene plant, as a diluant in the final styrene distillation process.

Wherever possible, the sensible heat of various fluids shall be recovered by producing approximately 2 ats steam.

2.10. STYRENE PLANT

2.10.1. Capacity

a/. Styrene : 45,000 to/year by a continuous running of 330 days/year.

The plant should be also capable to operate satisfactorily at 75 % of the design capacity.

b/. By-products

- Benzene
  Annual output shall be specified in the tender.

- Toluene Cut
  Annual output shall be specified in the tender.

2.10.2. Product Quality

a/.Styrene

- concentration	min.	99.7	% wt
- polymer	max.	0.005	% wt
- aldehydes (as benzaldehyde)	max.	0.02	% wt
- stabilizer content	max.	10	ppm
- density at 25°C		0.9038-0.9057	
- refraction index, $n_D 26$	min.	1.54	
- viscosity at 25°C	max.	0.87	cP
- sulphur	max.	0.01	% wt
- chlorine	max.	0.01	% wt

- peroxides, as
  diethyl peroxide max. 0.01 % wt
- colour max. 10 units APHA

suitable to be used for producing polystyrene, and styrene co-polymers.

b/. By-products

- Benzene

Quality and application shall be indicated in the tender.

- Toluene Cut

Quality and application shall be indicated in the tender.

Quality characteristics of by-products shall be specified in the tender.

2.10.3. Raw Materials

Ethyl-benzene having the quality as specified in Technical Specification 2.9. under 2.9.2.a.

2.10.4. Process

The process consists in catalytic dehydrogenation of ethyl-benzene in an adiabatic reactor, at high temperature and low pressure, followed by product separation and purification.

The BIDDER shall indicate processing possibilities of the tar resulting from the process.

Since the styrene plant shall be located in the neighbourhood of the ethyl-benzene plant, it may produce polyalkyl-benzene which will be used as diluant for the bottoms of the styrene purification column.

2.11. ACRYLONITRILE PLANT

2.11.1. Capacity

a/. Acrylonitrile: 24,000 to/year by a continuous operation of 330 days/year.

The plant should be also capable of running satisfactorily at 75 % of the design capacity.

b/. By-products

- Acetonitrile
- Ammonium Sulphate
- Hydrocyanic Acid

Annual outputs shall be specified by the BIDDER.

2.11.2. Product Quality

Acrylonitrile :

- concentration	min.	99.8	% wt
- acetone	max.	200	ppm wt
- acetonitrile	max.	250	ppm wt
- acidity as acetic acid	max.	20	ppm wt
- aldehydes as acetaldehyde	max.	50	ppm wt
- acroleine	max.	6	ppm wt
- copper	max.	0.1	ppm wt
- hydrocyanic acid	max.	5	ppm wt
- iron	max.	0.1	ppm wt

- water	max.	0.45	% wt
- peroxides	max.	0.2	ppm wt
- colour	max.	5	units APHA
- inhibitor	max.	45	ppm wt
- cyanobutadiene		nil	
- non-volatile matter	max.	100	ppm wt
- methyl-vinyl cetone		traces	
- stability at oxygen bomb	min.	4	hours
- pH		6.0 - 7.5	
- refraction index at 25°C		1.3882-1.3892	
- appearance		clear, suspension free	
- distillation range		74.5-78.5°C	
- specific gravity at 15-25°C		0.7990-0.8020	

adequate to produce PNA-type synthetic fibres.

By-products

a/. Acetonitrile

- concentration	min.	99.5	% wt
- acidity as acetic acid	max.	0.05	% wt
- water	max.	0.3	% wt
- acrylonitrile	max.	500	ppm wt
- hydrocyanic acid	max.	10	ppm wt
- free ammonia	max.	6	ppm wt
- Hazen colour	max.	15	
- clear, suspension-free			

adequate to be used as solvent for butadiene extraction.

b/. Ammonium Sulphate

Quality characteristics are to be indicated in the tender.

c/. Hydrocyanic Acid

concentration	min.	99.7	% wt

2.11.3. Raw Materials

a/ Propylene from the olefine plant, having the quality as specified under item 2.1.2.b.

b/. Ammonia having the following quality :

- concentration	min.	99.5	% wt
- evaporation residue	max.	5,000	ppm wt

c/. Natrium Hydroxide having the following quality characteristics :

total akalinity as Na_2O	31.1	% wt
- NaOH content	48	% wt
- Na_2CO_3 content	0.5	% wt
- Fe	0.005	% wt

2.11.4. Process

The process consists in catalityc amono-oxidation of propylene with ammonia, in the presence of air, at high temperature and low pressure, followed by product separation and purification. Hydrocyanic acid, obtained after purification, shall be used for further processing (by the GOVERNMENT).

The BIDDER shall consider the following requirements:

- to provide 2 fluidized bed reactors for producing acrylonitrile and to recover reaction heat, to the greatest extent;

- to provide acetonitrile purification for using it as solvent;
- to take all steps for labour protection and safety, when handling noxious substances;
- to provide treatment of waste water or waste water disposal by incineration;
- to design the plant as to make use both of A type catalyst and 21 - type catalyst;
- the plant shall be provided with special flare stack for burning hydrocyanic acid, when no further used.

2.12. PVC-SUSPENSION PLANT

2.12.1. Capacity :

a/. P.V.C.- suspension :

stage I : 20,000 to/year
final stage: 40,000 to/year

The plant shall be designed for a continuous operation of 330 days/year

The BIDDER has to consider the opportunity of realizing even during the first stage, several auxiliary plants (e.g. refrigeration units, waste water treatment plants, warehouses, etc.) at their final capacity.

b/. P.V.C. - quality II

The BIDDER shall indicate in the tender the outputs of PVC-quality II, as well as its quality characteristics (applications respectively).

2.12.2. Product Quality

The plant shall be designed to produce all PVC - suspension grades (trade marks) , as powder dust, for all common applications of this product, of the two main categories: compact and dry blend; for each catagory, there have to be produced various grades differentiated by K value and other characteristics such as :

Crrt No.	Quality Characteristics	Analytical Method	Type			
			I	II	III	IV
1	2	3	4	5	6	7
1.	K Value		61.5 - 63.5	63 - 65	69 - 71	73 - 75
2.	Intrinsic Viscosity	ASTM D 1243	0.78-0.83	0.82-0.89	0.99-1.05	1.11-1.17
3.	Volumetric Weight	ASTM D 1895	Defined for each grade of dry-blend and compact.			
4.	50 mesh sieve residue	ASTM D 1921	max. 0.5	max. 0.5	max. 0.5	max. 0.5
5.	Particles passed trough sieve 200 mesh	ASTM D 1921	max. 5.0	max. 5.0	max. 5.0	max. 5.0
6.	Water Content, %	Karl Fischer Method	max. 0.25	max. 0.25	max. 0.25	max. 0.25
7.	Ash Content, %	I. S. O.	0.00-0.03	0.00-0.03	0.00-0.03	0.00-0.03
8.	Chlorine Content, %	ASTM D 1303	56.3-56.8	56.3-56.8	56.3-56.8	56.3-56.8

1	2	3	4	5	6	7
9.	Thermal Conductivity microohm cm/gr	ASTM D 1755	0.15-0.30	0.25-0.75	0.4-1.2	0.5-1.4
10.	Flow Capacity under dry condition, sec. per 100 cu.cm.	ASTM D 1755 D 1895	7.9-10.2	7.9-10.2	7.9-10.2	7.9-10.2
11.	Plasticizer Absorption (parts per 100 parts polymer)	ASTM D 1755	Defined by the BIDDER for each grade. i.e : dry-blend and compact.			
12.	Methanol Extract %	ASTM D 2222	0.1-1.0	0.1-1.0	0.1-1.0	0.1-1.0
13.	Molecular Weight	Osmometric measurement	33.0×10^3 $\pm 3.0 \times 10^3$	44.0×10^3 $\pm 3.0 \times 10^3$	53.0×10^3 $\pm 3.0 \times 10^3$	58.0×10^3 $\pm 3.0 \times 10^3$
14.	Tensile Strength, psi	ASTM D 882	2,300 min.	2,300 min.	2,600 min.	2,700 min.
15.	Elongation, %	ASTM D 882	290 min.	290 min.	290 min.	290 min.

1	2	3	4	5	6	7
16.	Rockwell Hardness	ASTM D 785				
		scale m	65 min.	65 min.	65 min.	65 min.
		scale r	111 min.	111 min.	111 min.	111 min.
		scale l	85 min.	85 min.	85 min.	85 min.
17.	Breaking Strength	ASTM D 1004				
		average thickness, in	0.027	0.029	0.029	0.029
		maximum breaking load, pounds	8.0 min.	8.0 min.	8.0 min.	8.0 min.
18.	Dielectric Constant	ASTM D 150				
		frequency 10^3.Hz	3.7 ± 0.3	3.7 ± 0.3	3.7 ± 0.3	3.7 ± 0.3
		frequency 10^6.HZ	2.8 ± 0.3	2.8 ± 0.3	2.8 ± 0.3	2.8 ± 0.3
19.	Specific Electric Strength, ohm om	ASTM D 257	1×10^{15}	1×10^{15}	1×10^{15}	1×10^{15}
20.	Breakdown Resistance	ASTM D 199				
		Rupture voltage, V	32,000 min.	32,000 min.	32,000 min.	32,000 min.
		Thickness test tube, mils	125 ± 2	125 ± 2	125 ± 2	125 ± 2
21.	Heat Distorsion Temperature, °C	ASTM D 648	65 min.	65 min.	65 min.	65 min.

1	2	3	4	5	6	7
22.	Transparency, %	ASTM D 1746	90 ± 2	90 ± 2	90 ± 2	90 ± 2
23.	Density at shaking, gr/cu.dm.		Defined by the BIDDER for each grade.			
24.	Thermal Stability	Brabender Plastograph	Defined by the BIDDER for each grade.			
25.	Tensile strength for hard PVC, kg/sq.cm. (yield point)	ASTM D 638 - 64	500	500	500	500
		DIN 53 - 445	550	550	550	550
26.	Absorption of boiling water by hard PVC, %	ASTM D 570 - 63	0.25	0.25	0.25	0.25
27.	Fish Eye	For 95 %, obtained after a lamination period of		9 off/10 dm^2 7 min.	9 off/10 dm^2 6 min.	9 off/10 dm^2 5 min.
		For 98 %, obtained after a lamination period of	9 off/10 dm^2 8 min.	9 off/10 dm^2 8 min.	9 off/10 dm^2 7 min.	9 off/10 dm^2 6 min.

Products will have the following applications :

- blow moulding;
- injection moulding;
- calendering;
- extrusion.

Characteristics and possible applications of quality II product shall be specified in the tender.

2.12.3. Raw Materials

Vinyl chloride having the quality specifications listed under item 2.6.2.a.

2.12.4. Process

The process consists in polymerization carried in average-capacity autoclaves (20 - 40 cu.m) with high efficiency catalysts which can be easily purchased.

The BIDDER shall consider the following requirements:

- Unreacted vinyl chlorides shall be entirely recovered and sent to vinyl chloride plant for purification.

  Quality characteristics and quantity of recovered vinyl chloride have to be specified;
- Polymer obtained after autoclave cleaning and as sieve residue should not exceed 2 % of the output.
- End-product shall be packed in polyethylene bags of 20 - 25 kg.
- End-product warehouse shall be common with that of the PVC-emulsion plant.

2.13. PVC - EMULSION PLANT

2.13.1. Capacity

PVC-emulsion - stage I : 5,000 to/year
final stage : 7,500 to/year

The plant shall be designed for a continuous operation of 330 days/year.

The BIDDER has to consider the opportunity of providing several units, even during the first stage, at their final capacity.

2.13.2 Product Quality

PVC-emulsion, as powder, having the following quality characteristics:

- K value	71	approximately
- average polymerization degree	1,300	
- apparent specific gravity	0,25	kg/cu.dm.
- actual specific gravity	1.4	kg/cu.dm.
- particle size	150	mesh pass
- volatile matter, less than	0.5	%

The product has to be characterized by good thermal stability, low viscosity, good deaeration.

Product has to be adequate for the following applications:

- spread coating (synthetic leather) ;
- dip coating ;
- dip moulding ;
- slush moulding ;
- rotational moulding ;
- casting ;
- foam moulding ;
- other uses (paint, binder, putty) .

The tender has to contain a detailed characterization of the product (i.e. quality specification of the product) .

2.13.3. Raw Materials

Vinyl chloride having the quality characteristics as listed under item 2.6.2.a.

2.13.4. Process

The process consists in emulsion polymerization; polymer drying within a spray dryer.

The BIDDER shall consider the following requirements:

- Unreacted vinyl chloride shall be entirely recovered and sent to the vinyl chloride plant to be purified.

  Quantity and quality characteristics of recovered vinyl chloride have to be specified;
- Polymer obtained after autoclave cleaning and as sieve residue should not exceed 2 % of the output;

- End-product shall be packed in polyethylene bags of 20 - 25 kg. ;
- End-product warehouse has to be common with that of the PVC-suspension plant.

2.14. LOW DENSITY POLYETHYLENE PLANT

2.14.1. Capacity: stage I : 22,500 to/year
final stage : 45,000 to/year

The plant shall be designed for a continuous operation of 330 days/year.

The breakdown per grades of the output in stage I will be the following :

a/. Polyethylene film-grade, natural colour	50 %
b/. Polyethylene film-grade, coloured	10 %
c/. Polyethylene pipes-grade, coloured	10 %
d/. Polyethylene injection moulding-grade, coloured	20 %
e/. Polyethylene blow moulding-grade, coloured	5 %
f/. Polyethylene paper coating, natural colour	5 %

The BIDDER shall specify in the tender the maximum quantity of the second quality product obtained in the plant.

The BIDDER has to consider the efficiency of erecting, even during stage I, several equipment and auxiliary plants at their final capacity.

2.14.2. Product Quality

a/. Low Density Polyethylene Film Grade (used for bags, packages, sheets).

Crrt No	Characteristics	Method	Value
1	2	3	4
1.	Density, gr/cu.m	JIS K 6760 - 1960	0.922-0.926
2.	Melt Flow Index, gr/10 min.	JIS K 6760 - 1960	7-0.5
3.	Haze, %	ASTM-D-1003 - 61 and BS-2782-515 A	16
4.	Impact Strength, %	BS 2782 - Method 306 F	960
5.	Tensile Strength at break, kgf/sq.cm.	JIS K 6761 - 1962	150 - 220
6.	Elongation %	JIS K 6760 - 1962	550 - 690
7.	Surface Hardness, Shore D	ASTM-D-1484 - 57 T	46 - 49
8.	Brittleness Temperature, °C	ASTM-D-746 - 57 T	- 50 ÷ - 75
9.	Stiffness, kgf/sq.cm.	ASTM-D-747 - 58 T	2,000 - 2,100
10.	Vicat Softening Point, °C	ASTM-D-1525 - 58 T	90 - 100

b/. Low Density Polyethylene Pipes-Grade
(used in agriculture)

Crrt No	Characteristics	Method	Value
1.	Base Polymer Density, gr/cu.cm	BS 3412 - 1966	0.918-0.922
2.	Compound Density, gr/cu.cm	BS 3412 - 1966	0.929-0.933
3.	Melt Flow Index, gr/10 min	BS 2782 - method 105 C similar ASTM-D-1238 - 65 T	2-0.9
4.	Elongation at Break, max %	BS 1972; 1967 BS 1973; 1964	400 - 450
5.	Reversion %	BS-1972; 1967 BS-1973; 1964	1.2 - 1.5
6.	Tensile Strength at break, kg/sq.cm.	BS-1972; 1967 BS-1973; 1964	106 - 120

c/. Low Density Polyethylene for Injection Moulding

Crrt No	Characteristics	Method	Value
1	2	3	4
1.	Density, gr/cu.cm.	BS-3412-1966	0.916-0.922
2.	Melt Flow Index, gr/10 min	BS-2782 - method 105 C similar with ASTM-D-1238 - 65 T	20

Crrt No	Characteristics	Method	Value
3.	Vicat Softening Point, ^{o}C	BS-2782 - method 102 D	76 - 83
4.	Elongation at Break, %	BS-2782 - method 301 or ASTM-D-1248 - 68	130 - 375
5.	Tensile Stength at Yield, kg/sq.cm	BS-2782 - method 301 F or ASTM-D-1248 - 68	89 - 104

d/. Low Density Polyethylene for Blow Moulding

Crrt No	Characteristics	Method	/alue
1.	Density, gr/cu.cm	BS-3412 - 1966	0.917-0.922
2.	Melt Flow Index, gr/10 min	BS-2782 - method 105 C similar ASTM-D-1238 - 65 T	7-0.3
3.	Swelling Ratio		1.68-1.2
4.	Environmental Stress Cracking Resistance (ESCR)	ASTM-D-1692 - 66	Satisfactory up to Very Good

e/. Low Density Polyethylene for Paper Coating

Crrt No	Characteristics	Method	Value
1	2	3	4
1.	Density, gr/cu.cm.	BS-3412 - 1966	0.917-0.921
2.	Melt Flow Index, gr/10 min	BS-2782 - method 105 C similar with ASTM-D-1238 - 65 T	7 - 5
3.	Water Vapour Permeability, gr/sq.m., 24 hr, at a thickness of 0.025 mm	BS-2782 - method 513 B and ASTM E 69 - 63 T	19 - 15
4.	Comparative Adhesion to Paper %	Perkins Southwick Burst Tester	64 - 72

The tender has to specify complete quality characteristics of al trade marks (grades) which can be produced by the offered plant.

2.14.3. <u>Raw Materials</u>

Ethylene having the quality characteristics as specified under item 2.1.2.a.

2.14.4. <u>Process</u>

The process consists in ethylene polymerization at pressure up to 2,500 atm. carried within autoclave-type reactors with minimum three reaction areas or within tube-type reactors.

The plant has to be provided with the following main units:

- polymerization including ethylene compression, reaction, unreacted ethylene separation, in-line homogenization and pelletizing;
- pellet blending and mixing;
- compounding outside the main line for producing coloured compound and master batch with additives.

2.15. HIGH DENSITY POLYETHYLENE AND POLYPROPYLENE PLANT (Co-production)

2.15.1. Capacity

a/. Total capacity (HD-polyethylene + polypropylene):

- stage I : 22,500 to/year
- final stage : 45,000 to/year

The plant shall have to produce alternatively HD-polyethylene or polypropylene, in campaigns.

Production programme foreseen for stage I, corresponding of the nominal capacity, is the following:

- HD-polyethylene : 15,900 to/year (out of which 60% compounded and homogenized)
- polypropylene : 6,600 to/year (out of which 60% compounded and homogenized)

Plant output per hour will be defined by the BIDDER by considering time period covered by:

- plant periodical revision ;
- change of campaigns (HD-polyethylene to polypropylene and vice versa).

The BIDDER has to consider 4 shut-downs per year, 2 campaigns of HD-polyethylene and 2 campaigns of polypropylene respectively.

Output break-down per grades is indicated under 2.15.2.

b/. By-products

The amounts of by-products (low polymers, atactic polypropylene) will be specified by the BIDDER.

2.15.2. <u>Product Quality</u>

a/. HD-polyethylene - pellets adequate for the following applications :

- injection moulding, 50 % output ;
- blow moulding, 30 % output ;
- monofilament, 5 % output ;
- tubes, 15 % output ;

Quality characteristics of these grades will be the following :

Crrt No	Character-istics	ASTM Method	HD-polyethylene for			
			injection moulding	flow moulding	mono-fila-ment	tubes
1	2	3	4	5	6	7
1.	Specific gravity gr/cu.cm	D-1248	0.955	0.950	0.950	0.96
2.	Melt Flow index gr/10 min	D-1238	5.0-8.0	0.5-0.8	0.5	0.2
3.	Mold shrinkage (linear) %	D-955	1.5-2.5	1.5-2.5	1.5-2.5	1.5-2.5

1	2	3	4	5	6	7
4.	Tensile yield strength kg/sq.cm.	D-638	290	280-290	280	230
5.	Elongation %	D-638	500	500	500	900
6.	Flexural modulus kg/sq.cm.	D-790 D-747 (for pipes)	12,000	10,000-11,000	11,000	9,000
7.	Impact strength kg.cm/sq.cm.	D-1822 D-256-5 C (for pipes)	400-300	600-500	600	15
8.	Hardness, D type (Rockwel for pipes)	D-2240 D-785 (for pipes)	70	68	68	40
9.	Vicat softening point °C	D-1525	130	128	128	124
10.	Brittleness tempera-ture, °C	D-746	-70	-70	-70	-130
11.	Stress-crack resistance hrs.	D-1693	2.5-2.0	20-15	20	-

The BIDDER has to indicate all product grades (trade marks) which may be obtained by the process, listing also all quality characteristics.

b/. Polypropylene - pellets (homo-and copolymers) having the following applications :

- injection moulding 50 % output;
- fibres)
- film) 50 % output;
- flat-yarn)

Quality characteristics of these grades are the following :

Polypropylene for Injection Moulding

Crrt No	Characteristics	ASTM Method	Value
1	2	3	4
1.	Colour		translucent white
2.	Specific gravity, gr/cu.cm	D-792 - 50	0.90-0.91
3.	Flow rate, gr/10 min	D-1258 - 57 T	3.5-8
4.	Mould shrinkage, (linear) %		1.0-2.0
5.	Water absorption, (24 hours) %	D-570 - 54 T	0.01
6.	Tensile yield strength, kg/sq.cm	D-638 - 61 T	350
7.	Ultimate elongation, %	D-638 - 61 T	200
8.	Flexural modulus, kg/sq.cm	D-790 - 61	$1.3x10^4$-$1.4x10^4$
9.	Izod strength, kg.cm/sq.cm.	D-256 - 56	3 - 4

1	2	3	4
10.	Hardness (Rockwell)	D-785 - 60 T	100
11.	Melting point, ^{o}C		174
12.	Specific heat, cal/gr ^{o}C		0.45
13.	Linear thermal expansion coefficient, cm/cm ^{o}C	D-696 - 64	0.68×10^{-4}
14.	Deflection temperature, ^{o}C	D-648 - 56	105 - 110
15.	Flammability	D-635 - 56 T	slow burning
16.	Volume resistivity, ohm-cm	D-257 - 58 T	1×10^{17}
17.	Dielectric constant	D-150 - 54 T	2.28
18.	Dissipation factor	D-150 - 54 T	2×10^{-4}
19.	Arc resistance, sec.	D-495 - 56 T	130

Propylene for Film

Crrt No	Characteristics	ASTM Method	Value
1	2	3	4
	Polymer Characteristics		
1.	Specific gravity, gr/cu.cm	D-1505	0.9
2.	Flow rate, gr/10 min	D-1238	8.0 - 10

1	2	3	4
	Film Characteristics (0.03 mm thickness)		
1.	Haze, %	D-1003	1-2; 2-2.5
2.	Gloss at 20^o, %	D-523	85 - 90
3.	Friction coefficient, static 700 gr 150 mm/min dynamic 700 gr 150 mm/min	D-1894	0.2 0.1
4.	Tensile yield strength, kg/sq.mm	D-882	2.2
5.	Elongation at break, %	D-882	500 - 570
6.	Impact strength, kg.cm	D-781	3.5 - 3.9
7.	Water vapour transmission, gr/sq.m in 24 h	E-96	20
8.	Gas permeability (O_2) gr/sq.m in 24 hr. atm.	D-1434	3.5
9.	Welding rod temperature ^oC		200 - 220

c/. By-products (low polymers, atactic polypropylene)

Relevant quality characteristics as well as processing methods shall be specified in the tender.

2.15.3. <u>Raw Materials</u>

a/. Ethylene from olefine plant having the quality characteristics as listed under item 2.1.2.a.

b/. Propylene, from the olefine plant, having the quality characteristics as listed under item 2.1.2.b.

2.15.4. <u>Process</u>

The process consists in low pressure polymerization, in a continuous system, in the presence of stereospecific, catalysts of Ziegler-Natta type.

The BIDDER shall consider the following requirements:

- ethylene, respectively propylene unreacted during polymerization, shall be sent to the olefine plant, namely purification unit for being recovered;
- catalyst warehouse shall be located within battery limit at the corresponding distance from the plant for preventing fires;
- the plant should be provided with equipment required for producing natural pellets compounded, homogenized and necessary master - batch;
- product will be packed in polyethylene bags of 20 - 25 kg.

2.16. SBR PLANT

2.16.1. Capacity :

stage I : 20,000 to/year
final stage : 40,000 to/year

The plant shall be capable of operating continuously for 330 days/year at the design capacity or at a lower one down to 75 % throughput.

The BIDDER has to consider the opportunity of providing, even during the first stage, several auxiliary plants (e.g.waste water treatment plants, warehouse, etc.) at their final capacity.

2.16.2. Product Quality

a/. SBR-1500, with staining-type stabilizer;

b/. SBR-1502, with non-staining type stabilizer;

c/. SBR-1712, extended with 37.5 parts of highly aromatic oil per 100 parts elastomer and with staining-type stabilizer;

d/. SBR-1778, extended with 37.5 parts naphthenic oil per 100 parts elastomer and with non-staining-type stabilizer.

The above mentioned grades have to meet the following quality characteristics:

Characteristics		Grade 1500	1502	1712	1778
1	2	3	4	5	6
1.	Mass loss at 105^{o}, max. %	0.50	0.50	0.50	0.50
2.	Ash, % max.	0.8	0.8	0.8	0.8
3.	Iron content, % max.	0.004	0.004	0.004	0.004
4.	Stabilizer content, %	1 - 2	1 - 2	1 - 2	1 - 2
5.	Free organic acid content, %	5-7.25	4.75-7.0	3.9-5.7	3.9-5.7
6.	Soap content, % max.	0.5	0.5	0.5	0.5
7.	Bonded styrene content, %	22.5 - 24.5	22.5 - 24.5	22.5 - 24.5	22.5 - 24.5
8.	Mooney viscosity, ML (1 + 4) 100^{o}C	46-58	46-58	46-58	46-58
9.	Tensile strength, kgf/sq.cm. min	260	210	200	200
10.	Relative tear elongation, % min	550	570	500	500
11.	Flexural modulus at elongation of 300 %, after vulcanization at 145^{o} C:				
	after 25 minutes, kg/sq.cm	21-45	24-46	15-35	15-35
	after 50 kg/sq.cm.	56-84	54-79	35-65	35-65
	after 100 kg/sq.cm	84-119	88-116	55-85	55-85

2.16.3. Raw Materials

a/. Styrene having the quality characteristics specified under item 2.10.2.a.

b/. Butadiene having the quality characteristics as listed under item 2.5.2.a.

2.16.4. Process

The process consists in cold polymerization, within a continuous system, with polymerization active inhibitors of peroxide type which promote high reaction speed. Polymerization solutions are to be automatically metered.

The BIDDER shall provide the recovery of unreacted monomers from latex and their reuse for polymerization.

Waste waters shall be purified of monomers and polymers in order to be afterwards discharged to the sewage system.

The Rubber will be dried by means of a screw press.

It will be wrapped first in polyethylene sheet and afterwards packed in pallets or paper bags.

