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Third Consultation on the
Petrochemical Industry
Vienna, Austria, 2 - 6 December 1985

DEVELOPING COUNTRIES' TECHNOLOGICAL CAPABILITIES
IN PETROCHEMICALS* .

A note by the secretariat

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Summary

UNIDO's preparation of a Directory of Developing Countries' Technological Capabilities in Petrochemicals has reached the stage of a preliminary draft. Reporting on the project to the Third Consultation on the Petrochemical Industry, Vienna, Austria, 2-6 December 1985, a Secretariat note outlines the project, its status and proposed future work. Annexes present the questionnaire used to obtain data, the directory table of contents, and selected pages illustrating the directory's scope, layout and content.

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INTRODUCTION

1. The strategic importance of economic co-operation among developing countries in general, and industrial co-operation among developing countries (ICDC) in particular, has been stressed by many conferences and studies.^{1/} The activities of the United Nations Industrial Development Organization (UNIDO) to promote such co-operation go back at least to 1976 when the organization's Second General Conference, held in Lima (Peru), singled out ICDC as an area of prime concern. Since then, although ICDC has been taking place, for a variety of reasons it has not reached its full potential and experience gained at practical level has so far been limited.^{2/}

2. In this connection, petrochemicals are no exception and the reasons are the same as in other industrial sectors: constraints (especially lack of relevant information) that orient developing country trade and co-operation toward developed countries rather than other developing countries.^{3/}

3. The proposed solutions are also similar: reorientated policies, and development of ICDC mechanisms and instruments at subregional, regional and interregional level that will promote ICDC in petrochemicals. Specifically this could be achieved by:

(a) Sharing information and facilitating the flow of human, scientific, technological, energy and financial resources between the developing countries;

(b) Increasing direct foreign investment between developing countries, particularly for the benefit of the least developed countries;

(c) Increasing South-South trade in manufactured goods and requisite raw materials;

(d) Co-ordinating and harmonizing national industrialization plans and promoting regional industrial sectoral planning and programming;

(e) Establishing multinational industrial enterprises both in key priority areas and based on utilization of local raw materials;

(f) Promoting joint ventures between developing countries' industrial enterprises, both public and private;

(g) Encouraging joint tenders and project development by engineering and design consultancy organizations in developing countries.^{4/}

4. Suggested mechanisms and instruments for promoting industrial co-operation among developing countries include technical co-operation networks and joint technology enterprises.^{5/} The networks would link similar institutions in different countries in "soft" technology areas (such as vocational training, engineering education, technological research, standards etc.) and in "hard" technology areas such as, among others, petrochemicals. Joint technology enterprises would provide technological knowhow services to participating countries in areas such as, among others, plastics.

5. Other areas considered most promising for ICDC included industrial training,^{6/} development of technological capability,^{7/} energy,^{8/} trade^{9/} and industrial consultancy.^{10/}

6. In line with these considerations, the UNIDO System of Consultations has specifically recommended a programme of co-operation among developing countries in the field of petrochemicals.^{11/} The organization's Second Consultation on the Petrochemical Industry, held in Istanbul (Turkey) in 1981, urged that, in co-operation with the parties concerned, UNIDO develop a programme of co-operation among developing countries, including those with and without petrochemical feedstocks, to promote the development of the petrochemical industry in those countries.^{12/} In response, UNIDO convened, jointly with The Organization of the Petroleum Exporting Countries (OPEC) and the OPEC Fund for International Development (OPEC Fund), a Seminar on Co-operation among Developing Countries in Vienna (Austria) in 1983.

7. At the Seminar, opportunities for developing countries to co-operate in setting up petrochemical industries were the subject of a joint paper by the OPEC Fund and UNIDO secretariats. The paper noted that demand projections for petrochemicals in developing countries (even if conservatively estimated, considering their current low per capita consumption) show the need for a large number of plants by 1990. Since developing countries have significant resources in all areas of this industry, such projects could be successfully implemented within a framework of co-operation among themselves for mutual benefit. Considering them broadly in three groups (those with abundant raw materials and fund, those with knowhow and other technological capabilities, and those with neither but having good potential markets), co-operation could

be mutually advantageous in seven areas: financing, manpower training, plant design and engineering, construction, operation and maintenance, marketing and R and D.13/

8. With a view to facilitating and encouraging such co-operation, the Seminar recommended that a directory be prepared on developing countries' technological capabilities (including R and D, engineering and construction, equipment fabrication, training). This was to be carried out in close co-operation with the countries concerned. The Seminar cosponsors were recommended to continue to collaborate on following up the recommendation and they were to be assisted by an advisory group from among the seminar participants.14/

9. The first results of this collaboration, the Directory of Developing Countries' Technological Capabilities in Petrochemicals, now being prepared for publication by the UNIDO secretariat, is the subject of the present paper. On completion it is expected to facilitate both co-operation between producers of petrochemicals, equipment suppliers and plant designers in different developing countries, and to help fulfill the wider objectives of ICDC.

I. PROJECT STATUS

10. Preliminary discussions with other organizations took place in late 1983 and early 1984. Questionnaires were then drafted and distributed in December 1984. Based on the replies received in the first half of 1985, a preliminary version of the directory was prepared in June 1985 (see annexes 2 and 3 for table of contents and selected pages).

11. The preliminary investigations in 1983 indicated that information on petrochemicals and related activities of developing countries should be grouped under nine headings:

- . National production (by producers and product)
- . Other national capabilities
- . Process technologies used
- . Training facilities
- . Exports and export potential
- . Engineering contractors
- . Equipment and catalyst manufacturers
- . R and D centres
- . Raw material resources

Data acquisition for the directory--essentially by literature search, questionnaire survey and direct contact--therefore focused on these categories.

12. For budget reasons, the scope of the project was limited in its initial stages to data on production of the following 25 products:

- . Ethylene, propylene, butadiene, benzene, toluene, xylenes and methanol;
- . Styrene, vinyl chloride monomer (VCM), DMT/TPA, acrylonitrile, caprolactam, ethylene oxide, ethylene glycol and phenol;
- . PVC, LDPE/LLDPE, HDPE, polypropylene, and polystyrene;
- . Polyester, nylon (polyamide) and acrylic fibres;
- . Styrene butadiene (SBR) and polybutadiene rubbers

13. The questionnaire (see annex 1) was sent in English, French and Spanish to approximately 600 possible petrochemical producers in 35 developing countries. Replies were received from India (13), Indonesia (2), Malaysia (4),

Sri Lanka (4) and Thailand in Asia; Argentina (8), Brazil (14), Chile, Ecuador, Mexico (4), Peru (5) and Venezuela (5) in Latin America; Congo, Gabon, Ivory Coast, Kenya (2), Malawi, Mozambique, Nigeria (2), Senegal, Tanzania (3), Zambia (5) and Zimbabwe in Africa, the United Arab Emirates, Abu Dhabi, Saudi Arabia (2) and Turkey (4) in the Middle East. In addition, the UNIDO secretariat also made direct contact with members of its own Third Advisory Panel on Petrochemicals to check and supplement information on their countries' preliminary data sheets.

