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Meeting on Co-operation among the
Middle Eastern and North African Countries
in the Field of Research and Development in
the Petrochemical Industries

Aliaga-Izmir, Turkey, 16-20 October 1989

REPORT ON CO-OPERATION IN RESEARCH AND DEVELOPMENT IN PETROCHEMICAL INDUSTRIES AMONG MIDDLE-EASTERN AND NORTH AFRICAN COUNTRIES*

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* The views expressed in this document are those of the author and do not necessarily reflect the views of the secretariat of UNIDO. Mention of firm name and commercial products does not imply the endorsement of UNIDO. This document has not been edited.

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INTRODUCTION

As a follow-up to the Third Consultation Meeting on Petrochemical Industries held in Vienna in December 1985 and the recommendations of the Meeting on Co-operation Among the Countries of the Middle East and North Africa in the Petrochemical Industries held in Aliağa, Turkey in October 1984, UNIDO is planning to organize, in co-operation with the Government of Turkey, PETKİM, a Regional Expert Meeting on Co-operation in Research and Development in the Petrochemical Industries Among Middle East and North African Countries. The details of the meeting have not been finalized as yet, but it is anticipated to hold it during the early part of 1989.

The objective of the meeting will be to provide a forum for the review and exchange of information and experience on the diffeculties encountered and the progress made in the development of R+D at the national and regional levels and on the other hand, to explore modalities of co-operation in R+D in identified mutually beneficial programmes and projects in the petrochemical industries.

In preparation for this Meeting, Dr. O. Tunç Savaşçı was assigned as a UNIDO consultant to undertake technical missions to selected countries in the region for the purpose of evaluating the facilities of R+D institutions in the petrochemical industries in the respective countries and identify possible areas and activities of co-operation among them. The consultant was to collect information in line with the questionnaire prepared and sent by UNIDO to the respective R+D institutions through the UNDP officies in each country, ahead of his visits and prepare a report for submission to the above planned meeting.

The consultant's mission was realized in accordance with the following itenerary:

Nov. 25, - Nov. 30, 1988 Libya
Nov. 30, - Dec. 6, 1988 Algeria
Dec. 6, - Dec. 10, 1988 Egypt
Dec. 10, - Dec. 14, 1988 Saudi Arabia
Dec. 14, - Dec. 19, 1988 Quatar
Dec. 19, - Dec. 23, 1988 Kuwait
Dec. 23, - Dec. 27, 1988 Iraq

The questionnaire prepared and sent to the related Countries ahead of the consultant's visit was not recieved by Libya and Algeria. In Egypt and Quatar it was sent to institutions which are not directly envolved in Petrochemical R+D. In addition, in some countries, there are some institutions such as technical information centres and engineering companies which were not directly envolved in petrochemical R+D or are not part of petrochemical R+D institutions but give indirect service to such institutions. Since these institions are not covered by the questionnaire sent by UNIDO, the consultant has decided to write a section on each country he visited to give a more complete picture of the R+D facilities available for the petrochemical industries. Therefore, in the following pages there will be a section on each country the consultant visited in the sequence of the above given itenerary containing information on the status of the petrochemical industries, R+D facilities available for it and more information on the institutions he could visit or collect information on.

The questionnaires collected by the consultant during his visits are given at the appendixes section of the report together with a list of the names and addresses of the institutions and parsons visited by him.

COUNTRIES VISITED BY THE CONSULTANT

1. LİBYA

1.1. General Outlook of the Petrochemical Industries

Although there are many oil companies in Libya, there are two major operators of petrochemical plants in the Country. A general national organization under the Ministry of Industry and Ras Lanuf Oil&Gas Processing Company under the Libyan National Oil Company.

Ministry of Industry, through a general national organization operates a 625.000 MT per annum actual capacity vinyl chloride monomer (VCM) and 60.000 MT per annum actual capacity polivinyl chloride plants together with the associated chlorine-alkaline plant at Abu Kamasch.

Ras Lanuf Oil & Gas Processing Company operates a 330.000 MT per anum naptha steam cracker as a key plant for further petrochemicals. There are plans to produce 60.000 MT per anum butadiene, 58.000 MT per anum ethylene glycol, 171.000 MT per anum propylene, 68.000 MT per anum polypropylene and 80.000 MT per anum HDPE and 80.000 MT per anum LLDPE. It is the consultants impression that there might be delays or cancelations of the ethylene glycol, HDPE and LLDPE plants.

The consultant have been informed that petroleum and petrochemical activities are handled by the headquarters of the National Oil Company in Tripoli, particularly by the planning department of the company inquestion.

1.2. R + D Facilities Present for the Petrochemical Industries

In Libya there seems to be two institudes which could be envolwed in R + D activities for the petrochemical Industries. There are, Industrial Research Centre (IRC) and Petroleum Research Centre (PRC). IRC is under the Ministry of Industry while PRC report to National Oil Company. Both Institudes stated that they may refer some projects to the Universities in Libya or work together with them. Therefore, Universities can be considered as a third party which can be envolved in petrochemical R + D.

1.3. Institutions Visited by the Consultant

Industrial Research Centre, Petroleum Research Centre and Ras Lanuf Oil & Gas Company were visited by the consultant.

1.3.1. Industrial Research Centre (IRC)

IRC is located at Tacura, a few klometers off Tripoli. Communication details are as follows.

Address: Industrial Research Centre
P.O.Box 3633, Tripoli, LİBYA

Tell : 691512 (upto 18)

Telex : 20038

Director of the Centre : Dr. Abdoul Fadıl

Together with Dr. A. Fadıl, during his visit to IRC, the consultant met Mr. A. Rsheem, director of documentation and industrial information and Mr. M.N. El Bagigni, research engineer.

An offical organization chart could not be obtained. However it is stated that the Centre consists of

Geology and Mining Laboratories
Textile and Ladder Laboratories
Chemical Industries and Instrumental Analysis Laboratories
Food and Packaging Laboratories
Metals and metal Chemistry Laboratories
Construction Materials Laboratories
Engineering Materials Laboratories
Plastics Laboratories
Computer Centre and Doccumentation Department

It is also stated that Plastics Laboratories and Computer Centre which includes technical information are being established. No process design is done at the Centre. Only feasibility studies for the industries under the Ministry of Industry are done. It is also stated that a prefeasibility study for the petrochemical industries in general was made by the Centre in the past. In addition to above sections, training facilities for process control is being planned to train engineers and operaters in the chemical Industries which might include petrochemicals also. For this purpose, training units for process control available in the World market will be purchased to the Centre.

At the present 150-160 persons work at IRC, 60% of whom is stated to be professionals. The Centre has about 500.000 U.S.$ of yearly budget allocated by both the Government and the Industry.

In the line of petrochemicals the Centre gets corrosion problems referred to it. Since VCM, PVC and Chlorine plants at Abu Kamash is also under the Ministry of Industry, R + D needs of these plants are expected to be covered by IRC. As a matter of fact, the consultant is told that IRC sands it's engineers in groups to Abu Kamash. However as for specific areas of R + D concerning VCM, PVC or chlorine plants no specific examples could be obtained. In general the areas stated are corrosion and quality control.

Technical information services are just being started. A personal Computer (PC) has been purchased. As for the software. the Centre is to investigate the matter. At first step it is desired to computerize the present classical library. It is hoped to get on-line connections to the other centres in the Country. International on-line connections are not tought of as yet.

Process design & engineering and process research and development have not been started. Therefore product quality improvement studies are at the stage of quality control and specification tests.

For environmental protection quality tests and surveys are usually done. It is stated that, if there are any, remedies to problems are also recommended.

Persons whom the UNIDO questionnaire was discussed with stated interest in cooperating in the area of R + D and joint projects. However they also stated that it is rather early for IRC to identify specific areas and the details of related funding. They think these topics are to be identified during the Regional Cooperation Meeting and funding is to be discussed with the parties envolved.

As for the training programmes for the R & D staff of IRC, corrosion, identification analysis and testing of polymers and plastics, paints, packaging materials and information science are identified as general topics.

It is stated that, it is early for IRC to accept trainees in the area of petrochemicals.

1.3.2. Petroleum Research Centre (PRC)

Petroleum Research Centre is Located about ten kms. off Tripoli. Communication details are as follows:

Address: Petroleum Research Centre (PRC)
P.O.Box 6431 Tripoli, LİBYA
Tell : 73725 (up to 29), 833011 (up to 13)
Telex : 22016 Bahnaft Ly
General Manager: Dr. Mustafa A. Sola

During his visit to PRC, together with Dr. M.Sola, the consultant met Mr. M.M. Idris, exploration and explotation manager.

General Activities of PRC are described as follows:

- Establishment of research plans in exploration, exploitation, drilling, refining, petrochemistry, process and basic engineering.

- Collecting and indexing of technical data, performing studies and initiating research related to oil industry.

- Analysing and testing oil products and petrochemicals according to international specifications and standards.

- Study of corrosion problems.

- Investigations of pallution problems coused by oil products.

- Evaluation of economic studies and initiation of newly related research topics

- Publication of studies and researches that have been undertaken by P.R.C.

Organization chart of PRC is given below. As seen from the chart, PRC consists of four main departments, Exploration and Explotation, Industrial, Basic Engineering, Research Support. In addition, each Department has a scientific committe consisting mostly of university proffessers. Related persons from the National Oil company also sits in the scientific committtees. At the present some 32 university professers are envolved in the scientific comittees. Thus, R+D topics can easily be referred to the universities. National Oil Company (mostly planning department) can directly refer R+D problems to the Centre. Through scientific committeees, some problems are referred to the Universities abroad as Msc. and PhD.Thises. At the present about 20 projects are being carried out as such.

Sections which are expected to be envolved in petrochemical R+D are Fundementals of Processes and Catalysis, Processes and Products, all under Industrial Department. Research Support Department is also expected to support the R+D work carried out in the Industrial Department. The Basic Engineering Department has not been established as yet. The manager of PRC, Dr.Sola, strongly expressed that this could be an

Fundementals of processes and catalysis section has just been started. There are only four engineers in that section.