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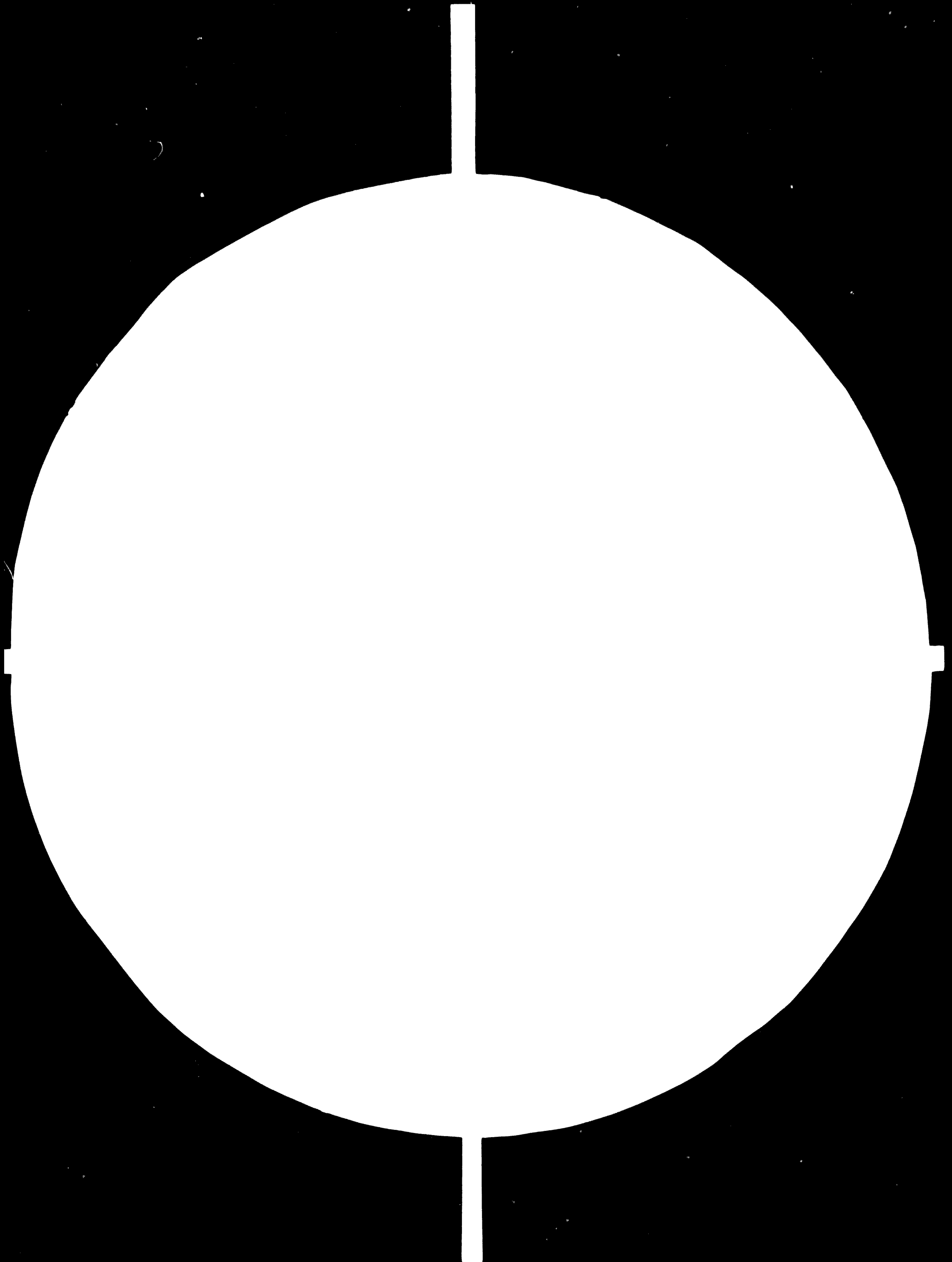

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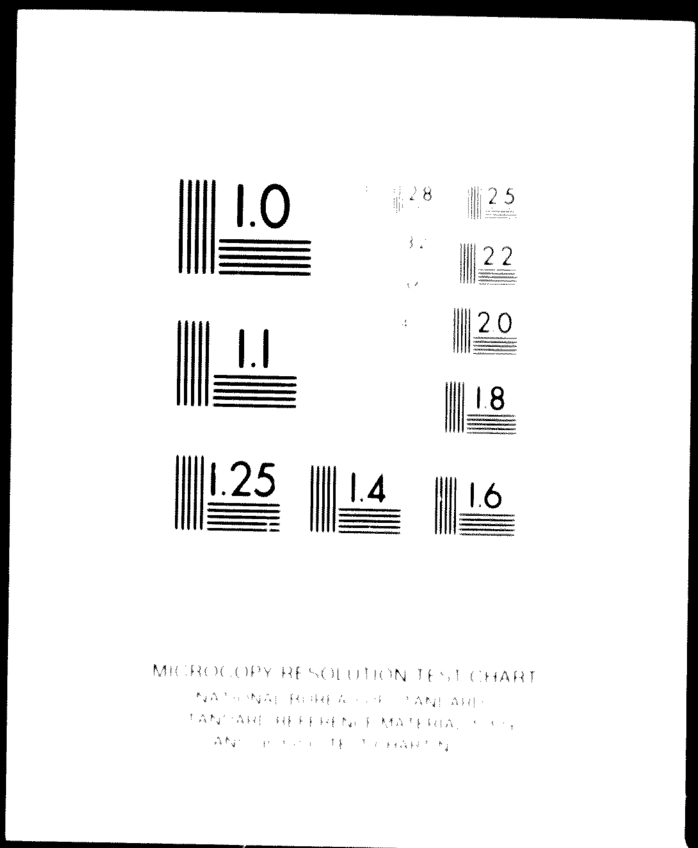

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2.17. ABS CO-POLYMER PLANT

2.17.1. Capacity

ABS co-polymers : 4,000 to/year.

The plant should be capable of producing at least the following main grades of ABS pellets :

a/. ABS - General purpose grade;

b/. ABS - Metal plating grade;

c/. ABS - High flow grade;

d/. ABS - Sheet grade.

The plant has to be designed at the highest flexibility in order to give the possibility of alternating product ratios as well as of producing other grades.

2.17.2. Product Quality

a/. ABS - General Purpose Grade
(grades : 1, 2, 3, 4)

Characteristics	ASTM Method	ABS - General Purpose			
		1	2	3	4
1	2	3	4	5	6
Tensile strength at 23^{o}C, kgf/sq.cm	D-638	330	420	470	550

1	2	3	4	5	6
Flexural yield strength, kgf/sq.cm at t = 23° C	D-790	520	680	780	920
Flexural modulus at 23° C, kgf/sq.cm	D-790	18,000	23,000	27,000	30,000
Rockwell hardness at 23° C	D-785	87	102	108	116
Specific gravity at 23° C	D-792	1.03	1.04	1.05	1.06
Izod impact strength, kgf.cm/sq.cm at 23°C	D-256 Method A	40	30	20	4
at 0°C		36	26	16	3
at -20°C		33	22	10	2
at 40°C		30	18	-	-
Heat deflection temperature, °C Unannealed bar	D-648	80	82	83	84
Heat deflection temperature, °C Annealed bar	D-648	90	92	93	94

b/. ABS - Metal Plating Grade

c/. ABS - High Flow Grade

d/. ABS - Sheet Grade

Characteristics	ASTM Method	Unit	ABS Grade Metal Plating	ABS Grade High Flow	ABS Grade Sheet
Tensile strength at 23°C	D-638	kg/sq.cm	420	380-430	420
Flexural Yield strength, at 23°C,	D-790	kg/sq.cm	680	650-750	680
Flexural modulus at 23°C,	D-790	kg/sq.cm	23,000	24,000-27,000	23,000
Rockwell Hardness at 23°C,	D-785	Scale R	102	102-107	102
Specific gravity, at 23°C	D-792	-	1.04	1.04-1.05	1.04
Izod Impact Strength, at 23°C,		kg.cm/sq.cm	30	23-19	30
at 0°C,	D-256		26	18-15	26
at -20°C,	Method		22	14-12	22
at 40°C,	A		-	-	18
Heat deflection temperature, unannealed bar	D-648	°C	82	80-82	86
Heat deflection temperature, annealed bar	D-648	°C	92	88-90	93

The tender has to include a complete specification of quality of all types and grades (trade marks) to be produced by the offered plant.

2.17.3. Raw Materials

a/. Acrylonitrile, having the quality characteristics as listed under item 2.11.2.a.

b/. Butadiene having the quality characteristics as listed under item 2.5.2.a.

c/. Styrene having the quality characteristics as listed under item 2.10.2.a.

2.17.4. Process

The process consists in batch co-polymerization in emulsion, carried in high capacity reactors.

The BIDDER shall consider the following requirements:

- the plant should produce polybutadiene latex;
- the plant should be of universal type, that is to produce any grade of ABS;
- polymerization reactors should be made of stainless steel;
- only one drying line should be provided with maximum two drying steps;
- coagulation phase should be continuous;
- pelletizing unit should be capable of producing at least two colours simultaneously;

- to provide equipment for by-product (polymer wastes) recovery;
- the end-product, under the form of pellets has to be packed in polyethylene bags of 25 kg.

2.18. POLYSTYRENE PLANT

2.18.1. Capacity

Polystyrene : 10,000 to/year

The plant should be capable of producing the following grades :

a/ Polystyrene – general purpose 2,000 to/year

b/. Polystyrene – expanded (standard and ignifugated) 4,500 to/year

c/. Polystyrene – impact 3,500 to/year

d/. Polystyrene – high impact

2.18.2. Product Quality

a/. Polystyrene General Purpose

Crrt No	Properties	Method	Value
1	2	3	4
1.	Specific gravity, gr/cu.cm	ASTM D 792-50	1.03-1.05
2.	Refraction index n^{25}_{D}	ASTM D 542-50	1.5 - 1.6
3.	Water absorption (24 hr) max. %	ASTM D 570-58	0.05

1	2	3	4
4.	Tear strength (tensile stress) min. kgf/sq.cm	ASTM D 638-58 T	380
5.	Tear elongation, %	ASTM D 639-58 T	1.0-2.5
6.	Flexural yield strength kgf/sq.cm	ASTM D 790-61 T	530
7.	Impact strength min. kg.cm/cm	BS-2782 Method 306 A	1.1
8.	Softening point min. ^{0}C	BS-2782 Method 102 C	88
9.	Melt flow index min. gr/10 min.	-	3
10.	Monomer content, max. %	BS-1493	0.3

b/. Expanded Polystyrene - Standard and Ignifugated

Crrt No	Characteristics	Standard	Ignfugated
1	2	3	4
1.	Appearance	homogenuous, with holes, without fragments of unsintered material and agglomerates of not expanded material.	
2.	Apparent density, kg/cu.m	15 - 17 22 - 24	26 - 29
3.	Flexural yield strength (static bending) min. kgf/sq.cm	1.4	1.8.

1	2	3	4
4.	Compression stress min. kgf/sq.cm	0.7	1.12
5.	Thermal conductivity max.kcal/m h ^{o}C	0.032	0.032
6.	Water absorption, (24 hr) max. g/sq.m	70	50
7.	Monomer content, max. %	0.2	0.3

The product will be supplied as boards and blocks.

c/. Impact Polystyrene (Grade 1, 2, 3, 4)

Crrt No	Characteristics	Method	Grade 1	Grade 2	Grade 3	Grade 4
1	2	3	4	5	6	7
1.	Specific gravity gr/cu.cm	ASTM-D 792 - 50	1.01-1.05	1.01-1.05	1.01-1.05	1.01-1.05
2.	Tear strength (tensile stress) min.kgf/sq.cm	ASTM-D 638-58 T	1.9	1.7	3.0	2.3
3.	Elongation at break min. %	ASTM-D 638-58 T	25	25	25	30
4.	Impact strength, min. kg.cm/cm	ASTM-D 256	6.0	5.5	6.0	7.0
5.	Softening point-Vicat, min. ^{o}C	ASTM-D 1525	78	78	90	85

1	2	3	4	5	6	7
6.	Melt flow index, gr/10 min.		1.0	1.2		0.9
7.	Monomer content, max. %	Denka GLC	0.1	0.1	0.1	0.1

d/. Polystyrene - High Impact (Grades: 1, 2, 3, 4, 5)

Crrt No	Characteristics	Method	Grade				
			1	2	3	4	5
1	2	3	4	5	6	7	8
1.	Tensile strength min. kgf/sq.cm	ASTM-D 638	1.6	3.0	2.1	2.5	2.8
2.	Tear elongation min. %	ASTM-D 638	40	50	40	50	50
3.	Impact strength min. kg cm/sq.cm	ASTM-D 256	12	8.5	7	7	7
4.	Softening point Vicat, °C	ASTM-D 1525	75	85	85	75	85
5.	Monomer content min. %	Denka GLC	0.1	0.1	-	-	-

The tender has to include a complete specification of quality of all types and grades (trade marks) produced by the offered plant.

2.18.3. Raw Materials

Styrene having quality characteristics as specified under item 2.10.2.a.

2.18.4. Process

The process consists in batch polymerization in suspension.

The BIDDER shall consider the following requirements:

- 2 drying lines should be provided, i.e.: one for impact and general purpose polystyrene beads and another one for gasified polystyrene beads ;
- polystyrene beads to be expanded should by gasified with C_5 - cut ;
- a line for producing expanded polystyrene for different applications (blocks and boards) should be provided;
- the pelletizing unit should be capable of producing concurrently at least two colours ;
- by-products (polymer wastes) should be entirely recovered;
- products under the form of pellets should be packed in 25 kg polystyrene bags.

TECHNICAL SPECIFICATIONS
FOR
STORAGES AND WAREHOUSES

3.1. STORAGES FOR LIQUID PRODUCTS

3.1.1. Generals

This technical specification concerns the centralized storages of liquid products outside the battery limits of plant.

The GOVERNMENT intends to arrange the tanks in separate, distinct storages depending on the danger of the various products and the adequate steps to be taken. For this purpose the BIDDER shall provide the following storages:

a/. Storage for liquid flammable products;

b/. Storage for liquified gases;

c/. Storage for liquid auxiliary materials (sulphuric acid, NaOH solution,etc.).

3.1.2. Tanks and Capacities within Each Storage

For intermediate products captively used within the COMPLEX, capacities are to be defined and suggested by the BIDDER, based on his experience and considering the operating conditions of the plants imposed for the relevant tanks.

For auxiliary and end-products, storing capacities shall be according to outputs i.e. for a 30 days consumption.

For raw materials, liquid fuel and pyrolysis gasoline to be returned to the refinery, storage capacity shall correspond to consumption, to the 7 days output respectively,except for the imported feedstock (butadiene and o-xyiene) for which storage capacity shall meet consumption during 30 days.

The BIDDER has to decide whether one or several tanks have to be provided for meeting the capacity defined for each product.

The BIDDER has to provide tanks for products, grouped per tank yards, as follows:

a/. Tank yard for liquid, flammable products:

- naphtha;
- toluene;
- ortho-xylene;
- benzene;
- styrene;
- ethyl-benzene;
- acrylonitrile;
- dodecylbenzene;
- BTX-cut produced by the ethylene plant;
- reformate for aromatics extraction;
- gasoline to be returned to the refinery;
- selective solvents for butadiene and aromatics extraction;
- waste fuel oil (from the ethylene plant);
- liquid fuel for thermoelectric power station.

b/. Tank yard for liquefiel gases:

- ethylene;
- propylene;
- butadiene;
- vinyl chloride;
- ammonia.

c/. Tank yard for liquid auxiliary materials:

- 98% fresh sulphuric acid;
- rezidual sulphuric acid;

- fresh hydrochloric acid solution;
- rezidual hydrochloric acid;
- 40% NaOH solution.

d/. Tank yard for liquid chlorine:

- chlorine

NOTE

If the BIDDER considers it more advantageous to locate the tanks for some products (e.g. vinyl chloride, ethyl-benzene) outside the above mentioned tank yard (e.g. near the process units or consumers) he has to make location proposals accordingly, specifying the relevant tanks in the tender.

If necessary, the BIDDER has to provide tanks for other products too, besides the above mentioned ones.

3.1.3. Loading and Unloading Platform

For products transported or delivered in tanks, tank trucks or tank cars, platforms necessary for product unloading and loading respectively have to be provided.

For the first stage, the following transportations by tank truck or tank cars are envisaged:

Product	Maximum Quantity t/yr	Tank Type	Remarks
1	2	3	4
butadiene	2,000	tank car	unloading
dodecyl benzene	10,000	tank truck and tank car	loading
selective solvents	approx. 50	tank truck	unloading

1	2	3	4
sulphuric acid	approx. 2,500	tank truck	unloading
hydrochloric acid solution	approx. 1,000	tank truck	unloading
NaOH solution	approx. 8,000	tank truck	unloading
acrylonitrile	approx. 12,000	tabk truck	loading

The loading and unloading platforms shall be dimensioned and arranged in such a way as to allow the performance of these works, within maximum 8 hours, for quantities twice bigger than the average daily amount.

These platforms have to be provided with facilities for washing, blowing, etc.,for tanks requiring such operations.

3.1.4. Pumps and Pipes

Liquid product storages shall be provided with adequate pumps and a pipe system ensuring relevant liquid vehicling under satisfactory conditions, irrespective of the situation arising during the long standing operation.

The BIDDER has to consider the following:

- to exclude the possibility of mixing the products in pipes or pumps and the necessity of washing them after operation respectively;
- to provide stand-by pumps for ensuring a continuous operation (based on his experience);
- pump capacities should meet the maximum flow rates considering mainly the time provided for loading and unloading on platforms.

3.1.5. Instruments

Storage shall be provided with instruments required for the operation under satisfactory conditions, in any circumstances.

The instruments shall perform the following:

- registration of all incomings and outgoings;
- level and pressure indication at the control points of the storages as well as in the control rooms of the process plants connected with the storages;
- optic and acoustic alarms in the above mentioned places signaling exceeding of safety levels and pressure;
- required interlocks for preventing any risks.

3.1.6. Station for Barrel Loading

Certain products shall be delivered, totally or partially, in barrels, namely:

- acrylonitrile	max. 20,000 t/yr
- styrene	max. 20,000 t/yr

For these products shall be provided adequate facilities for loading in barrels, having a capacity which allows loading of average daily amounts within maximum 8 hours.

Barrel loading stations shall be equipped with facilities for barrel washing and drying.

The types and capacities of barrels (including the construction material) shall be suggested by the BIDDER, based on his experience.

In the initial delivery and in the tender shall be included the barrels required for a three months output.

3.1.7. Miscellaneous

a/. Within each tank yard, tanks shall be located in individual trays or in trays for tank groups which provide collection of products (in the event of emergencies) and prevent the spreading of fires.

b/. Construction materials for trays shall be selected depending on the relevant products. The distances between tanks have to observe the norms valid in the BIDDER's country.

c/. Tank yard shall be generally located towards the western side of the COMPLEX to provide the simplest and shortest pipe routes and to observe the fire fighting regulations (valid in the BIDDER's country).

d/. The BIDDER shall provide the possibility of extending the tank yard and loading / unloading platforms considering the necessity of a liquid chlorine tank yard in the final stage, and shall indicate solutions.

3.2. WAREHOUSES

3.2.1. Generals

The BIDDER shall consider the following principles:

a/. End (solid) - products shall be stored in separate warehouses located within the battery limits of the relevant process plant and directly connected to the conditioning and parking departments. If different products or types of products are produced by one plant, the warehouse shall be common to all, being devided on sectors of products or types of products.

b/. Auxiliary materials easily inflammable or dangerous requiring special storing conditions, for instance: Ziegler catalyst or peroxides, reaction initiators, shall be stored in one on several warehouses specially arranged and located according to fire fithing regulations and requirements. Liquid materials of this category shall be also stored in these warehouses in barrels or special packages.

c/. Other auxiliary materials, maintenance materials, spare parts and epuipment shall be stored in one central (unique) warehouse for the whole COMPLEX divided into typical categories of materials.

d/. Bulky materials in large quantities, which are not sensitive to atmospheric agents, (in the climate conditions of the COMPLEX area) such as: construction materials, certain raw materials (sulphur), shall be stored on open platforms.

3.2.2. Warehouses

According to the above mentioned principles, the following warehouses shall be provided:

a/. One warehouse for each of the following end-products:

- high density polyethylene and polypropylene;
- low density polyethylene;
- vinyl polychloride;
- polystyrene;
- SBR;
- ABS copolymers;
- caprolactum;
- ammonium sulphate.

b/. For dangerous auxiliary materials requiring special storing conditions:

- one or two warehouses.

c/. For the other materials:

- one central (unique) warehouse.

3.2.3. Capacities

The following storing periods shall be considered for establishing the capacity and size of the warehouses:

a/. 30 days for end-products;

b/. 4 mounts for imported dangerous auxiliary materials;

c/. For the other materials (auxiliary, maintenance, spare parts and equipment etc.) the medium period shall be 12 months except for the current production materials from Peru for which the storing period shall be only one month.

3.2.4. Construction data and requirements

a/. Being located within the battery limits of the process plants and functionally connected to them, the end-products warehouses shall be adjusted - from an architectural point of view - to the process buildings to which they belong and shall be built on several levels if this solution is convenient.

b/. All the other warehouses shall be one-storied.

c/. Construction materials for the warehouses shall corespond to relevant storing and fire-fighting requirements avoiding unnecessary expensive materials.

d/. Each warehouse shall be provided with an office for the administrator and a sanitary battery for the service personnel.

Warehouses for dangerous materials which do not need permanent personnel are excepted from this rule.

3.2.5. Endowment

All warehouses shall be provided with the equipment (devices) necessary for an easy handling and arrangement of the stored materials (electric trucks, pilers, blades, shelves etc.)

For warehouses for materials requiring special conditions (of temperature, humidity, ventilation) the BIDDER shall provide relevant equipment.

3.2.6. Access

The warehouses for end-products and the platforms for storing bulky materials shall be provided with both railroads and roads for facilitating loading and unloading into and from waggons and truck.

The other warehouses shall be provided with roads only.

3.2.7. Development possibilities for the final stage

The BIDDER shall consider the development of the warehouses for the final stage under economic conditions and shall indicate relevant solutions.

4. TECHNICAL SPECIFICATIONS FOR UTILITY PLANTS.

4.1. THERMO-ELECTRIC POWER STATION (PS).

4.1.1. Introductory note

There is no available thermal power source in the location area of the COMPLEX.

Regarding the electrical energy, the GOVERNMENT intends to develop a distribution system of the electric power in the location area of the COMPLEX, to which the PS of the COMPLEX shall also be connected. Conditions related to this connection are listed under item 4.2.

In principle, the connection to the extrenal electric system is necessary for the following:

- to supply the electric power required for the PS starting-up;
- to cover a possible power shortage with reference to the capacity of the thermo-electric power station;
- to provide a spare source for an emergency in the thermo-electric power station;
- to increase the PS operational stability;
- to render valuable any possible permanent or temporary excess of electric power of the PS.

The thermo-electric power station has to meet the following duties:

- to provide the total steam output at the parameters required by users in the COMPLEX;
- to produce concurrently the maximum amount of electric power which can be reached under the most economic conditions at this compulsory steam output, starting

from a pressure higher than that required by users and flashing the steam in back-pressure or expansion and condensing turbines coupled to electric generators.

For fulfilling these conditions, the following shall be defined:

- the number and type of steam boilers
- the number and type of turbogenerator sets and intermediate pressures which have to correspond to the requirements of various steam consumers of the COMPLEX.

4.1.2. <u>Capacity of Thermoelectric Power Station</u>

a/. Steam

The effective steam requirement (and its parameters) shall be defined by the BIDDER, considering the following:

- consumptions of process and auxiliary utility plants;
- consumptions within the power station including the steam provide for condensation.

When defining the steam requirement, the steam produced within some process plants by waste energy recovery shall be also considered (e.g. from the olefine plant).

By analogy with other similar complexes, a total steam requirement of about 300 t/h can be estimated for the first stage for the whole COMPLEX, except the own PS steam consumption.

The following pressure levels at PS outlets should be adopted in the steam distribution to consumers:

40 ats;

16 ats;

5 ats.

One may anticipate that the highest steam flow rate will be at 16 ats pressure level.

A certain overheating has to be provided for all the above mentioned pressure levels.

The above mentioned pressure levels are only information figures; the final figures shall be defined by the BIDDER.

Anyhow the steam distribution system shall not comprise more than three different pressure levels.

b/. Electric power.

The BIDDER shall establish the COMPLEX's requirements of electric power, on the some basis as for the steam requirements.

By analogy with other similar complexes, it is estimated that the maximum absorbed power shall be of about 40 MW, with relatively low fluctuations.

Anyhow PS has to supply the total amount of electrical energy necessary to the whole COMPLEX.

For this purpose the BIDDER may increase the proportion of steam used in condensation, if necessary. If, on the contrary, the power production corresponding to the imposed steam production exceeds the COMPLEX requirements, the quantity of condensation used steam shall be reduced to the minimum, as required for the turbo-alternators steady operation; any possible excess of electrical energy shall be delivered to the national electrical system, via the connection transforming station (see item 4.2.)

The electrical energy shall be delivered by the PS as three phase 6000 V 60 cps with maximum + 5% voltage variations, and + 1% frequency variations.

4.1.3. Fuel

a/ Liquid Fuel

Liquid fuel shall be available for the entire capacity of the PS. Due to the relatively high amounts required, it is foreseen that relevant fuel shall be provided from several sources, outside the COMPLEX.

The great majority of the required liquid fuel amount shall be a petroleum cut of "Fuel Oil No 6" type, having the following characteristics:

- API Gravity (at 15°C)	15.6
- Specific Gravity (at 15°C)	0.962
- Flash Point °C	113
- Furol Viscosity (at 50°C)	170
- Ash (% wt)	0.03
- Pour point, °C	1
- Sulphur (W%)	0.20
- Heating power (Kcal./Kg.)	10,000
- Spray Temperature, °C	100
- Pumping Temperature, °C	38

Besides external liquid fuel sources, the BIDDER should consider the priority use of waste fuel oil from the ethylene plant.

In order to ensure a continuous fuel supply the COMPLEX will be provided with its own storage for the PS feeding (see item 3.1.).

b/. Gaseous fuel

Considering the fact that fuel offgases are produced by the COMPLEX (in different plants) and the neighbouring refiney " LA PAMPILLA " might have an excess of offgases, the BIDDER shall provide the equipment of PS with burners for gaseous fuel too in a ratio of maximum 25% of the total consumption.

The accurate composition of fuel gas can not specified by now but a heating power within the range of 7,000 - 10,000 Kcal/N.cu.m. may be considered.

4.1.4. Type of Equipment

Steam generators should be of the highest possible pressure (100 ats minimum).

Rating of each turbogenerator will be chosen to cover the total electrical energy required by the COMPLEX with minimum 2 or maximum 3 sets.

The BIDDER shall indicate the types of equipment used and their characteristics.

4.1.5. Conditions of Safety Operations-Spares

As specified under item 4.1.1. the thermoelectric-power station will stand for the single steam source of the COMPLEX except for the steam produced in the process plants.

As regards the electric energy, though the COMPLEX shall be connected to the national electric system, it has to be considered that the GOVERNMENT intends to cover the entire consumption by the output of the thermoelectric-power station due to both economic and safety reason. Consequently, the BIDDER shall provide the following spares :

a/. Steam generators should have the necessary spare so that both in case of periodical maintenance and in case of emergency of one unit (not simultaneous with the maintenance shutdown) the entire steam comsumption of the COMPLEX should be covered;

b/. For electric power the spare shall be met by the connection to the national electric system (see item 4.2.)

c/. For producing the required steam output at distribution parameters - in case of a failure of one turboalternator - the BIDDER has to provide reducing - cooling stations, with automatic start-up for high pressure steam.

4.1.6. Special Requirements

a/. Considering local conditions, one of the special problems to be solved in a satisfactory and economic way is that of water supply of the steam boilers.

From the standpoint of water sources, the local situation is relatively unfavourable (see Section 5 Volume IV) .

Following the same idea it has to be considered that the condensate recovery by the petrochemical plants can be performed at a low percentage due to possible contaminations. Consumption of water basing the grade adequate for supplying the boilers shall be covered by a unique central station for water treatment supplying also the other users. (See item 4.4.) .

Related to the supply of boiler feed grade water, the BIDDER has to consider the possibility of using steam transformers by means of which to supply steam to the users of the COMPLEX.

In this way it is possible to recover practically the entire amount of condensate corresponding to the steam supplied by the thermoelectric power station, making thus easier the activity of the plant producing high quality water.