14. Altogether some 425 data sheets, each representing a developing country production site were processed. The breakdown by region and country was as follows:

<u>AFRICA</u>		<u>LATIN AMERICA</u>	
Algeria	2	Argentina	44
Kenya	2	Bolivia	1
Nigeria	3	Brazil	82
Total	<u>7</u>	Chile	8
<u>ASIA</u>		Colombia	15
Bangladesh	2	Costa Rica	1
Burma	1	Ecuador	6
China	7	Guatemala	1
India	46	Mexico	70
Indonesia	13	Nicaragua	1
Korea, D.P.R.	2	Peru	8
Korea, Rep. of	37	Trinidad and Tobago	1
Malaysia	2	Venezuela	11
Pakistan	9	Uruguay	<u>3</u>
Philippines	8	Total	253
Thailand	<u>7</u>	<u>MIDDLE EAST</u>	
Total	<u>134</u>	Bahrain	1
AFRICA	7	Egypt	3
ASIA	134	Iran (Islamic Rep. of)	3
LATIN AMERICA	232	Libyan Arab Jamahiriya	2
MIDDLE EAST	<u>32</u>	Qatar	1
Total	<u>425</u>	Saudi Arabia	8
		Turkey	<u>14</u>
		Total	32

15. Based on the survey response and parallel literature searches, the information was organized initially in the form of country profiles. Subsequently this was separated into groups corresponding to the three main parts of the directory:

- Part one: (i) Product directory (sources of petrochemicals--by country)
- (ii) country data sheets (showing names of petrochemical producers, production sites, products, present capacity and expansions, process licensor, raw materials used, year of start up and current production.
- (iii) national background (additional producer information, available process technologies, domestic engineering contractors, domestic equipment, spare parts and catalysts, training facilities and raw material reserves.)
- Part two: (i) regional and national technological capabilities
- (ii) technologies used (by product and country)
- Part three: (i) petrochemical producers
- (ii) contractors and engineering firms
- (iii) equipment, spares and catalyst supplies

Product directory

16. Developing countries that produce each of the 25 petrochemicals in the survey are listed. This serves two purposes: it acts as an index for the following section showing which petrochemical each country produces; and it gives an overview of the production of each product, indicating where it can be sourced and which countries are already have the technological capability to produce it.

Country data sheets (part one, section 1)

17. All known petrochemical producers are listed by country and the countries are grouped in four regions: Africa, Asia, Latin America and the Middle East. Each producer is listed again with its full address in the manufacturers registry in part 3. The country tables show the name of each

producer, their petrochemical products, the capacity and location of each manufacturing unit, planned expansion capacity, new product capacity, the process technology used, the raw materials involved and year production began. Unless otherwise footnoted, production capacity refers to actual output in 1983 and is only listed when reported by the producer. Capacity, expressed in tons of product per year, means operating capacity as of 1984. Where capacity data was reported as nominal daily, nameplate or design capacity the figures were converted to an annual basis by multiplying by 330 days.

18. This part of the directory serves both as an overview of the scale of petrochemical activity in a given country and as indication of potential for present and future sourcing or supplies--sales as well as purchases of raw materials, intermediates and finished products. Developing country producers seeking assistance or co-operation in assessing particular technologies for their own use can determine which neighbouring country may already have acquired it and how long it has been in use there. Suppliers of process technology and equipment may be alerted by entries under plant expansions to the opportunity to bid for part of the project. (Further information on each of these are given in the subsequent section (see below); company addresses are given in the company registry in part 3.)

National background (part one, section 2)

19. Rounding out the petrochemical profile of each country, the directory will eventually contain brief information on the achievements, capabilities and main problems experienced by its petrochemical producers. This includes their (and others') access to indigenous technology, training facilities, indigenous contractors, equipment and materials suppliers, R and D support, and the availability of local raw materials. The status of each country's exports of petrochemical raw materials is also noted.

Additional company information--further information on each producer, including company size and ownership, access to raw materials, main achievements in petrochemicals (total production, recent investments, productivity changes, design and fabrications facilities, experience in adapting technology and equipment to suit local needs) and major problems encountered.

Available process technologies--description of the technology; companies to which these technologies have been transferred and the conditions of transfer.

Training facilities--the companies listed have reported that they have training facilities. Those that can provide for outside trainees are indicated. Further details include a description of facilities, types of training provided, areas of emphasis, language, fees, and duration.

Export capability--information on the listed companies current and projected exports, together with any problems experienced.

Domestic engineering contractors--information on their technical capabilities and services provided. (For addresses see part 3.)

Domestic manufacturers of equipment, spare parts and catalysts--types of equipment and spare parts produced are listed and the names of the companies known to have produced them for petrochemical plants given. (All manufacturers are listed in the company registry in part 3.)

Petrochemical R and D centres--institutions categorized by their capabilities, years of experience and willingness to contact similar centres.

Reserves and production of raw materials--Organized by country, data is given on reserves and production of raw materials usable for manufacturing petrochemicals. These include natural gas, oil and coal (anthracite and bituminous coal, except where otherwise indicated), oil refineries with catalytic cracking and catalytic reforming capacity and biomass.^{15/}

Regional and national technological capabilities

20. Part two of the directory comprises a cross reference of the technological capabilities of the listed countries. The first of two sections is an overview indicating the availability of specialized training facilities, the scale of production (e.g. less than 100,000 tons/year or over 1 million tons), the size of the indigenous petrochemical plant design and equipment manufacturing sector, availability of process technologies for transfer, and a summary of gas, oil and coal reserves.

21. The second section analyses the technologies used for each product showing the countries that use each one.

Addresses for further contact

22. Part three is a directory listing all producers and other manufacturers in one of three groups: petrochemical producers, contractors and engineering firms, and suppliers of petrochemical equipment, spare parts and catalysts. Addresses, and (where available) telephone and telex numbers are given.