At the Processes section, for refining there are seven engineers and three technitions. It is stated that, despite the fact that the Centre lacks an engineering group, these engineers have carried out work to evaluate the efficiencies of some refineries. In the petrochemistry section there are only two engineers at the present. However this group is planned to be enlarged.

At the products section other activities than polymers and fertilizers are done at the present However, particularly in the polymer testing-identification-analysis area there are plans for expensions. It is stated that PRC expects support from the countries of the region and UNIDO in this line also. What is expected at the begining is identification and analysis and quality testing of plastics and polymers. It is believed that development work will follow.

Research Support Department seeems to be the most developed of all departments. 56 persons are employed in this department, 42% of whom are professionals. Here too, it is stated that PRC would like to cooperate with the countries of the region in training of their staff in special analysis and testing techniques such as electron microscopy, special petroleum testing and separation systems etc.

PRC has just started computerising the classical library it has. For this purpose a PC and a software developed in house are used. The books in the library are being processed at the present to be loaded to the PC which will be part of the network system being established. It is stated that there are plans to have on-line connection to the Information Centre at the National Oil Company. Furthermore, international on-line connections to various data bases are said to be thought of.

At the present 179 persons work at PRC, 68% of whom are stated to be professionals. These persons are mostly accumulated at the Research Support Department and products section for fuel and special products, lubricating oils, greases and engine tests.

1988 budget of PRC was about 9 million U.S.$. Expected 1989

budget is about 25 million U.S. $. Both budgets are mostly investment budgets. In 1989, it is desired that polymers and fertilizers section be strengthened, activities in corrosion R + D increased and first steps for the establishment of the Basic Engineering Department be taken. Investments of the PRC are expected to be finalized in 2-3 years time.

Since no process design and engineering activities are present at PRC, process research and development work is not carried out. Product quality improvement work is done mostly on petroleum products such as lubricating oils and greases. Activities on petrochemicals have not been started as yet.

Analysis and asseys have been done in PRC for both water and air pollution. These work is often carried out in co-operation with the Environmental R + D Centre in Tripoli.

General interest have been stated in cooperating in the area of R + D and joint projects. However it is also stated that it is early for PRC for such activities as yet. In the area of petrochemicals PRC is more interested in training their staff than recieving trainees from the countries of the region. The main resion for that is the recently started activities for the establishment or strenthening of the departments or sections related to petrochemicals. Areas of training for the staff of PRC can be identification-analysis-testing of polymers and plastics, process engineering including process design, some special analytical identification techniques such as electron microscopy and possibly catalysis.

1.3.3. Ras Lanuf Oil and Gas Processing Company

Ras Lanuf Oil and Gas Processing Company is about 800 km. away from Tripoli. The communication details are as follows.

Address: Ras Lanuf Oil and Gas Processing Company Inc.
Ras Lanuf City,
P.O.Box 1971 Bengazi-LİBYA
Tel : 49994 (Tripoli)
Telex : 50661 Rasco Ly.
Director: Mr. Mahmoud A Naas
(Chairman of the Managing Commettee)

During his visit to Ras Lanuf, together with Mr. M.A. Naas, the consultant met Mr. S. Abu Shawashi, general manager of maintenance, Mr. Y. El Sharif, general manager of operations and Mr. Khalil M. Rustom, manager of technical services department. As a matter of fact, after having discussions with Mr. Naas, Mr. Shawashi and Mr. El sharif, attempts had been made to fill out the UNIDO questionnaire with Mr. Rustom.

In Ras Lanuf there is no R + D facilities as such. As problems arize they are usually referred to the licencer or similar petrochemical companies abroad for ready answers from their past experience. It is stated that some problems, particularly concerning corrosion had been referred to both IRC and PRC in the past. However satisfactory answers had not been recieved. It is also stated that their direct contact with universities is practically nill.

Discussions in general concerning the problems of the presently operating plants, (Naptha cracker and the utilities plant) and the plants under construction revealed that major needs in the line of R + D are more in the area of plant problem solving and process design which brings about the area of process engineeering and design. Another major area seems to be corrosion particularly originating from using sea water as cooling media and the special titanium made coolers and cathodic protection. It is also expressed by every body met that with the polypropylene plant shortly to startup, the company needs R + D back up in the line of plastics polymers particularly quality tests and problems concerning quality.

For technical information the company has a classical doccumentation centre for plant drowings, licenser manuals and books. Recently they have started microfilming some of the doccuments. However they have no plans for a technical information unit in the modern sence. They plan to depand on the information unit at the PRC.

As mentioned before no process engineering and desig is done in Ras Lanuf. for any need in this line licensers or engineering firms abroad are contected.

The company is not envolved in environmental R + D. Both the Raso City and the plant area has waste treatment units. They have

operation problems from time to time which are referred to the lincenser. Noise pollution is mentioned to be the major problem to be solved and an area of cooperation.

The company is interested in cooperation on plant problem solving or R + D. Most urgent areas are stated as noise pallution, coke laydown on the transfer lines of the cracker, vibration analysis of the cracked gas compresser and fresh wate conservation.

For the funding of possible R + D projects, in principle, the Company is willing. However it is stated that the details has to be discussed later between the parties envolved.

As for training, in Ras Lanuf, there is more interest in training the plants staff then R + D. However desire in training staff in corrosion and plastics testing was expressed.

1.4. Conclusions

Discussions of the consultant reveals that Libya is willing to cooperate in R + D in Petrochemicals for training of their staff. Corrosion, identification-analysis-testing of plastics and polymers, process engineering and design, information science seems to be the general areas of interest.

For joint projects, naptha cracker problems in general, noise pollution and prevention, fresh water conservation, coke laydown on the transfer lines of the cracker, vibration analysis of the cracked gas compresser are mentioned as some topics.

The funding of the joint projects, is stated to be discussed later. Having trainees in the area of petrochemicals R + D in Libya is also stated to be possibble in some years to come but not at the present.

Organization Chart of PRC - Libya

- GENERAL MANAGER and Assistants
  - Planning
  - General Services
    - Technical Inform.
    - Computer Services
    - Safety
  - Administrative Support
    - Human Researces
    - Health and Benefits
    - Accont, finance and budget
    - Auxiliary Services
  - EXPLORATION AND EXPLOITATION
    - Exploration
      - Geolojy
      - Geochemistry
      - Geophysics
    - Exploitation
      - Drilling
      - Production
    - Reservoir
      - Reservoir Geology
      - Reservoir Symulation
      - Enhanced Oil Reoovory
      - PVT and Petrophysics
    - Sample Preparation
  - INDUSTRIAL
    - Fundementals of Processes and catalysis
      - Characterization of catalysts
      - Evaluation
      - Fundementals of processes
    - Processes
      - Refining
      - Petrochemistry
      - Fertilizers
    - Products
      - Fuels and Special Products
      - Lubricating oils Greases and Engine tests
      - Polymers and fertilizers
  - BASIC ENGINEERING
    - Process Engineering
      - Oil and Natural gas processing
      - Atmospheric and vacuum distillation and treatments
      - Catalytic cracking coking
    - Equipment Design
      - Piping and Instrumentation
      - Vessel and Draft
      - Machines and heat transfer
    - Calculation methods development
  - RESEARCH SUPPORT
    - Chemistry
      - Identification Analysis
      - Separation Analysis
      - General Analysis
    - Technology of Materials
      - Inspection and metallurgy
      - Corrosion
    - General Engineering
      - Equipment development and maintenance
      - Instruments development and maintenance
      - Utilities
      - Building maintenance

2. ALGERİA

2.1. General Outlook of the Petrochemical Industries

The main petrochemical company of Algeria is Enterprise Nationale de Industrie Petrochimiqe (ENİP). ENİP has two main production sites. One at Skikda, about 500 kms west of Algiers and one at Arzew about 450 kms east of Algiers. There are plans to produce carbon black at Bauria.

At Skikda ethylene (from ethane), LDPE, VCM, PVC, Chlorine, costic soda, hypochloride and Hcl are produced. At Arzew methanol and synthetic resins such as pnenol-formaldehyde, urea formaldehyde, melamine are produced. There are plans to produce BR and SBR at Arzew. In a sence Skikda is EMİP's thermoplastics and related monomers production site while Arzew is ENİP's thermosets and related monomers production site.

Besides ENİP, in Algeria, there are two other companies concerning petrochemicals. Enterprise National de Raffinage (NAFTECH) operaters a rafinary and together with petroleum products, produces benzene, toluene and xylenes. Enterprise Nationale de Plastiques et Caoutchoucs (ENPC) is actually a plastics processing company under whose umbrella about twenty companies produce consumer goods from plastics and limited amount of rubber goods which does not include tires.

2.2. R + D Facilities Present for the Petrochemical Industries

In Algeria there are several R + D facilities which are directly or indirectly related with the petrochemical industries. These are,

- "Institut Algerian du Petrole" (IAP)
- "Institut National de Hydrocarbores" (INH)
- "Centre du Recherche pour la Valorisastion de Hydrocorbures et Leur derives " (CERHYD)
- R+D Facilities at ENİP's plants at Skikda (Complexe cp 1/K)
- R+D Facilities at ENİP's plants at Arzew (Complexe cp 2/Z)
- R+D Facilities of National Committeee of Research (Haut commissariat a Recherche, HCR)
- Facilities of the Universities in Algeria

In addition, there are plans to establish new facilities at production site of NAFTECH and at Arzew to suppord the planned production of BR and SBR. Thus ENİP will have one R+D facility for thermoplastics and related monomers at Skikda and two R+D facilities in Arzew, one for

thermosets and related monomers including methanol production and another one for BR, SBR and related monomers.

It is stated that there are also plans to establish a National Plastics Processing Institude, both for training and R + D, for the down-stream industries. This institude is planned to be a focal point in the close region, thus will serve Moroco, Tunusia and possibly Libya together with Algeria.

2.3. Institutions Visited by the Consultant

Ministry of Energy and Industry, "Centre de Recherche pour la Valorisation des Hydrocarbures et Leur Derives," CERHYD, Department of Project Engineering for Petrochemicals of ENİP (PEP) and Scientific and technical information Centre of HCR, CERİST are visited by the consultant.