If the method based on steam transformers is adopted, these shall be included in the deliveries for the thermo-electric-power station, indicating the operating parameters relevant utility requirement (lower grade water).

b/. For cooling purposes of the condensers within the thermoelectric-power station, the BIDDER shall suggest the most economic solution, under the local conditions.

4.2. ELECTRIC STATION CONNECTING THE THERMO ELECTRIC POWER STATION WITH THE NATIONAL ELECTRIC SYSTEM.

4.2. Introductory note

The thermo-electric power station of the COMPLEX has to be interconnected with the national electric system, due to reasons detailed under item 4.1.

For defining the detailed connecting conditions and the possibilities to feed / supply electric power from / to the national system, BIDDER shall contact Messrs EDES S.A. Juan Orellana, Herman Estabridis in Peru, in charge with the preparation of the study:

" Actualizacion de la Demanda i Estudio de la Oferta Electrica en la Region Central del Pais ".

4.2.2. Capacity

The rated power of the connecting power station shall be of about 50% of the power of the thermoelectric power station necessary to the COMPLEX, so that the connection should replace one of the turbogenerators of the thermoelectric power station, in case of a failure.

4.2.3. Nominal parameters of the connecting transformer are the following :

- Rated power: power of a set in the thermoelectric-power station.

- Rated frequency : 60 Hz
- Secondary voltage: 6,000 V (towards the COMPLEX)
- Short circuit voltage: 10 % approximately

The other parameters related to the transformer such as:

- Primary rated voltage (towards the national network);
- Range and voltage steps of the contact plate switch;
- Connection group;
- Neutral treating method;
- Cooling method;
- Accurate short-circuit voltage

shall be defined according the study prepared by EDES at the GOVERNMENT's request.

The study to be elaborated by EDES has to define also the fault power at incoming terminals from the national system into the connecting transformer. This value together with the fault input of the generators in the thermoelectric-power station and that of the high rated motors (higher that 1 MW) of the COMPLEX, define the actual short-circuit value to be considered by the BIDDER when selecting both the transformer and the class of the high voltage apparata included in the electric connecting station.

4.2.4. Type of equipment

The main equipment provided within the connection unit of the thermoelectric-power station as the following:

a/. high voltage equipment;

b/. transformer;

c/. medium voltage equipment (6 KV);

d/. relays, protection circuits, auxiliary services.

The equipment provided under item a and b stand for the proper connection unit; equipment under c and d, though belonging to the connection to the system shall be included in the 6 KV distribution unit of thermoelectric power station.

The high voltage equipment and the transformer shall be installed outside being located in the close neighbourhood of the 6 KV unit of the thermoelectric-power station.

Considering the rather high degree of atmosphere pollution (owed mainly to the corrosivity of the ocean atmosphere), all high voltage equipment including transformer insulations, shall be provide with a reinforced insulation e.g.: leakage line of about 3.2. cm/KV.

4.2.5. Reliable and Safe Operation

In order to ensure a safe operation, the BIDDER shall provide transformers and equipment of the best quality.

It is up to the BIDDER to decide - together with EDES- whether to provide a transformer and/or spare equipment assemblied or not, for the connection unit.

4.3. SEA WATER COLLECTING AND TREATING PLANT

4.3.1. Introductory note

Under the location conditions of the COMPLEX, sea water stands for the only water source available in large quantities. (See also Section 5 - Volume IV).

The most important water consumptions at high flow rates occur in :

- cooling various assemblies within process and utility plants;
- fire fighting purposes (accidentally).

As far as cooling of assemblies is concerned, considering the disadvantages of using sea water, the BIDDER shall resort to air cooling whenever it might be more advantageous than sea water cooling.

When sea water cooling can not be avoided, the following alternatives may be considered:

a/. Assembly cooling by desalted water, recycled after passing through cooling towers.

When using this alternative, desalted sea water stands for make-up water covering the losses due to evaporation, purges and accidental leakages.

b/. Direct cooling of assemblies by means of sea water which underwent a previous treatment (less expensive) in view of lessening the disadvantages of this water.

c/. Closed system cooling of assemblies by means of softened, underground water, cooled in its turn (in heat exchangers) with sea water treated as specified under item b.

Considering the high costs of water desalination as well as the relatively expensive facilities required for alternative a/the GOVERNMENT considers this alternative has to be excluded as being uneconomic.

Alternatives b/and c/are quite similar because colling is performed with sea water as well.

The selection of alternative b/(direct, sea water cooling) or c/(closed system cooling with softened water) shall be made by the BIDDER depending on the special conditions imposed by the relevant processes of the plants in the COMPLEX.

Related to fire fighting water, the BIDDER shall provide the following:

- internal hydrants shall be supplied with drinking water for reaching this a unique distribution network within the buildings:

- external hydrants shall be supplied either with untreated sea water or with untreated underground water (at BIDDER's option).

Consequently, the sea water collecting and treating plant, standing for the subject-matter of this technical specification, has to meet only the cooling water requirements and-presumally-provide water for the external fire fighting network.

4.3.2. Characteristics of Sea Water

The main characteristics of sea water are listed in Section 5.1. - Volume IV.

4.3.3. Quality Specification (after treatment)

Sea water has to be treated for reaching the following conditions:

a/. lowering the content of suspended matter below 10 mgr/l;

b/. extirpation (devitalizing) of flora and microfauna in order to prevent growing of micro-organisms within pipes and equipment;

c/. decrease of corrosive action by adding corrosion inhibitors.

4.3.4. Capacity

Plant capacities have to be defined by the BIDDER based on COMPLEX consumptions .

By analogy with a similar petrochemical complex where all coolings are performed with recycled water (cooled in towers) having a temperature difference of 10°C, water consumption is estimates to about 30,000 cu.m/hr (for stage I).

This is an informative figure which can be lowered, considering the use of air cooling as well as the adoption of a higher temperature difference.

The BIDDER shall define and substantiate in the tender the capacity of the sea water collecting and treating plant, presenting a water balance for the entire COMPLEX.

4.3.5. Pressure

At the battery limits of the consuming plants, the available pressure has to reach the figure of 4 ats.

The BIDDER shall check this figure according to the requirements of the majority of consumers. Where higher pressures are required, local pumping shall be provided.

4.3.6. Treating Method

The treating method shall be selected and suggested by the BIDDER at the present level of world technique in view of providing, under the most economic conditions, quality characteristics meeting the most exigent requirements and conditions of the consumers.

4.3.7. Safety Operating Conditions

a/. All equipment liable to emergency shut-down or periodical shut-down shall be provided with standby's in order to ensure a continuous operation of the plants at the nominal capacity for minimum 8,000 hr. per year.

b/. The BIDDER has to take all necessary steps for feeding all electric motors of the pumps from two different sources.

c/. When locating the suckers, the places of waste water descharge into the ocean have to be considered (particularly the discharge place of hotter water) so that it shouldn't alter the quality of fresh sea water.

d/. Construction materials for equipment and pipes coming in touch with sea water should have an adequate resistence to corrosion.

4.4. UNDERGROUND WATER TREATING PLANT

4.4.1. Introductory note

Underground water stands for the source to produce:

- drinking water;
- treated water for feeding the steam boilers of the thermoelectric-power station;
- treated water with various process applications (water used directly in the process) .

Underground water sources from the location area of the COMPLEX are the following:

- underground water from the bordering area, for the drinking water;
- underground water from a remote area, for treated water used to supply the thermoelectric-power station and as process water. (See Section 5.2., Volume IV) .

4.4.2. Underground Water Characteristics

The characteristics of underground water are listed in Volume IV, Section 5.2.

4.4.3. Quality Characteristics of Treated Water

a/. Drinking water shall meet the following quality conditions:

Phisical-chemical characteristics:

Normal alkalinity in CO_2	120.00	mg/l
Arsenic	0.20	mg/l
Barium	0.10	mg/l
Borine	2.00	mg/l
Cadmium	0.01	mg/l
Cyanides	0.01	mg/l
Chlorides	250.00	mg/l
Colour	10.00	APHA
Copper	1.00	mg/l
Chrome	0.05	mg/l
Total hardness ($CaCO_3$)	250.00	mg/l
Hardness (in French degrees)	84.00	
Iron	0.30	mg/l
Fluor	1.50	mg/l
Magnesium	125.00	mg/l
Manganese	0.30	mg/l
Lead	0.10	mg/l
pH	7.5	
Selenium	0.05	mg/l
Silica	25.00	mg/l
Sulphates	250.00	mg/l
Turbidity	10.00	mg/l
Zinc	5.00	mg/l

Bacteriological characteristics :

Less than 2.2. colibacills in 100 cu.cm.

b/. Demineralized water, quality I, to be used for supplying the steam boilers and having special process applications (PVC-suspension,polystyrene,ABS,caprolactum, phthalic anhydride,maleic anhydride), shall meet the following quality characteristics :

- suspended matter	0.000
- hardness	traces
- oxidability	traces
- oil	nil
- SiO_2	0.02 mg/l
- solved O_2	0.02 mg/l
- pH	8.3
- sodium bicarbonate	0.7 mval/l
- free CO_2	0.00 mval/l
- conductivity	0.3 μS/cm.
- Fe	0.02 mg/l
- Cu	0.005 mg/l

c/. Demineralized water, quality II, having less exigent process applications (toluene dealkylation, acrylonitrile, LD-polyethylene, HD-polyethylene, polypropylene) shall meet the following quality characteristics:

- hardness	0.02 mval/l
- conductivity	100 S/cm
- total alkalinity	0.3 mval/l
- silica	0.6 mg/l
- oil	nil
- total Fe	0.03 mg/l
- oxidability	10 mg KMn04/l

d/. Softened water, quality III, having other process applications (SBR, phthalic anhydride, maleic anhydride) with the following quality characteristics:

- hardness	0.07 (0.2^{o}G)	mg.equiv./l
- CO_2	5-10	mg/l
- O_2	0.3-0.5	mg/l

The quality characteristics mentioned above for treated water quality I,II and III stand for reference figures, based on the experience acquired from a similar petrochimical complex.

The BIDDER shall define the quality characteristics of treated water according to the requirements of the COMPLEX consumers.

4.4.4. Pressure

A pressure of 4 ats is recommended at treating plant outlet. The BIDDER shall check this figure against the requirements of the majority of users. Where higher pressures are required, local pumping shall be provided.

4.4.5. Capacity

Capacities of water treating plants shall be defined by the BIDDER based on the consumptions of process and utility plants and on common consumption norms for drinking water.

The following figures are specified for information:

- drinking water: 20 cu.m/hr (average flow rate per day)
- treated water, quality I: approx. 300 cu.m/hr
- treated water, quality II: approx. 100 cu.m/hr
- treated water, quality III: approx. 200 cu.m/hr

When finalising water flow rates per grades, the BIDDER has to consider the consequences of providing steam transformers if such equipment shall be proposed for the thermo-electric power station (see item 4.1.)

4.4.6. Process

The BIDDER has to propose the most economic processes for each of the treated water grades specified under item 4.4.3.

In the main, it is recommended:

- for drinking water:	treatment by chlorination;
- for demineralized water:	ion exchanger treatment;
- for softened water:	Na-cation ion exchanger treatment.

4.4.7. Special Requirements

a/. Plants for water treatment have to operate at normal flow rates for minimum 8,000 hours per year.

For meeting this requirement the BIDDER has to provide all necessary, stand-by equipment or lines.

b/. In order to cover flow rate fluctuations, tanks having a minimum capacity equal to the consumption of 4 hours for drinking water and 2 hours for treated water quality I,II and III, have to be provided.

4.5. PROCESS COMPRESSED AIR PLANT

4.5.1. Introductory note

Compressed air shall be used for various periodical or random operations, such as:

- equipment and pipe blowing;
- pneumatic seal tests;
- pneumatic tool driving;
- the laboratory, etc.

The BIDDER shall provide a central compressed air unit and a distribution network respectively for all the users of the COMPLEX.

If the BIDDER considers that the production of compressed non-centralized air at each consumer would be a more economical solution, the central compressed air unit shall be given up, fixed or mobile compressors (of lower capacity) being provided for each consumer.

4.5.2. Pressure and Quality Conditions

a/. Pressure: 8 ats.

b/. Maximum temperature: $40^{o}C$

c/. Maximum oil content: corresponding to oil vapour pressure at $40^{o}C$

4.5.3. Capacity

By analogy with other, similar petrochemical complexes a medium consumption of 800 Ncu m/hr is estimeted, with momentary flow rate fluctuations of 0 1,200 Ncu m/hr for very short periods of time

For covering this flow rate, the BIDDER shall provide three compressors (one spare), with a capacity of about 60% of the medium consumption each, and a tank of about 200 cu.m at 8 ats for covering flow rate fluctuations

In order to avoid useless power consumption, the plant shall be provided with instruments for compressor shut down at pressures of 7.5 and 8 ats. (successively) and start up at pressures of 6.5. and 6 ats.

The accurate requirement of compressed air, pressure, capacity and number of compressors as well as the tank's capacity shall be defined by the BIDDER in the tender.

4.6. NITROGEN, OXYGEN AND INSTRUMENT COMPRESSED AIR PLANT.

4.6.1. Introductory note

a/. Nitrogen is used as inert gas for isolating (from atmospheric oxygen and humidity), various substances involved in the process and susceptible to these agents.

Nitrogen may be also used for fire fithing purposes in certain special situations.

Nitrogen concentration (purity) and particularly oxygen content differs from one consumer to another.

Nitrogen consumption generally undergoes high fluctuations because some processes where nitrogen is used (equipment and pipe purgings, running over) occur periodically, last for short periods and require relatively high flow rates.

b/. Oxygen is required by the vinyl chloride plant, namely for the unit producing dichloroethane by oxychlorination (from ethylene and hydrochloric acid produced by dichloroethane cracking) if the oxychlorination process based on oxygen (instead of air) shall be adopted.

The necessity of producing oxygen has to be defined by the BIDDER considering the process proposed for oxichlorination.

The BIDDER shall also consider an alternative for producing bottled oxygen (having the quality specification required for welding) which shall represent a selling product of the COMPLEX. The additional price due to this alternative shall be indicated separately in the tender.

c/. Instrument compressed air.

As in the plants for nitrogen and oxygen separation atmospheric air has to meet pressure and purity conditions corresponding also to instrument air, it is quite advantageous that the plant producing nitrogen should also cover the additional amount of instrument compressed air required for the entire COMPLEX.

4.6.2. Product Quality Characteristics.

a/. Nitrogen.

Two conditions are required for the COMPLEX users:

- high purity nitrogen : 99.99 % with 10 ppm O_2 max.
- nitrogen : 98-99 %

Pressure for both grades: 8 ats. approximately.

The BIDDER shall estimate whether it is more advantageous to produce two different grades of nitrogen or only high purity nitrogen considering the idea that, by producing only one grade, the simplifications of the plant and distribution network would balance the excess of capital costs and production expenses corresponding to the extention of capacity for high purity nitrogen.

The BIDDER may also consider the alternative of producing the entire amount at a concentration of 98 - 99 % purifying chemically only the flow rate that has to meet the purity of 10 ppm O_2.

b/. Oxygen.

- concentration : 99.5 %
- pressure : 8 ats approximately.

c/. Instrument Compressed Air.

- pressure : 8 ats
- dew point : - 40 °C
- oil-and dust free.

The above mentioned quality specification have to be compared by the BIDDER with the requirements of the consumar plants.

4.6.3. Capacity

a/. Nitrogen

Approximate medium and maximum consumption estimated by analogy with a similar complex is :

- 2,500 N cu.m/hr - medium

- 3,500 N cu.m/hr - maximum

out of which about 70 % high purity.

These figures stand for reference figures and shall be finalised by the BIDDER according to the consumptions of the COMPLEX.

b/. Oxygen

If the oxygen based oxychlorination process is adopted (in the vinyl chloride plant), oxygen consumption reaches approximately 200 N cu.m/hr, being actually constant.

For bottling, the BIDDER shall consider a capacity of about 300 N cu.m/hr.

c/. Instrument Compressed Air.

By analogy with similar complexes, it is estimated a consumption of approximately 4,000 N cu.m/hr (if the pneumatic-type instruments are adopted).

This figure stands for a reference figure and has to be finalised by the BIDDER.

The BIDDER has to reach a judicious grouping of production lines, tanks, spare lines or/and assemblies so that the plant capacity in its whole should meet the above mentioned consumptions in minimum 8,000 hr/y continuously.

Both periodical and emergency shut-downs of the lines have to be considered.

The tender has to specify in details the way of meeting this requirement.

4.6.4. Process

The process has to be up-to-date requiring minimum power consumption and periodical shut-downs at the longest possible periods.

The suggested process has to be mentioned in the tender specifying also the characteristics and trade-marks of the main equipment.

4.6.5. Special Requirements

Since the plant shall be located within a petrochemical complex where hydrocarbons may be released into the atmosphere, all necessary steps have to be taken to ensure a safe operation.

For the alternative of producing bottled oxygen, the BIDDER shall also include in the tender steel bottles for a 7 days - production.

4.7. CENTRAL REFRIGERATION UNIT

4.7.1. Introductory note

The scope of this specification covers common refrigeration units which can be satisfactorily used by several process plants requiring cooling below the environment temperature, e.g. plants for: toluene dealkylation, ethylbenzene, styrene, caprolactum, acrylonitrile, PVC, polyethylene.

Refrigeration units requiring special conditions or those directly connected to the relevant processes, e.g. the olefine plant, shall be approached when dealing with those process units.

The idea of constructing a central refrigeration unit is based on the possiblity of grouping the users in several categories according to the required cooling temperature and refrigerating agent.

4.7.2. Temperature Levels and Refrigerating Agents

The BIDDER shall consider the following temperatures and refrigerating agents:

a/. - temperature: + 5°C; refrigerating agent: water;

b/. - temperature: - 1°C; refrigerating agent: aqueous solution of ethylene-glycol, methanol or calcium chloride.

c/. - temperature: - 7°C; refrigerating agent: as for -1°C;

d/. - temperature: - 18°C; refrigerating agent: as for -1°C.

These temperatures are specified for the battery limit of the central refrigeration unit.

The above mentioned temperatures and refrigerating agents be changed by the BIDDER in the following situations:

- if they do not correspond to the consumers requirements;
- if other temperatures would lead to a more judicious arrangement of the consumers and a more economic operation of the refrigeration units.

4.7.3. Capacity

By analogy with other similar petrochemical complexes the following consumptions are estimated:

+ 5^{o}C,	3 million Kcal/hr approximately;
- 1^{o}C,	3.5 million Kcal/hr approximately;
- 7^{o}C,	1.5 million Kcal/hr approximately;
-18^{o}C,	0.5 million Kcal/hr approximately

These consumption figures stand for reference figures; the accurate consumptions and relevant capacities of the refrigerating units shall be defined by the BIDDER according to the necessary consumptions of the COMPLEX plants.

4.7.4. Process

The selection of the process to be definitely used for each temperature level shall be made by the BIDDER.

The GOVERNMENT recommends the following processes:

- for +5^{o}C, ejection process;
- for -1^{o}C and -7^{o}C, absorbtion process, if waste

thermal power or waste fuel gases exist in the COMPLEX and can be used in the refrigeration units based on absorbtion. This matter has to be defined by the BIDDER.

If the absorbtion process proves disavantageous under local conditions, the compression process may be used; refrigerating agent is at the choice of the BIDDER.

The tender has to specify the types, trade-mark and characteristics of the main equipment.

4.7.5. Special Requirements

a/. The arrangement and location of the refrigeration units shall be made judiciously for decreasing to minimum the number of pipes for the refrigerating agent.

b/. The BIDDER shall provide all necessary spares for the safe and continuous operation of the consumer plants.

4.8. FINAL WASTE WATER TREATING PLANT

4.8.1. Generals

Under the location conditions of the COMPLEX waste waters may be discharged only into the ocean.

As the COMPLEX is located in the neighbourhood of some resorts on the coast, the conditions of water discharge are very severe within the area.

Consequently, an advanced treatment on the waste waters released from the COMPLEX has to be performed.

As specified under 1.3. each process unit has to include within its battery limits specific local treating facilities so that released waters may enter the final treating plant where an advanced biological treatment is performed.

The scope of this specification covers only the final treating plant used by the whole COMPLEX.

4.8.2. Quality Conditions of Water Discharged into the Ocean

As stipulated by the provisions of the Peruvian regulations, (Ley General de Aquas), waters discharged into the ocean, within the area where the COMPLEX is located, have to meet the following conditions:

- colour	nil
- substances producing taste and smell	nil

- suspended matter	nil		
- oils, fats	nil		
- phenols	below	0.001	mg/l
- nocive substances:			
- lead	below	0.1	mg/l
- fluor	below	1.5	mg/l
- arsenic	below	0.2	mg/l
- selenium	below	0.05	mg/l
- hexavalent chrome	below	0.05	mg/l
- cyanides	below	0.01	mg/l
- barium	below	0.10	mg/l
- cadmium	below	0.01	mg/l
- silver	below	0.05	mg/l
- iron	below	0.30	mg/l
- manganese	below	0.10	mg/l
- copper	below	100	mg/l
- zinc	below	500	mg/l
- colibacilles ;			
- biochemical consumption of oxygen at 5 days and 20°C		max.1	mg/l
- dissolved oxygen		min.6	mg/l
- pH	between	6 and 9	

The composition of the waste water entering the final treating plant shall be defined by the BIDDER considering the composition of the relevant effluents and the efficiency of the local treatment.

4.8.3. Capacity

Based on the data reached by operating a similar petro chemical complex, the following reference figures can be specified:

- total flow rate of waste waters undergoing biological treatment : approximately 12,000 cu.m/day;
- total BOC: 8,000 kg/day;
- total COD: 16,000 kg/day.

The accurate amounts of waste water and the capacity of the treating plant have to be defined by the BIDDER based on the amounts released from the whole COMPLEX.

4.8.4. Process

For reaching the conditions listed under 4.8.2. concerning waste water treatment, the BIDDER shall consider the biological processes combined with steps of mechanical and chemical treatment.

The treating plant has to be provided with a unit for processing slurry released from the process so that the final wastes should be absolutely harmless and in the smallest amounts (e.g. by incineration or anaerobic sludge digestion).

The tender has to provide also the equipment for preparing the necessary reagents.

The detailed process and the relevant flow sheet shall be defined by the BIDDER.

Based on the experience acquired by operating other similar works, it is considered that the final treating plant should be provided also with:

- pits and equipment for separating non-soluble hydrocarbons which occur accidentally;
- homogenizing pits for diminishing flow rate and concentration fluctuations.

4.8.5. Safety Operating Conditions

The BIDDER has to take all necessary standby's for providing a continuous operation of minimum 8,000 hours/year.

5. TECHNICAL SPECIFICATIONS
FOR
AUXILIARY WORKS.

5.1. FIRE - FIGHTING SYSTEMS

5.1.1. Generals

The COMPLEX has to be provided with efficient fire-fighting systems according to the regulations valid in the BIDDER,s country, considering also his experience and the fire-fighting regulations generally used in the petrochemical industry.

In the main, the fire-fighting systems will consist of the following :

a/. local automatic or manual alarm and intervention systems for each process unit;

b/. local, specific fire-fighting systems, e.g. sprinklers, drenchers, fixed spraying devices, steam flushing, inert gas flushing;

c/. local mobile devices, such as: portable or carryable extinguishers of chemical foam,power-jet or compressed inert gas type;

d/. internal hydrant network within the buildings;

e/. external hydrant network;

f/. water gun;

g/. mobile equipment, e.g.: motorpump, motor-ladder, foam generators, autoguns located in a central fireman point which can be used in any place of the COMPLEX where a fire may occur;

h/. general, centralized signalizing and alarm system with connections from each unit to the central fireman point.

5.1.2. Water Sources

The BIDDER shall consider the following water sources:

a/. For internal hydrants and local, automatic facilities (sprinklers): drinking water (in order to provide a unique distribution network within the buildings). An intangible drinking water spare has to be provided to cover the consumption of at least 1 hour of intervention at a flow rate of 60 l/sec.

b/. For the external network (external hydrants and water guns) either an untreated, sea water supply or an untreated underground water supply has to be considered. For the latter alternative, an intangible water spare has to be provided to cover the consumption of at least 3 hours of intervention at a flow rate of 100 l/sec.

For refreshing the spare a flow rate of 50 cu.m/hr. maximum has to be consider.

If untreated sea water shall be supplied, all pipes, fittings and equipment belonging to the fire-fighting system have to be made of proper materials, having an adequate resistance to the corrosive action of sea water in order to ensure a permenent satisfactory operation with no risks of pluggings, blockings, etc.

The BIDDER has to compare these two ways of water supplying of the fighting system and propose the most economic one.

5.1.3.

Dimensioning of the fire-fighting networks, the number and diameter of the hydrants and water guns shall be defined according to the norms valid in the BIDDER's country and shall be made in such a way as to ensure a rapid and efficient intervention in any point of the COMPLEX where a fire might occur.

5.1.4. Other Requirements

a/. Signalizers have to be provided in the plant's supervision points and alarms located in dangerous areas. The buttons design has to correspond to the relevant environment conditions.

b/. Irrespective of the provisions of the regulations the fire-fighting networks shall be permanently kept under pressure, being provided with pumps, water supply facilities and instruments required for maintaining a flow rate equivalent to the consumption at the pressure provided under the norms.

The pressure shall be of minimum 7 ats for external hydrants and water guns and of minimum 3 ats for internal hydrants.

c/. The pumps actuated by electric motors shall be supplied from two independent sources with automatic switchover from one sources to another. The BIDDER shall analyse the necessity of providing several spare pumps driven by internal-combustion engines, making the relevant proposal.

d/. Mobile devices (motopumps, ladders, foam generators) shall be provided based on the BIDDER's experience (specifying in the tender the proposed equipment).

5.2. CENTRAL WORKSHOPS

5.2.1. Introductory Note

The BIDDER shall provide the COMPLEX with central workshops where current maintenance and repair works for the plants, equipment and structures shall be effected as well as certain small modifications which might occur as necessary during operation.

Periodical revisions, capital repairs of the plants and equipment as well as possible completions of greater importance shall be performed with the assistance of the specialized enterprises of Peru, based on agreements.

Spare parts necessary in greater amounts and generally all cast parts shall be purchased from other companies.

5.2.2. Workshops

For fulfilling the above mentioned tasks, the following workshops shall be provided:

a/. Mechanical workshops with the following sections:

- machine-tool shop;
- fitter's shop (mounting and dismounting);
- boiler, piping and forging shop.

b/. Workshop for current maintenance and repairs of the equipment and electric facilities.

c/. Workshop for current maintenance and repairs of instruments.

d/. Workshop for car maintenace and repairs.

e/. Maintenance workshop for relevant buildings and plants, railways and roads.

5.2.3. Equipment for Workshops

The BIDDER shall make proposal for providing machinery and apparata for the workshops, based on his experience, considering the total volume of plants and equipment as well as the use of the workshops as defined under 5.2.1.

As a reference for workshops, the following data are specifying the main equipment and devices to be provided for each workshop:

a/. Mechanical workshop.

a/1. **Machine - Tool Shop**:

- parallel lathes, of various sizes for diameters up to 800 mm and length up to 3 m	10 off's
- universal milling machines (two sizes)	2 off's
- vertical milling machines	1 off
- planing machines	1 off
- mechanical thaw	1 off
- simple boring machines of various sizes (up to Ø 40 mm)	3 off's
- grinding machines (universal,plane) total	1 off

- tool-grinding machines	1 off
- grinders	2 off's

a/2. Fitter's Shop :

- benches with complete tool sets for various works	10 off's
- transformers for electric welding	2 off's
- mechanical thaw	1 off
- air motor-compressor, 7 ats per tyre	1 off
- mobile turning (facing) device	1 off
- shape shears	1 off
- **hydraulic turbines for pipe decoking**	2 off's
- drilling machines of various sizes up to 25	4 off's
- various portable, electric and pneumatic devices (drilling, milling, grinding, etc)	10 off's
- various lifting devices (lever, winch, etc.) up to 10 to	7 off's
- stable grinders	1 off's
- screw press (manual) 5 tf	1 off
- device for grinding valve sockets (valves generally)	2 off's

a/3. Boiler, Piping and Forging Shop.