II. FUTURE WORK

23. As of October 1985, all parts of the directory had been compiled in preliminary form. As noted above this was limited to production and related facilities in some 35 developing countries and 25 products. The immediate task, therefore, is to complete this first draft for circulation to the companies involved and the appropriate industry ministries in each country. At the same time the layout and printing processes will be reconsidered with a view to achieving the highest possible standards using available resources. It is hoped that, taking into account the feedback from the companies and ministries, the first edition can be produced in 1986.

24. A similar approach is planned for regularly updating the directory each year. First the questionnaires, then the preliminary draft will be circulated to the main information sources and users. Already for the second edition it is planned to expand the coverage to all developing countries and approximately 50 petrochemical products.

25. At the same time links would be established with the UNIDO supply and demand data base so as to avoid any duplication and to compliment the functions of both activities.16/

26. It is also foreseen that, through these activities, UNIDO would be in a position to provide (on request) special information services to Member Countries and their petrochemical industries.

Notes

1. See "Report of the High-Level Conference on Economic Co-operation among Developing Countries, Caracas 13-19 May 1981" (A/36/333), p.iii; "Lima Declaration and Plan of Action on Industrial Development and Co-operation" (A/10112), chapter IV; and "New Delhi Declaration and Plan of Action on Industrialization of Developing Countries and International Co-operation for Their Industrial Development" (ID/CONF.4/22).

2. See background paper for the UNIDO Fourth General Conference, "Strengthening of economic co-operation among developing countries (ID/CONF.5/4).

3. Ibid., para. 21. In this connection, UNIDO's Fourth General Conference, in Vienna in 1984, identified among other constraints two of particular relevance: lack of information systems on needs and capabilities to undertake ICDC; and lack of proper organizational and technical capability at the national, regional and interregional levels to facilitate ICDC. Examples cited included consumption and production preferences favouring products and technologies originating in the industrialized countries; the existence of institutional infrastructures that favour or tend to perpetuate historical patterns of developed/developing country co-operation; and uncritical acceptance of the concept of the nation-state as a national-state as an economic unit irrespective of its natural endowments or size.

4. See ID/CONF.5/4, para 28.

5. Ibid., para. 38.

6. Industrial training in a developing country has the advantage that the training conditions, environmental factors and problems to be solved are likely to be similar to those in the trainee's country, and the cost will be less in than in developed countries. Development of entrepreneurial, managerial and technical capabilities not alienated from developing country situations are therefore considered key priority areas, see "Accelerated development of human resources for industrial development: some issues for consideration" (ID/WG.394/1).

7. Development of a technological capability in industrial production is a vital step in reducing the South's technological dependence on the North. In view of the common problems they face in this area, it is considered essential that developing countries exchange information on their experiences, see "Report of the High-Level Expert Group Meetings Preparatory to the Fourth General Conference of UNIDO: International Forum on Technological Advances and Development, Tbilisi, USSR, 12-16 April 1973" (ID/WG.389/6), pp 28-29.

8. In 1983 an expert group meeting on industrial co-operation among developing countries singled out opportunities for ICDC in the energy field-- in equipment manufacturing, design and consultancy services, operational management and training programmes, see "Report of the High-Level Expert Group Meetings Preparatory to the Fourth General Conference of UNIDO: Energy and Industrialization, Oslo, Norway, 29 August-2 September 1983" (ID/WG.402/12).

9. Factors inhibiting increases in trade in manufacturers between developing countries include uneven and biased information, inadequate communication and lack of marketing networks available to industrial enterprises in developing countries, see "Report of the International Expert Group Meetings Preparatory to the Fourth General Conference of UNIDO: Industrial Co-operation among Developing Countries, Bangkok, Thailand 18-22 July 1983" (ID/WG.399/4), p.18.

10. Development of indigenous industrial consultancy capability could be enhanced through co-operation schemes involving sharing of experiences, exchange of personnel, joint work on projects, joint ventures between developing country consultancy firms and regular exchange of information, see background paper for the UNIDO Fourth General Conference, "Strengthening of Economic Co-operation among Developing Countries" (ID/CONF.5/4), para. 55.

11/ The UNIDO System of Consultations was established by the General Assembly in its resolution 3362 (S-VII) in response to the Lima Declaration and Plan of Action, see Official Records of the General Assembly, Seventh Special Session, Supplement No.1, para.3; in 1980 the Industrial Development Board decided that it should be an instrument through which UNIDO would serve as a forum for developed and developing countries in their contacts and consultations directed towards the industrialization of developing countries, see The System of Consultations (PI/84).

12. Report of the Second Consultation on The Petrochemical Industry (ID/273), para. 3.

13. See "Report of the Seminar on Co-operation among Developing Countries in Petrochemical Industries, Vienna, 7-9 March 1983", (Vienna, OPEC, 1983), chapter II.

14. Ibid., chapter V.

15. Except where footnotes indicate otherwise, the data was taken from three sources: oil and gas reserves as of 1 January 1984 and average daily oil production in 1983 published in Oil and Gas Journal, 26 December 1983, pp. 80-81; gas production in 1982 in International Petroleum Encyclopedia, (Tulsa, Oklahoma, Pennwell Publishing, 1983), p. 318; coal reserves (in 1977, 1978 or 1979) as available in Yearbook of World Energy Statistics 1980, United Nations publication, Sales no. E/F.81.XVII.10, 1982, pp. 210-220, table 56, .

16. In order to help developing countries identify investment opportunities in the petrochemical sector and to improve the transparency of the market, UNIDO has initiated the preparation of a supply/demand data base. Data on the more important petrochemical products is solicited by direct contact with companies, professional organizations, government organizations and other sources in both developing and industrialized countries. It is hoped that the data base, together with the survey of developing countries' technological capabilities, will become an authentic source of reference for the sector, providing an important tool for identifying potential partners for co-operation. See also "Issue No.1: Long-term Arrangements for The Development of the Petrochemical Industry in Developing Countries" (ID/WG.468/2) para. 25.