Due to time limitation and the distances envolved, the consultant could not visit the R + D facilities of ENİP both at Skikda and Arzew. Similarly, IAP and INH are also not visited becouse it is stated that they are envolved mostly in petroleum area and their major activities are in the line of training rather then petrochemical R + D. Particularly IAP seems to have a rather through training facilities to educate high school graduates as petroleum engineers and technicions. However, it is stated that they can be envolved in petrochemical R + D projects as in the case of universities and Institudes of HCR while yearly R + D programmes are made under the direction and coordination of HCR which is the national coordinating body for all R + D activities in Algeria. However, due to practical impact both the R + D facilities at Skikda and Arzew might have on production, the consultant did his best to collect information on both facilities and they will be elaborated on as a sperate entery depending on the information collected.

2.3.1. Ministry of Energy and Industry

Ministry of Energy is in Algiers. The communication details are as follows.

Address : Ministere de l'energie
Subdirection des Industries Chimiques et Petrochimiques
P.O.Box 264 Algiers/ALGERİA

Tel : 663300

Subdirector: Mr. A. Bessan

During his visit to the Ministry, together with Mr. A. Bessan, the consultant also met Mr. M. Djema, a petrochemical engineer from the subdirection. Mrs. Costandy of the UNDP office in Algiers also kindly joined the meeting. The information given at above paragraphs was obtained during this meeting. In addition all the arrangements for the consultants meetings are decided upon and arranged there. Both Mr. Bessan and Mr. Djema, expressed their interest and support in regional cooperation in petrochemical R + D.

2.3.2. ENİP's Facilities in Skikda and Arzew

As mentioned above ENİP's R + D facilities in skikda and Arzew could not be visited by the consultant. Below given information was obtained at the Ministry of Energy and Industry and during the visit to CERHYD.

R + D facilities of ENİP at the production sites started as divisions of the Technical Departments both PCl/K and PCl/Z have. In the neerpast they were made seperate departments. There are plans to have one managing body for all the R + D facilities ENİP has, which will report directly to the general management. There are also plans to have all R+D facilities concerning petroleum and petrochemistry under one management at the Ministry of Energy and Industry. There is already a deputy minister who is responsible for all R+D activities in this line.

At ENİP, Skikda (complex PCl/K) total of 36 staff consisting of 9 engineers, 14 senior technicions and 13 technicions work at the R + D Department. The Department consists of four major divisions.

- VCM polimerization laboratory to carry out polymerizations in laboratory and semi-industrial scale where three small scale one pilot, semi-industrial sale polymerization reactors are present.
- Analysis laboratory which consists of three major subdimisions. These are general analysis laboratory, spectral analysis laboratory and gass analysis laboratory
- Laboratory of rheologycal and aging tests
- Compounding and processing workshop

The work done in Skikda mostly concerns PVC production. Laboratory polymerizations including pilot scale ones are done to solve PVC production and quality problems. In addition tests are also carried out in the line of morphology and reheology of PVC together with

compounding and formulation studies. One of the major R + D topics at the present seems to be prevention of crust formation at the surfaces of the PVC reactors. It is stated that plant problems concerning the monomer units are also handled by this group. However studies on PVC seems to dominate.

At ENİP, Arzew (Complex PCl/Z) total of 12 staff consisting of 4 engineers 4 senior technicions, 4 technicions work at the R+D Department. The Department here too consists of four major divisions.

- A polymerization laboratory for the synthesis of phenolyic, melaminic and urea based resins in pilot scale polymerization units
- A laboratory for production of standard test sample
- Physico-mechanich and reheologycal studies laboratory
- A work shop for formulation studies of both solid and liquid resins

The work done in Arzew concerns laboratory and pilot size production of thermoset resins such as phenolic, melaminic and urea based ones. Differant formulations for different applications are also investigated.

As seen from information above, if not for expensions, process research and development for the improvement of production and product quality is carried out at both R + D facilities. However they both seem to lack the support of process engineering and design facilities. It is stated that at least two engineers, extra to the production engineers work at each plant for the purpose of process engineering to investigate the plants from various points of views.

No design is done by these groups. It is stated that, if they have such a need, they refer the small ones to the Technical services Departments and the major ones to the engineering department under ENİP. (Petroleum Project Engineering; PEP)

Both R + D facilities has classical libraries. However, it is stated that there are plans to computerize them with possible on-line connections to the national information units.

No figure could be obtained for the R + D budged or expenditures of Skikda and Arzew R + D facilities. It was mostly becouse these facilities were not budgeted seperately which was due to the fact that up to recently, together with quality control and corrosion they were part of the Technical Services Departments.

Although the persons directly envolved could not be contacted, at the ministry of Energy and Industry, at the subdivision responsible for the petrochemical R + D activities, it was stated that for both Skikda and Arzew R + D facilities, Algeria would be interested in sending trainees, recieving trainees and having joint R + D projects. These can be in the area of PVC production in laboratory and pilot scale to solve plant and quality problems, catalysis, PVC formulations and similar topics for pheonolic, melaminic and urea based resins together with methanol production. Research laboratories concerning BTX, BR, SBR production also seem to be areas of training for the R+D staff to be for the planned ENİP, Arzew and NAFTECH facilities.

2.3.3. CERHYD (Centre de Recherche Pour le Valorisation de Hydrocarbures et leur Derives)

CERHYD is a few kms away from Algiers near to the Airport. The communication details are as follows.

Address : CERHYD
P.O.Box 131
Dar El-Beida, Algiers/ALGERİA

Tell : 765920 (up to 23)

Telex : 64307

Director: Mr. Nasserddine Djeghri

During his visit to CERHYD; together with Mr. Djeghri the consultant met

Mr. Tavajbia	Chief of fertilizers department
Mr. Yahiaoui	Chief of polymer department
Mr. Daoudi	Chief of refining department
Mr. Menni	Engineer
Mr. Zehad	Engineer
Mr. Aoudia	Engineer
Mr. Chalal	Engineer

CERHYD is a joint venture of all the major petroleum and petrochemical companies in Algeria such as NAFTAL, TAFTEC, ENİP, ENPC, ASMİDAL and the Algerian Government. Organization chart of CERHYD is given below. As seen from this chart polymers and other petrochemical subjects are to be covered by CERHYD. However the centre is still being established. Therefore, some of the activities are not started asyet. For example, the equipment of the catalyst laboratory have just been installed. There is a catalyst test unit purchased from Hungary with two 100 ml reactors and the relevant control units, gas chromatographs etc. There are also the related catalyst chracterization instruments such as a BET system and a mercury porosimeter. Similarly instruments for the Polymer Depatrment such as a DSC-DTA-TGA system, a GPC, mechanical testers, an extruder etc. had just arrived or expected to arrive in the Centre. For laboratory scale polymerizations preparetions are made. However, studies on different subjects already seems to have started. Control tests done in the Refining Department and around the clock outomatic measurements of some air pollutents such as ozone, various hydrocorbous, No_x etc. for environmental impact studies can be given as examples. In addition computer applications such as stacistical evaluation of test results etc. have just been started.

At the catalyst Laboratory activities will start by catalyst characterization and screening studies. However, by by-the-desk calculations a mathematical model for oxydizing SO_2 to SO_3 for the production of H_2SO_4 have already been accomplished.

In the polymer area, activities are planned to start by analysis, identification and testing of polymers. It is stated that there have already been number of requests from various industries. Then, subjects like improving UV stability of PE films, polymer blends and perhaps engineering plastics area will be covered.

As can be seen from the organization chart no process engineering and design activities will be officially covered by CHERYD. However, the engineers of the centre have handled, by by-the-desk studies some engineering subjects such as prevention of evaporation losses during the transpart of LNG, possibility of production of ethanolamine

in Algeria etc. It is stated that process engineering and design aspects of the R + D work will be referred to the engineering department of ENİP (PEP) or to the engineering company for the petroleum industry ENEP. It is stated further that while the yearly R + D programmes are made under the coordination of HCR, there is always the possibility of having the cooperation of PEP or ENEP or one of the Algerian universities concerning process engineering and design.

For the time being CERHYD has a classical library which contains about 2000 volumes of books. About 2000 periodicals are subscribed. Computerization of the library with possible links to the national information Centres is also thought of. At the present if a scientist wants some information which is not available in the library or if he wants further information, he has to contact either CERİST (Centre de Recherche Sur l'information Scientific et Technique) or CITEC (Centre de Information Technique et Chimique). In addition there is a national patent library (INAPI) which he can be condacted for patent information.

For the time being 90 persons work at CERHYD 30% of whom are scentis. The rest work under secretery general. There are plans to increase the number of scientists as the institude grows.

As mentioned before CERHYD is a joint venture of the Algerian Government and the Algerian petroleum and petrochemical companies. Thus, 50% of the budget is covered by the Government, while the other 50% being covered by the companies concerned. These are NAFTAL, NAFTEC, ENİP, ENPC and ASMİDAL. 1989 budget of CERHYD is planned to be about 4 million U.S.$. 50% of this budget is allocated for investments, the rest being the total R + D cost. About 0.02% of the total budget of the above mentioned companies is allocated for R + D. As the major petrochemical company, ENİP's share in the 4 million U.S.$ budget is about 1 million U.S.$.

People met at CHERYD expressed strong interest in cooperation and joint R + D programmes between the countries of the region in all areas shown at their organization chart. They also expressed that it might be wiser to start cooperation by exchanging researchers on either specific R + D projects or general topics like analysis,

identification and testing of polymers. The centre is willing to send staff for training in the subject areas indicated at their organization chart.