- frontal lathe up to diameter of 2,000 mm	1 off
- radial drilling machine, diameter of 40 mm	1 off

- pipe bending machine, diameter of 6"	1 off
- power shears for steel plate up to 5 mm thickness and 1.5 m width	1 off
- rolling-machine for sheet iron up to 10 mm thickness and 1.5 m width (with prebending)	1 off
- transformers for welding	3 off's
- carbide acetylene generators, 10 Ncu.m/hr	1 off
- complete set of oxyacetylene welder	5 off's
- complete facilities for argon submerged arc - welding	1 off
- portable device for pipe end welding in plates	1 off
- apparatus for welding inspection	1 off
- stable grinder	1 off
- various portable electric and pneumatic devices (drilling, milling, grinding, etc.)	10 off's
- pumps for hydraulic tests (for 400 and 3,000 ats) total	2 off's
- benches for piping works with relevant tools	5 off's
- forging and heat treatment furnaces	2 off's
- pneumatic hammer of about 50 kgf	1 off
- forge for pipe heating	1 off

b/. Workshop for electric plant and equipment maintenace :

- instruments for checking and setting up protection control and signalizing devices of electric equipment;
- benches and relevant common tools (6 centres) for various activities, such as:
  - electric motor dismounting and cleaning;
  - remaking of windings for electric motors;
  - repairs of various devices (switches, protection devices, etc.);
- rotor centring machine;
- winding machine;
- impregnating and drying facilities;
- apparata for electric and revolution measurement;
- test stand for electric motors and electric start-up and protection devices.

Note: Activities requiring machine-tools shall be performed in the machine-tool shop of the mechanical workshop.

c/. Workshop for current rapairs of instrument :

- fine turning lathes	2 off's
- precision milling machines	1 off
- drilling, grinding machines total	4 off's

- winding machine for small windings 1 off

- check gauges (portable and fixed) for all types of instruments and measurements

- heating furnaces for thermocouples;

- ultrathermostat for thermal resistance, etc.

- electronic control instruments (electronic voltmeter, cathodic oscilloscope, etc.)

- tools and common devices for this category of works.

d/. Car revision and repairs workshop :

- access platform 1 off

- mobile crane for motor dismounting load 1 to 1 off

- complete sets of tools for mounting and dismounting 2 off's

e/. Maintenance workshop for relevant buildings and plants, railways and roads.

- generators and sets for oxyacetylene and electric welding 1 set

- painting and whitewashing devices

with compressed air spraying	1 set
- mortary mixer of 100 l. capacity	1 off
- sump pump of 3"	1 off
- sheet iron bending machine	1 off
- benches for fitters, tinmen and carpenter	3 sets
- electric truck of 0.5 to	1 off
- railway waggon	1 off
- electric mobile crane of 0.5 to	1 off
- hand-operated crane of 0.5 to	1 off
- manual winch of 5 to	1 off
- winch of 3 - 5 to	1 off
- pneumatic hammer for concrete	2 off's
- pneumatic hammer for refractory brick shaping	2 off's
- manual forge	1 off
- mechanical hammer for earthwork compaction	2 off's
- electric vibrator for concrete compaction	2 off's
- steel scaffolding	100 sq.m.

as well as common tools and protection equipment for maintenance of brickwork, sheet-metal works, woodwork, sanitary and electric facilities for buildings.

Note: Specifications under items a, b, c, d, e, are given for reference, consequently they may be altered and completed by the BIDDER.

5.3. CENTRAL LABORATORY

5.3.1. Introductory Note

a/. Current and frequent analyses for process control shall be performed in local laboratories (control centres) for each process unit. The endowment of these laboratories shall be included in the supply of each process plant.

b/. Besides local laboratories, the COMPLEX shall be provided with a central laboratory equipped for the following works:

- periodical analyses with lower frequency especially those requiring highly trained personnel and expensive apparata common for several processes;

- current analyses for the control of the quality of raw materials and end-products, including physico-mechanical testes;

- research works aimed at improving the processes used within the COMPLEX and for enriching the product grades.

This technical specification deals only with the central laboratory.

5.3.2. Sizes and equipment provided

Sizes and equipment provided within the central laboratory shall be defined by the BIDDER, based on his experience, considering the works to be performed within this laboratory.

Related to research works, the GOVERNMENT intends to provide 20 engineers and chemical operators and 40 laboratory operators for these works.

The BIDDER shall provide for the central laboratory all current apparata and devices as well as special apparata for performing the works listed under paragrapf 5.3.1.b. such as: cromatographs, spectrophotometers, apparata for physico-mechanical tests, apparata for sample processing (plastics and rubber), conditioning oven, autoclaves, microscopes, etc.

Within the central laboratory separate rooms shall be provide for:

- chemical analysis laboratories;
- physico-chemical analysis laboratories;
- physico-mechanical analysis laboratories;
- laboratories for plastics and rubber processing;
- offsites (balance room, storages, glass-ware workshop, furnace room, etc.).

The rooms for physico-chemical analyses and for preparation of plastics and rubber mixtures shall be provided with air conditioning whereas the other rooms with proper ventilation.

Rooms where noxious products are handled shall be provide with recesses and adequate ventilation devices.

The working areas shall be sized for four operating points (if not otherwise stated).

The laboratory has to be provided with the following utilities: drinking water, fuel gas at the pressure of 500 mm G, technical compressed air, electric power at 440 V and 260 V, steam at 5 ats.

5.3.3. Other Provisions

a/. The building of the laboratory shall be at least two-storied and mostly three-storied.

b/. Waste water shall be directed to the final treating plant of the COMPLEX, after having reached the conditions required for biological treatment.

5.4. WEAK CURRENT UNITS

5.4.1. Required Units

The petrochemical complex shall be provided with the following weak current units:

a/. Local telephone network having about 100 telephone stations, of which 30 are located in the administration building while the remaining 70 in process plants of the COMPLEX.

The local telephone network shall connected to the automatic telephone exchange belonging to the COMPLEX which is connected in its turn, by at least 10 call numbers, to the trunk - line system of the Peruvian State.

The telephone exchange of the COMPLEX shall provide a spare of at least 25% for future increase of local telephone stations and the possibility of further extension.

b/. Intercommunication system having about 40 inside stations.

c/. Clock network consisting of:

- 4 telltale clocks (time keeping) at the COMPLEX entrance;

- 20 indicating clocks installed in various points of the COMPLEX;

- 1 allarm - clock to announce shifthours.

d/. Wire - broad-casting network having 40 loudspeakers (located in various parts of the COMPLEX) controlled by a central radio transmitter broadcasting various programs or occasional news.

e/. Telex Facility

f/. Handie - talkie set in explosion proof construction to ensure rapid communication particularly during erection, commissioning or special operations. The number of such devices shall be suggested by BIDDER based on his experience.

5.4.2. Technical Requirements

a/. All apparata belonging to the weak current units shall be of modern design supplied by well-known manufacturers on world market.

b/. The apparata as well as conduits and connection boxes shall comply in all cases to the existing working conditions.

c/. The outside connections of the buildings shall consist in underground cables protected by concrete or sandstone tubes.

The location of the apparata within the weak current networks (telephones dispatcher, clock, loudspeaker stations) shall be decided in due time by mutual agreement with the GOVERNMENT.

5.5. ADMINISTRATION AND SOCIAL BUILDINGS

The following are included in this category of works:

a/. Administration building consisting in:

- 4-5 offices for managing staff, secretariat and separate sanitary groups;

- administration staff offices sized as each employee be asigned 5 sq.m. useful area. The number of administration personnel shall be estimed by BIDDER;

- design office for about 20 persons providing 5 sq.m. for each person;

- 3 - 4 meeting rooms having 20 - 25 sq.m. each and separated by folding walls;

- library with reading hall for 20 persons and separate rooms to keep books and documentation;

- one office for training of the personnel on labour safety precautions;

- consulting room and first-aid post (at groundfloor);

- sanitary rooms in adequate number;

- telephone exchange and intercommunication office;

- an exhibition hall of about 100 sq.m. shall be arranged at groundfloor.

b/. The social groups shall take in:

- locker rooms with wardrobe divided into two compartiments for clean and working clothes (one wardrobe for each worker) ;

- showers, washers and sanitary batteries;

- smoking rooms.

The social groups shall be built in the vicinity of process plants; eventually they may serve several plants.

c/. Laundry for protection clothes subject to the action of toxic substances.

The other clothes shall be washed outside the COMPLEX.

d/. Canteen, taking in:

- kitchen;

- food store;

- dining room;

sized to serve the lunch for employers in three series,

- 2 dining rooms for about 20 persons each for guests.

e/. Playing field, taking in:

- football field;

- changing room and showers;

- sportswear store.

5.2.2. All constructions belonging to this category shall be provided with inside facilities and furniture suitable for the purpose.

The offices shall be air - conditioned.

5.5.3. Finishing of the administration and social buildings shall be suggested by BIDDER and mentioned in the tender, avoiding unreasonable and expensive finishing.

5.5.4. The architecture of the constructions belonging to this category shall meet the local requirements for which reason the CONTRACTOR shall contact a local architecture.

5.6. ROADS, PLATFORMS, WALKWAYS, RAILWAY.

For the works belonging to this category, the CONTRACTOR shall consider the following requirements:

5.6.1. Driveways, Platforms, Alleys.

- The roads shall be built of vibrated concrete on a suitable fondation considering the nature of ground and traffic.

- Main roads shall be 6 m wide whereas the sub - siadiary roads shall be 3.5 m wide.

- The routes of main and subsidiary roads shall be indicated on the plot plan enclosed to the tender.

- The road network shall be in rectangular system. The routes, and distances between roads shall be determined in such a way as to enable the access to the plants during operation and emergency.

The approach roads shall be as short as possible. It is recommended to provide a few number of such roads, only where they are absolutely required for operation purposes.

- Subsidiary roads being 3.50 m wide shall be provided with crossing platforms for vehicles at distances varying between 150 and 200 m. The road shall be 6 m wide at crossing area.

- Platforms shall be provided at end of blind roads enabling vehicles to drive back.

- All underground networks crossing the road shall be properly strengthened.

- The platforms belonging to the loading / unloading ramps of storages shall be sized to the overall dimensions and technical characteristics of transportation vehicles as well as to traffic and loading - unloading procedures. They shall be made of concrete on suitable foundation.

- No pillars shall be erected (for racks, lighting or other purposes) on roads and platforms for vehicles.

- The approach roads to building entrances shall be 1 - 1.5 m. wide depending on the number of employees having access to the respective building. These roads shall be made of concrete slabs on sand layer.

- The platforms inside the plants where process equipment is located shall be made of concrete and shall be corrosion resistant if necessary. In all cases the platforms shall be provided with water collecting systems connected to the chemically contaminated water sewage.

- The clearance between plants where underground networks and pipe racks are laid shall be leveled without further arrangements.

5.6.2. Railways

Two group of railways shall be provided inside the plant platform:

- tracks for receiving trains, selection of waggons and gathering of carriages;

- siding track for waggons during loading and unloading operations.

The length and number of tracks shall be calculated depending on traffic, type of waggons and number of loading and unloading ramps.

Layout of too many loading - unloading ramps on one line shall be avoided. As a rule, each ramp shall have its own line.

Waggons shall be shunted by Diesel type engines belonging to the COMPLEX while explosion proof engines shall be used for the ramps of liquid nonflammable products and liquefied gases. The switch lamps in this area shall be explosion proof type.

The number of locomotives shall be calculated depending on traffic and distance to the railway station where trains are taken over or delivered.

Laying of track, type of rail sleepers and ballasting material shall be suggested by BIDDER following to make them agree to the Peruvian norms after concluding the contract.

No railways shall be located at an elevation below + 5.00 against ocean level.

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TENDER SPECIFICATIONS
FOR THE
DESIGN, SUPPLY, ERECTION AND COMMISSIONING
OF THE
LIMA—CALLAO PETROCHEMICAL COMPLEX
IN PERU

VOLUME IV
LOCAL CONDITIONS, DESIGN NORMS AND REQUIREMENTS

October 1973

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BUCHAREST—ROMANIA

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This document is prepared for the United Nations Industrial Development Organization acting as Participating and Executing Agency for the United Nations Development Programme (Special Industrial Services)

C O N T E N T S

1. GEOGRAPHIC DATA

1.1. Geographic Position

The region where the COMPLEX is to be located is situated in the western part of the country, along the coast of the Pacific Ocean in latitude 12^{o} South and in longitude 77^{o} West (see enclosed maps: Appendices I, II and III).

As referred to the important neighbouring localities, this region is situated at a distance of about 14 Km north of Lima, the capital of the country - having about 2 million inhabitants - and the Callao port; and at a distance of 7 Km south of Ventanilla town, having 15 thousand inhabitants approximately.

1.2. Relief and Natural Geographic Elements

In the COMPLEX area, the land looks like a plain strip of variable width within the range of 800 - 1,200 m along the coast of the ocean followed eastwards by a series of hills of increasing altitude, ending in the Andes chain so that the altitude reaches more than 4,000 m at a distance of about 60 Km from the coast.

In the close neighbourhood of the region where the COMPLEX is to be located, southwards to it, the Chillon river flows into the ocean whereas, at about 12 Km, the Rimac river flows into the ocean, both following east - west direction.

Northwards, the site is limited by the refinery " La Pampilla " (to be extended southwards) and by hills which, in that area, start even from the coast of the ocean, reaching the altitude of about 50 m at a distance of 100 m approximately from the ocean coast and of 100 m at a distance of about 500 m.

The coastline looks like and arid, sandy beach generally uncultivated, having an altitude in the range of 0 - 13 m.

In the close neighbourhood of the coast, there is a steep slope increasing from the sea level up to 5 m, along a distance of about 40 m; it climbs afterwards gently from 5 m up to 13 m, along a distance of 800 - 1,200 m.

The profile of surface between the coast of the ocean and Lima - Ventanilla highway is shown in Appendix IV.

1.3. Seismic Data

As shown on the map in Appendix I, the COMPLEX is to be located in a region having the seismic degree of 8 on the international M.S.K. scale (Mercalli - Cancani, modified).

1.4. Economic and Industrial Units in the Area

At present, the following important economic and industrial units are to be found in the bordering area (see enclosed map: Appendix II) :

- the refinery " La Pampilla ", neighbouring the COMPLEX on its northern side;

- the factory " Quimica del Pacifico ", at about 8 Km southwards;
- the airport of Lima, " George Charez ", at about 9 Km southwards.

The COMPLEX will closely co-operate with the refinery " La Pampilla " wherefrom it is to be supplied with main raw materials:

- naphtha for pyrolysis;
- depentanized naphtha for catalytic reforming; and
- liquid fuel for the thermoelectric power station of the COMPLEX

and whereto it will supply:

- gasoline, from pyrolysis and from catalytic reforming, to be conditioned and processed to motor gasoline; and
- L.P.G. cut, from butadiene extraction, for bottling or other applications.

The co-operation with the factory " Quimica del Pacifico " is limited to the supply, from this factory, of a certain amount of chlorine required for dichloroethane synthesis and vinyl chloride respectively.

Related to the airport of Lima, its presence in the neighbourhood of the COMPLEX leads to beaconing of tall structures of the COMPLEX for the safety of air traffic.

1.5. Communication Ways

The area where the COMPLEX will be located disposes of the communication means required for the transportation of equipment, materials and people, as follows (see map: Appendix II):

- The Callao port provides connection with foreign countries, being in its turn connected with the internal railway network.

At present, the nearest existing railway is at a distance of about 15 Km from site location, namely in the Callao port.

The GOVERNMENT envisages to provide a direct rail-connection in this port for all transportations required by the COMPLEX.

- The highway " Lima - Ventanilla " provides the connection with the Callao port, the airport " George Charez " and then joins the northern Pan - American highway between Lima and Ancon.

Details on the available ways and means of transportation are given under Section 4.

2. CLIMATIC DATA

2.1. Barometric Pressure is characterized by extremely low fluctuations, the minimum, mean and maximum values being very close, as follows:

- minimum mm Hg 759
- maximum mm Hg 763
- mean mm Hg 760

2.2. Wind Direction and Intensity

- Prevailing wind direction: from south and south - west
- Average speed: 4 m/sec.
- Maximum speed: 6 m/sec.

No storm has been recorded in the area of the COMPLEX.

Wind rose is shown in Appendices I,II,III and VII.

2.3. Air Temperature

Summer (January - March) :	mean:	+ 22.0°C
	maximum:	+ 30.8°C
Winter (June - August) :	mean:	+ 16.8°C
	minimum:	+ 8.0°C

Frost or snow was never reported.

The tables in Appendix V are listing main values of air temperature during a period of 8 years (1962 - 1969) showing that temperature fluctuations are particularly low.

2.4. Air Humidity

Annual mean : 84.7 %; dew point : 19.9°C
Mean in summer : 85.0 %; dew point : 20.0°C
Mean in winter : 86.0 %; dew point : 13.9°C

Mean values per month in the period 1961 - 1970 are shown in Appendix VI.

2.5. Rainfalls

Rainfalls are very scarce in the region where the COMPLEX is to be located, the annual mean, recorded in the last four years, reaching only 23.8 mm/sq.m.

The few rains are falling only between June - November whereas between December - May no rain is falling.

2.6. Tide

Maximum low tide : - 0.75 m
Maximum high tide: + 0.82 m

2.7. Atmospheric Corrosion

a/. Sulphating number (ppm SO_2), as compared with allowable values provided by U.S. standards has the following figures:

In COMPLEX Area			As per U.S. Standards
max.	min.	mean	
0.013	0.004	0.008	0.008

b/. Corrosion index (mg. iron oxide/sq.cm. 30 days) as compared with values defined in Lima:

In COMPLEX Area			In Lima
max.	min.	mean	mean in May - June 1968 - 1971
5.16	1.59	3.36	1.21

The maximum values of corrosion index in COMPLEX area are recorded on the ocean coast whereas the minimum ones are reported from the opposite side; this leads to the conclusion that atmosphere corrosion is mainly owed to air salinity.

c/. Pollution index (Cohs per 1,000 linear feet) as compared to U.S. standards.

In COMPLEX Area			Class as per U.S. Standards
max.	min.	mean	
1.70	0.13	0.75	0.0 - 0.9 reduced
			1.0 - 1.9 moderate
			2.0 - 2.9 intense
			3.0 - 4.0 very intense
			over 4.0 extremely intense

The above mentioned figures were collected from the study prepared by INSTITUTOS NACIONALES DE SALUD, in Lima - Peru.

Generally, in COMPLEX area, atmosphere corrosion is moderate whereas pollution is reduced.

The BIDDER has to consider adequate protection of plants, buildings and instrumentations.

At the refinery " La Pampilla ", under operation for four years which is located in the neighbourhood of the COMPLEX, no considerable atmospheric corrosive action has been noticed.

3. DETAILS ON SITE WHERE THE COMPLEX IS TO BE LOCATED

3.1. Demarcation, Perimeter, Configuration

The site on which the COMPLEX is to be located covers a surface area of 128 ha, delimited by:

- west : the coast of the Pacific Ocean;
- south : the Chillon river;
- east : the Lima - Ventanilla highway;
- north : future expansion of the refinery " La Pampilla ".

Northwards, the site is bordered by low hills whereas a certain area is covered by the route of crude oil pipe line supplying the refinery " La Pampilla " (see the map: Appendix III).

The COMPLEX has to be delimited as follows (see Appendix VII - a tentative plot plan):

- west : contour line of 5 m, at 30 - 40 m from the ocean coast;
- north : existing crude oil pipe line; contour of steep sloped hills; southern side of the refinery " La Pampilla ", after expansion;
- east : the highway Lima - Ventanilla, which imposes the following distances:
  - 20 m from the highway border up to the fence of the COMPLEX;
  - 50 m from the highway border up to process plants;
- south : slope of the Chillon river.

Flare stacks will be located outside the limits mentioned above, namely on the neighbouring hill of the northern side of the COMPLEX, as shown on the plot plan, Appendix VII.

Site levelling has to be properly done and only where necessary for providing a normal traffic and access within the COMPLEX in order to reduce diggings and fillings to a minimum.

Appendix IV shows profile of surface on east - west direction, almost perpendicular on the highway Lima - Ventanilla and, in a way, on the coast of the ocean as well as on the direction of the greatest slope line (see also Appendix VII).

The site map with contour lines, each one meter, will be made available to the BIDDER when and if necessary, at his request.

3.2. Possibilities of Framing the COMPLEX on the Available Surface Area

Appendix VII stands for a Tentative Plot Plan of all units (works) belonging to the COMPLEX.

By considering this Tentative Plot Plan, it is concluded that the available surface area defined under the previous item is meeting the location requirements of the COMPLEX, for the development foreseen for the final stage.

The BIDDER has to make a proposal of a plot plan he considers the best.

When working out the plot plan, the BIDDER has to consider the following principles and requirements :

- the plot plan has to be prepared for stage I, indicating blank areas for the final stage;
- administration and social buildings have to be located towards the Lima - Ventanilla highway, wherefrom one can enter the COMPLEX;
- relative location of process units has to be defined in such a way as to provide a reasonable flow of products by means of the shortest and very simple pipe routes ;
- the main tanks for the liquid products are to be arranged within a tank yard, located on the western side of the area;
- railway connection with the Callao port has to be located as near as possible to the ocean coast (but not lower than 5 m); according to this, it will be decided the location on internal siding tracks and relevant warehouses;
- the main raw materials (naphtha) are to be supplied by pipe-lines from the refinery " La Pampilla ", located to the northern side (north - east corner of the COMPLEX); gaseous chlorine will be supplied by a pipe-line entering the COMPLEX at the south-west corner;
- the great majority of products will be transported by means of road trucks;
- provision of a ground for sports and rest will be considered.

3.3. Geotechnic Data

The area where the COMPLEX is to be located belongs to the alluvial cone of the Chillon river and is made up of alluvial matter.

Appendix VIII gives the drill logs made by LAGESA Laboratorio Geotechnico, S.A. in Peru (for two points indicated on the drawing - Appendix VII).

By considering the " Technical Information " prepared by LAGESA, the following important conclusions can be drawn:

a/. In the COMPLEX area, soil is generally made up of a superficial layer of oozy clay and fine clay under which there are succesive layers made of gravel and sand with insertions of ooze fine clay down to the depth of 40 m from the surface;

b/. Underground water is traced at + 2.00 m from sea level;

c/. The bearing capacity of soil varies between:
1.0 Kgf/sq.cm. at the depth of 1.5 m, and 2.5 Kgf/sq.cm. at the depth of 4.5 m in the northern area of the site; and 1.5 Kgf/sq.cm. at the depth of 1.5 m, and 5.0 Kgf/sq.cm. at the depth of 4.5 m, in the southern area of the site.

These figures are only reference figures; they can be used for preliminary sizing and for estimating the cost of foundations.

The final figures will be reached by performing several drillings to be carried by the CONTRACTOR in areas where heavy buildings and structures are to be located.

d/. Soil settlements will be moderate in the northern area and reduced in the southern one; they shall not exceed the figures allowable for industrial buildings.

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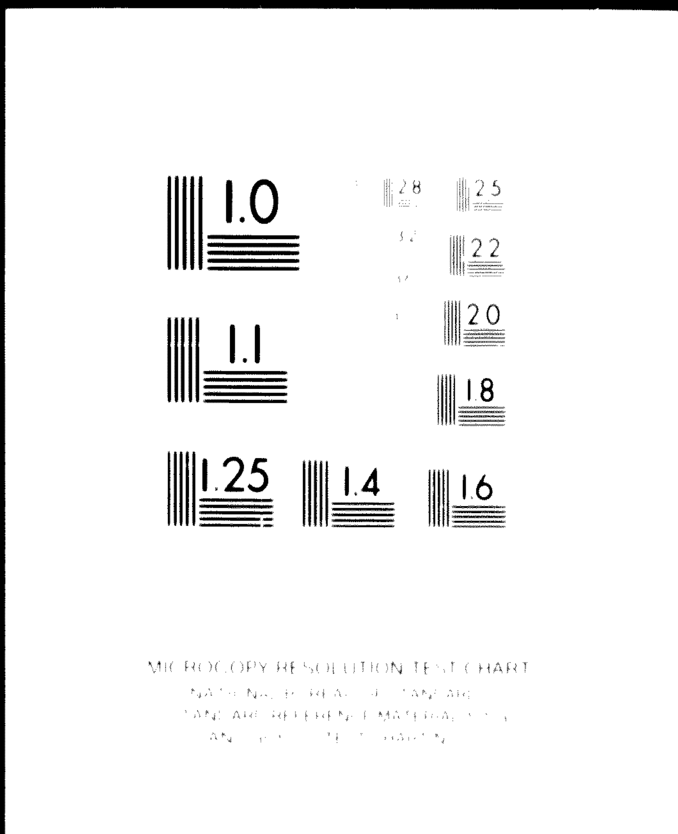

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4. DATA ON WAYS AND MEANS OF TRANSPORTATION

4.1. Maritime Ways

Maritime transportation can be made through the Callao port, the greatest port in Peru and one of the great ports of South America, on the Pacific Ocean coast.

The GOVERNMENT has provided the further development of the Callao port together with the industrial area along the Peruvian coast of the Pacific Ocean.

The present situation of the Callao port as well as the developments foreseen for 1975 and 1990 are shown on drawings of Appendices IX and X.

The roadstead of the harbour is bounded and protected by the breakwater piers with a span to the ocean of 130 m.

Water depth at roadstead inlet and at roadstead is of 11.5 - 12 m and sometimes only of 6 m (see Appendix VIII).

The tonnage of ships which can moor along is of 40,000 t, dw.

The harbour is provided with hoists and transportation devices (cranes, hoists, forklifts, tractors, pulleys) for various types of loads with common loads in the range of 1 and 30 to.

For higher loads, an 80 to. floating crane is available.

The list of the main lifing devices and transportation means is given in Appendix XI.

Platforms in the open air and covered warehouses are available for the storage of unloaded equipment and materials.

In the harbour there are available railways for berths, storage platforms and warehouses and locomotives for riggings inside the harbour.

The railway of the port is connected with the Lima - Ancon railway.

4.2. Railways

4.2.1. Railways have the following main characteristics:

- common clearance (1,435 mm);
- rails of 80 BS-type, design 1936, of 40 Kg/m, BS 11/1959 with a length of 14.02 m;
- sleepers made of wood or reinforced concrete;
- minimum ray of 120 m;
- maximum superelevation 100 mm at a ray of 135 m;
- maximum existing gradient : $45^{o}/00$;
- platform width : 4.5 - 5.0 m;
- loading overall sizes : on vertical : 4.73 m
on horizontal: 3.15 m
- minimum clearance between center lines of two rails: 4.25 m;
- calculation train for the design of bridges and culverts: Cooper F 60, as per " American Railways Engineering Association " norms.

4.2.2. Railroad cars used on railway network have the following main characteristics:

- maximum length : 12 m;
- maximum loading capacity : 40 to.;
- maximum height of railway car from rail up to the highest part : 4.184 m;
- maximum width : 3.009 m;
- maximum train tonnage : 850 to per convoy.

As specified also under 1.5., the nearest railway can be found in the Callao port, consequently during the COMPLEX erection, the transportation of equipment and materials between Callao port and the SITE shall be made on roads.

4.3. Transportation on Roads

4.3.1. Roads

Road routes in the area where the COMPLEX is to be located are specified under 1.5. and shown on the map Appendix II respectively.

In the close neighbourhood of the COMPLEX, there is a highway which connects, southwards, the airport with Lima and Callao and northwards with Ventanilla town, afterwards entering Lima - Ancon highway at the kilometer 27.900 (the kilometer 0.00 standing for the road intersection with the Argentina boulevard, when leaving the Callao port).