Annex 1: Letter and questionnaire to developing country
petrochemical producers



UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
ORGANISATION DES NATIONS UNIES POUR LE DEVELOPPEMENT INDUSTRIEL

VIENNA INTERNATIONAL CENTRE P.O. BOX 300, A-1400 VIENNA, AUSTRIA TELEPHONE: 26 310 TELEGRAPHIC ADDRESS: UNIDO VIENNA	CENTRE INTERNATIONAL DE VIENNE B.P. 300, A-1400 VIENNE (AUTRICHE) TELEPHONE: 26 310 ADRESSE TELEGRAPHIQUE: UNIDO VIENNE	TELEX: 136612	TELEX: 136612
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REFERENCE: ID 223/7

DATE: 18 December 1984

Dear Sir,

UNIDO is in the process of compiling a Directory of Technological Capabilities in Developing Countries Related to the Petrochemical Industry.

..... The Directory will provide a compendium of information on developing countries concerning their petrochemical capacity, production, exports and raw materials, technologies available for transfer, training facilities and R and D centres, as well as equipment manufacturers and engineering contractors for petrochemical plants, as set out in the attached Country Data Sheet. The 25 petrochemicals covered are listed in Annex B. The purpose of the directory is to facilitate the process of co-operation among developing countries in the field of petrochemicals by increasing their awareness of each other's existing and potential capabilities in this sector.

It is being compiled in accordance with the recommendations of the OPEC/UNIDO/OPEC Fund Seminar on Co-operation among Developing Countries in the Petrochemical Industries held in Vienna, 7-9 March 1983, as revised by the Advisory Panel on Petrochemicals at its First Meeting held in Vienna, 3-4 October 1983.

..... We would appreciate it greatly if you would co-operate in our efforts to make this directory as complete and up to date as possible by filling out the enclosed Country Data Sheet as well as adding any missing information and return it to us by 31 January 1985. As soon as all the information is received and compiled, we will send you a copy of the directory.

Thank you very much for your co-operation in this matter.

Yours sincerely,


G. R. Latortue
Head, Negotiations Branch

Note: This letter has been sent to petrochemical companies in ASIA as per attached list.

INVENTORY OF TECHNOLOGICAL CAPABILITIES IN DEVELOPING COUNTRIES
RELATED TO THE PETROCHEMICAL INDUSTRY*

COUNTRY DATA SHEET

A. Petrochemical Companies

(COMPANY NAME)

Plant(s):(location)

1. Production

Product	Capacity 1 Jan. 1984 (in tpa)**	Technology used	Planned expansion of capacity (tpa)(year)	Year Production started	Production 1983(tpa)**	Raw materials

2. Major problems and achievements of the company.

3. Technologies available for transfer

(a) description of technology

(b) companies to which this technology has been transferred

(c) conditions for transfer

4. Training facilities available

(a) type of training programme

(b) whether available for outside trainees;

language of instruction; course duration; fees

B. Exports of Petrochemicals

1. Current and projected exports

Product	Exports (in tpa)**			Average FOB price 1983	Main export countries	Average pro- jected exports next 5 years (in tpa)**
	1981	1982	1983			

2. Major problems encountered in exporting.

* Basic and intermediate petrochemicals, plastics, rubbers and fibers (refer to Annex B).

** Tons per annum or in units per year giving unit weight.

C. Domestic engineering contractors for the design, construction and erection of petrochemical plants

- Names of contractors
 - (a) technical capabilities and services offered
 - (b) companies for which the contractor has worked

D. Domestic equipment manufacturers

- Types of equipment according to the list in Annex A and names of companies producing these types of equipment

E. Petrochemical Research and Development Centres

- Names of R and D centres
 - (a) technical capabilities and major areas of interest
 - (b) years of activity
 - (c) interest in contacting other R and D centres

F. Raw Materials Reserves and Production
(LPG, Petroleum, natural gas, coal, shale oil)

Raw material	Reserves	Current Production (year)	Estimated Future Production (year)

G. Directory of Addresses of companies listed in the preceding sections

1. Petrochemical companies
2. Engineering contractors
3. Equipment manufacturers
4. Research and Development Centres

TYPES OF EQUIPMENT*1. Standard equipment

Such as: water treatment, cooling towers, air separation, air compression, filtration, materials handling, air conditioning/refrigeration

2. Fabricated equipment

- (a) Pressure vessels and reactors
- (b) Columns including towers, strippers, separators, etc.
- (c) Heat exchangers
- (d) Furnaces, waste heat boilers
- (e) Storage tanks
- (f) Gas holders and bunkers

3. Rotating equipment

- (a) Compressors: centrifugal, reciprocating, axial, etc.
- (b) Fans and blowers
- (c) Pumps: water pumps, chemical pumps, etc.

4. Power generation

- Boilers
- Steam turbines
- Power generators
- Transformers
- Motors

5. Instrumentation

- Electronic
- Pneumatic

6. Bulk supply materials

- Pipes and tubes
- Forgings and pipe fittings
- Valves
- Castings

7. Laboratory equipment8. Workshops equipment

* Please give the names and addresses of the main local equipment suppliers and/or manufacturers.

LIST OF PETROCHEMICAL PRODUCTS

A. BASIC PETROCHEMICALS

Ethylene
Propylene
Butadiene
Benzene
Toluene
Xylene
Methanol

B. INTERMEDIATE PETROCHEMICALS

Styrene
Phenol
Ethylene Oxide
Ethylene Glycol
Acrylonitrile
Caprolactam
Vinyl Chloride Monomer (VCM)
DMT/TPA

C. END PETROCHEMICALS

1. Thermoplastics

PVC
LDPE + LLDPE
HDPE
Polypropylene
Polystyrene

2. Fibers

Polyester
Polyamide
Acrylic

3. Rubbers

SBR
Polybutadiene

Annex 2: Directory table of contents

CONTENTS
(provisional)

Preface
Explanatory notes
Introduction

Part one

- I. Product directory
- II. Country data sheets
 - Africa
 - Asia
 - Latin America
 - Middle East
- III. National background
 - Africa
 - Asia
 - Latin America
 - Middle East

Part two

- IV. Regional and national technological capabilities
- V. Technologies used (by product and country)

Part three

- VI. Company directory
 - Petrochemical producers
 - Contractors and engineering firms
 - Equipment, spares and catalyst manufacturers

Annex 3 Selected directory pages

Product directory

Country data sheets (Nigeria, Brazil, Mexico)

National background (Mexico)

**Regional and national technological
capabilities**

Company directory

Petrochemical producers

Contractors and engineering firms

Equipment, spares and catalyst suppliers

Annex 3

Sample page - showing sources of petrochemical products

Product	Country
Acrylic fibre	Argentina Bolivia Brazil Colombia Chile Ecuador México Perú Venezuela
Acrylonitrile	Argentina Brazil Colombia India México Perú Turkey Venezuela
Benzene	Argentina Brazil Colombia Chile Ecuador México Perú Venezuela
Butadiene	Argentina Brazil México
.....	