2.3.4. Petrochemical Project Engineering (PEP)

Petrochemical Project Engineering department of ENİP is located in Arzew, about 400 kms. east of Algiers. Fortunatelly the director of PEP was in Algiers on Dec. 4, 1988 and kindly spared time for the consultant. The communication details of FEP are as follows

Petrochemical Project Engineering (PEP)
P.O.Box 24, Arzew-ALGERİA
Telex : 12953 Eng PC Dz
Director: Mr. Ali Ghozali

Petrochemical Project Engineering (PEP) is a part of ENİP and consists of 10 engineers at the present. It is stated to be a nucleus of an engineering company ENİP wants to establish as an independent company with a foreign partner. Therefore, the main task of PEP at the present is to establish the partnership desired to start a new engineering company. Thus, for the time being, their process design and engineering activities are practically nill. Again for the time being, work in this line is said to be carried out by the technical departments at both Skikda and Arzew production sites. It is stated that modern computerized methods have not been introduced as yet. Process design and engineering activities of the technical departments are usually concerned with the day to day requirements of the plants such as addition of a new piperline, replacement of heat exchanger etc. According to Mr. Ghozali, at ENEP, the engineering company for petroleum industries, modern computerised methods are not also utilized.

2.3.5. CERIST (Centre de Recherche Sur L'information Scientific et Technique

To cover how R + D Institudes obtain technical information from other national sources and how they can get support on the area of technical information, the consultant also visited CERİST of HCR. CERİST is in Algiers whose communication details are given below.

CERİST
6 Place El Qods, RİST
P.O.Box 47, Hydra, Algiers/ALGERİA

Tell : (2) 600054, (2) 600224, (2) 600414

Telex : 66036

Director : Mr. Ben Hamadi

CERİST is the main technical information body in Algeria, It is being organized as a reference library and as a main institution to establish an information network in Algeria. Therefore they have developed a software for the mainframe computer they have to computerize all the PhD thisis and R + D reports done in Algeria. Data bases like INIS NUCLEAİRE, INSPEC, AGRİS. PASCAL, LC/Marc/et, UK/Marc etc. were purchased.

NIS NUCLEAİRE is a data base which contains about 91000 references covering the period of 1970-1987 on theoretical physics, molecular and atomic physics, nuclear chemistry and physics and applications of nuclear energy.

INPEC is a data base which contain about 200.000 references extracted from 300 periodicals on physics, electricity, electronics, informatics and information and communication technologies. The data base at CERİST starts from 1987.

PASCAL and AGRİS are also reference data bases on metalorgy, minerology and information science containing references, LC/Marc and UK/March contains the list of all the publications held by the Library of congress of U.S.A. and %95 of that of Biritish library.

The Centre does not have a data base on petrochemistry. Since CERHYD suggested to them, a data base colled CEA (Chemical and Engineering Abstacts) is being planned to be purchased. There are also plans to purchase a data base on patents. For the time being needs are refered to INAPI (Institude National de Patent Industrial). It is hooped that all libraries in Algeria including that of Universities will be computerized and be connected on-line to the mainframe computer at CERİST.

At CERİST a sofware colled SACODD is developed for the libraries to be computerised. It is written in both fortran and cobal and both mainframe and PC versions are available. CERİST is to supply this software to the libraries interested in computerisation.

CERİST has a library of its' own which contains 2000 books and

70 periodicals are subscribed. These printed matter are mostly on computer and information science. This library is to help the staff of CERİST to computerize their information centre and to help others to computerize their libraries.

Besides having all the thisis and R + D reports done in Algeria in computerized form, CERİST has union catalogues of various libraries in Algeria and abroad. Some of these catalogues are obtained in computerized form. Some are being computerized by themselves. Therefore if an information request comes either by telephone (however written requests are preferred. As a matter of fact there is a standard form developed for this purpose) or by mail, if CERİST has the data base on the subject, a surch is made and the references found is send to the requester. What is send is either a bibliographia or contains a key worded abstract. If the data base is not present, union cataloques are made use of. CERİST herself does not obtain the literature, it is the requesters task to obtain it. This way, it is told that, it takes two weeks to one month for the researcher to get the literature.

It seems that, besides computerized libraries, information centres on sectorial bases are also planned. An example for the chemical industry have already been started. The Centre is CİTEC (Information Centre for the chemical Industry). It is told that CİTEC is at the same development level as CERİST:

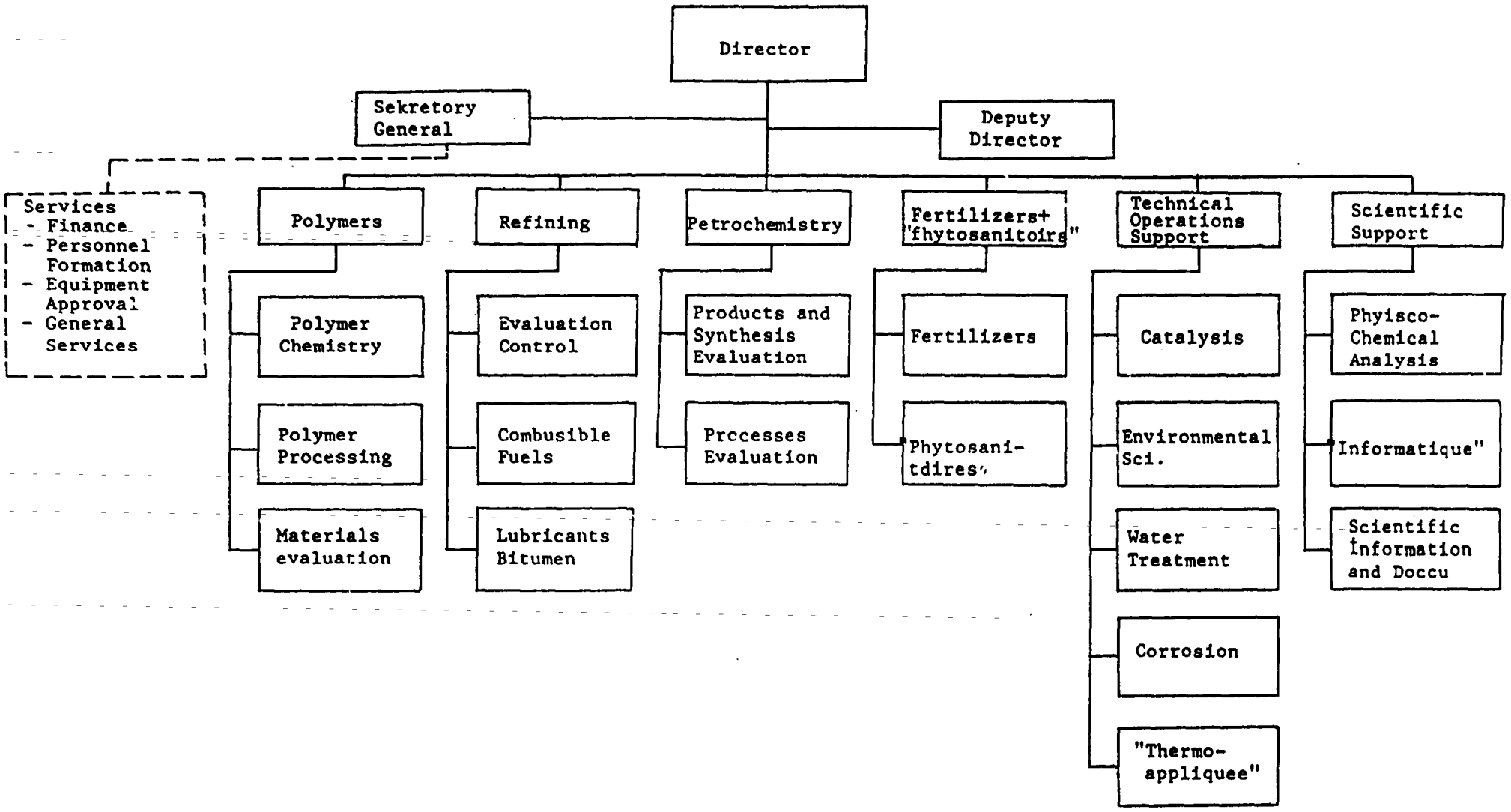
Information Centres in Algeria prefer purchasing data bases rather than on-line connections to international information networks such as DIALOG, ORBİT etc. The reason for this is stated to be the expensive telecommunication facilities present in Algeria. However it is also stated that as the telecommunication systems gives way, international on-line connections will be realized.

2.4. Conclusions

As can be concluded from above information, in the area of petrochemicals R + D, R + D facilities of ENİP at Skikda and Arzew can offer cooperation for the interested countries of the region on bench and pilot size polymerizations of VCM to PVC for production and quality problem solving and PVC formulations. The same conclusion can be drawn for thermoset resins.

The major areas Algeria could get cooperation are identification, analysis and testing of polymers, catalyst testing and screening, process engineering and design and partly technical information. On the other hand the software developed for libraries to comp' terize by CERİST, SACODD, might be of interest to the interested countries including Algeria herself.

ORGANIZATION CHART of CERHYD - ALGERIA



3. EGYPT

3.1. General Outlook of the Petrochemical Industries

The major petrochemical company of Egypt is Egyption Petrochemical Company (EPC) which is located in Alexandria where a chlorine plant, vinylchlorine monomer (VCM) plant based on imported ethylene and a PVC plant are operated. There a plans to have an ethylene and the related PE plant at the same site. As part of a refinery at Ameriyak benzene, toluene, xylenex are produced and a lineer alkyl benzene (LAB) plant is planned at the same site. There are also plans to produce carbon black in Alexandria. In addition, for the production of purc therophthalic acid (PTA) at Ameriyak, the relevant work have been started and international bidding for the plant will commence shortly.

As a matter of fact, in Egypt, all petroleum activities including petrochemicals are governed by Egyption Petroleum Company (EGPC). EGPC owns seven refineries at various parts of the Country, EPC, one national drilling and exploration company about 8 joint venture drilling and exploration companies and an engineering company colled Engineering for the Petroleum and Process Industries (ENPPI). EGPC is also one of the main bodies in Egypt concerning R + D in petrochemicals.

3.2. R + D Facilities Present for the Petrochemical Industries

Egyption petrochemical Company (EPC) is stated to have no R + D facilities as such. Any R + D need is expected to be handled by the petrochemical division of the Egyption Petroleum Research Institude (EPRI). There has not been a case as yet. But, the needs of EPC in the area of process design and engineering are to be handled by ENPPI. A plastics Institude is also mentioned which is to serve the down streem industries in Egypt.