The main technical data on this highway are the followings:

a/. Width of practicable side:

- 7.20 m dual-highway, starting from kilometer 0.000 up to kilometer 12.300 and from kilometer 21.000 up to kilometer 25.000;
- 14.40 m dual-dual highway from kilometer 12.300 up to kilometer 21.100;

b/. The road structure consists of concrete on several sections and asphaltum on others;

c/. Bearing capacity: the maximum load to be overtaken without damages, reaches 11 to per axle, for an intense traffic. It is allowed a load increase of 13.5 to per axle, for a traffic of maximum 200 vehicles of this type per day, or 16.5 to per axle, for a traffic of maximum 5 vehicles of this type a day;

d/. Maximum gradient 6 % inbetween kilometers 20.300 and 23.400;

e/. Bridges:

- at 1,400 Km, over the Rimac river, with:
  - length : 66.80 m;
  - span number: 3;
  - calculation train: H 20.S 16;
- at 12,300 Km, over the Chillon river, with:
  - length : 25 m;
  - span number : 1;
  - calculation train: H 20.S 16;

f/. Culverts

Culverts are sized for the calculation train of H 20.S 16;

i/. Critical points

In the neighbourhood of Callao, the highway is crossed by several telephone lines which are to be superelevated.

Other constrictions are nor reported.

On the Lima Ventanilla highway there was trasported equipment with lengths up to 45 m and weights up to 80 to for the refinery " La Pampilla ".

4.3.2. Transportation Means

Generally, transportation on roads is very developed in Peru, local companies have available various types of vehicles having loading capacities of 4; 7; 10; 12 and 16 to as well as trailers for loads up to 50; 100; 150 and 250 to.

The list of local companies owning transportation equipment and lifting devices is given in Appendix XII.

5. WATER SOURCES

The potential water sources in the area of the COMPLEX are:

- sea water;
- underground water, in the neighbourhood of the COMPLEX;
- surface water of Chillon and Rimac rivers.

The main available data on these sources are the followings:

5.1. Sea Water

5.1.1. The ocean coast is situated at a distance of 30 up to 40 m from the western side of the COMPLEX area (see also Appendix VII).

In the close neighbourhood of the COMPLEX, the shore looks like a sandy beach with a slope of about 12 - 15 %; at a distance of several hundred meters northwards from the north-western corner of the COMPLEX there is a rocky region.

5.1.2. The main characteristics of sea water are the followings:

Temperature (^{o}C)	Summer (January March)	Autumn (April June)	Winter (July September)	Spring (October December)
mean	19	17	16	16
maximum	27	26	21	21
minimum	17	14	13	15
Salinity, gr/l				
mean	34.9	35.0	35.0	35.0
maximum	35.6	35.5	35.5	35.6
minimum	33.7	34.3	32.0	33.8
Solved oxygen Ncu.cm/l				
mean	5.0	4.0	4.0	5.0
maximum	7.0	6.0	6.0	6.0
minimum	2.0	2.5	2.75	2.75

5.1.3. The maximum level difference of sea water (high tide - low tide) is of 1.57 m.

5.2. Underground Water

5.2.1. In the area close to the COMPLEX there is, at present, a system of wells supplying several populated centres and existing industrial units.

The area where wells, made by the company " Perforadora Alemana " in Peru are located, can be found on the map, Appendix II.

By considering the previous hydrological studies and the remarks on wells under operation, it is concluded that the underground water flow rate can reach about 20 cu.m/hr., thus covering the requirement of drinking water for the COMPLEX.

All works required for the supply of water up to the COMPLEX limits shall be performed by the GOVERNMENT.

Plants making water reach the grade of potable water are to be provided by the CONTRACTOR, consequently they shall be included in the tenders.

Reference chemical characteristics of the natural underground water are the followings:

- pH	7.2 - 7.6
- total hardness, ppm $CaCO_3$	500 - 760
- total salts, ppm	700 - 1,400
- methyl - orange, alkalinity ppm $CaCO_3$	100 - 190
- calcium, ppm $CaCO_3$	130 - 480
- magnesium, ppm $CaCO_3$	140 - 380
- sodium and potassium, ppm $CaCO_3$	50
- sulphates, ppm $CaCO_3$	300 - 420
- chlorides, ppm $CaCO_3$	75 - 420
- silica, ppm SiO_2	22 - 34
- CO_2, ppm	2.4
- Fe, ppm	0.4
- organic matter, ppm	3

The quality specification of drinking water is the following, as imposed by the Peruvian legislation:

Physico-Chemical Characteristics	Maximum Content	Units
- Normal alkalinity, as CO_3	120.00	mgr/l
- Arsenic	0.20	mgr/l
- Barium	0.10	mgr/l
- Boron	2.00	mgr/l
- Cadmium	0.01	mgr/l
- Cyanides	0.01	mgr/l
- Chlorides	250.00	mgr/l
- Colour	10.00	APHA
- Copper	1.00	mgr/l
- Chromium	0.05	mgr/l
- Total hardness ($CaCO_3$)	250.00	mgr/l
- Hardness, French degrees	84.00	
- Iron	0.30	mgr/l
- Fluor	1.50	mgr/l
- Magnesium	125.00	mgr/l
- Manganese	0.30	mgr/l
- Lead	0.10	mgr/l
- pH	7.5	
- Selenium	0.05	mgr/l
- Silica	25.00	mgr/l
- Sulphates	250.00	mgr/l
- Haze	10.00	mgr/l
- Zinc	5.00	mgr/l

Bacteriological characteristics: less than 2.2 colon bacillus in 100 cu.cm.

Considering the relatively small amounts of underground water and the already existing wells or wells foreseen to be provided, it can not be relied on the possibility of increasing the underground water flow rate in this area.

5.2.2. New Underground Water Sources

Hydrological studies lately made have proved the possibility of acquiring underground water from a remote area (up to about 30 km).

The main characteristics of underground water in this area have not been yet defined, but for the tenders the following data can be considered:

- average flow rate : 600 - 700 cu.m/hr.;
- composition: as under 5.2.1.

The BIDDER shall consider that water in this area covers consumption of water with more strict quality characteristrics, e; g, : boiler feed water and process water.

Works for collecting and suppling water up to the COMPLEX limits are to be performed by the GOVERNMENT whereas treating facilities (to make water reach the grade imposed) are to be provided by the CONTRACTOR and, consequently, shall be included in the tender.

5.3 Surface Water

5.3.1 Chillon River

This river flows into the ocean in the neighbourhood of the COMPLEX limits, bordering southwards the area where the COMPLEX is to be located.

Considering the previous measurements performed for a long time period, there were concluded the following data on Chillon river:

Average Flow Rate

- for 45 years : 284×10^6 cu.m per year, 9.017 cu.m/sec respectively;
- in 1967 - 68: 4.564 cu.m/sec;
- in 1968 - 69: 5.167 cu.m/sec.

Minimum Flow Rate for 30 years:

- for the frequency of 27/30 (90% safety degree): 0.431 cu.m/sec;
  for the frequency of 30/30 (100% safety degree):
  0.00 cu.m/sec in May, June, July, August.

Chemical Properties (reference figures as per analysis made on June 18th 1969):

Cation

Ca^{2+}	mval/l	6.2
Mg^{2+}	mval/l	3.4
Na^{+}	mval/l	1.2
K^{+}	mval/l	0.05
	Total	10.85

Anion

CO_3	mval/l	1.0
HCO_3	mval/l	6.0
NO_3	mval/l	3.8
SO_4	mval/l	0
Cl	mval/l	0
Total		10.8
pH		7.3

5.3.2. Rimac River

This river flows into the ocean at about 12 Km south of the COMPREX location, after passing through Lima.

By considering the measurements made for a long period of time, the following data on Rimac river water were concluded:

Average Flow Rate

- for a period of 53 years: 894×10^6 cu.m/year, 28.4 cu.m/sec respectively.

Minimum Flow Rate

- for the frequency of 27/30 (90 % safety degree): 8.53 cu.m/sec;
- for the frequency of 30/30 (100 % safety degree): 7.63 cu.m/sec.

Chemical Characteristics before entering Lima

(reference figures, as per analysis made on April 5th 1971) :

Ca^{2+}	mval/l	3.5
Mg^{2+}	mval/l	0.65
Na^+	mval/l	0.7
K^+	mval/l	0.05
Total		4.9

CO_3	mval/l	0
HCO_3	mval/l	2.0
NO_3	mval/l	0.5
SO_4	mval/l	1.4
Cl	mval/l	1.0
	Total	4.9
pH		8.5

The water of Rimac river, when flowing into the ocean is strongly contaminated and polluted due to the discharge of Lima sewage system.

5.4. Conclusions and Recommendations on Water Sources.

5.4.1. Chillon river can not stand for and economic water supply source due to the high flow rate fluctuation and to extremely low values of minimum flow rates which sometimes reach 0.

Water of Chillon river can be used only on condition of flow rate adjustment which implies high capital costs, not foreseen by the GOVERMENT in the next future.

5.4.2. Rimac river can not stand for an economic water source also due to the high pollution and contamination and excessive capital costs and expenses respectively, necessary for a proper treatment.

Water feeding out of Rimac river upstream to Lima, would bo possible on the condition of adjusting the flow rate, which implies high capital costs.

5.4.3. By considering the above mentioned data, when preparing the tenders, the BIDDER will use the following water sources:

- sea water for cooling purposes and as fire fighting water in external fire-fighting network;
- underground water from wells existing in the bordering area, for preparing drinking water and for internal fire-fighting networks;
- underground water from new wells (in remote area), for preparing hot water of special grade, e.g.: demineralized water for steam boilers and for various process applications.

5.4.4. If the BIDDER would still consider that the disadvantages of using sea water might justify the use of water of the Chillon and Rimac rivers and the economic efficiency of it, he has to make proposals accordingly.

6. DE^SIG^N NORMS AND REQUIREMENTS

6.1. GENERALS

6.1.1. This section is dealing with design norms and requirements to be observed when working out designs and which are to be considered by the BIDDER when preparing the tenders.

This section deals only with the norms and requirements the GOVERNMENT considers necessary or useful to draw BIDDER,s attention on. Consequently, the CONTRACTOR has the entire responsibility as regards guarantees stipulated by the contractor by observing also any other technical norms and requirements which, though not listed in this section, are compulsory or necessary for the satisfactory operation of plants and the COMPLEX in its whole.

6.1.2. Generally, the GOVERNMENT wants the BIDDER to adopt- to the greatest extent, justified from an economic standpoint, the same standards and regulations for all plants making up the COMPLEX and to have in view an advanced standardization of equipment, instrumentation, piping, fittings and of spare parts for facilitating maintenance and procurement works.

6.2. EQUIPMENT

6.2.1. Pressure Vessels, Containers, Towers, Tanks, etc.

a/. Pressure vessels shall be designed and manufactured, inspected and tested according to ASME code, the latest issue.

b/. Pressure vessels shall be sized at a design pressure by 10 % higher than working pressure or at a pressure by 1.8 Kgf/sq.cm. higher than working pressure, whichever is the greatest.

c/. The maximum allowable load to be considered at design for pressure vessel parts, which are not under pressure, excepting weldings, shall be 33.3 % of tensile strength.

d/. Containers with a diameter greater than 800 mm and without removable cover shall be provided with at least one manhole.

Containers with a diameter smaller than 800 mm and without removable cover shall be provided with cleaning holes located in such a way as to allow welding inspection.

e/. Containers operating under vacuum shall be designed for full vacuum.

f/. Containers operating at atmospheric pressure shall correspond to the American norms API, the latest issue.

g/. Towers shall be provided with a proper number of manholes, depending on the type of vehicled fluids, relevant tower design and operating conditions, in view of facilitating a rapid intervention or repair in case of an emergency. In this respect, the BIDDER shall rely on his own experience.

6.2.2. Heat Exchangers

a/. Tubular heat exchangers shall be designed according to the American norms TEMA, class R, the latest issue.

b/. Pressure heat exchangers shall be dimensioned at a design pressure of 1.1 x maximum working pressure or at a pressure equal to the maximum working pressure + 1.8 Kg/sq.cm. whichever is the greatest and according to ASME code.

c/. If heat exchangers outlet pipe is provided with a closing valve, the exchanger shall be calculated for the maximum pressure of compressor or pump with which is connected at inlet.

d/. For fluids rendering the possibility of deposits, it shall be provided easily cleaned heat exchanger types such as heat exchangers with floating head or with removable bundles made of U-shaped tubes.

e/. It is not allowed to use welded tubes and cast iron as construction material for heat exchangers.

f/. The length of tube bundle has to provide an easy dismounting by considering equipment location in the plant.

g/. For heat exchangers using sea water as cooling agent, it has to be provided construction materials meeting the characteristics of sea water, specified under item 5.1. (see also item 4.3. in Volume III).

Temperature of sea water at heat exchanger outlet should not exceed 40^{o}C.

h/. For air coolers, particular notice should be taken when selecting material for fings by considering atmospheric corrosion . d climatic conditions (see item 2.7.).

i/. Due to the great number of heat exchangers provided in different plants of the COMPLEX, the BIDDER must show special interest in standardization and interchangeability by this category of equipment.

6.2.3. Furnaces and Boilers

a/. Tubular furnaces processing hydrocarbons shall be designed according to American norms API, the latest issue.

b/. Steam boilers shall be designed according to ASME code.

c/. Furnaces for heavy products, where coking may occur, shall be provided with the possibility of mechanical cleaning of tubes.

d/. Slight depression operating conditions shall be preferred for furnaces.

e/. Furnace stacks shall be of self-supporting type, with a height by at least 3 m greater than that of the surrounding equipment, on a distance of 30 m.

f/. Burners for boilers and furnaces shall meet the following conditions:

f.1/. To be entirely suitable for fuels available in the COMPLEX, namely:

- fuel gas from ethylene plant;
- fuel oil from ethylene plant;
- fuel oil (from neighbouring refinery (with specific gravity of 0.960 gr/cu.cm. and freezing point of $0^{o}C$ (complete quality specification of these fuels is given in Volume III, item 4.1.) .

f.2/. It is desirable that burners should satisfactorily operate with any of these fuels.

Anyhow, the BIDDER has to provide, by means of installed burners, the complete use of fuels, produced as process by-products, and the proper operation of all furnaces and boilers by using the available fuels.

f.3/. Any gas or oil burner shall be removable, in case of failure, while the others are under operation.

f.4/. Burners shall be of the latest design for providing combustion under optimum conditions with a minimum content of noxious components in off-gases at a minimum excess of air.

6.2.4. Pumps Compressors

a/. Equipment in this category shall be selected to meet normal operating loads, with optimum energetic efficiency

b/. Pump designs and spare parts shall be standardized in so far as possible.

c/. Pump design, selection of materials and testing methods shall be in accordance with API or/and DIN, the latest issue.

d/. For pumps delivered, the CONTRACTOR shall make available relevant performance curves, namely:

- capacity curve;
- power curve;
- efficiency curve;
- NPSH curve.

e/. Pumps vehicling fluids at temperatures higher than 120^{0}C shall be provided with liquid cooled stuffing boxes.

f/. All pump under permanent operation shall be provided with stand-by's.

Pumps operating intermittently should not be provided with stand-by's if they could be replaced or repaired between two operation periods.

The number of stand-by's, defined by the BIDDER based on experience acquired shall be indicated in the tender.

g/. Pump driving motors shall have a rated power by 10 - 15 % greater than the power required at the maximum load of relevant pump.

h/. Mounting position, suction pipes of centrifugal pumps and speed of piston by reciprocating pumps, must be selected in such a way - depending on viscosity, temperature and volatility of relevant fluids - as to remove the possibility of cavitation.

i/. When vehicling dirty fluids filters shall be provided on suction connections of pumps.

j/. Design, selection of materials, shop inspection and testing methods for compressors (reciprocating and centrifugal) shall be in accordance with API or DIN, the latest issue.

The tender shall indicate the method for checking the flow rate provided.

k/. Reciprocating compressors shall be provided with vibration dampers.

l/. Reciprocating compressors for hydrocarbons liquefied at normal temperatures shall be of horizontal cylinder - type in view of facilitating liquid drainage.

m/. Reciprocating compressors shall be provided with stand-by's. Regarding rotating compressors (helical, centrifugal), the BIDDER shall judge whether or not to provide stand-by's, by considering the necessity of a continuous operation for a period of minimum 8,000 hr/year.

n/. For compressors the tenders shall indicate:

- theoretical power required;
- effective absorbed power under normal operating conditions; and
- driving motor power.

o/. Besides common overpressure and overload protection devices, process compressors shall be provided with devices detecting dangerous vibrations and relevant protection respectively.

p/. Compressors shall be provided, on suction and connecting pipes between stages, with devices retaining mechanical impurities.

r/. Compressors shall have two lubricating systems with rapid switching over from one to the other.

6.3. INSTRUMENTATION

6.3.1. Plants shall be provided with instruments required in view of meeting the following requirements:

a/. Centralized supervision and control of each plant shall be performed from a control room, possibly common for several plants.

b/. Automatic control of all parameters which have an influence on the proper running of process.

c/. Acoustic and visual alarms for deviations from normal running, located in control room with possibilities of detecting rapidly the point where deviation occured.

d/. Personnel and plant safety against any injuries or damages, i.e. to provide automatic interlocks for all emergencies presenting any risk as regards personnel and plant safety; acoustic and visual alarms in control room and acoustic alarms in working areas where an emergency for personnel can occur.

e/. Recording of the most important parameters of the process, having an influence on the process and on further control of operation. It is allowed to group several points on the same recorder on condition to distinguish relevant values.

f/. Registering of all material and utility consumptions.

6.3.2. Local supersivion and control are allowed only for exceptional situations, when according to BIDDER,s experience and up-to-date world practice a centralized control system would be either unrecommended or unjustified. These situations shall be pointed out in the tender.

For local operations, local indicators shall be visibly installed where relevant operation is performed.

6.3.3. For design, erection and running, ISO, VDE and NEC norms shall be observed.

The BIDDER shall follow the standardization of all types of instruments and relevant norms for an easier operation and maintenance.

6.3.4. Instruments shall be preferably of pneumatic type. When, due to technical and economic reasons, the use of electronic instruments is required, these must be explosion proof type adequate to conditions in relevant working area.

All instruments shall conform to local climatic conditions (T.H. type).

6.3.5. Instruments shall be miniaturized and installed on central panels where the flow sheet and measuring and control points are plotted.

Instrument installment should provide an easy access for control and maintenance.

6.3.6. Only well-known and highly appreciated instruments shall be provided.

6.3.7. When economic reasons would justify the provision of special instruments for process optimization, the delivery shall be included in the tender together with relevant reasoning.

6.3.8. When selecting instrument accuracy and instrument scale, it has to be considered the possibility of running the plants also at reduced capacities.

6.3.9. Values of all parameters will be expressed in I.S. units and recording systems shall be provided according.

6.3.10. All labels on control panel shall be written in Spanish.

6.3.11. For power supply of instruments (compressed air and electric power) the BIDDER shall provide equipment for the entire COMPLEX.

6.3.12. In each plant, it has to be taken all necessary steps for preventing the consequences of compressed air or electric power supply failures.

6.4. EQUIPMENT LAYOUT

6.4.1. By considering the favourable climatic conditions, listed under Section 2, it has to be contemplated to the maximum possible extent, the possibility of loca'ing equipment in the open air.

6.4.2. In view of saving ground, due to the limited surface area, it has to be followed the most efficient and compact location of equipment, by observing safety norms and regulations (in BIDDER's country) and providing an easy access of the personnel both during normal running and emergency.

The BIDDER shall consider the provision of surface areas for the initial installment of equipment and for its removal when replaced or repaired which implies removal from working position.

6.4.3. Distances between plants (process units) are not defined in Peru. These distances shall be provided by the CONTRACTOR, based on his experience, in compliance with legislation valid in his on own country and by having in view both safety of operation and saving of ground.

For flare stacks used for burning fuel or noxious gases, the following minimum distances have to be observed:

- 100 m from tanks and any other equipment, producing in normal operation or accidentally fuel gas or liquid leakages;
- 50 m from COMPLEX enclosure towards inside.

The height of flare stacks has to provide a good dispersion of gases into the atmosphere in the event of its blowing out.

6.4.4. For equipment mounting and dismounting, the BIDDER shall consider, first, equipment (cranes, hoists, etc.) available in Peru at specialized companies (see Appendix XII) and if special equipment or devices are required, which can not be procured from local sources, the tenders shall provide their hiring or delivery.

6.4.5. For equipment requiring more frequent, periodical or accidental maintenance, the BIDDER, based on his experience, shall provide means (or methods) for dismounting and removing relevant equipment (travelling cranes, fixed cranes) or the possibility of using mobile cranes.

6.4.6. All equipment with stand-by's is to be mounted in order to allow the switching over to the stand-by. Repair or removal of relevant equipment should be done without plant shut-down.

6.4.7. Related to equipment exceeding common overall sizes, which is to be assembled on site, the followings are to be specified:

- In Peru there are specialized companies capable of performing and overtaking responsibility for such works and for erection of equipment, pipes and complete plants as well. Some of the companies working in this fields are listed in Appendix XVII;
- For these works, the CONTRACTOR has to take all necessary measures for providing a good fabrication by bearing the whole responsibility.

6.5. PIPING

6.5.1. Design, erection and inspection of pipes shall be performed in compliance with ASA-B-31.3 " Pressure Refinery Piping " and ASA-B-31.1 " Power Piping " norms.

6.5.2. U.S. standards shall be used for selecting sizes for pipes, fittings, flanges, valves, etc.

6.5.3. All external pipes for materials and utilities, excepting sewage, shal be located in the open air, above ground, at ground level or overhead on piperacks, as required.

Pipe routes and piperack heights at crossing with roads shall be provided so that they should not disturb the traffic on internal roads of the COMPLEX.

Clearance between pipe supports shall provide a pipe deflection not exceeding 5 mm.

6.5.4. Pipes for fluids freezing at ambient temperature will be steam traced and overall insulated together with them.

6.6. ELECTRICALS

6.6.1. Power consumers in the COMPLEX shall be fed on voltages of 6,000 V and 440 V, three phase current, 60 cps. The 220 V - 60 Hz voltage will be used for normal lighting and 220 V direct current for emergency lighting and special circuits (e.g. alarms, control circuits).

6.6.2. By considering the economic importance of continuous running of process plants, electric power distribution shall use double radical-type networks, from the sources up to the last distribution panels (6 kV and low voltage). Each " half network " is to be sizes for the total load. As an exemple, it is attached hereto the one-line diagram typical to a consumer supply station of medium and low voltage, to be found in any process or utility plant (see Appendix XIII).

The two 6 kV feeders of each local 6 kV station (of process and/or utility plants) shall be connected with central 6 kV distribution station (in thermo-power station) which is supplied from two separate sources, namely: turbogenerators in thermo-power station (covering the whole consumption) and connection with national electric system (covering about half of the power of thermo-power station).

6.6.3. For the supply of less exigent consumers, from the viewpoint of continuity in operation (e.g. workshops for mechanical repairs), it is admitted a simple radial diagram: only one feeder of 6 kV, only one distribution of 6kV, one transformer of 6/0.4 kV and only one low voltage distribution.

6.6.4. For plants exclusively provided with low voltage consumers, the diagram of switchgear station is kept, as shown in Appendix XIII, transformers being block-fed from the different bus bars of the closest 6 kV distribution station.

6.6.5. For electric facilities located outside battery limit of each plant, " Electrical Code " issued by Ministerio del Energya y Minas in Peru shall be observed if the GOVERNMENT can put these regulations at the disposal of CONTRACTOR before signing the contract. If not, norms valid in CONTRACTOR's country shall be observed.

6.6.6. Switchgear stations and switchgear rooms of 6 kV and low voltage as well as their auxiliary facilities shall be located outside hazardous areas (as per definitions of NEC and API-PR-500) in order to avoid pressurizing systems which are expensive and difficultly fed with electric power.

6.6.7. Equipment for 6 kV distribution and 440 V shall be of draw-out type with sufficient stand-by's for extensions not initially provided (about 15 - 20 % spares).

Electric distribution shall be provided with two simple bus bar systems coupled by longitudinal switches (tie - breakers), that are open under normal operating conditions. These shall be provided with automatic time-relay actuation and interlocks with the two incoming switches, so that only two of the three switches (2 inputs and 1 tie) can be simultaneously closed.

Electric distributions shall be provided with interlocks and locking shutters preventing any personnel contact with " live " parts during normal operation.

6.6.8. Operating voltages:

- 6,000 V $\pm$ 5 % (three phases, 60 cps.) for electric motors with rated powers over 200 kW;
- 440 V $\pm$ 5 % (three phases, 60 cps.) for electric motors with rated powers between 1 - 200 kW and for electric

motors of main importance with rated powers smaller than 1 kW;

- 220 V $\pm$ 5 % (one phase, 60 cps.) for artificial, normal lighting, for instruments and motors with rated power smaller than 1 kW;

- 220 V direct current for emergency lighting and special circuits (e.g. control circuits, interlocks, inverted supply).

6.6.9. Electric motors shall be of induction type with squirrel-cage rotor, direct on-line starting for rated powers up to 100 kW.

For equipment with rated power over 100 kW and which does not claim for automatic restarting, when voltage failure occur, synchronous motors shall be used for the power factor improvement.

Motors with rated power greater than 1,000 kW shall be provided with auxiliary equipment for limiting the starting current (e.g.: start-up with reactors with controlled reactance, reduced-voltage start-up).

Motors driving main equipment (whose restart reduce or prevent production losses and/or other damages) shall be provided with equipment either for reacceleration or for automatic, time-delaied start-up following short-period failures (1 - 3 seconds) of the electric power supply.

This step shall be taken when frequency of short-period failures or important voltage drops in electric network is relatively high (about 10 times per year).

6.6.10. If process control measures and instrumentation are not enough for preventing any risks or damages for the personnel or equipment following electric power supply failures, the BIDDER has to provide emergency sources having technical characteristics imposed by users.

These shall be located together with switchgear system and electric distribution equipment provided outside the hazardous areas.

6.6.11. Location and sizing of 6 kV distributions and of 6/0.4 kV transformed stations shall be made by considering the following main criteria:

- each process unit has to be supplied by its own electric station, leading thus to the possibility of performing simultaneous revisions;

- total distributed power of a 6 kV station shall be limited to 6 - 8 MW maximum, in order to prevent the provision of several 6 kV feeders made up of more than 3 cables in parallel;

- 6,000/440 V transformers shall be limited to 2 types of rated power, e.g.: 1 MVA and 2 MVA and those for 6,000/220 V lighting to one type. Thus, the COMPLEX should be provided with a limited number of spare transformers, e.g. 3 off's, one for each type;

- less important consumers (" non critical process ") located within the same area can be fed from a common distribution station of 6 kV and a common transformer station of 6,000/440 V respectively.

6.6.12. Normal electric lighting should provide required levels according to the activity carried in relevant areas and in compliance with the norms in BIDDER's country, but not less than figures given below:

- in offices	300 lux (incandescent)
- in control rooms	
- in front of panel	300 lux (fluorescent)
- behing the panel	30 lux (incandescent)
- generally	150 lux (fluorescent)
- in areas with machinery	50 lux (incandescent)
- in electric distribution rooms	40 lux (incandescent)
- on structures and walk-ways	10 lux (incandescent)
- tank yards	20 lux (mercury vapours)
- roads	6 lux (mercury vapours)

6.6.13. Emergency lighting, supplied from an independent source (accumulator battery) and with automatic start-up shall be provided as follows:

- in control rooms (minimum 30 % of normal lighting);
- at access to plants (for rescue and personnel safety);
- where manual operations are required in case of an emergency.

6.6.13. Cable laying (under and above ground) is at BIDDER's option (though specified in the tender).

6.7. SEWAGE

6.7.1. General sewage system shall have separate networks for each typical category of waste water, namely:

- conventionally clean waste water (including meteoric water) meeting the conditions for discharge into the ocean without previous treatment;

- chemically contaminated waste water;

- sanitary waste water.

According to waste water treating methods suggested by the BIDDER , he can consider an propose collecting of chemically contaminated and domestic waste water into a unique sewage network.