Annex 3 (contd.) - Sample country data sheets

NIGERIA

Product	Capacity (tons/year)	Expansion or project (tons/year)	Process licensor	Raw material	Start up year	Current production (tons/year)
<u>Nigerian National Petroleum Corporation (Port Harcourt)</u>						
Ethylene	...	310,000 ^a	...	Refinery LPG, NGL, naphtha	...	...
Propylene	...	100,000 ^a	...	Refinery LPG, NGL, naphtha	...	...
EG	...	35,000 ^a	...	Ethylene	...	...
LDPE	...	110,000 ^a	...	Ethylene	...	...
HDPE	...	70,000 ^a	...	Ethylene	...	...
PVC	...	175,000 ^a	...	VCM	...	...
PP	...	60,000 ^a	...	Propylene	...	...

^aBy 1991

Annex 3 (contd.) - Sample country data sheets

BRAZIL

Product	Capacity (tons/year)	Expansion or project (tons/year)	Process licensor	Raw material	Start up year	Current production (tons/year)
<u>Acritonitulo do Nordeste (Acrinor) (Camaçari, Bahia:)</u>						
ACN	60,000	-	Sohio	Propylene, ammonia	1980	...
	14,000	-	Sohio	Propylene ammonia	1984	57,585 ^a
<u>Cia Petroquímica Camaçari (CPC) (Camaçari, Bahia:)</u>						
VCM	150,000		Goodrich	Ethylene dichloride	1979	150,000 ^a
		180,000	...		1984	
PVC	220,000	-	Mitsubishi	VCM	1979	159,000 ^a
<u>Estireno do Nordeste (EDN) (Camaçari, Bahia:)</u>						
Toluene	5,400 ^b	-	...	Ethylbenzene (by-product)	...	-
Styrene	120,000 ^b		Badger	Ethane, benzene (via ethyl- benzene)	1978	112,000 ^a
		150,000	...	...	...
PS	45,000 ^b		Foster Grant	Styrene	1978	33,000 ^a
		55,000	...	Styrene	...	
<u>Metanor do Nordeste (Camaçari, Bahia:)</u>						
Methanol	60,000		ICI	Natural gas	1976 1986	56,000 ^a
		86,000				
<u>Polialden Petroquímica (Camaçari, Bahia:)</u>						
HDPE	80,000		Mitsubishi Chemical	Ethylene	1979	71,000 ^a
		120,000	...	Ethylene	1989	

Annex 3 (contd). - Sample country data sheets

BRAZIL (contd.)

Product	Capacity (tons/year)	Expansion or project (tons/year)	Process licensor	Raw material	Start up year	Current production (tons/year)
<u>Polipropileno (Camaçari, Bahia)</u>						
PP	80,000	-	ICI	Propylene	1979	69,000 ^a
<u>Politeno, Indústria e Comércio (Camaçari, Bahia)</u>						
LDPE	120,000	-	Sumitomo	Ethylene	1978	120,000 ^a
<u>Pronor Petroquímica (Camaçari, Bahia)</u>						
DMT	60,000	-	Dynamit	p-Xylene, methanol	1977	58,447 ^a
<u>Companhia Brasileira de Plásticos Monsanto (Sao José dos Campos, Sao Paulo)</u>						
PS	42,000	-	Monsanto	Styrene	1982	15,000 ^a
<u>Consórcio Paulista de Monômero (Copamo) (Santo André, Sao Paulo)</u>						
VCM	100,000	-	Solvay	Ethylene, chlorine	1972	96,000 ^a
<u>Rhodiaco Indústrias Químicas (Paulínea, Sao Paulo)</u>						
PPA	75,000	90,000	Standard Oil	p-Xylene p-Xylene	1977	64,000 ^a

Annex 3 (contd.) - Sample country data sheets

BRAZIL (Contd.)

Product	Capacity (tons/year)	Expansion or project (tons/year)	Process licensor	Raw material	Start up year	Current production (tons/year)
<u>Salgema Indústrias Químicas (Maceió, Alagoas)</u>						
Ethylene	60,000		Petrobras/ Cenpes	Ethanol	1985	...
<u>Petroquímica Triunfo (Triunfo, Rio Grande do Sul)</u>						
LDPE	100,000	-	ATO Chimie	Ethylene	1984	...
<u>Companhia Indústrias Polipropileno (PPH) (Triunfo, Rio Grande do Sul)</u>						
PP	50,000	-	Hercules	Propylene	1983	41,000 ^a
<u>Polibrasil, Industria e Comercio. (Mauá, Sao Paulo)</u>						
PP	50,000	-	Shell	Propylene, ethylene	1978	93,415 ^a
<u>Prosint, Produtos Sintéticos (Rio de Janeiro, Rio de Janeiro)</u>						
Methanol	50,000	90,000	Casale ...	Natural gas ...	1974 1988	50,000 ^a
<u>Ultrafértil, Indústria e Comércio de Fertilizantes (Araucária, Paraná)</u>						
Methanol	7,920	-	Lurgi	Syngas	1983	4,600 ^a

Annex 3 (contd.) - Sample country data sheets

BRAZIL (Contd.)

Product	Capacity (tons/year)	Expansion or project (tons/year)	Process licensor	Raw material	Start up year	Current production (tons/year)
<u>Union Carbide do Brasil (Cubatao, Sao Paulo)</u>						
Ethylene	23,000	-	UCC	Ethanol	1965-1971	...
LDPE	130,000	-	UCC	Ethylene	1982 ^c 1958	112,400 ^a
<u>Usinas Siderúrgicas de Minas Gerais (Usiminas) (Ipatinga, Minas Gerais)</u>						
Benzene	18,220	-	Mitsui	Coke oven gas (condensates)	1979	10,110 ^a
Toluene	2,999	-	Mitsui	Coke oven gas (condensates)	1979	2,063 ^a
Xylenes	882	-	Mitsui	Coke oven gas (condensates)	1979	603 ^a