3.3. Institutions Visited by the Consultant

Engineering for Petroleum and Process Industries (ENPPI) where the UNIDO questionnaire was sent to by the UNDP office in Cario is visited by the consultant. The consultant was kindly given the apportunity to have an extensive discussion on the R + D activities of Egyption Petroleum Research Institude (EPRİ) with it's director, Dr. Borham Mahmoud Hamed.

3.3.1. Engineering for the Petroleum and Process Industries, ENPPI

ENPPI is located in Cairo. The company is scattered to various buildings not far from each other at the Heliopolis section of Cairo. However a new and modern facilities are being built for the company at the site of EPRI. Thus, in the near future all departments of the company will be at one building. It is hooped that being physically at the premice of EPRI will give them a chance of better contacts with EPRI to serve tham better in the area of process design and engineering. The communication details of the company are as follows.

ENPPI
(General management)
2, El Oraube Street
Heliopolis, Cairo, EGYPT
or
P.O.Box 2521 El Horriya
Heliopolis, Cairo, EGYPT
Tell : 2901163, 42900704, 2901797
Telex : 93258 ENPPI UN
Telefax : 29001804
Director : Mr. M.M. El-Rifai

Due to a misunderstanding, the consultant could not meet Mr. M.M. El-Rifai, instead he was kindly recieved and introduced to ENPPI by Dr. M. Nabil El. Khawaya, Senior Feasibility Specialist.

ENPPI is owned by EGPC. Therefore the share holders are the companies of EGPC. They are,

Alexandria Petroleum Company
Ameriya Petroleum Refining Company
Cooperative Petroleum Company
Egyption General Petroleum Company
General Petroleum Company
Misr Petroleum Company
Nasr Petroleum Company
Petroleum Gasses Company
Petroleum Pipeline Company
Suez Oil Processing Company

ENPPI started as a joint venture with Western Engineering Companies. However, the joint ventures tried did not succeed. ENPPI actually florished after it was bought by the EGPC family national companies given above.

To day, ENPPI is a well developed engineering company with it's about 500 staff of whom 80-85% are engineers of various diciplines. Both process and detailed engineering is done by the company by modern computer aided methods. Among many exampes in their list of references, construction of a complete refinery at Assiut, starting from process design to start-up can be given as one of the major examples.

Main industries served by ENPPI are oil & gas production and processing, petroleum refining, petrochemicals, chemicals and fertilizers, mining and minerals. They are also envolved in utilities and off sites such as water treatment, power generation and distribution, steam plants, environmental protection, facilities, storage etc. and infrasructure like civil work, communication facilities etc.

Although ENPPI is envolved mainly in petroleum industries, it has served petrochemical industries also. Their recent experience includes 40.000 MT per anum LAB plant and 100.000 MT per anum VCM plant at Amerya and Alexandria respectively. Detailed engineering of the chlorine plant at Alexandria was also done by ENPPI.

The company carries out both basic and detailed engineering. In addition it is organized for and carried out work for procurement and construction services. They get envolved in plant commissioning also. At ENPPI there is a department to carry out feasibility studies. Recent examples can be given as the feasibility studies done for MTBE production in Egypt associated with the planned butadiene and PTA production.

Since ENPPI have carried out work together with companies of different nationalities, together with their own developed through about 14 years of experience, engineering codes and methodologies of different origins have been accumulated.

ENPPI has a mainframe computer which gives service to various departments of the company through links. There are also facilities of computervision system CADD mainframe which is used for two or

three demensional designs by the engineering diciplines. Office outomation is realised by either the mainframe or personnal computers. As part of project control system, computer applications such as D BASE III in status reports, EXCUPLAN in engineering progress measurement, LOTUS 1, 2, 3 in procurement progress measurement, cost engineering etc., are also made use of.

Besides rutine reprographic facilities such as photocopiers and an ozalith machines, ENPPI has facilities for microfilming the doccuments produced for filing and easy retrival.

The company has a classical library which is not computerized yet. It is stated that this is due to plans to move to the new building being build at the premises of EPRI. However, the library has on-line connections to international information networks such as DIALOG and SDC.

Another facility of the company which is worth mentioning here is its' Centre for Engineering Development (CED). CED is in Alexandria. The location is said to give way to at the plant training together with classroom training. It is stated that the classrooms has modern audo-visual aid systems used in training of personnel of ENPPI and it's client companies. CED has been functioning since five years which has a regular programme of training. However special topic courses are said to be orranged upon request. The courses are arranged for engineers who has 4-5 years of either plant operation or process engineering experience. CED has already had some international experience by training engineers form the neighboring countries such as Nigeria and Saudi Arabia.

3.3.2. Egyption Petroleum Institude (EPRİ)

EPRİ is one of the seven Institudes of Egypt's Academy of Scientific Research and Technology. The Institude it self was not visited by the consultant. However a meeting was arranged with the directer of the Institude, Dr. Barham Mahmoud Hamed who was kind enough to spent part of his weekend with the consultant.

EPRI is located in Nasr City, Cairo. The communication details are as follows

EPRI, Egyption Petroleum Research Institude
Nasr City, Cairo, EGYPT
Tell : 607433, 605799
Director : Dr. Borham Mahmoud Hamed.

R + D Activities of Egypt is managed by a state minister. The main managing body which is responsible to the state minister in question is the Academy of Scientific Research and Technology. This Academy has about seven institudes. EPRİ is one of them .

EPRI has a board of directors which is headed by the chairman of EGPC. The members of the board consists of five company directors from the petroleum industry including EPC and five research professors from EPRI. Thus petroleum and petrochemical industry is directly envolved with the management and activities of EPRI.

Universities are also envolved in the activities through National Committees of the Academy. There are several National committees on different subjects such as petroleum and mineral welth. These committees has subcommittees on more specialized subjects such as product applications and standards, exploration of oil, refining and petrochemicals through which more direct envolvement of the universities are achieved.

Half of the budget of EPRI comes from the Egyption Government through the Academy. The other half is obtained from the industry mostly through contracted R + D projects. At the present EPRI has a budget of about 4.5 million Egyption pounds (2.32 EP=1 US $).

About 750 persons work at EPRI 1/3 of whom are high level technical professionals 1/3 are technicions and 1/3 are administrative staff.

It is stated that there are three blocks of laboratories behind the administrative building which all together adds up to about 15.000 sq. meters of building area. All utilities such as water, compressed air etc. together with stores, cold stroge, mechanical shops, glass blowing etc. are also provided with.

The institude has seven divisions. These are;
Exploration Division
Production Division

Refining and Catalysis Division
Analysis and Evaluation Division
Product Applications Division
Process Design and Engineering
Petrochemicals Division

Among these Divisions, Refining and Catalysis, Analysis and Evaluation, Product application, Process Design and Engineering and Petrochemical Division are or might be envolved directly or indirectly with petrochemical R + D.

In the Refining & Catalysis Division there seems to be a well equipped laboratory for catalyst testing and screening which can be utilized for petrochemical processes also. The division is stated to have experience in this area.

In the Analysis an Evaluation Division verious techniques are said to be applied successfully for the analysis of various petroleum products. This division also envolved with environmental asseys and problems whose expertise can be used for the petrochemical industries also.

The prodcts applications Division developes products to be used in petroleum and petrochemical industries. The Division has developed processes for the production of lublicating oil additives. Another example of their work is the emulsifier developed to clean the sludge which accumulates at the bottom of the petroleum storoge tanks. It is stated that by using this new emulsifier the sludge is obtained almost like crude oil again and the tanks are cleaned very easily. As can be seen, this Division can be envolved in application areas of petrochemicals.

Process Design and Engineering Division is said to have good capabilities for process design using modern computer techniques. In this Division pilot plants are designed and some plant operation problems are solved. It is planned that this Division will also be envolved in nondestructive testing and maintenance techniques. For the time being 8 engineers work in this Division headed by a division head. However there are plans to enlarge this group. It is also stated that the training facilities of ENPPI might be used for this purpose.

Petrochemical Division consists of 60 staff 35 of this staff are high level technical professionals. The Division has three

subdivisions

- Macromolecules
- Applied products
- Detergents.

Another division for identification, analysis and testing of polymers is planned to be added to the Petrochemical Division. In the Macromolecules Subdivision, it is stated that basic rather then applied research such as testing various catalyst and polymerization parameters is carried out. The Subdivision seems to have the relevant equipment however the approach to the research topics has to be changed. There are plans to achieve so that more applied R + D particularly on PVC to serve the plants at Alexandria will be done. This area seems to need further development. In the Applied Products Subdivision, application of specially polymers, pesticites etc. are formulated. In the Detergents Subdivision. R + D on every aspects of detergents is stated to be carried out.

EPRI has a classical library. However there are plans to computerize it as part of a programme concerning establishment of a computer network in the institude. The technical information needed by the scientists which are not found in the library are obtained through National Information and Doccumentation Centre (NİDOC) which is stated to have a computerized library and on-line connections to the international information networks. In addition it is also stated that other research institudes of the Academy like the one for agriculture has computerized libraries with international on-line connections, thus, their software and expertise can be made use of when computerising EPRI's library.

In general the Institude is interested in cooperation between the countries of the region both for joint projects and exchenge of trainees and researchers.

EPRI would like to send staff to the Countries of the region for training or as visiting researchers on bench and pilot scale polymerizations of PVC and/or PE for plant and quality problem solving or development of new types. Another area in this line is identification analysis and testing of polymers, both plastics and rubbers. Although it was stated that it could be handled locally, information science might be another area for training.

Non destructive testing of materials and preventine maintenance is another area in this line.

On the other hand the Institude is willing to recieve trainees and/or visiting researchers in the areas which are covered by them. Particularly in the area of catalysis and process design and engineering.

It is further stated that EPRI has quite good facilities to arrange international conferences, symposiums, seminars etc. The Institude is stated to have five auditoriums largest of which has a capacity of 900. These auditoriums is stated to have the relevent facilities including a high capacity cafeteria to support such activities.