6.7.2. For conventionally clean waste water, it can be considered collecting, sewage and discharge into the ocean by means of uncovered trenches.

Sewage systems for chemically contaminated and sanitary waste water shall be underground sewage systems.

6.7.3. Construction materials for sewage system shall be selected and suggested by the BIDDER so that to meet relevant mechanical and chemical conditions.

In addition, for chemically contaminated and sanitary waste water it shall be provided a proper sealing of trenches in order to avoid infiltration which might contaminate underground water or damage foundations.

6.7.4. Underground sewage pipes for very noxious water (e.g. with CN-ion) shall be laid, up to treating plant within battery limit, into concrete ducts with slopes towards sealed pits so that any accidental leakages should be collected and noticed.

6.7.5. Main sewage piping and drain collectors shall be sized with an allowance of about 40 % as compared to the final stage.

6.7.6. Underground sewage shall be provided with accessible pits when route direction in changed and when sewage tube size is modified whereas along linear parts at a distance of maximum 60 m.

6.7.7. General conditions of waste water discharge : " Ley General de Aquas " of Peru stipulates that sea water in this area, due to its physico - chemical and bacteriologic characteristics, shall become adequate to be used as potable water and for recreative applications; consequently, discharges with or without treatment should not alter water characteristics, at the limit of the beach, including temperature too.

Defined characteristics are the followings:

a/ Colour	nil
b/ Components giving taste and odour	nil
c/ Suspended matter	nil
d/ Oil, grease	nil
e/ Phenols	below 0.001 mgr/l
f/ Toxic and potential toxic matter:	
- lead	below 0.1 mgr/l

fluorine	below 1.5 mgr/l
- arsenic	below 0.2 mgr/l
- selenium	below 0.05 mgr/l
- hexavalent chromium	below 0.01 mgr/l
- barium	below 0.10 mgr/l
- cadmium	below 0.01 mgr/l
- silver	below 0.05 mgr/l
- iron	below 0.30 mgr/l
- manganese	below 0.10 mgr/l
- copper	below 100 mgr/l
- zinc	below 500 mgr/l
g/ Colon bacillus	500 - 5,000/100 ml
h/ BOC figure at 5 days and $20^{o}C$	max. 1 mgr/l
i/ Dissolved oxygen	min. 6 mgr/l
j/ pH	6 - 9

6.8. CIVIL - WORKS

6.8.1. When preparing the tender, the BIDDER shall observe " Reglemento Nacional de Construcciones ", 3 volumes (12 sections) and appendices, issued in Peru in Spanish.

These regulations are to be made available to the CONTRACTOR by the GOVERNMENT, immediately after or even before concluding the contract, at BIDDERS' request.

These regulations are well-known by the enterprises of civil - works in Peru which will be presumably used as SUB-CONTRACTOR by the CONTRACTOR.

Appendices XIV, XV and XVI are dealing with several important provisions of these regulations, related to:

- stresses and loads;
- firefighting regulations;
- construction materials.

6.8.2. For all steel structures it shall be observed " Design, Fabrication and Erection of Structural Steel for Buildings ", Publication of American Institute of Steel Construction AISC - USA.

6.8.3. When defining sizes of structures it has to be considered modulus recommended by the Peruvian norms " ITINTEC " 400.001.

According to these norms, basic modulus for dwellings and offices is M = 10, recommending:

a/. For offices:

- horizontal modulus 9 M = 90 cm.
- vertical modulus 2 M = 20 cm.

b/. For industrial civil-works, for which " ITINTEC " regulations do not stipulate data for modulus, the CONTRACTOR can adopt and suggest a modulus system considered by him as advantageous.

6.8.4. Seismicity degree and geophysical characteristics to be considered when designing civil works are specified under items 1.3. and 3.3. respectively (see also Appendix XIV).

6.8.5. When working out civil design, the following requirements have to be considered:

a/ Use to the maximum possible extent of reinforced concrete for reinforcing structures. Structures with steel frame are to be provided only when imposed by process requirements or by considerable savings in price cost;

b/. In covered buildings, for walls, it has to be used, to the maximum extent, light and cheap materials. The main materials available in Peru are listed in Appendix XVI. Materials can be found in the area where the COMPLEX is located, at a distance of about 30 Km. and can be transported by trucks.

c/. Reinforced concrete precast parts made of reinforced concrete shall be used anytime this leads to economies in price cost or shortening of construction and erection period (see Appendix XVI).

d/. Related to building finishings, these are to correspond strictly to the destination of relevant building, in view of reaching a good operation by minimum maintenace costs, including also protection against corrosion.

For all structures, the BIDDER has to specify in the tender all finishings suggested.

e/. Related to joinery it has to be provided steel or reinforced concrete joinery for industrial buildings.

f/. When selecting construction materials is has to be considered also possible fire and explosion dangers for relevant building.

Related to this matter, the CONTRACTOR has to follow both his own experience and the provisions of " Reglamento Nacional de Construcciones " (see Appendix XV).

g/. Steel structures shall be protected against dangerous overheating, in the event of a fire, by covering with fire-proof concrete up to the height of 6 m.

6.9. PROTECTION AGAINST CORROSION

6.9.1. Generally, protection against corrosion shall be provided by a proper selection of materials for equipment, pipes, fittings and structures according with specific process conditions in working areas and climatic characteristics of the region, so that to reach an actual unlimited corrosion resistance.

If this method prooves not efficient from an economic viewpoint, because of too expensive materials, the BIDDER shal consider other posibilities, sanctioned by world-wide technique, consisting in using cheaper materials protected against by corrosion by coatings or adequate treatment.

6.9.2. When corrosion resistance of construction materials provided is actually not unlimited, there shall be provided a corrosion allowance for thicknesses of elements exposed to corrosion, in order to reach an increased operating life.

6.9.3. The BIDDER shall indicate in the tender construction materials of main equipment or categories of equipment and pipes; for those where it can not be granted an unlimited corrosion resistance, the followings shall be specified (besides construction material suggested):

- steps to be taken for protection against corrosion;
- corrosion allowances;
- minimum operating period of equipment (or pipes and structures).

6.9.4. When selecting construction materials and methods for protection against corrosion, the BIDDER shall consider also local climatic conditions (T.H.).

6.10. INSULATIONS AND PAINTINGS

6.10.1. All equipment and pipes operating at temperatures above $80^{0}C$ with which the personnel can come into contact during their work shall be provided with thermal insulation for preventing accidents. All other surfaces having temperatures higher than ambient ones shall be provided with thermal insulation only if such a provision is necessary for preventing heat losses or is imposed by the process.

Thermal insulation is not required for mechanical equipment, e.g. compressors, pumps and certain fittings, (small valves, steam traps, compensators, etc.) to which insulations could lead to difficulties in operation and maintenance, thus being not compulsory.

6.10.2. Removable insulations shall be provided on parts of plants and equipment requiring interventions, such as flanges, valves, manholes, etc.

6.10.3. Equipment and pipes operating at temperatures below the temperature of wet-bulb thermometer are to be provided with thermal insulations for preventing condensation of vapours in the atmosphere.

6.10.4. Selection of insulating materials and their methods of application is always made in such a way as to prevent corrosion of insulated surfaces.

Protection of insulations against weathering and normal mechanical loads is made by coating with sheets made of aluminium or other cheaper materials to be indicated in the tender.

6.10.5. All equipment and pipes made of carbon steel are to be painted according to operating temperatures and working areas for preventing corrosion and providing a convenient appearance.

Thermal insulated surfaces shall be painted before providing of insulation in order to prevent corrosion.

Insulations coated by galvanized iron and aluminium sheets shall not be painted.

6.10.6. All surfaces to be painted have to undergo a previous treatment for removal of rust, scale and dust, finishing and degreasing so that to provide a high quality of painting.

6.10.7. For indentifying process and utility pipes, these are to be painted according to relevant fluids. Selection of colours shall be made based on a project proposed by the CONTRACTOR and approved by the GOVERNMENT.

Pipes made of alloy steel and those insulated shall not be painted but marked here and there by the same colours.

6.10.8. Outdoor equipment made of carbon steel shall be coated with aluminium paint.

Equipment made of alloy steel shall not be painted.

6.11. LABOUR PROTECTION AND SAFETY

6.11.1. In the main, it is recommended to make use and observe provisions pertaining to labour safety issued by API (American

Petroleum Institute) and MCA (Manufacturing Chemists Association) in USA.

6.11.2. When, due to certain reasons, it is not possibile to observe the above mentioned regulations, it is allowed to make use of norms valid in CONTRACTOR's country.

6.11.3. Related to the maximum allowable concentrations of noxious substances in working areas, it has to be considered the official figures in USA or those valid in Western Germany.

6.11.4. The BIDDER has to take all necessary steps for preventing atmosphere pollution of limitrophe populated areas. For the above mentioned, it is recommended, if US norms do not provide more severe conditions, to observe VDI norms, the latest issue.

It is particularly requested that all fuel gases released (from safety valve or other places of plants) to be directed to flare stacks whereas noxious gases should be directed to adequate disposal devices for air pollution prevention.

6.11.5. For each plant of the COMPLEX, it has to be elaborated a detailed analysis and description of potential hazards, specifying adequate steps to be taken for preventing them.

6.11.6. Irrespective of legal provisions, it is requested that the BIDDER, based on the latest knowledge, should provide in deliveries:

- adequate alarms and instruments detecting, during and emergency, noxious and hazardous concentrations;

- interlocks and automatic control for preventing hazardous situations;
- apparata and materials for individual protection, of the best quality and sufficient amount;
- first air equipment and materials.

6.11.7. Control rooms, laboratories and offices shall be provided with air conditioning.

6.11.8. The location of electric distribution and control rooms in hazardous areas should be avoided in so far as possible.

When such a location is inevitable, relevant rooms are to be pressurized with double mechanical ventilation systems so that to provide clean and fresh air at each 5 minutes or an overpressure of minimum 5 mm gauge.

Visual and accustic alarms shall be provided for pressurizing system failure.

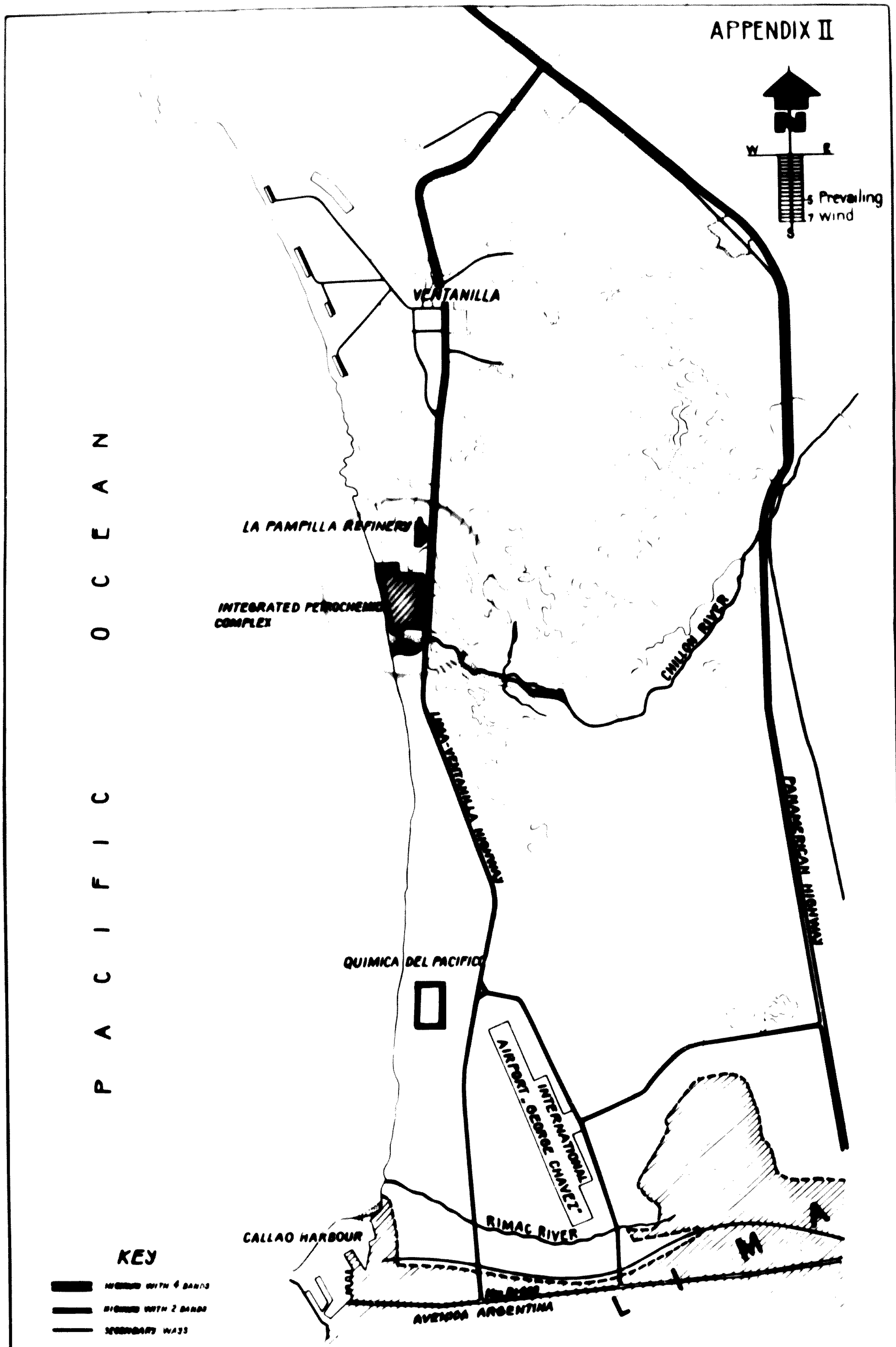
6.11.9. Rooms where is located equipment releasing heat have to be provided with natural or mechanical ventilation so that internal temperature should not exceed ambient temperature by more than 6 - 8^{o}C.

MAP OF THE REPUBLIC
OF PERU, SHOWING
SEISMIC AREAS

PERU

DWG. Nº 04

APPENDIX II

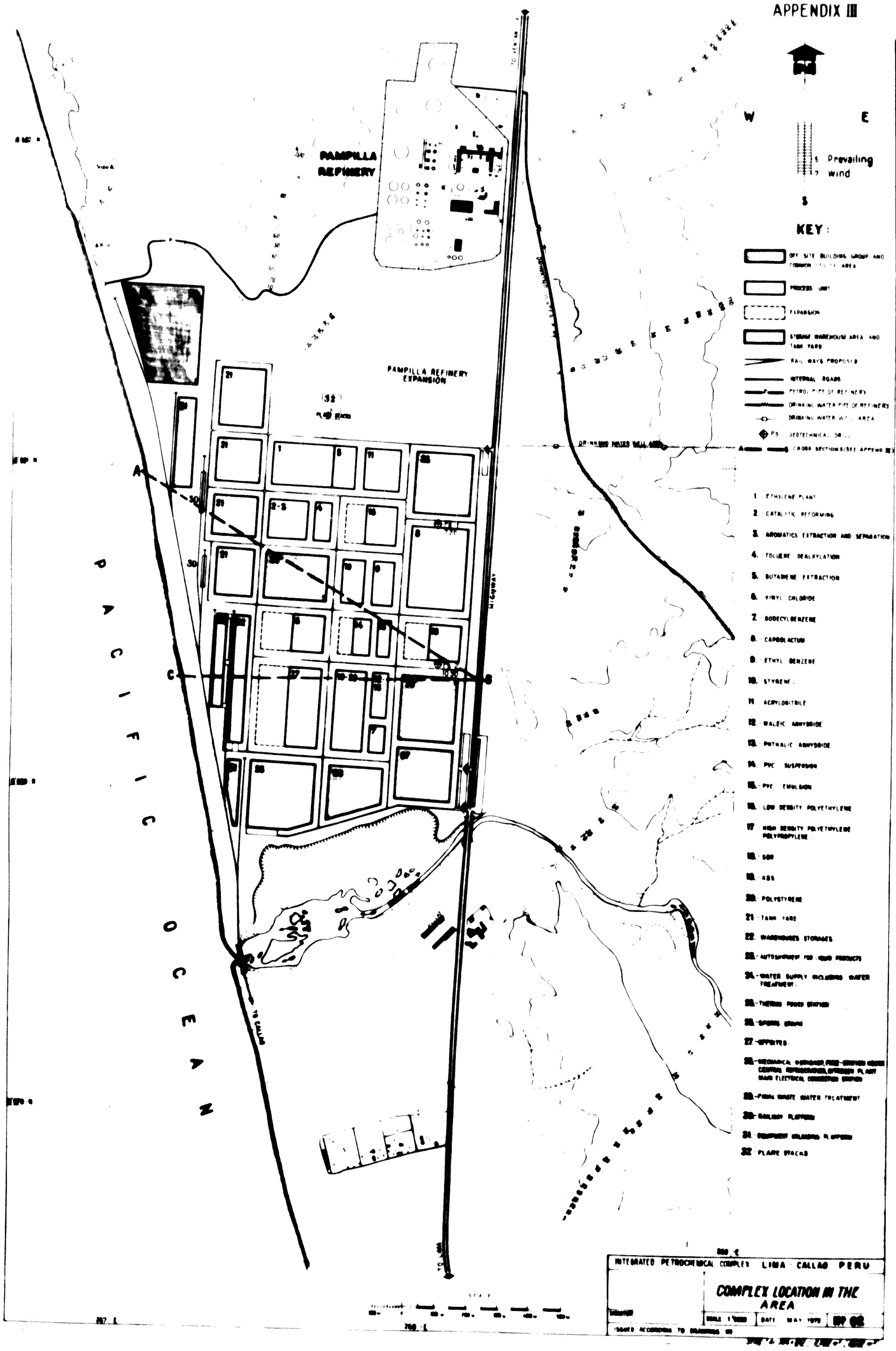


INTEGRATED PETROCHEMICAL COMPLEX LIMA-CALLAO PERU

MAP OF COMPLEX AREA AND SURROUNDINGS

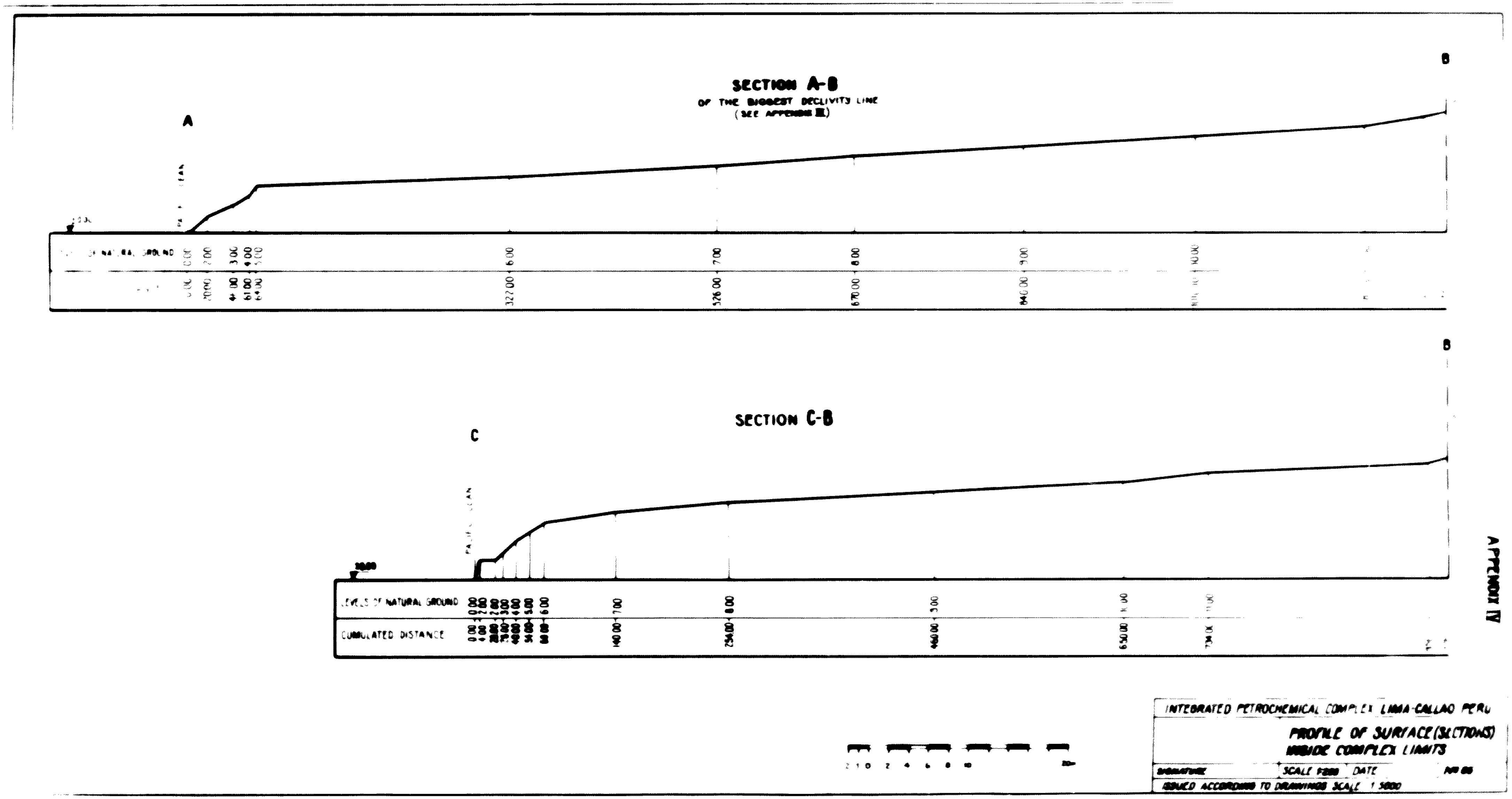
SIGNATURE | SCALE 1:50 000 | DATE MAY 1972 | Nº 03

ISSUED ACCORDING TO DRAWINGS SCALE 1:100 000



PAMPILLA REFINERY
PAMPILLA REFINERY EXPANSION
HIGHWAY
PACIFIC OCEAN
TO CALLAO
W
E
S
Prevailing wind
KEY:
PROCESS UNIT
EXPANSION
INTERNAL ROADS
1 ETHYLENE PLANT
2 CATALYTIC REFORMING
3 AROMATICS EXTRACTION AND SEPARATION
4 TOLUENE DEALKYLATION
5 BUTADIENE EXTRACTION
6 VINYL CHLORIDE
7 DODECYLBENZENE
8 CAPROLACTUM
9 ETHYL BENZENE
10 STYRENE
11 ACRYLONITRILE
12 MALEIC ANHYDRIDE
13 PHTHALIC ANHYDRIDE
14 PVC SUSPENSION
15 PVC EMULSION
16 LOW DENSITY POLYETHYLENE
17 HIGH DENSITY POLYETHYLENE POLYPROPYLENE
18 SBR
19 ABS
20 POLYSTYRENE
21 TANK YARD
22 WAREHOUSES STORAGES
32 FLARE STACKS
INTEGRATED PETROCHEMICAL COMPLEX LIMA CALLAO PERU
COMPLEX LOCATION IN THE AREA

APPENDIX IV


SECTION A-B
OF THE BIGGEST DECLIVITY LINE
(SEE APPENDIX III)
A
B
SECTION C-B
C
B
LEVELS OF NATURAL GROUND
CUMULATED DISTANCE
INTEGRATED PETROCHEMICAL COMPLEX LIMA-CALLAO PERU
PROFILE OF SURFACE (SECTIONS) INSIDE COMPLEX LIMITS
SCALE
DATE
ISSUED ACCORDING TO DRAWINGS SCALE 1:5000

A P P E N D I X V - 1

ABSOLUTE MAXIMUM AIR TEMPERATURE

IN COMPLEX AREA (^{o}C)

Month	YEAR							
	1962	1963	1964	1965	1966	1967	1968	1969
JANUARY	27.5	28.0	28.7	28.8	28.1	30.8	27.5	29.0
FEBRUARY	29.8	29.5	27.5	27.5	29.3	28.7	28.8	28.1
MARCH	28.4	28.5	28.2	29.3	29.7	29.2	27.0	29.3
APRIL	28.3	26.4	26.8	28.5	26.8	28.5	26.4	27.9
MAY	25.0	26.5	22.8	27.1	26.5	26.6	22.4	26.8
JUNE	21.4	21.6	21.4	25.1	21.9	21.0	20.8	24.5
JULY	20.3	21.6	19.5	23.5	19.9	18.4	21.6	22.7
AUGUST	18.2	18.2	19.2	22.8	19.5	18.9	20.1	21.7
SEPTEMBER	20.7	20.6	21.0	20.9	20.8	20.6	21.8	21.8
OCTOBER	22.5	22.5	23.2	21.3	22.6	20.7	22.0	22.5
NOVEMBER	26.7	24.1	25.6	25.5	24.3	22.2	22.7	27.0
DECEMBER	27.6	27.6	27.6	27.8	25.6	26.9	25.4	26.7
Annual Maximum	29.8	29.5	28.7	29.2	29.7	30.8	28.8	29.3

A P P E N D I X V - 2

ABSOLUTE MINIMUM AIR TEMPERATURE

IN COMPLEX AREA (^{o}C)

Month	YEAR							
	1962	1963	1964	1965	1966	1967	1968	1969
JANUARY	15.6	16.2	16.5	15.0	18.5	16.0	16.6	16.0
FEBRUARY	16.5	15.0	17.4	16.0	17.8	17.6	16.1	17.5
MARCH	15.8	16.3	16.6	17.7	16.5	15.7	15.3	18.0
APRIL	14.4	13.6	14.4	15.6	13.8	15.0	11.4	16.2
MAY	11.9	12.2	10.4	13.7	11.3	13.1	9.7	14.5
JUNE	8.8	10.7	8.7	12.3	11.5	10.0	8.0	14.0
JULY	9.7	9.2	11.2	13.3	12.5	13.1	9.0	14.2
AUGUST	13.4	12.2	13.0	12.0	11.0	9.7	12.5	12.5
SEPTEMBER	13.6	14.4	13.4	14.0	13.0	13.0	13.5	12.5
OCTOBER	13.0	14.0	12.5	14.0	14.4	14.6	13.8	13.0
NOVEMBER	13.8	12.0	12.7	14.1	12.4	10.0	15.2	10.0
DECEMBER	13.9	15.0	14.6	14.6	14.1	13.8	12.5	15.3
Annual Minimum	8.8	9.2	8.7	12.0	11.0	9.7	8.0	10.0

A P P E N D I X V - 3

MEAN AIR TEMPERATURE PER MONTH

IN COMPLEX AREA (^{o}C)

Month	YEAR							
	1962	1963	1964	1965	1966	1967	1968	1969
JANUARY	20.7	21.3	21.6	21.7	22.4	20.5	21.2	22.0
FEBRUARY	21.6	21.7	21.8	21.2	22.5	22.3	21.6	22.6
MARCH	20.7	21.3	21.4	23.6	22.2	21.0	20.4	22.6
APRIL	20.2	19.7	19.7	22.0	19.8	20.6	18.1	21.6
MAY	17.8	18.6	16.3	20.0	17.8	18.3	16.6	20.7
JUNE	15.9	17.0	15.1	19.7	16.5	15.8	15.5	18.8
JULY	15.8	16.9	15.1	18.2	15.9	15.3	15.4	16.4
AUGUST	16.0	16.7	15.2	18.1	15.3	14.8	16.0	16.2
SEPTEMBER	16.2	17.0	15.9	16.5	15.8	15.1	16.3	17.0
OCTOBER	16.6	17.7	16.6	17.1	16.9	15.9	17.1	18.0
NOVEMBER	18.1	18.3	18.5	19.0	18.2	17.0	18.0	19.1
DECEMBER	20.2	19.9	20.0	21.0	19.8	19.1	20.2	20.5
Annual Mean	18.3	18.8	18.1	19.8	18.6	18.0	18.03	19.6