^a In 1983

^b In 1985

^c Reactivated

Annex 3 (contd.) - Sample country data sheets

MEXICO

Product	Capacity (tons/year)	Expansion or project (tons/year)	Process licensor	Raw material	Start up year	Current production (tons/year)
<u>Industrias Resistol (Lechorfa, Edo. de México)</u>						
PVC	28,000	-	Mitsubishi/ Monsanto	VCM Styrene	1957 1957	......
PS	24,200	26,000	...	Styrene		
SBR	6,000		Uniroyal/ Mitsubishi	Butadiene, styrene	1964	...
<u>Industrias Resistol (Lerma, Edo. de México)</u>						
SBR	10,500	-	Uniroyal/ Mitsubishi	Butadiene, styrene	1964	...
<u>Industrias Resistol (Xicohtzinco, Tlaxiala)</u>						
PVC	20,000		Mitsubishi/ Monsanto	VCM	1977	...
PS	20,000	40,000 -	... ...	... Styrene	... 1978	......
<u>Fenoquímica (Cosoleancaque, Veracruz)</u>						
Phenol	25,000	38,000	BP Chemicals ...	Cumene ...	1976 ...	22,000 ^a
<u>Petróleos Mexicanos (Pemex) (Cosoleancaque, Veracruz)</u>						
p-xylene	40,000	-	Engelhard/ Chevron	xylene	1973	...
AN	24,000	-	Distillers (BP)	Propylene, ammonia	1971	...

Annex 3 (contd.) - Sample country data sheets

MEXICO (Contd.)

Product	Capacity	Expansion or project	Process licensor	Raw material	Start up year	Current production
<u>Petróleos Mexicanos (Pemex) (Altamira)</u>						
Acrylic acid	30,000	-	IMP	...	1983	...
AN	50,000	-	...	...	1984	...
PB	10,000	-	...	Butadiene	1984	...
<u>Petróleos Mexicanos (Pemex) (Atzacapatzalco, México DF)</u>						
Propylene	27,000	-	Esso	Refinery gas	1959	...
<u>Petróleos Mexicanos (Pemex) (Cadereyta, Nuevo Leon)</u>						
Propylene	45,000	-	Kellogg	Refinery gas	1980	...
<u>Petróleos Mexicanos (Pemex) (Dos Bocas, Tab.)</u>						
Ethylene	-	400,000	IMP	...	...	...
Propylene	-	100,000	...	...	...	...
LDPE		100,000	...	Ethylene	...	...
PP		100,000	...	Propylene	...	...
<u>Petróleos Mexicanos (Pemex) (Posa Rica, Veracruz)</u>						
Ethylene	182,000	38,000	Lummus	Cumene	1976	22,000
Propylene	300,000	-	...	...	1980	...
HDPE	100,000	-	Asahi	Ethylene	1977	...
LDPE	70,000	-	ICI	Ethylene	1971	...
PP	100,000	-	...	Propylene	1980	...

Annex 3 (contd.) - Sample country data sheets

MEXICO (Contd.)

Product	Capacity	Expansion or project	Process licensor	Raw material	Start up year	Current production
Petróleos Mexicanos (Pemex) (Laguana Del Ostion, Veracruz)						
Methanol	825,000	-	...	...	1984	...
Ethylene	500,000	-	IMP	...	1983	...
Benzene		299,000	...	...	...	...
Toluene		371,000	...	...	...	...
o-xylene		55,000	...	...	...	...
m-xylene		310,000	...	...	...	...
p-xylene		240,000	...	...	...	...
Propylene		26,900	...	...	...	...
LDPE		240,000	...	Ethylene	...	...
Petróleos Mexicanos (Pemex) (Morales, Ver.)						
Ethylene	500,000	-	IMP	...	1983	...
EO	200,000	...	...	Ethylene	1983	...
Propylene	26,900	...	...	...	1983	...
LDPE	100,000	...	...	Ethylene	1983	...
AN	50,000	...	...	...	1984	...
Petróleos Mexicanos (Pemex) (Pajaritos, Ver.)						
Ethylene	32,000	-	McKee	Ethane	1967	...
	182,000	-	Lummus	Ethane	1972	...
EDC	42,000	-	...	...	...	...
	43,000	-	...	...	...	...
	71,000	-	...	...	...	...
	330,000	-	...	...	1982	...
VCM	19,500	-	Shell	EDC	1967	...
	70,000	-	Monsanto/ Scientific Design	Ethylene chlorine	1973	...
	200,000	-	B.F.Goodrich/ Badger	Ethylene, chlorine	1982	...
EO	28,000	-	Scientific Design	Ethylene	1972	...
Petróleos Mexicanos (Pemex) (Reynosa, Tamaulipas)						
Ethylene	32,000	-	McKee	Ethane	1966	...
LDPE	29,000	-	ICI	Ethylene,	1966	...

Annex 3 (contd.) - Sample country data sheets

MEXICO (Contd.)

Product	Capacity	Expansion or project	Process licensor	Raw material	Start up year	Current production
<u>Petróleos Mexicanos (Pemex) (Salmanca, Guanajuat)</u>						
Propylene	48,000	-	Kellogg	Refinery gas	1978	...
<u>Petróleos Mexicanos (Pemex)(Salina Cruz, Oaxaca)</u>						
Propylene	45,000	-	Kellogg	Refinery gas	1980	...
<u>Petróleos Mexicanos (Pemex) (San Martin, Texmelucan, Pue.)</u>						
Propylene	30,000	-	...	...	...	...
AN	50,000	-	...	...	...	...
<u>Petróleos Mexicanos (Pemex) (Tula, Hidalgo)</u>						
AN	50,000	-	Vistron (Sohio)	Propylene, ammonia	1979	...
Methanol	31,000	-	Gulf	Refinery gas	1969	...
	150,000	-	Lurgi	Refinery gas	1978	...
Propylene	45,000	-	Kellogg	Coking gas	1976	...
<u>Petróleos Mexicanos (Pemex) (Poldesa)</u>						
EPS	10,000	-	...	...	...	...
<u>Petróleos Mexicanos (Pemex) (Madero)</u>						
Ethylene	14,000	-	UOP	Ethylene	1970	...
Styrene	33,000	-	UOP	Ethyl benzene	1967	...

Annex 3 (contd.) - Sample country data sheets

MEXICO (Contd.)