3.4. Conclusions

As can be concluded from above information, Egypt can offer cooperation to the countries of the region on process design and engineering and catalyst testing and cataliytic reactions. On the other hand She can recieve cooperation on banch and laboratory scale polymerizations of PVC and other polymers such as HDPE for production and product problem solving, PVC formulations for different applications like PVC bottles for water, identification, analysis and testing of polymers, nondestructive testing and preventive maintenance. Although it is stated that it could be handled locally, technical information might also be included.

4. SAUDİ ARABİA

4.1. General Outlook of the Petrochemical Industries

In Saudi Arabia, Saudi Basic Industries Corporation (SABIC) is the main organization which controls and actively takes part, either alone or usually with foreign partners, in the petrochemical industries. To establish and to develope the petrochemical industries in the Kingdom, partnerships have been made with international companies such as Exxon, Mobil, Shell, Celanese, Texas Eastmen, the Mitsubishi Group Companies, Taiwan Fertilizer, Lucky-Gold Star Group, DEG, Neste Oy, Ecofuel, Apicorp etc.

The following are SABIC's main joint ventures in the line of petrochemicals.

- Saudi Methanol Co. (AR-RAZI) is a joint venture of SABIC with group of Japanese companies headed by Mitsubishi Gas Chemical Co., to produce chemical grade methanol at Al-Jubail
- National Methanol Co. (IBN-SINA) is SABIC's joint venture with Celanese and Texas Eastern of the United States to produce chemical grade methanol at Al-Jubail
- Saudi Petrochemical Co. (SADAF), the largest of SABIC's petrochemical companies is a joint venture with shell Oil CO. of the United Sates to produce ethylene, ethylene di-chlcride, styrene, crude industrial ethanol and costic soda at Al-Jubail
- Al-Jubail Petrochemical Co. (KEMYA) is a joint venture with Exxon of the United States to produce LLDPE and/or HDPE and/or high alpha olefin polyethylene (HAO) depending on the market
- Saudi Yanbu Petrochemical Co. (YANPET) is a joint venture with Mobil Yanbu Petrochemical Co. Inc., to produce ethylene, LLDPE, HDPE and ethylene glycol at Yanbu
- Arabian Petrochemical Co. (PETROKEMYA) is a wholly-owned SABIC company to produce styrene. There are plans to produce butene-1 and very shortly production of various types and grades of PS will be started up at their Al-Jubail facilities.
- Eastren Petrochemical Co. (SHARQ) is a joint venture with a group of Japanese companies head by the Mitsubishi Group to produce LLDPE and ethylene glycol

- National Plastics Co. (IBN HAYYAN) is a joint venture with Lucky-Goldstar Group of South Korea to produce vinyl chloride (VCM) and PVC.

- Saudi European Petrochemical Co. (IBN ZAHR) is a joint venture with Neste Oy of Finland, Ecofuel of Italy and Arab investment Corp (APICORP) to produce methyl tertiary buthyl ether (MTBE) at Al-Jubail

- National Industrial Gas Co. (GAS) is a joint venture with other Saudi Arabion Companies who had already been envolved in the manufacture of industrial gasses to produce oxygen and nitrogen from air at Al-Jubail.

- SABIC also has various fertilizer companies. Among them one is to be mentioned here which is SAFCO. SAFCO produces urea, sulphuric acid and melamine.

Basides above mentioned companies SABIC has one-third partinership with Kuwait and Bahrain in Gulf Petrochemical Industries (GPIC) which produces ammonia and methanol.

4.2. R + D Facilities Present for the Petrochemical Industries

SABIC and its subsediaries have no R + D facilities as such. Any R + D required by the plants operating under the management of various SABİC companies are met through the capabilities and facilities of the partners SABİC has for each production. However, as will be stated later, there are plans for national petrochemical R + D facilities. The consultant is told by practically every one he met that the Research Institude of the University of Petroleum and Minerals at Dahahran is the major R + D facilitiy available in the Kingdom for the petrochemical industries at the present. For the general planning of R + D activities and macro scale policy making, including R + D in petrochemicals industries, King Abdulaziz City for Science & Technology (KACST) have been established. Concerning petrochemicals there has been a new development. This is the establishment of a National Committee for petrochemicals. This comittee consists of representatives from the related ministries companies such as SABİC and PETROMİN and institutions such as KACST and universities. The committee will investigate possible areas of new investrumets, expensions, establishment of down stream industries etc. and will define global areas of R + D to be implemented in the country. since KACST,

SABİC and universities are represented in the com. . ee, the relevant coordination is hooped to be easily realized.

For the general aspects of petrochemical R + D, Universities in Saudi Arabia are also stated to be available.

4.3. Institutions Visited by the Consultant

The consultant visited the Petrochemicals Division of King Abdulaziz City for science and Technology (KACST). Royal commission for Jubail and Yanbu, Ministry of Industry and elelctricity, SABİC, General Petroleum & Minerals Organizatien (PETROMİN), Ministry of Planning and Engineering Committee of Council of Saudi Chambers. Due to the time limitation and the distance envolved the consultant could not visit the Research Institude of the University of Petroleum & Minerals in Dahahran. However, the consultant did his best to collect information on the institude and asked the UNDP office in Riyadh kindly to send a coppy of the questionnaire prepared by UNIDO to the Institude hoping that an answer will be recieved. Therefore, there will be some elloboration on the İnstitude based on the collected information.

4.3.1. King Abdulaziz City for Science & Technology (KACST)

KACST is in Riyadh. The communication details are as follows.

KACST, King Abdulaziz City for Science&Technology
P.O.Box 6086
11442 Riyadh, SAUDİ ARABİA
Tell : 4788000
Telex : 401590 kast sg
President : Dr. Saleh A. Al Athel
Director : (Petrochemical Division): Dr. Hassan Ahmet Tayim

When the consultant visited KACST; Dr. H.A.Tayim was abroad. Therefore, the consultant was kindly recieved by Mr. Adnan Al Saati who was substituting for Dr. Tayim.

KACST is an independent scientific organization, administratively attached to the primeminister.

KACST has a Supreme Board chaired by the prime minister. Deputy prime minister acts as a vice chairman. The members consists of minister of defence and aviation and inspector general, minister of higher education, minister of agriculture and water, minister

of industry and electricity, minister of petroleum and mineral Resources, minister of planning, minister of finance and national economy, president of intelligence directorate, president of KACST and three members to be nominated by H.M. the King

The objectives of KACST are;

- To formulate the national policies for science and technologycal development and to drow up the strategy and plans for it's implementation
- To conduct applied scientific research programmes to promate further the development of the Kingdom.
- To assist the private sector in R + D of agricultural and industrial products.
- To support joint research programmes between KACST and international scientific institutions
- To aword scholarships to develop necessary skills of individuals and to award grants to institutions to undertake applied research work
- To coordinate with government egencies, scientific organisations and research centres in the Kingdom.

KACST has four Directorates. These are, Directorate for Scientific Research, Directorate of Information Systems & Technical Services, Directorate of Scientific Awareness, Directorate for Technology Transfer. Under these Directorates there are various departments such as Atomic Energy Department, Space Science Department, Facilities Department, Public Relations Department, Patent Office, General Administration.

On going projects of KACST are solar energy research, aqualculture project, national observatory project and lunar observatory project.

For the time being 233 staff work at KACST of whom 19 are phDs, 21 post-groduates and 124 university graduates.

As part of facilities development, KACST is assigned the job to establish various national research institudes. Tehese are

- Energy Research Institude
- Petroleum & Petrochemical Research Institude
- Arid Lands Research Institude
- Environmental + Natural Resources Institude
- Ground Station for Recieving Satellites Trarsmissions
- National Observatory

The consultant visited Petroleum and Petrochemical Research Institude (PPRI) which is currently being established. For the time being about 30 persons work at PPRI. There are some laboratory facilities provided for the time being. However starting from 1989, through a five year development programme PPRI will fully be established so that the Institude can serve the Kingdom on national base projects. At the present some R + D is done utilizing the present facilities. This work is mostly related to water quality tests, environmental serveys including environmental impact studies by computer modelling and applications. However real R + D on petrochemicals is expected to start with the establishment of PPRI which will be complete in the caming five years. Majority of the efford is put in this area. Therefore majority of the peresent staff of 30 are heavily envolved in the work concerning the establishment of PPRI.

For the time being process engineering and design activities are practically nill. However there are elaborate plans as part of the establishment of PPRI.

For polymer testing, identification and analysis agin there are no facilities as yet. Establishment of PPRI will also cover this area. For the time being for standard tests, facilities of the Saudi Arabian Standard Organization (SASO) could be made use of.

For technical information services, KACST has quite well developed facilities which are and will be available for the Institudes. KACST is establishing.

KACST has access, through on-line search, to its own data bases and over 200 foreign data bases which provide scientific and technical information. When requested, KACST supplies the requesters with hard-copy of print either from it's own sources or from Kingdom's other information centers or from abroad.

At the present KACST has data bases on, ongoing research projects, English Bibliographic, Arabic Bibliographic, Manpower, union list

of periodicals, current avorenesses, KACST funded projects, to encourage Arabicization a data base for scientific and technologycal terms in Arabic is also prepared.

With a view to uncourage exchange of latest scientific and technologycal information among the Arab Gulf Countries, KACST has initiated a plan to develop an academic and research network (GULFNET) which interconnects computer facilities operated by various Institutions in the Kingdom and Arab Gulf Countries. As a first step, KACST has interconnected the computer facilities of Kingdom's Universities and the Kuwait Institude of Scientific Research (KISR), Kuwait.

KACST also has a library which seems to have more on nuclear energy including microfiche collections of various reports on nuclear energy.

On the other items mentioned by the UNIDO questionnaire, there seems to be a general positive approach however it could not be elaborated on.

4.3.2. Saudi Basic Industries Co., SABIC

Headquartes of SABIC in Riyadh was visited by the consultant. He was kindly recieved by the Planning and Reseach Department. The communication details are as follows.

SABİC (Saudi Basic Industries Corporation)
P.O.Box 5101 Riyadh 11422, SAUDİ ARABİA
Tell : 4012033 (upto 45)
Telex : 401177 Sabic sj.
Managing Director: Ibrahim A. İbn. Salamah
Director of Planning and Research: Mr. Nasır El Seyyeri

Since Mr. El Seyyeri was accupied in a meeting, during his visit to SABİC, the consultant was kindly recieved by Abdullah. S. Al-Alweet, process Development and Engineering Manager of the Research Department and by Mr. Ayman H. Al-Khadhra, chemical eng. of the Research Department.