APPENDIX V - 4

MONTHLY MEAN OF MAXIMUM AIR TEMPERATURE

IN COMPLEX AREA (^{o}C)

Month	YEAR							
	1962	1963	1964	1965	1966	1967	1968	1969
JANUARY	24.8	26.1	26.2	26.2	26.7	24.6	25.7	26.3
FEBRUARY	26.2	26.5	26.0	25.5	26.9	26.8	26.0	26.6
MARCH	25.7	25.5	25.8	27.8	26.4	25.4	24.6	26.8
APRIL	25.6	23.2	23.7	26.3	23.9	25.5	22.2	25.0
MAY	22.5	22.4	19.8	23.4	21.6	21.7	19.8	23.9
JUNE	19.3	19.8	17.9	23.0	19.3	17.7	18.4	21.2
JULY	18.1	19.8	17.4	21.3	18.3	16.9	18.5	18.6
AUGUST	18.8	19.2	17.5	20.7	17.5	17.1	18.7	18.6
SEPTEMBER	18.6	19.3	19.4	18.6	18.5	17.5	19.4	19.8
OCTOBER	20.2	20.1	20.7	19.5	19.9	18.9	20.0	20.8
NOVEMBER	22.5	21.7	22.7	22.4	21.5	20.2	21.1	22.2
DECEMBER	25.2	23.8	24.3	25.0	23.7	22.9	24.2	24.1
Annual Mean	22.3	23.3	21.8	23.3	24.0	21.3	21.6	22.8

A P P E N D I X V - 5

MONTHLY MEAN OF MINIMUM AIR TEMPERATURES

IN COMPLEX AREA (^{0}C)

Month	YEAR							
	1962	1963	1964	1965	1966	1967	1968	1969
JANUARY	18.0	18.5	18.8	18.4	19.6	18.2	18.3	18.5
FEBRUARY	18.6	18.1	18.8	18.2	19.6	19.7	18.2	19.7
MARCH	17.4	18.6	18.6	20.6	19.3	18.5	17.2	19.7
APRIL	16.8	17.4	16.9	18.6	16.9	17.4	15.2	18.9
MAY	14.1	15.8	13.8	17.5	15.2	15.8	14.0	17.8
JUNE	13.5	14.9	13.0	17.0	14.3	14.4	13.2	17.1
JULY	14.3	14.7	13.6	16.5	14.4	14.1	13.1	15.0
AUGUST	14.4	14.9	13.6	15.9	13.9	13.3	14.1	14.5
SEPTEMBER	14.4	15.1	14.0	15.0	14.3	13.5	14.6	15.3
OCTOBER	14.7	15.0	14.5	15.4	15.2	14.2	15.1	16.1
NOVEMBER	15.7	16.0	15.9	16.7	16.1	14.9	15.9	17.1
DECEMBER	17.0	17.3	17.1	18.4	17.5	16.6	17.2	18.1
Annual Mean	15.8	16.4	15.7	17.3	16.4	15.8	15.5	17.4

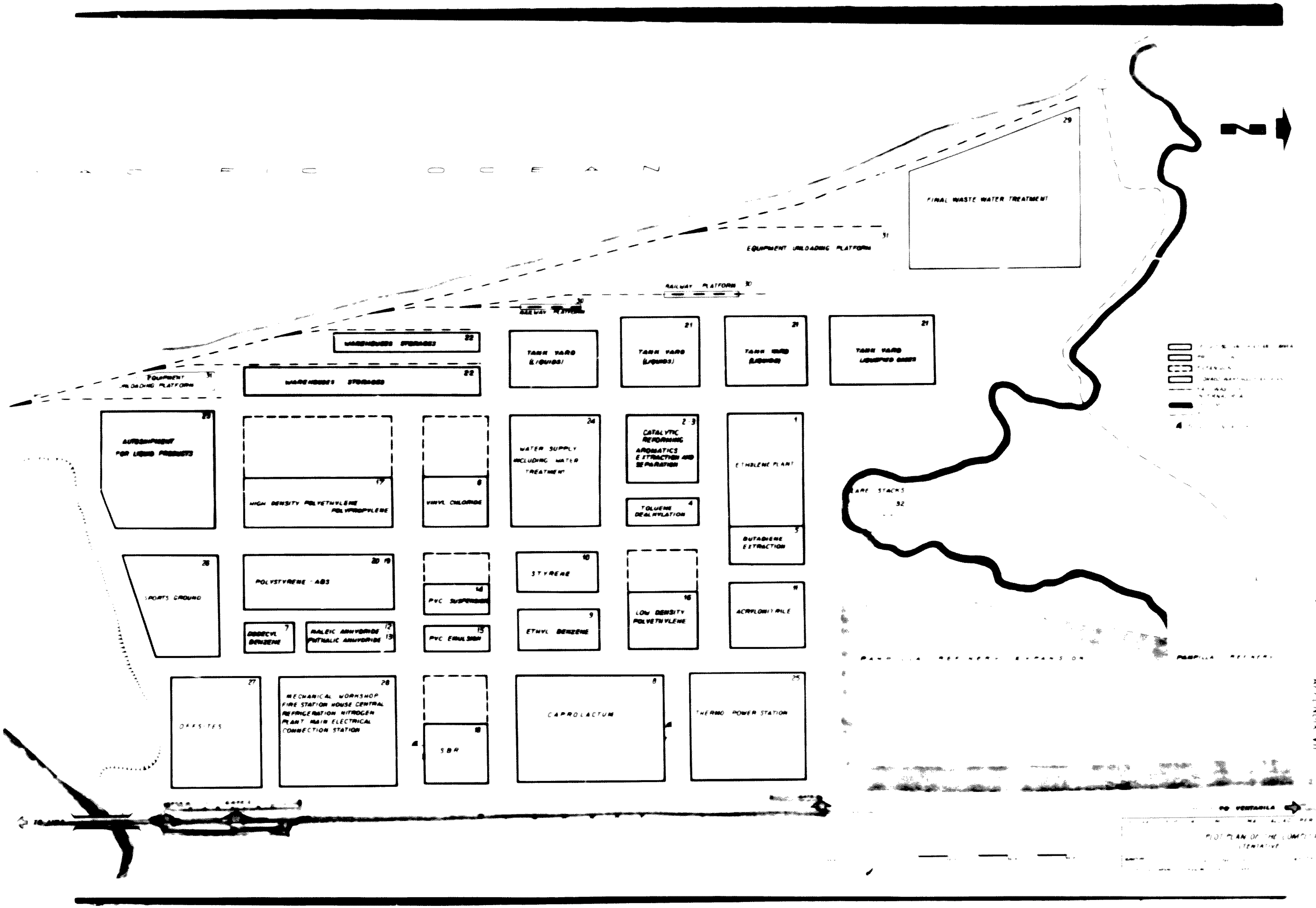
APPENDIX VI - 1

RELATIVE MEAN AIR HUMIDITY

IN COMPLEX AREA (%)

Month	YEAR									
	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
JANUARY	82	86	83	83	83	80	85	84	82	84
FEBRUARY	84	84	85	83	86	81	82	83	82	83
MARCH	86	85	85	85	81	82	86	86	83	82
APRIL	85	84	88	86	84	83	84	89	83	86
MAY	84	84	86	89	84	85	88	88	82	89
JUNE	85	85	84	90	80	84	87	88	84	84
JULY	85	86	84	87	82	83	89	85	83	89
AUGUST	84	87	86	88	83	87	89	89	85	87
SEPTEMBER	86	88	87	85	90	86	89	86	86	86
OCTOBER	85	85	81	86	85	85	86	88	83	85
NOVEMBER	82	83	83	83	80	83	84	81	83	84
DECEMBER	83	82	83	82	82	83	83	82	82	85
Annual Mean	84	85	85	86	83	83	86	86	83	85

APPENDIX VII



APPENDIX VIII-1

DRILL LOG

LAGESA

GEOTECHNIC LABORATORY

JOB - PETROCHEMICAL COMPLEX
LOCATION - LA PAMPILLA - PROPERTY MARQUEZ
CLIENT - INDUPERU

DRILL Nº - P S 1
DATA 26 5 1972

LEVEL	DEPTH	SYMBOL	COMPOSITION OF SOIL	COMMON SAMPLE	OBS
5.40	1.80	CL	OOZY CLAY WITH VEGETATION SCRAPS ON SURFACE	M-1	
4.10	3.10	SM	LEAN BURDENED OOZY GRAVEL	M-2	
3.80	3.40	CL	OOZY CLAY	M-3	
3.50	3.70	SM	OOZY SAND	M-4	
2.70	4.50	CL	OOZY CLAY	M-5	
2.50	4.70		PARTING SAND WITH ORGANIC SCRAPS	M-6	
2.30	4.90		SANDY OOZE	M-7	
2.00					UNDERGROUND WATER
1.65	5.55	SM	OOZY SAND	M-8	
1.40	5.80	CL	OOZY CLAY	M-9	
1.20	6.00	SM	OOZY SAND	M-10	
-0.20	7.40	GP	LEAN BURDENED GRAVEL	M-11	
			OOZY LEAN BURDENED GRAVEL WITH A MAXIMUM STONE SIZE OF 10cm	M-12	

LEVEL	DEPTH	SYMBOL	COMPOSITION OF SOIL	COMMON SAMPLE	OBS
-1.20	8.40	SP/GM		M-12	
-2.30	9.50	SP/SM	OOZY LEAN BURDENED GRAVEL WITH A SCARCE PRESENCE OF STONES OF 10 cm	M-13	
-3.30	10.50	SP/GM	OOZY LEAN BURDENED GRAVEL WITH PREVAILING PRESENCE OF STONES OF 5 cm	M-14	
-3.50	10.70	CL	OOZY CLAY LENS	M-15	
-4.80	12.00	SM	MEDIUM SAND WITH LOW GRAVEL PERCENTAGE	M-16	

DRILL LOG

LAGESA

GEOTECHNIC LABORATORY

JOB-PETROCHEMICAL COMPLEX
LOCATION-LA PAMPILLA-PROPERTY MARQUEZ
CLIENT-INDUPERU

DRILL Nº-PS 2
DATA 26 5 1972

LEVEL	DEPTH	SYMBOL	COMPOSITION OF SOIL	COMMON SAMPLE	OBS
10 90 10 30	0 60	CL	OOZY CLAY WITH VEGETATION SCRAPS ON SURFACE	M-1	
10 00	0 90	ML	SANDY OOZE	M-2	
9 65	1 25	GM	OOZY GRAVEL	M 3	
8 20	2 70	CL/ML	CLAY WITH SANDY OOZE OF MEDIUM HARDNESS	M-4	
7 90	3 00	CL	OOZY CLAY	M-5	
7 60	3 30	ML	SANDY OOZE	M-6	
4 90	6 00	GP	LEAN BURDENED GRAVEL WITH BLOCKS WITH A MAXIMUM SIZE OF 10 cm	M-7	
		GP/CH	LEAN BURDENED GRAVEL WITH STONES OF VARIOUS SIZES AND SELDOM BLOCKS WITH A MAXIMUM SIZE OF 50cm SMALL PLASTIC CLAY LENS ARE TO BE FOUND	M-8	

LEVEL	DEPTH	SYMBOL	COMPOSITION OF SOIL	COMMON SAMPLE	OBS
1 90		GP / CH		M - 8	UNDERGROUND WATER
1 70	9 20				
0 90	10 00	GP	LEAN BURDENED GRAVEL	M - 9	
-0 10	11 00	GP	LEAN BURDENED GRAVEL	M - 10	
-0 45	11 35	GP	LEAN BURDENED GRAVEL	M - 11	
-1 10	12 00	GP	LEAN BURDENED GRAVEL	M - 12	

L. A. G. E. S. A.

GRANULOMETRIC ANALYSIS-CONSISTENCY LIMIT-CLASSIFICATION AS PER UNIFIED SYSTEM

JOB : PETROCHEMICAL COMPLEX „LA PAMPILLA"
LOCATION : MÁRQUEZ RANGE „LA PAMPILLA"
CLIENT : PETROCHEMICAL DIVISION
DATE : JULY 1972

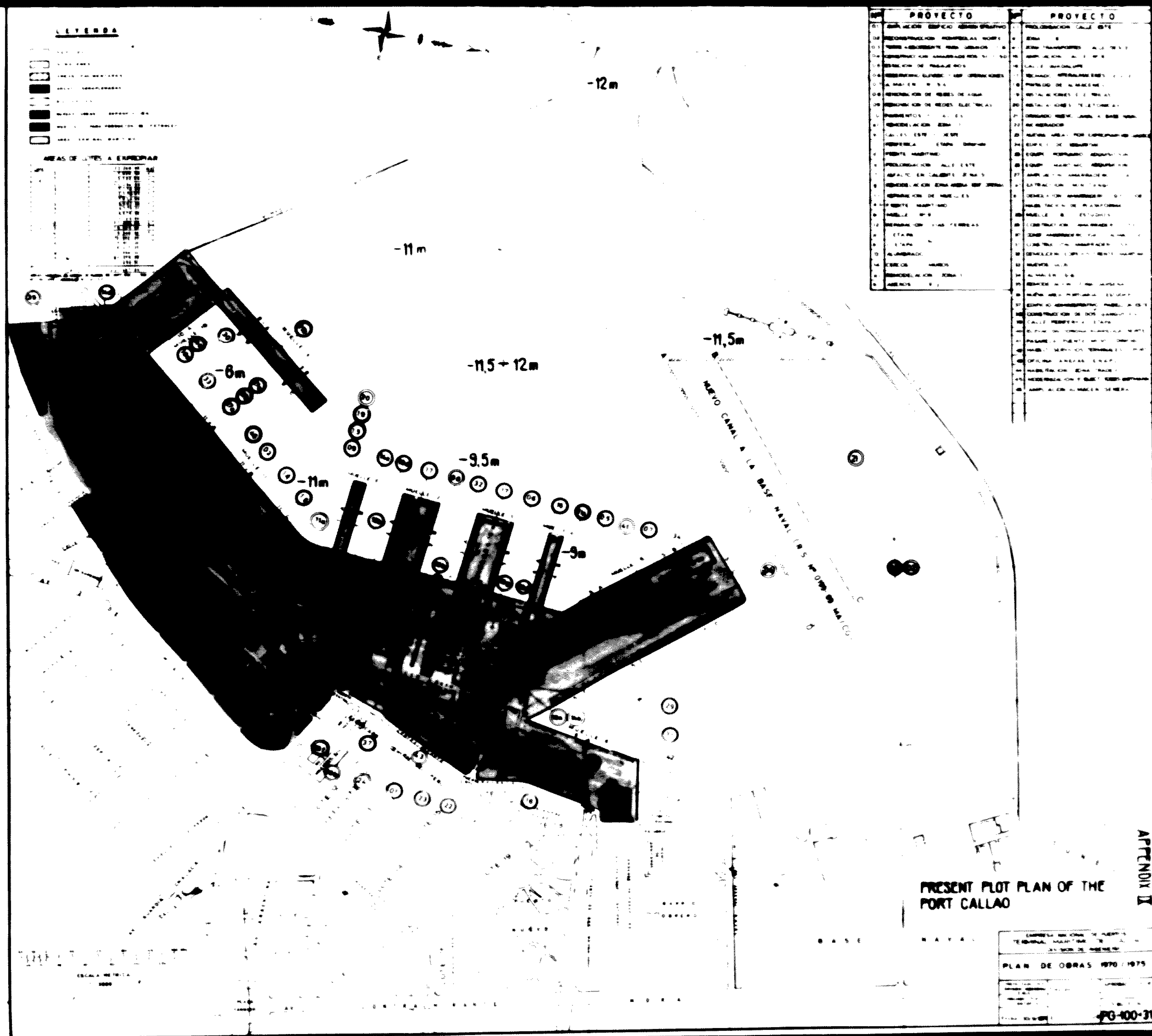
DRILL N°	Ps - 1																
SPECIMEN N°	M-1	M-2	M-3	M-4	M-5	M-6	M-7	M-8	M-9	M-10	M-11	M-12	M-13	M-14	M-15	M-16	M-17
DEPTH (mts)	000 180	180 310	310 340	340 370	370 450	450 470	470 490	490 520	520 555	555 580	580 600	600 740	740 840	840 950	950 1050	1050 1070	[illegible] 1200
CUMULATIVE PERCENTAGE OF MATTER PASSED THROUGH SIEVE — GRANULOMETRIC ANALYSIS:																	
2"												100	89	100	100	73	
1/2"		100										92	83	81	87		[illegible]
1"		54										72	70	63	60	65	[illegible]
3/4"	100	39										58	63	61	54	63	
1/2"	98	34										51	55	57	47		[illegible]
3/8"	97	31										43	53	55	45		
1/4"		29									100	37	51	53	43		48
N° 4		28						100			90	34	49	51	41	[illegible]	[illegible]
N° 10	96	27				100		99			88	30	43	47	37		[illegible]
N° 20	95	26		100		99	100	97	100		86	26	35	42	32	61	85
N° 40	92	19		96		96	98	67	99		83	20	20	26	20	59	78
N° 60	85	11		83		87	95	45	94	100	69	14	14	16	12	58	63
N° 100	77	7	100	50	100	75	86	29	76	99	43	9	10	10	8	56	54
N° 200	69	6	99	27	99	67	51	16	48	98	33	5	[illegible]	[illegible]	6	54	49
CONSISTENCY LIMIT: - LIQUID LIMIT	27		42		33					39						34	
- PLASTIC INDEX	8	NP	19	NP	11	NP	NP	NP	NP	8	NP	NP	NP	NP	NP	13	NP
CLASSIFICATION AS PER UNIFIED SOIL SYSTEM	CL	GP-GM	CL	SM	CL	SM	ML	SM	SM	CL	SM	[illegible]	GP-GM	SP-SM	GP-GM	[illegible]	[illegible]

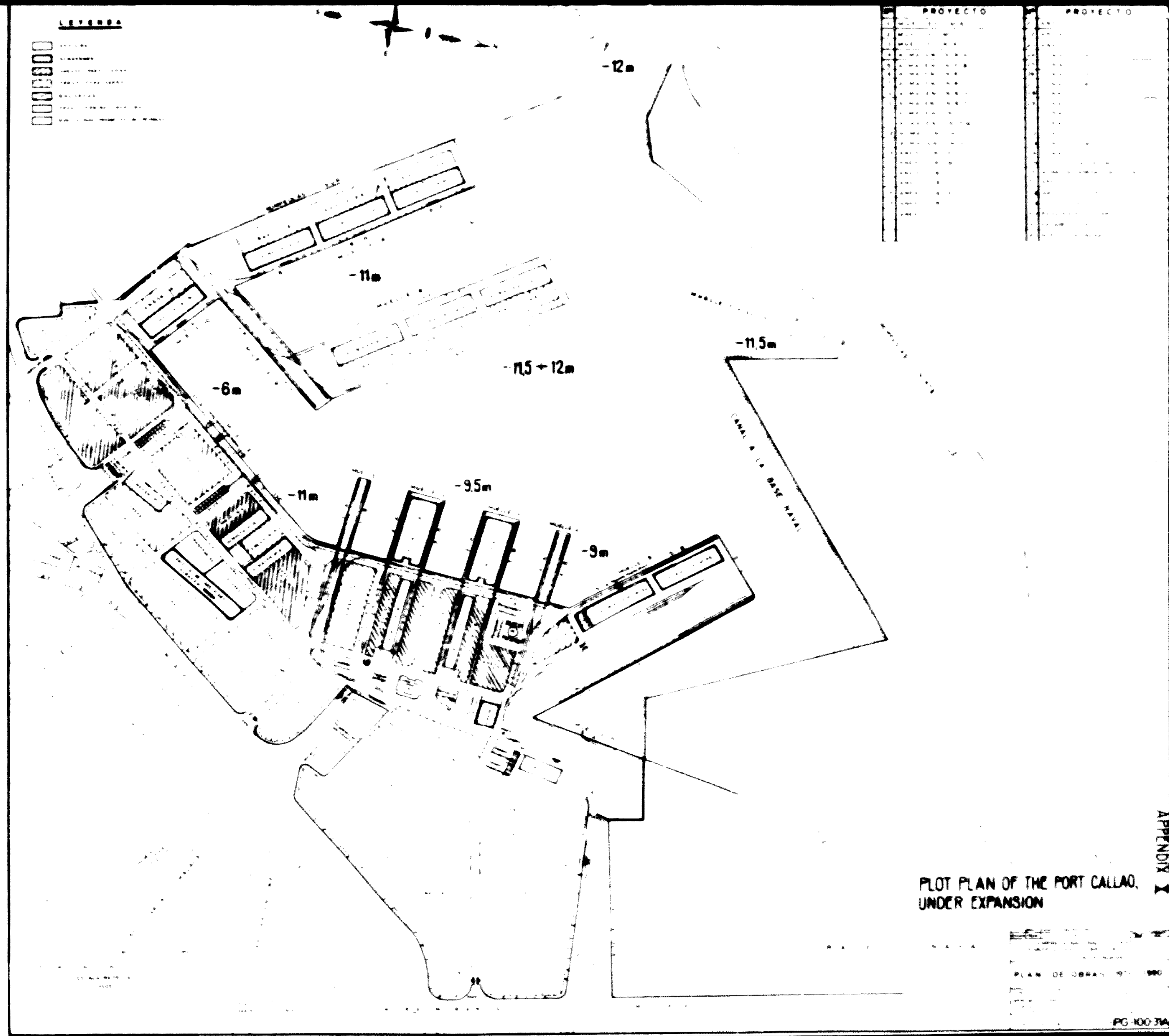
L. A. G. E. S. A.

GRANULOMETRIC ANALYSIS - CONSISTENCY LIMIT - CLASSIFICATION AS PER UNIFIED SYSTEM

JOB : PETROCHEMICAL COMPLEX „LA PAMPILLA"
LOCATION : MÁRQUEZ RANGE „LA PAMPILLA"
CLIENT : PETROCHEMICAL DIVISION
DATE : JULY 1972

	DRILL N°	Ps - 2											
	SPECIMEN N°	M - 1	M - 2	M - 3	M - 4	M - 5	M - 6	M - 7	M - 8	M - 9	M - 10	M - 11	M - 12
	DEPTH (mts)	0.00 0.60	0.60 0.90	0.90 1.25	1.25 2.70	2.70 3.00	3.00 3.30	3.30 6.00	6.00 6.20	6.20 10.00	10.00 11.00	11.00 11.35	11.35 12.00
CUMULATIVE PERCENTAGE OF MATTER PASSED THROUGH SIEVE	GRANULOMETRIC ANALYSIS												
	2"									100	100		
	1/2"			100				100		95	92	100	100
	1"			90				88		90	56	67	84
	3/4"			84		100		66		87	48	58	70
	1/2"			63		94		57		60	39	49	50
	3/8"			56		90		51		49	35	45	42
	1/4"		100	49		87		47		40	32	40	34
	N° 4		99	45	100	86		43		35	30	37	29
	N° 10	100		40	99	84		37		29	27	31	21
	N° 20	99	98	37	98	83		33		26	24	26	16
	N° 40	97	97	31	95	79	100	25		18	18	16	11
	N° 60	91	94	24	88	62	98	14		10	12	8	7
	N° 100	84	89	18	76	38	97	7	100	7	8	5	4
	N° 200	76	82	14	61	19	96	4	99	4	3	4	2
CONSISTENCY LIMIT:	- LIQUID LIMIT	29			24				55				
	- PLASTIC INDEX	10	NP	NP	5	NP	NP	NP	27	NP	NP	NP	NP
CLASSIFICATION AS PER UNIFIED SOIL SYSTEM		CL	ML	GM	CL-ML	SM	ML	GP	CH	GP	GP	GP	GP


APPENDIX IX
PRESENT PLOT PLAN OF THE
PORT CALLAO
PROYECTO
PROYECTO
LEYENDA
-12m
-11m
-11,5 ÷ 12m
-11,5m
-9,5m
-11m
-6m
-9m
NUEVO CANAL A LA BASE NAVAL
PLAN DE OBRAS 1970 - 1975
PG-100-31


LEYENDA
PROYECTO
PROYECTO
-12m
-11m
-11,5m
-11,5 ÷ 12m
-6m
-11m
-9,5m
-9m
CANAL A LA BASE NAVAL
APPENDIX X
PLOT PLAN OF THE PORT CALLAO,
UNDER EXPANSION
PG-100-31A

APPENDIX XI - 1

LIST OF LIFTING AND TRANSPORTATION EQUIPMENT IN THE CALLAO PORT

Denomination	Capacity		No.off
1	2		3
Tractors	30.0	to	26
	60.0	to	60
Forklifts	1.40	to	38
	1.80	to	26
	2.20	to	39
	2.70	to	16
	3.20	to	6
	6.80	to	3
	10.00	to	2
	22.40	to	3
Presses	2.20	to	16
Cable Hoists	1.40	to	4
Cranes	1.00	to	1
	2.50	to	1
	3.00	to	3
	5.00	to	11
	7.00	to	6
	8.00	to	1
	12.0	to	3
	30.0	to	1
Floating Crane	80.0	to	1
Locomotive Engines	80	HP	2
	250	HP	1
	300	HP	4
	450	HP	2

APPENDIX XI - 2

1	2		3
Trucks	2.0	to	150
	10.0	to	257
	30.0	to	165
Open Waggons	10.0	to	6
	15.0	to	10
	25.0	to	9
	50.0	to	7
Covered Waggons	15.0	to	9
	25.0	to	10
	30.0	to	2

APPENDIX XII - 1

LIST OF COMPANIES FOR TRANSPORTATION, EQUIPMENT FABRICATION AND PLANT ERECTION IN PERU

The company " STIGLICH " - for transportation of heavy equipment, equipment lifting and construction works.

The company owns 47 trailers having the following characteristics:

- 2 off's : maximum load 250 to each; sizes: 12 x 3.10
- 4 off's : maximum load 150 to each;
- 8 off's : maximum load 50 - 100 to.
- 33 off's : maximum load 25 to and 35 to.

Average sizes : 9 m x 3 m.

The company owns cranes having the following characteristics:

- 2 off's on caterpillar tractors of 70 to and 120 ft (40 m) length of arm (which can be increased)
- 2 off's on trucks of 50 to
- 2 off's on trucks of 35 to
- 2 off's on trucks of 15 to

Parts of 45 m length can be transported by these means.

Besides transportation, they perform also equipment erection.

The company " FABRICACIONES METALICAS S.A. FABRIMET "

Address: Contralmirante Moro 590 - Callao

Field of activity:

fabrication of equipment and steel mechanical equipment for industry, especially for fishing and mining, as follows:

- fishing ships
- boilers
- tip lorries
- accessories.

This company provides equipment for agriculture and mining.

The company " METAL EMPRESA "

Address: Located between Lima and Callao, near the port and airport.

Speciality: equipment manufacturing

- cryogenic equipment for industrial refrigerating units;
- equipment for chemical and petrochemical industry, based on own designs, i.e.:
  - reactors
  - distillation towers
  - pyrolysis towers
  - process tanks
  - storage tanks
  - heat exchangers
  - pipes, tubes
  - low and high pressure fittings
  - 10 - 600 HP steam generators
  - water treatment equipment
  - water softeninf equipment.

The company fabricates also:

- fishing ships

- transportation and storage equipment
- incinerating furnaces
- mining equipment
- steel structures.

The company " MARTINEZ LINARES S.A. INGENIEROS "

Address: Av. O.R. Benavides No. 5016 Bellavista - Callao P.O. Box 267 Lima

Speciality:

- process equipment
- steel machinery
- steel plates (sheet platos)
- structural steel for civil works.

Works are performed:

- based on own designs
- based on Client's designs
- under licence.

The company performs also erection works. It is considered as the greatest and most skilled enterprise for erection.

This enterprise has performed the complete mechanical and electrical works for the great industrial complexes in Peru, such as:

- oil refineries
- concentrators
- cement plants
- sugar factories
- fertilizer plants

- chemical and electrochemical complexes
- food industry
- textile industry
- rubber and tire plants
- fish meal complex
- car assemblying plants.