Product	Capacity	Expansion or project	Process licensor	Raw material	Start up year	Current production
Petróleos Mexicanos (Pemex) (Minatitlán)						
Benzene	71,000					
	47,600					
Ethylene	3,000	3,000	UOP	Ethylene	1967	6,000
			UOP	Ethylene	...	
m- and p-xylene	57,000	-	UOP	xylene	1964	...
o-xylene	17,000	-	UOP	xylene	1964	...
Toluene	118,000	-	UOP	Aromatics	1964	...
Petróleos Mexicanos (Pemex) (Cangrejera)						
Benzene	168,000	-	...	...	...	...
	49,000	-	...	...	...	...
	82,000	-	...	...	...	...
	75,000	-	...	...	...	...
Ethylene	500,000	-	Lummus	Ethane	1977	...
EO	100,000	-	Scientific Design	Ethylene	1978	...
LDPE	240,000	-	ICI	Ethylene	1979	
Styrene	150,000	-	Monsanto/Lummus	Ethyl benzene	1979	...
Toluene	371,000	-	Atlantic	Aromatics	1978	...
m- and p-xylene	370,000	-	Atlantic Richfield	xlenes	1978	...
o-xylene	55,000	-	Atlantic Richfield	xlenes	1978	
p-xylene	240,000	-	Atlantic Richfield/Chevron	xlenes	1978	...
	100,000	-	...	xlenes	1982	...
Petróleos Mexicanos (Pemex) (Allende)						
Ethylene	500,000	-	...	...	1981	
EO	200,000	-	Scientific Design	Ethylene	1978	...
HDPE	100,000	-	...	Ethylene	1981	

Annex 3 (contd.)

Country: MEXICO

Additional company information

Petroleos Mexicanos (Pemex)

Background: Pemex is Mexico's Government-owned petroleum company responsible for exploration, exploitation, refining, transportation, storage, distribution and sale of petroleum, natural gas and their immediate derivatives. It is the largest enterprise in Mexico and has around 150,000 employees.

Raw materials: In addition to supplies of ethane, Pemex operates nine oil refineries processing 1.3 million barrels of crude daily. Catalytic cracking capacity (298,000 b/d) is distributed between Azcapotzalco, Cadereyta, Madero, Minatitlan, Salamanca, Salina Cruz and Tula (Hidalgo). Catalytic reforming capacity (163,800) is located at Cadereyta, Madero, Minatitlan, Salamanca, Salina Cruz and Tula

Main achievements: Pemex established its first petrochemical units in the late 1950s, and many of the later plants are 10 or more years old. Despite their somewhat dated technology, the company continues to use them to meet the country's needs replacing them by constructing plants using the most advanced technology.

In order to improve productivity, the company has established more efficient systems of maintenance, acquisition of supplies and equipment, control of raw materials and products, training, security, information and labor relations.

Major problems encountered: Transport problems, specifically insufficient availability of railroad cars; difficulties with supplies of raw materials; difficulties with supplies of machinery and equipment; certain difficulties deriving from the imported technology.

Available process technologies

Petroleos Mexicanos (Pemex)

Pemex has adapted and developed its own technology for a number of petrochemical processes.

Instituto Mexicano del Petróles (IMP)

In addition to a number of processes and basic engineering designs from IMP in the area of oil refining, the institute offers licensed technology to produce butane, ethane, natural gasoline, LPG, acrylonitrile (purification), propane and surfactants.

Annex 3 (contd.)

Domestic engineering contractors

The list of Mexican engineering contractors experienced in various phases of petrochemical plant design and construction can be obtained from Pemex as well as from Instituto Mexicano del Petróleo (IMP).

Domestic manufacturers of equipment, spare parts and catalysts

Standard equipment (cooling towers, air compression, refrigeration etc.)

Jacuzzi Universal
Mayekawa de México
Torres Marmex

Fabricated equipment (pressure vessels and reactors, columns, towers, heat exchangers, furnaces, storage tanks etc.)

Avante Ingenieros
Consortio Industrial
C.S.R. de México
Ecología
Fabricaciones de Acero Inoxidable
Industomex
Mexicana de Bienes de Capital
Pfaudler
Swecomex
Tanques de Acero Trinity
Tecnotanques del Noroeste
Trinox Manufacturera

Rotating equipment (compressors, fans, pumps etc.)

Gunn
Ingersoll Rand de México
Industrias Guillermo Murguía
Máquinas de Proceso
Worthington de México

Power generation (boilers, steam turbines, power generators, transformers, motors etc.)

Babcock and Wilcox de México
Ce-rrey
Clayton de México
Clever Brooks de México
Industrias IEM
Ingersoll Rand
Industrias Pesadas
Manufacturera Fairbanks Morse
Megatek
Motores U.S. de México
Reliance de México
West Instruments de México

Annex 3 (contd.) - Sample pages giving additional
background information on each country

Bulk supply materials (pipes, forgings, castings etc.)

Ascomática
Dezurid de México
EMCA
Nibco de México
OYM
Puriti
Senkowski Control Definidos

Training facilities

Petroleos Mexicanos (Pemex)

Training facilities at general offices include simulator equipment;
further facilities at 13 industrial units throughout the country;

Training programmes for staff members at all levels include induction
courses, technical training and instruction, personal development,
executive development and instructor training programmes;

On-the-job and classroom training; ratio of theoretical to practical
training time 1:3;

Language of instruction: Spanish

Instituto Mexicano del Petroleo (IMP)

Training programmes available in English.

Available raw material and reserves

<u>Raw material</u>	<u>Proven reserves</u>	<u>Current production</u>
<u>Mineral resources</u>		
Natural Gas	2,134 x 10 ⁹ cu m	43.89 x 10 ⁹ cu m
Oil	48,000 x 10 ⁶ bbl	2,702 x 10 ³ b/d
Coal	1,500 x 10 ⁶ tons	8,086 x 10 ³ tons
Ethane		
<u>Refined products</u>		
From catalytic cracking		298 x 10 ³ b/d
<u>From catalytic reforming</u>		<u>164 x 10³ b/d</u>

Annex 3 (contd.) - Sample pages showing
regional and national technological capabilities

Key to symbols

Engineering contractors and equipment manufacturers

+	1 - 4 firms
++	5 - 10 firms
+++	over 10 firms
PCT	Petrochemical process technologies available for transfer

Raw material reserves

Gas:	x	less than	30×10^9 cu m (1,000 x 10^9 cu ft)
	xx	more than	30×10^9 cu m
Oil:	x	less than	50×10^6 bbl
	xx	more than	50×10^6 bbl
Coal:	x	reserves available	

Annex 3 (contd.) - Sample page showing
Regional and national technological capabilities