SABİC has been very heavily envolved in establishing the petrochemical industries in the Kingdom. It was only in 1983 that the first SABİC plant came on stream. Therefore SABİC has beeen very busy in erecting and starting up of various petrochemical plants.

Now that they all have full production and the products enjoy full acceptance, SABİC has started thinking of investments in R+D. There have been plans to accelerate development of new polyolefine technologies and to discover new commercial applications for them. For this purpose a SABİC Research and Development Centre is going to be build adjacent to the new SABİC Marketing Technical Centre in Riyadh.

In October 1988 a contract for engineering and design of the R + D Centre has been awarded. It calls for a small, one-ton-perday PE pilot plant along with related laboratories, a computerized technical information Centre and other support facilities. Agreements are also concluded for advanced computer softwares to be used in the design of new process technologies. The Centre is forcast to be operational in 1990.

R + D work will mainly focus on polyolefines particularly PE polymerizations, processes and their applications in new and/or developed areas. The new Centre will have three main departments. These are;

- Process development which includes process design and engineering with computer aided modern methods
- Catalyst development which mainly covers new catalysts for polyolefin polymerizations
- Product development which covers development of new areas of applications for polyolefines.

A modern information Centre will also be present together with other facilities such as laboratories for identificaton, anaysis and testing of polymers.

For the time being SABİC has practically no R + D activities, therefore, R + D expenditures of SABİC is also nill. R + D needs of the operating plants, particularly in the area of debottleneching and process engineering are met by the partners. Some process engineering to meet day to day needs of the plants is carried out at the Technical Departmens of the Companies. However, national capabilities in this area is expected to develop with the establishment of the new SABİC R + D Centre, in Riyadh.

Again for the time being, only 20 research staff is present who are at he Headquarters of SABİC in Riyadh and are envolved in selection of new technologies to be purchased by SABİC and establishment of the R + D Centre. With the establishment of the new Centre, the number of staff working for R + D is planned to increase. It is stated that in 1991, over 150 persons will be working at the New SABİC R + D Centre.

After going through the UNIDO Questionnaire filled out by SABİC, it is understood that their answer to No. 6 which is "yes" and indicates the area of technical information services, could have additions. Mathemathycal madelling particularly in the area of kinetics, simulation techniques, usage of engineering package programmes particularly that of flowsheeting ones seems to be added to SABİC's answer to No. 6.

It is also stated that SABİC can contract out projects to the R + D institude in Dahahran and to other universities in the Country which has Chemical engineering departments such as King Saud University in Riyadh.

4.3.3. Persons Visited who are Related to Petrochemical Industries and R + D in Saudi Arabia

The consulted was kindly recieved by the following who helped him to collect the relevent information given above and particularly the information on the Research Institude of the University of Petroleum and Minerals at Dhahran.

- Mr. Moustefa Sharabash
  UNIDO consultant with Ministry of Industry & Electricity
  c/o UNDP
  P.O.Box 558
  11421 Riyadh - SAUDI ARABIA

- Mr. Rasseed Riza
  Assistant Secretory General for Technical Affairs
  Royal Comission for Jubail and Yanbu Riyadh-SAUDI ARABIA

- Dr. Said F. Haimor
  Senior Industry Planner
  UNIDO consultant with ministry of Planning

P.O.Box 26764
Riyadh 11496 - SAUDI ARABIA

- Dr. Khalid F. Al - Madiny
  Secretory Gneral
  Engineering Committee
  Concil of Saudi Chambers
  P.O.Box 85041
  Riyadh, 11691 SAUDİ ARABIA

- Mr. Musallam Nowalati
  Director
  Project Coordination & Control Dept., PETROMİN
  P.O.Box 757
  Riyadh, 11189 SAUDİ ARABİA

- Mr. Daniel J. Fontugue
  General Petroleum & Minerals Organization, PETROMİN
  Technical Services Manager
  P.O.Box 757
  Riyadh 11189, SAUDİ ARABİA

4.3.4. The Research Institude, University of Petroleum & Minerals, Dhahran - Saudi Arabia

As mentioned at 4.2. , the institude was not visited by the consultant. However, it was mentioned as one of the active, as a matter of fact the major R + D facility for the petrochemical industries in Saudi Arabia, Therefore the following information was collected by the kind help of the persons met, particularly by that of Mr. M. Nowalati and Mr. D. J.Fontugue of PETROMİN. The communication details of the Institude are as follows.

The Research Institude
University of Petroleum & Minerals (UPM)
P.O.Box 1803
Dhahran 31261, SAUDİ ARABİA
Tell : 8603318, 8603319
Telex : 801913 UPMRI SJ
Director : Dr. Abdallah Dabbagh

The Research Institude is the principal instrumentality of the University of Petroleum & Minerals (UPM) for fundemental and applied research conducted under contract for the Government, industry and general public and is primarily concerned with petroleum and gas technology, energy resources, geology and minerals, environment and water resaurces, metrology, standards and materials and ecomomic and industrial research. The Research Institude is in organization and integral part of the University, but in operations it is semi autonomous. It's major research facilities and administration are on the main Dhahran campus of the University, but it has specialized installations and test areas at several sites in the Kingdom and maintains an office for recruting and technical procurement in Houston, U. S. A. General organization chart of the institude is given below. In addition to the given organization there are several committees which are made use of in the management of the Institude, such as personnel, polcy and planning, conference and publications, safety and scurity, proposal evaluation, space allocation, equipment selection committees.

At the present about 300 regular employees work at the Institude. In addition to the regulars, UPM faculty members or students also work at the institude, the total number of whom is about 100. Laborers and casual employees are not included in these figures.

A figure for the budget of the Institude could not be obtained. In the Institude however, three types of projects are handled. "Client-founded","Research Institude funded" and "Cooperative (Client and Institude) funded". In 1986 the Institude had about thirtly client-funded projects with total contact value of about 80 million Saudi Riyals. Similar amounts can be given for previous years also.

R + D concerning petrochemical industries is mainly carried out in the petrochemicals section of Division I, Petroleum + Gas Technology. In Division I about 50 fulltime researchers together with about 5 UPM faculty members and about 10 UPM students work. Amount of researchers particularly allocated for the petrochemicals section could not be obtained.

Petrochemical section has 12 laboratories which are very well equipped. These are,

- Polymer synthesis and instrumentation laboratory
- Polymer evaluation and testing laboratory
- Polymer characterization laboratory
- General analytical, wet chemistry and plastic physical property evaluation laboratory
- Catalyst application & characterization laboratory
- Catayst t..ing & evaluation laboratory
- Crude oil and petroleum products laboratory
- Polymer mechanical testing laboratory
- Polymer applications laboratory
- Artificial weathering laboratory
- IPT plastic pipe test laboratory
- Catalytic reaction engineering Laboratory

The petrochemical section has carried out various work on contract bases. "A study of the present and future Plastic Packaging Materials in the Kingdom of Saudi Arabia and other GCC countries", "Testing evaluation and Inprovement of Unplasticized PVC Piping Products", "Consulting & Technical Services Given to Jaddah Oil Refinery Company in the line of Catalyst Testing and characterization", Research + Development on Catalyst Utilization and Catalytic Processes", "Development of Polyethylene Cement Bags", "Development of Plastic Weathering Database in Saudi Arabia" can be given as some examples.

Under Division I, there is another section colled "The process Engineering and desalination Section". It can be assumed that process engineering and process design needs of Division I are met by this section. If not, it is again assumed that, in such a well developed R + D Institude, process design and engineering aspect is covered anyhow.

Technical Information Centre of the Institude is operated by the Programme Development Office. This Centre obtains technical information needed by the researchers. It conducts on-line literature searches on specialized technical subjects, accessing to data bases in the United States, Europe and Saudi Arabia. The Information Centre also obtains reprints of articles needed by the researchers. In the addition the Institude can make use of the library of UPM which is a fully developed and well facilitated one. The number