The assemblying plant is provided with a good team and materials, being capable of working in all ports of the country at it disposes of modern materials and highly trained personnel.

The company " MAESTRANZA GENERAL S.A. MAGENSA "

Address: Rodolfo Baltron No. 631 (Cuadra 8 Av, Argentina) P.O. Box 1075 - Telephone 24 - 0123

Speciality: Steel and mechanical works for various industries. Various equipment for industries, such as:

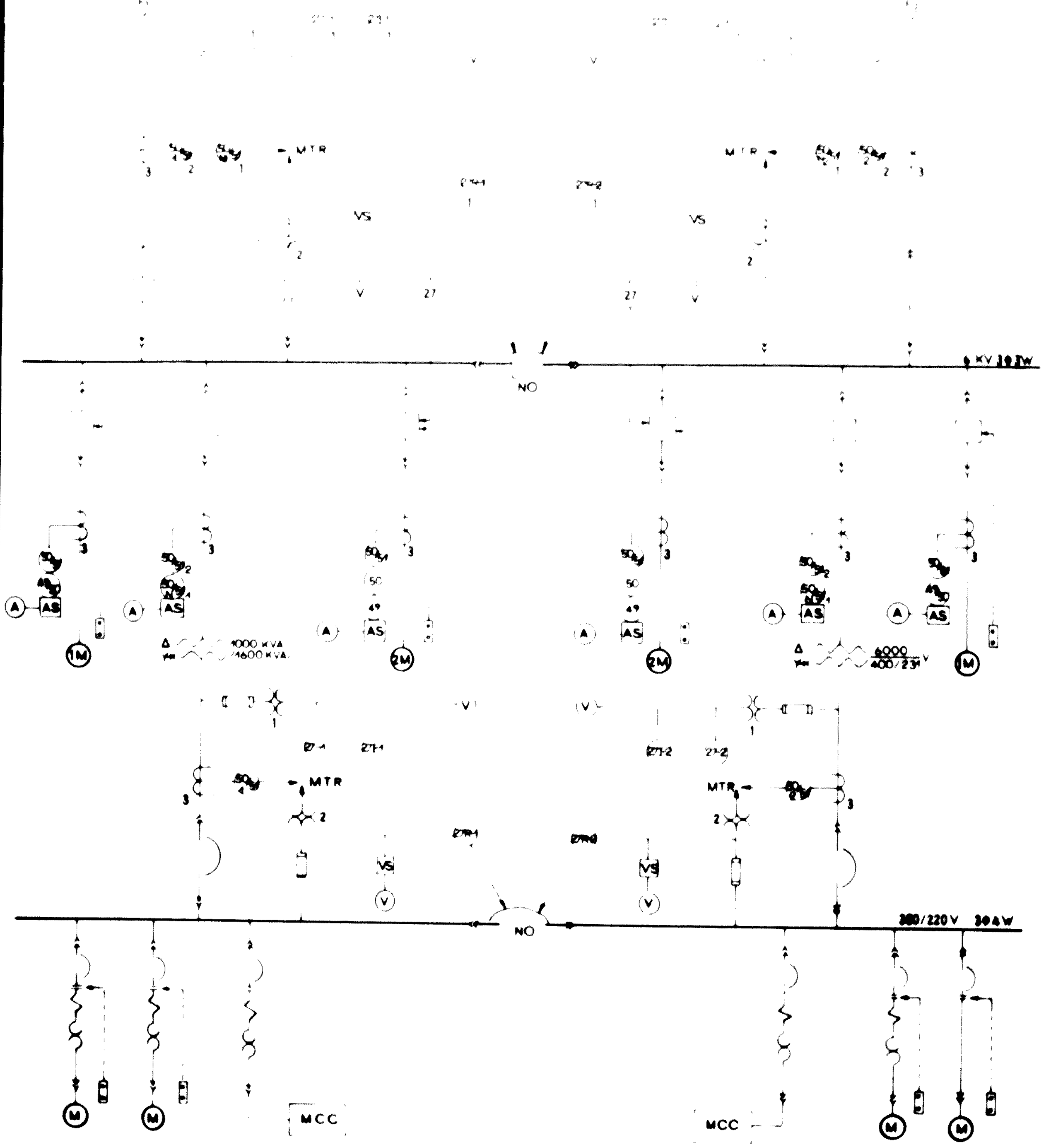
- cyclones
- elevators
- combustion rooms
- ball mills
- hammer mills
- locks
- rotating driers
- screw conveyers
- cutters
- heavy trucks
- tanks
- boilers
- centrifugal extractors

- helical distributors
- fan rotors
- air absorbers.

This company performs the following works:

- prefabricated steel structures
- beams
- reinforcing structures
- pillars for buildings
- steel structures in general.

TYPICAL ONE - LINE ELECTRICAL DIAGRAM FOR USERS' POWER DISTRIBUTION AT MEDIUM AND LOW - VOLTAGE



RELAY LEGEND

27	SHORT TIME UNDERVOLTAGE
27I	INSTANTANEOUS UNDERVOLTAGE
27R	RESIDUAL VOLTAGE
49/50	THERMAL OVERLOAD
50/51	OVERCURRENT, INSTANT AND TIME
49	THERMAL
50	INSTANTANEOUS OVERCURRENT

ABBREV - EXPLANATION

3Φ	THREE PHASE
4W	FOUR WIRE NETWORK
VS	VOLTMETER SWITCH
AS	AMMETER SWITCH
1M	ELECTROMOTOR RATED 0.2 -1MW
2M	ELECTROMOTOR RATED OVER 1MW
MCC	MOTOR CONTROL CENTER
F_1	FEEDER /SOURCE/ No 1
NO	NORMALLY OPEN
MTR	METERING

N O T E S

1 AUTO - TRANSFER IS BLOCKED BY a BUS FAULT, b SIMULTANEOUS LOSS OF BOTH FEEDERS OR LOSS OF ONE SOURCE AND LOW VOLTAGE ON THE OTHER SOURCE. c SIMULTANEOUS RESTORATION OF BOTH SOURCES AFTER DOUBLE OUTAGE, PROVIDED THAT BOTH SOURCES ATTAIN NORMAL VOLTAGE WITHIN THREE SECONDS OF EACH OTHER

2 RESIDUAL VOLTAGE RELAYS DELAY TRANSFER UNTIL RESIDUAL VOLTAGE DROPS TO A SAFE LEVEL

APPENDIX XIV 1

LOADS AND STRESSES FOR CIVIL WORKS

(Excerpt of " Reglamento Nacional de Construcciones ")

14. External loads and stresses considered when sizing the structures are:

    dear load
    live load
    seismic load
    wind load
    other loads

14.1. Volumetric weights for various construction materials and weights per sq.m. for various construction elements are listed in " Reglamento Nacional de Construcciones ".

14.2. In " Reglamento Nacional de Construcciones ", Section VII - III - 1.1., live loads per sq.m. are specified according to the use building or rooms. There are specified loads ranged between 300 Kg/sq.m. (libraries) and 600 Kg/sq.m. (excepting weight of equipment) for heavy industry. It is stated that for industry, loads given are only reference figures as they depend on equipment, consequently they are to be defined by the BIDDER.

14.3. The location covers a seismic area, as shown on the map in Appendix I, area 2.
" Reglamento Nacional de Construcciones " - Section 4 deals with steps to be taken in design and construction

works. Seismic action is stressed in design works by introducing horizontal forces, H

14.3.1. $H = UKCP$ for reinforced concrete structures
$H = UC_1P$ for structures with supporting walls made of brickwork.

14.3.2. Coefficient u has values ranged within 0.7 and 1.2. depending on seismic area and category of structure (table 1 of Section VII - III - 1.1 in " Reglamento Nacional de Construcciones ").

Coefficient K has the values of 0.67; 0.80; 1.00; 1.33 depending on reinforcing structure (flexible structure, flexible and diaphragms, etc.).

Coefficient C is deduced by formula : $C = \frac{0.05}{\sqrt[3]{t}}$

where t is vibration period and can be deduced from formula $t = \alpha \cdot \frac{h}{\sqrt{D}}$

In this formula α has values of 0.05; 0.07; 0.09 depending on structure; h is the height of structure whereas D is the width or length of structure depending on earthquake calculation on a direction or another.

Coeficient C_1 has the values of 0.16; 0.14; 0.12 depending on the number of storeys (2, 3 or 4) of the building.

Force P is equal to total permanent load of structure to which it is added a percentage of live load: 25 up to 80 % of total live load depending on the use of building.

14.3.3. The horizontal force H is distributed on height, as per formula :

$$F_j = 0.95\,H \frac{Wj \cdot hj}{\sum Wj \cdot hj}$$

The remaining of 5 % of the force H is considered as concentrated at the highest part of the structure.

14.3.4. For structures whose height and length ratio along the direction considered is equal or higher than 5 to I, horizontal force is to be distributed as per formula:

$$F_j = 0.90\,H \frac{Wj \cdot hj}{\sum Wj \cdot hj}$$

when 10 % of H is considered as concentrated at the highest part of the structure.

14.3.5. Seismic degree depends on the nature of foundation ground.

14.4. The method for calculating wind loads is specified in Section V of " Reglamento Nacional de Construcciones " of which it is quoted :

14.4.1. For structure calculation it is assumed that wind direction is horizontal.

14.4.2. Unitary wind load " q " per square meter exposed to the direct wind action, depending on wind velocity " V " expressed in meter per second, is calculated by the formula :

$$q = \frac{V^2}{16}$$

14.4.3. Dynamic load fluctuation on vertical is calculated by the formula :

$$\frac{qh}{q_{10}} = 2.5 \frac{H + 18}{H + 60}$$

where :

qh = dynamic load at height H

q_{10} = dynamic load at height of 10 m and can be acquired from the Meteorological Institute of the locality.

14.5. Other Loads

14.5.1. The " Reglamento Nacional de Construcciones " provides that for the general calculation of structures it has to be considered that temperature fluctuations are :

- for steel structures :	+ 30° C
	- 25° C
- for reinforced concrete and	+ 15° C
prestressed reinforced structures :	- 20° C
- for civil works made of wood :	+ 10° C
	- 10° C
- for civil works made of brick-work :	+ 10° C
	- 20° C

For the location defined, the following temperatures were specified :

maximum 30.8^{o} C
minimum 10.6^{o} C

reaching thus a temperature difference of about 20^{o} C.

14.5.2. The location defined does not arise the problem of freezing danger, foundation depth depending on the characteristics of foundation soil and on characteristics of structures.

14.5.3. Expansion coefficients per materials, for calculations, are the followings :

- for steel and concrete : $0.010^{o}/oo$
- for wood : $0.005^{o}/oo$
- for brick : $0.006^{o}/oo$

APPENDIX XV - 1

FIRE FIGHTING REGULATIONS

(Excerpt of " Reglamento Nacional de Construcciones ")

15. Fire fighting regulations are incorporated in " Reglamento Nacional de Construcciones " Section V II, out of which are quoted:

15.1. A structure whose components (roof, walls, etc.) correspond to various degrees of fire strength is to fall into the category providing the highest class of fire strength.

15.2. Buildings are split into 4 (four) degrees of fire strength depending on thermal and mechanical strength during and due to a fire.

15.3. Conditions Defining Fire Strength of Civil Works

Main Constructions Elements	Conditions pertaining to Flammability and Limits of Fire Strength Defining the Degrees of Fire Strength for Civil Works			
	I	II	III	IV
1. Supporting and self-supporting walls	Non flammable 4 hours	Non flammable 2 hours	Hardly flammable by protection 2 hours	Civil works not included

	I	II	III	IV
2. Non-supporting internal walls	Non flammable 2 hours	Non flammable 1 hour	Hardly flammable by protection 1 hour	in fire strength degrees I, II, III
3. Pillars 4. Floors, beams	Non flammable 4 hours	Non flammable 2 hours	Hardly flammable by protection 1 hour	
5. Roof	Non flammable 2 hours	Non flammable 1 hour	Hardly flammable by protection 1 hour	

15.4. Flammable liquids are grouped in three categories:

Category I Acetone, benzol, ether, gasoline.

Category II Alcohol, amyl acetate, ethyl acetate, methyl acetate, toluene.

Category III Amyl alcohol, solvents, fuel oils, petroleum.

It has to be taken steps for the storage of these liquids as follows:

15.4.1. It is not allowed to store flammable liquids in categories I and II into crowded rooms.

15.4.2. It is not allowed to store flammable liquids in categories I and II into bottles made of glass provided a special approval is issued.

15.4.3. It is not allowed to store flammable liquids in categories I and II at a distance smaller than 3 m from escapes (ladders, stairs, passages) unless a fireproof wall is provided inbetween.

15.5. Switchgear rooms have to provide natural ventilation. Aboveground walles of switchgear rooms have to be of minimum 15 cm when made of reinforced concrete, 20 cm when made of solid brick and of 30 cm when made of perforated brick.

If located underground, it is allowed the thickness of 20 cm for perforated brickwork as well.

All holes in walls and floors are to be covered with woodwork having a fire resistance of minimum 2 hours.

Doors are to be located higher than the place where transformer leakage oil is collected.

It is forbidden to pass any pipe (excepting electrical ones) through switchgear room.

15.6. No obstruction of escapes is allowed in civil works.

1

15.7. For buildings not provided with an automatic fire extinguishing system, the maximum allowable distance between the farthest point and escape exit or ladder is of 45 m.

15.8. For buildings provided with an automatic fire extinguishing system, the distance under item 15.7 can be of 60 m.

15.9. The minimum width of passages is of 1.20 m.

15.10. Automatic fire fighting system are provided as follows:

15.10.1. Buildings with a height greater than 15 m used as storage of flammable materials, being resistant or semi-resistant to fire.

15.10.2. Buildings with a height greater than 10 m used as storage of combustible materials, being hardly flammable in the event of a fire.

15.11. For situations when no provisions are to be found in " Reglamento Nacional de Construcciones " or in regulations recently issued, regulations valid in CONTRACTOR's country are to be observed.

LOCAL CONSTRUCTION MATERIALS AND DESIGN NORMS

16. The main construction materials to be found in the area where the COMPLEX is to be located or in sorrounding areas are the followings:

16.1. Lime, hydraulic lime as per ITINTEC 339.001.

16.2. Portland cement - type : 1, 2, 3, 4 and 5.

16.2.1. Common cement of Portland type 1 is currently used excepting otherwise stated when other grades of cement are recommended (ITINTEC 334.009).

16.2.2. Cement Portland type 2 - with lower strength to sulphates (ITINTEC 334.038).

16.2.3. Cement Portland type 3 - with high initial strength (ITINTEC 334.039).

16.2.4. Cement Portland type 4 - with low heat release.

16.2.5. Cement Portland type 5 - resistant to sulphate action (ITINTEC 334.040).

16.2.6. Besides the above mentioned five types of Portland cement, there are made also white cement, cement of 1 A, 2 A, 3 A - type Portland.

16.3. Steel for reinforced concrete.

16.3.1. Carbon steel with ribs (with periodical profile)

ITINTEC 341.031 with diameters of 8, 10, 12, 14, 16, 18, 20, 22, 25, 28, 32, 36, 40 mm.

Minimum values of tensile strength are the followings:

Steel Denomination	Tensile Strength R (Kg/sq.mm)	Flow Index kg/sq.mm
A - 28	49	28
A - 42	63	42
A - 50	70	50

16.3.2. Cold twisted carbon steel - INANTIC 12/3 431.029 with diameters as specified under 16.3.1. plus 5 and 6 mm.

Minimum values of tensile strength are the followings:

Minimum Tensile Strength kg/sq.mm	Flow Index kg/sq.mm
1.1 x flow index reached	40
	46
	50
	60

Cold twisted steel is of three grades : smooth, round with longitudinal ribs and round with longitudinal and transversal ribs.

16.3.3. Smooth carbon steel of circular section INANTIC 341.030

For this steel see diameters specified under items 16.2. and 16.3.1.

The minimum values of tensile strength are the followings:

Steel Denomination	Tensile Strength R (kg/sq.mm)	Flow Index (kg/sq.mm)
A 37 - R	37	23
A 40 - R	40	25
A 44 - R	44	28
A 50 - R	50	32
A 56 - R	56	35
A 63 - R	63	38

16.3.4. Steel made of steel alloys of high resistance for elements made of precompressed concrete, having the following values:

Tensile strength : 10,000 kg/sq.cm.
Flow index : 9,000 kg/sq.cm.

16.3.5. Besides the standards corresponding to the above mentioned steels, one can quote also:

- Draft official norm 341.038 Carbon steel, hot rolled bars for bolts
- Draft official norm 341.025 Carbon steel, hot rolled bars for nuts
- Draft official norm 341.027 Carbon steel, hot rolled bars for rivets.

16.4. Light blocks with holes for floors ITINTEC 339.008 having the following characteristics:

Nominal sizes of blocks

Height (cm)	Width (cm)	Length (cm)
10		
12		
15		
20	30	25 30 33 40
25		
30		

Compression Strength

Average strength 12 kg/sq.cm. of rough section

Minimum strength per block 9 kg/sq.cm. per net section

16.5. Bricks made of burnt clay have sizes of 10 x 24 cm, being used for external or internal walls. Wall thicknesses made of burnt clay bricks can reach:

12, 25, 37.5 cm.

Clay brick walls are used as load bearing walls for apartment houses up to 4 storeys.

Lime-cement-sand mortary is used as binder when performing brickworks made of burnt clay bricks.

Physico-mechanical characteristics of burnt clay bricks are the followings:

Classification per consistency	Specific Gravity to cu.m.	Minimum Compression Strength kg/sq.cm.	Minimum Bending Strength kg/sq.cm	Water Absorbtion (max.%)	Saturation Coefficient
resistant type bricks	2.0-1.8	150-200	30	20	0.80
average resistant type bricks	1.8-1.6	100-150	20	25	0.90
porous bricks of low resistance	1.6-1.4	70-100	10	without limit	

16.6. Concrete blocks with holes for partition walls.

Technical norm No.339.005

These blocks are of two types:

Type I - supporting (bearing loads)

Type II - self-supporting for partition walls.

Blocks have the following sizes

	Fabrication Sizes (cm)		
	Width	Height	Length
	9	19	39
	14	19	39
Blocks for partition walls	19	19	39
	24	19	39
	29	19	39
	34	19	39

16.7. Asbestos cement corrugated plates ITINTEC 339.022 are used for roofs and walls. The thickness of corrugated asbestos cement plates is of 4.5 mm minimum.

The sizes of wave, plate thickness, plate length and width are dependent on the factory and can be found in the catalogues of relevant factories.

Asbestos-cement plates can be made in natural colour or can be coloured by addition of pigments.

16.8. Flat asbestos-cement plates, INTINTEC 339.025 are used especially for roofs and side walls.

Depending on material composition, flat plates are classified as follows:

- flat, asbestos-cement plates
- flat, fibro-cement plates,

and can be made in natural colour or can be coloured by addition of pigments.

Plate sizes depend on factories and can be found in catalogues of relevant factories.

16.9. Vinyl slabs for floors and wall coatings have plan sizes of 25 x 25 cm and thicknesses of 1.6 - 2.5 mm, being of various colours, one single colour or with patterns.

16.10. Reinforced concrete pillars for above-ground lines, INTINTEC 339.027, which can be classified as follows:

- vibrated concrete pillars
- centrifugated concrete pillars
- precompressed concrete pillars

having a circular, polygonal and square section.

Pillar length within 6 m and 8 m fluctuates each 50 cm and at a length greater than 8 m fluctuates each one meter.

16.11. Prefabricated Elements for Walls and Floors

Type	Application	Material	Length m	Width m	Thickness cm	Remarks
1	2	3	4	5	6	7
Perca-Huasi	walls	reinforced concrete	2.40	0.40	8.5	only for 1 floor
Perca-Huasi	floors	-"-	3.20 (max.)	0.40	8.5	
Auracret	floors	-"-	4.50 (max.)	0.40	15	
Muracret	walls	-"-	2.25 to 2.40	0.40	2	
Listos	roof	light reinforced concrete	2.00 to 7.00	0.60 multiple	20; 25	
Listos	walls	-"-	2.38	0.40	15	
Listos	walls	-"-	2.38	0.60	20	
Simplex	walls	-"-	2.25 to	0.80	7 to	limited for 2 floors
Cepol			2.40	1.20	9.5	
Benavides Costa	walls	-"-	2.40	variable	15	
Benavides Costa	roof	-"-	variable	variable	15-20	
Unicreto	walls and floors	reinforced concrete	up to 4.00	up to 2.50	7.5-10	Tridimensional structure

Besides the above mentioned prefabricated elements, there are other ones the characteristics of which depend on manufacturing enterprise.

16.12 Reinforced Concrete

Design and execution of reinforced concrete structures are defined by "Reglamento Nacional de Construcciones".

Appendix 12 "Concreto Ciclopeo y Armado" provides addition to the regulations and is applied to all situations when there are discrepancles as compared to regulations for civil works.

Civil drawings for reinforced concrete, issued according to provisions of the above mentioned regulations are to be registered by Civil Engineering Department as a permenent document, before issuing the approval for construction.

Sizing of reinforced concrete structures can be made by one of the methods:

- A. classic method (allowable strengthes)
- B. breaking method

A. Allowable concrete strength and elasticity modulus:

- Concrete grade kg/sq.cm.	140	175	210	280	350
- Steel elasticiy modulus $E_s = 2,100,000$ kg/sq.cm.					
- Elasticity modulus for reinforced concrete (Ec) kg/sq.cm	180,000	208,000	226,000	263,000	292,000

Elasticity modulus ratio E_s/E_c	11	10	9	8	7
Allowable strength for bending compression $f_c = 0.45\ f_c$	63	79	95	126	156
Allowable stress strength kg/sq.cm	5	5.6	6.2	7.1	7.9

Volumetric weight normal reinforced concrete is to be of 2.4 to/cu.m.

Flow index of reinforcing bars depending on material is the following :

f_y = 2,800 kg/sq.cm.
f_y = 3,500 kg/sq.cm.
f_y = 4,200 kg/sq.cm.

whereas allowable strength is of 0.5 f_y.

The minimum amount reinforcings within bent elements varies depending on steel, so that:

Flow limit f_y =	2,800	3,500	4,200 kg/sq.cm.
- simple platas	0.0025	0.0020	0.0017
- plates with ribs and beams	0.0030	0.0025	0.0020

Vertical reinforcing for pillars will not be smaller than 0.01 of cross section area and not greater than 0.03 of cross section area.

B. Breaking strength method starts from strength at the moment of breaking reinforced concrete element.

By this method, concrete tensile strength due to bending is neglected wherease compression effort listributton coresponds to a rectangle.

The calculations will include :

f_y = flow limit of reinforcing

f_c = design strength of concrete depending on concrete grade

ϕ = factor for capacity decrease.

Concrete grades and steel flow limit are specified in the method of allowable strengthes.

Related to ϕ coefficient, the values are ranged between 0.90 - 0.70, i.e. :

- 0.90 for simple bending
- 0.85 for stressed and twisted elements
- 0.75 for compressed and hooped elements
- 0.70 for compressed elements with cross-ties.

16.13. Design of steel structures is defined by " Design, Fabrication and Erection of Structural Steel for Buildings " - Publication of American Institute of Steel Construction AISC - USA.

APPENDIX XVII - 1

CATEGORY " A " CONSTRUCTION COMPANIES IN PERU

Crrt. No.	Denomination	Representative	Address	Telephone
1	2	3	4	5
1.	Cia. Constructora Arbuluy Pazos Ingenieros S.A.	Augusto Pazos Gamarra Biaggio Arbulu G.	Av. Larca 743 Miraflores	459381
2.	Cia. Const. e Inversiones IMASA S.A.	Carlos Malpartida Tello	Av. Chosica 1789 Lima	242540
3.	COSAPI S.A.	Manuel Beraun	Huallaga 4340/502 Lima	283510
4.	Construcciones Villasol S.A.	Carlos Muncher	Av. Ricardo Palma 120 10^{o} Asa Miraflores	455190
5.	Corporacion de Inginieria Civil S.A.	Alfonso Pons M.	Fdo. Wiese 680 Lima	328652
6.	EPIPSA Contratistas Generales S.A.	Enrique Palacios	Av. Tcana 359 Of. 23 Lima	284920

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1	2	3	4	5
7.	Alvarado Cisneros Ingenieres S.A.	Mario Alvarado	Paseo de la Republica 385 11^{o} Piso Lima	328547
8.	Benavides y Costa S.A.	Jose Benavides Munoz	Bajada Balta 169. 10o Piso Miraflores	455142
9.	Bruce S.A. Contratistas Generales	Guillermo Bruce Coceres	Plazuela Arraspide No 9 San Isidro	403040
10.	Caceres Velasquez Oscar	Oscar Caceres Velasquez	Av. Arenales 395 Of. 406 Lima	316676
11.	Camet Y. y. Y.	Jorge Camet	Republica de Chile 388.9^{o} Piso Lima	239860
12.	Cilloniz-Olazabal-Urquiaga S.A.	Alberto Llave Espinoza	Av. Abancay 291 Lima	288040
13.	Ferreyros Garcia Jose	Jose Ferreyros Garcia Lima	Av. Arenales 371 Of. 603	236330

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1	2	3	4	5
14.	Florez Costa S.A.	-	Huancavelica 279 Lima	283270
15.	Fujita Gumi S.A. Fugusa	Jose Hamaguchi	Pablo Bermudez. 274/604 Lima	318991
16.	Grana Montero S.A.	Carlos Montero Bernales	Los Magnolias 791. 8° Piso San Isidro	401750
17.	Guiulfo Constructora de Camions S.A.	Armando Guiulfo Zender	Carabaya 1146. 2° Piso Lima	280296
18.	Ingenieros Ejectuores S.A.	Carlos Chaves	Guzman Blanco 465/302 Lima	233609
19.	Irgar Peruana S.A.	Julio Morales B.	Bajada Balta 169 9° Piso Miraflores	450645
20.	Labsa Contratistas Generales S.A.	Hernan del Aguila	Camino Real 159 Of. 600 San Isidro	406694
21.	Li Carrillo Carlos	Carlos Li Carrillo	Pablo Bermudez 234 Lima	242981

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1	2	3	4	5
22.	Olaechea Jaime S.A. Ingenieros Contratistas Generales	Jaime Olaechea Y Alfredo Muro	Plaza Francia 220/2 Lima	287710
23.	Octavio Bertolero y Cia Contratistas Cenerales S.C. de R. L.	Octavio Bertolero	Manuel Cisneros 605 La Victoria	327990
24.	Payet Guillermo S.A.	Jorge Zegarra Russo	Wilson 955 10^{o} Piso Lima	287400
25.	Pezo Y.y. Cia S.A. Ingenieros	Y. Pezo	Urb. Vivero Calle 7 Lote 12 MzA-1 Miraflores Apdo, 7 Mirfl.	
26.	Suministro de Equipas S.A.	Augusto Bedoya	J. Puno 206 Lima	272179
27.	Vargas Centeno Federico	Federico Vargas Centeno	E.Larraburre y Unanue 231/302 Lima	240600
28.	Wimpey Co. Ltd.George	Kevin Y. Warry	Nicolas de Pierda 742/708 Lima	312188

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1	2	3	4	5
29.	Woodman Mohme Ingenieros Contratistas	Arturo Woodman P.	Av. Larco 743 Of. 505 Miraflores	456442
30.	Caceres Piaggio Ingenieros S.A.	Jorge Cacereas Lizarzabarru	San Martin 749 San Miguel	615930
31.	Impresit del Pacifico S.A.	Ubaldo Andreoli	Los Begonias 393 San Isidro	404360
32.	Inginieros Civiles Contratistas Grales S.A.	Carlos Lazarte	Mariano de Los Santos 198/204 San Isidro	400065
33.	Rodriguez Larrain y A. Madueno Cotratistas Generales S.A.	Federico Valdizan Riva	Nicolas de Pierdo 938 Of. 305 Lima	288233

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