Country	Training facilities	R and D facilities	Engineering contractors	Equipment manufacturers	Raw material reserves			
					Gas	Oil	Coal	
AFRICA								
Algeria	Yes	...	...	xx	xx	x	...
Cameroon	...	...	...	xx	xx	-	x
Ivory Coast	...	...	...	xx	xx	-	...
Kenya	...	...	...	-	-	-	...
Madagascar	...	...	...	-	-	-	x
Mauritius	...	...	...	-	-	-	...
Mozambique	...	...	...	-	-	x	x
Nigeria	...	...	...	xx	xx	x	x
Senegal	...	...	...	-	xx	-	...
Somalia	...	...	...	-	-	-	...
Sudan	...	...	...	x	xx	-	...
Swaziland	...	...	...	-	-	x	...
Tanzania	yes	...	...	x	-	x	...
(United Rep.of)								
Togo	...	...	...	-	-	-	...
Tunisia	yes	...	++	xx	xx	-	...	
Uganda	...	...	...	-	-	-	...
Zambia	yes	...	...	-	-	x	...
Zimbabwe	...	...	...	-	-	x	...
ASIA								
Bangladesh	yes	...	...	xx	-	x	x
Burma	...	...	...	x	x	x	x
China	yes	...	++	xx	xx	x	x	
India	yes	...	+++	xx	xx	x	x	
Indonesia	yes	+	...	xx	xx	x	x	

.....
Source: 1980 Yearbook of World Energy Statistics, United Nations

^a In 1983.

Annex 3 (contd.) Sample page - showing addresses of petrochemical producers

LATIN AMERICA

Argentina

Agrocom

Agrocom S.A., Castro Barros 2050, 1770 Aldo Bonzi, Pvcia, Buenos Aires
Telephone: 652-6665/4968/4960

Atanor

Atanor SAM, Lavalle 348 Piso 3º, 1306 Buenos Aires
Telephone: 312-8141/45; telex: 21386 atsam

Carbochlor

Carbochlor Industrias Químicas SA y C, Paseo Colón 315 4º piso, 1063
Buenos Aires
Telephone: 34-4244/5803/3518; telex: 2462h ciqsa

Carboquímica

Carboquímica Argentina Sociedad Mixta, Córdoba 1351, 1372 Buenos Aires
Telephone: 46-2798/44-7204

Carmal

Carmal SA de Productos Químicos, 25 de Mayo 375, 1002 Buenos Aires
Telephone: 311-3830/8785

Celulosa Argentina

Celulosa Argentina SA, Avda, Paseo Colón 635, 1063 Buenos Aires
Telephone: 33-0552/1593/2575; telex: 21449 celsa, 22697 celsa

Coafi

Coafi SA, Venezuela 3456, 1211 Buenos Aires
Telephone: 93-2010/1920

Compañía Química

Compañía Química SA, Sarmiento 329, 1041 Buenos Aires
Telephone: 311-5394/312-3016; telex: 21703 coba

Deccar

Hilanderías Deccar SA, Cangallo 525, piso 8º, 1038 Buenos Aires
Telephone: 45-3212/0811

Annex 3 (contd.) Sample pages - showing addresses of engineering contractors

LATIN AMERICA

Argentina

Techint SA, Carlos M. della Paolera 299, Buenos Aires
Telephone: 361 0020; telex: 9132

Brazil

Paulo Abib Engenharia SA

Brastechnip, Rua de Lapo 180, Grupo 604, 20021 Rio de Janeiro, R.J.
Telephone: 2426365

Davy Projetos Industriais Ltda, Caixa Postal 22210, CEP 01000 Sao Paulo, S.P.
Telex: 1121956 ZIMM BR

Haldor Topsoe SA, Rua Marconi 124, 3º Andar, Sao Paulo, S.P.
Telephone: 326791, 2390412, 376757; Telex: 1123346

Inter-Uhde Engenharia Química Ltda, Edifício Andraus, Rua Pedro Américo 32,
23º Andar, EP 01045 Sao Paulo, S.P.
Telephone: 326479, 355908, 363767; telex: 1122588 then br

Internacional de Engenharia SA, Rua Pinheiro Machado 22, CEP 1860, 22232 Rio de
Janeiro, R.J.
Telephone: (21) 205 5252; telex: 2123238

Krebs do Brasil Engenharia Ltda, Avenida Rio Branco 277, Grupo 401, Rio de
Janeiro, R.J.

Lurgi do Brasil, Instalações Industriais Ltda, Av. Rio Branco, 245-15º Andar,
ZC-00, Rio de Janeiro, R.J.
Telephone: 242 8177; Telex: 02122572

Montreal Engenharia SA, Rua Sao José 90, Rio de Janeiro, R.J.
Telephone: 222-9901 (pabx); telex: 21 22491

Annex 3 (contd.) Sample pages - showing addresses of equipment, spares and catalyst suppliers

LATIN AMERICA

Brazil

Addresses available in Annário ABDIB published annually by:

ABDIB, Associação Brasileira para o, Desenvolvimento das Indústrias de Base, Rua General Jardim, 645 - 4º Andar - Conj.41, CEP 01223, Sao Paulo - SP

Colombia

Distral SA, Edificio Distrral, Calle 22, 6-27, Apartado Aéreo 6088, Bogotá
Telephone: 2842900; telex: 44570

Forjas de Colombia SA, Carretera Cafe Madrid, Palenque Km.3, Apartado Postal 700
Telephone: 31410/31165; telex: 077733

A. Johnson and Co. de Colombia SA, Calle 13 No. 65-70, Apartado Postal 8669, Bogotá
Telephone: 26 11 364; telex: 041254

Siemens S.A., Carrera 65 No. 11-83, Apartado Postal 80150, Bogotá
Telephone: 628811; telex: 044750

Tissot

Unión Industrial y Astilleros SA (Unial), Vía 40 74-240, Apartado Aéreo 319, Barranquilla
Telephone: 344850; telex: 33321

México

Ascomática SA de CV, Lago Chalco 230, México 17, D.F.
Telex: 1775738 ASCOME

Avante SA Ingenieros, Av. Ejército Nacional, 752 México 5, D.F.
Telephone: 5-31-32-75; telex: 017-72-501

Plant: Km. 23 Aut. México, Querétaro Tlalnepantla
Telephone 5-65-38-55

Monterrey Office: Padre Mier 249 Pte. Desp. 102, Monterrey, N.L.
Telephone: 43-47-28

Babcock and Wilcox de México SA de CV, Apdo. Postal No.416, México 1, D.F.
etc.