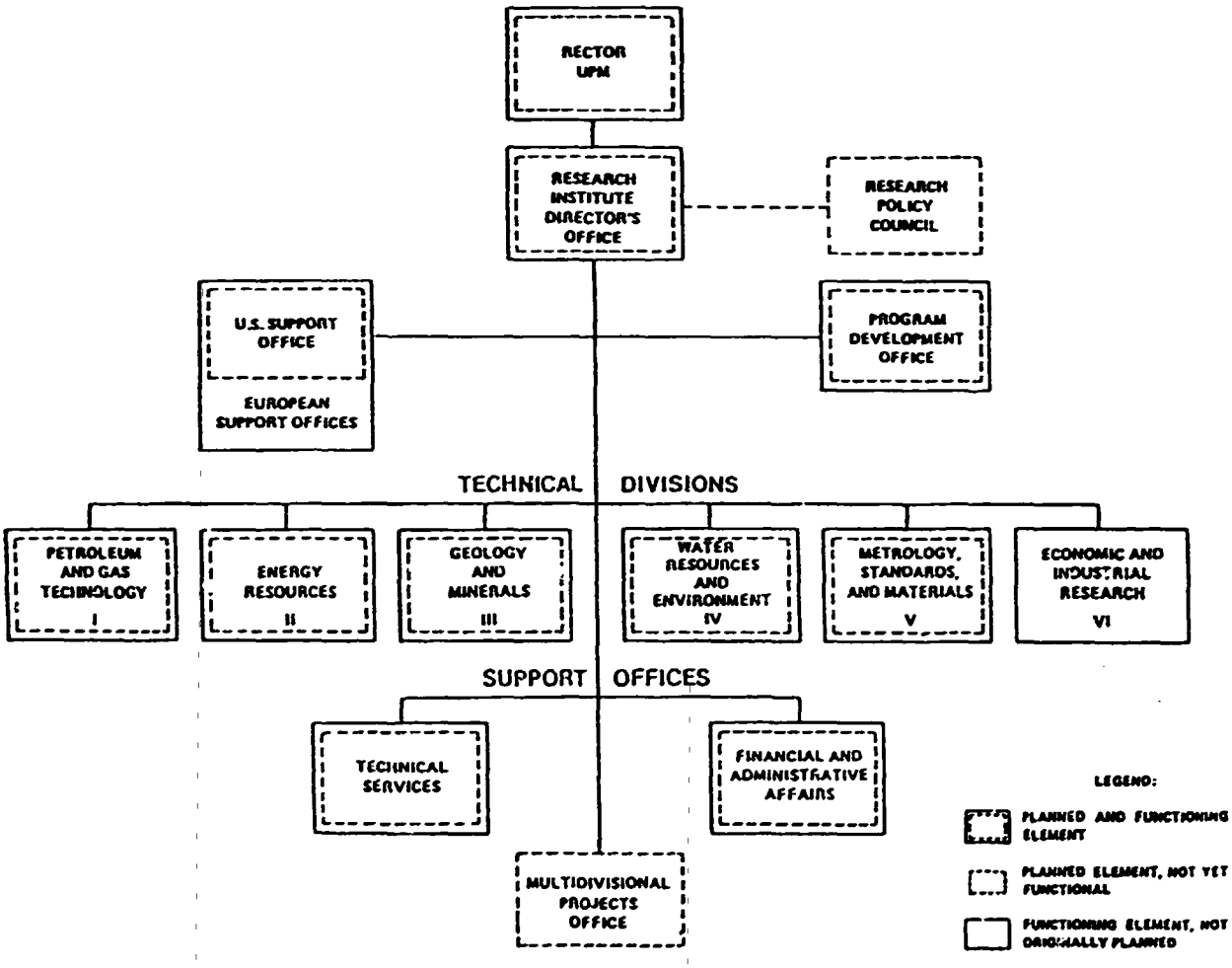
of books held by the Library is about 250.000. The library also owns about 500.000 technical reports on microfiche, numerous 16-mm films, cassettes and other non-print materials. Serials number aproximately 5000. Back issues of important journals are held prodominantly on microfilm. All library services such as cataloging, catalog search, sirculation functions etc. have been computerized. The library has plans of networking and thus sharing with other academic and research libraries in the Kingdom. On-line retrieval of information is also available. There is access to two major on-line services in North America, System Development Corporation's ORBİT and Lockheed's DIALOG.

It must be mentioned here that environmental studies are also carried out by the Institude. There is a special Division colled Water Resourcess and Environment where about 60 regular researchers, about 10 UPM faculty members and about 5 UPM studens work. This division carries out work such as "Hazardous Waste Management for UPM", "Development of the Arabian Gulf Environmental Data Bank", "Simulation of Oil Slics in the Arabian Gulf", "Organic Pollution in Desalinated Water from Al-Aziza and Al-Jubail".

4.4. Conclusions:

As can be concluded from above information, although there isn't inhouse R + D activities of the petrochemical industries on the national side in Saudi Arabia as yet, there are plans to start it in the very near future. In addition there is one well developed Research Institude in Dhahran which covers petrochemicals also to serve the petrochemical industry on the contrat bases. In this sence, Saudi Arabia can offer cooperation to the countries of the region particularly from technical Information point of view. Perhaps identification, analysis and testing of polymers, environmental studies and area of catalysis can be added to technical information. From his discussions with SABİC Research Department and the Engineering Committee of the Council of Saudi Chambers, the consultant has the notion that, Saudi Arabia could get cooperation on process design and engineering particularly an computerized process design, flowsheeting, simulating and kinetics mathemathycal modelling.

ORGANIZATION CHART OF RI OF UPM - SAUDI ARABIA



5. QUATAR

5.1. General Outlook of the Petrochemical Industries

Quatar Petrochemical Company (QPCO) Operates an ethylene plant based on ethane rich NGL and LDPE plant in partnership with CdF Chime of France, both at Umm Said. Since only about half of the ethylene produced is consumed by the LDPE production, another plant to produce HDPE have been in consideration. In addition, in paralel to North Field Natural Gas reservairs, studies are being carried out on various alternative productions such as methanol, ethylene, polyethylene, propylene, polypropylene etc. at prefeasibilty level.

5.2. R + D Facilities Present for the Petrochemical Industries

QAPCO has no R + D facilities as such. Any R + D required by the plants are told to be met by the means and facilities of the partner, CdF Chime. The only national R + D facility seems to be available in the Country is the Scientific & Applied Research Centre which is part of the University of Quatar. In the area of Feasibility studies and/or investment promation, there are two major organizations. These are, Industrial Development Technical Centre (IDTC) and Gulf Organization for Industrial Consultancy (GOİC).

5.3. Institutions Visited by the Consultant

The consultant visited Industrial Development Technical Centre (IDTC), Gulf Organization for Industrial Consultancy (GOİC), Scientific and Applied Research Centre of the University of Quatar and Quatar General Petroleum Corporation (QGPC)

5.3.1. IDTC (Industrial Development Technical Centre)

IDTC is in Doha. The communication details are as follows.

IDTC, Industrial development Centre
P.O.Box 2599
Doha, QUATAR
Tell : 832121
Telex : 4223 Idtc DH
Director General : Mr. M.S. Mis'hal

During his visit the consultant was kindly recieved by Dr. Eng. M.Haruni and Dr. Eng. G.Sastry, both, consultants on chemical

and petrochemical Industries.

IDTC is the States technical and advisery authority in diversification affairs and major industrial projects. The functions of IDTC includes inter alia, coordination of ministerial planning in accordance with long term requirements and budgetory considerations, supervision of projects and control of feasibility studies. IDTC also recommends R + D topics and areas to the Government. Agricultural R + D activities and research on desalination can be given as examples. IDTC is actually an advisery body whose recommendations have to be approved by the Ministry of Finance and Petroleum. IDTC is represented at the board of Scientific & Applied Research Centre thus, could recommend R + D areas and topics to be handled by the Centre in question.

It was stated by IDTC that process design and engineering activities done in Quatar are practically nill. The only possibility is said to be the Scientific and Applied Research Centre and the University of Quatar. In the technical information area University of Quatar and Gulf Organization for Industrial Consultancy (GOİC) is highly recommended. It is also stated that in the area of R + D in general in the petrochemical Industries, any need is met by the foreign partner.

5.3.2. GOİC (Gulf Organization for Industrial Consultancy)

GOİC is located in Doha. The communication details are as follows.

GOİC, Gulf Organization for Industrial Consultancy
P.O.Box 5114, Doha, QUATAR
Tell : 831234
Telex : 4619 Goic DH
Secretary General : Dr. Abullah Hamad Al Moajil

During his visit to Goic, the consultant was Kindly recieved by Dr. N. A. Atalla, Director of Projects Deportment, Mr. V. A. Halajian, Acting Director of Industrial Data Bank and Mr. M. Talib. Hussain, chief Librarian.

GOİC is a joint establishment of seven Arab Gulf States including Republic of Iraq. According to it's establishment charter, GOİC's main objective is to realize industrial cooperation and coordination

amongst the member states. This is performed through collection and dissamination of information related to industrial policies and projects, proposing industrial projects to be implemented jointly by member states, recommending ways and means of coordination amongst on-stream development projects, providing technical assistance in project preparation and evaluation and preparation of data and studies related to industry.

At GOİC the consultant was informed about the general status of the petrochemical industries and the R + D activities in this area. As stated before, there seems to be no industrial R + D activity as such carried out in Quatar. The foreign partner of the petroleum and petrochemical companies seems to be meeting the requirements by their own means and facilities.

The consultant thinks, the technical information facilities of GOİC is to be mentioned here. GOİC has fully computerized technical information and Library facilities. It has about 6000 books, 4000 reports and about 370 periodicals are subscribed. About 2000 doctoral theses relating to the industry in the Gulf/Arab region are also kept on microfilms. Several multi-client sutdies such as SRI International, Wharton Econometrics, Predicasts etc. are subscribed for.

Besides fully computerized library activities, data collection and analysis services are also done. Periodicals recieved by GOİC are processed and abstracts and/or sitetions of related articles are prepared to be loaded to the computer. At the present about 7000 sitations and 4000 abstacts have been computerized.

GOİC have created several data bases such as Gulf Industrial Data base, Gulf Trade Data Base, Market Related data Base for products etc. In addition to the data bases mentioned, GOİC has developed computerized packages and programmes that perform various analysis/ tasks required by project evaluation. It covers cash flow analysis, sensitivity-risk analysis and finencial modeling etc. In addition, two comprehensive multi-product appraisal packages, one developed by UNIDO and the other by KISR (Kuwait Institude for Scientific Research) have been installed and utilized.

The system installed in GOİC is a DEC computer model VAX 750 with UMS operating systems, a database management system and various programming languages. The Data Bank has on-line connections to

major international information networks such as DIALOG of U.S.A. for 214 data bases of all types including trade, technology, engineering etc., INFO-LINE of U.K. for 21 data bases for patents, processes, technologies etc., WEFA of U.S.A. for computer programmes for forcasting and economic modelling.

At the present 18 staff work for the Data Bank of whom 5 for data collection, 7 for computer applications and 6 for the library.

5.3.3. Scientific & Applied Research Centre

The Centre is a part of University of Quatar in Doha. The communication details are as follows.

Scientific & Applied Research Centre
P.O.Box 2713
Doha, QUATAR
Tell : 874961
Telex : 4630 UNVSTY DH
Director : Prof. Dr. Mohd. Omar Abdulrahman

During his visit to the Centre, together with Prof. Abdulrahman, the consultant met Dr. Hassan Ma' Ayergi, the Secretory General of the Institude.

As mentioned before, the Centre is a part of the University of Quatar. The University employs about 200 high caliber scientists and teachers about 60 of whom are heavily envolved in the activities of the Centre. The budget of the Centre is about 3 million U.S.$., given to the Centre by the Government through the University of Quatar.

The Centre is managed by a Managing Board which consists of 16 members. Eight of these members come from the University. The rest are from the related Ministries and organizations. In this sence IDTC, Quatar General Petroleum Company-QPCO are also members of the Managing Board.

Despite the composition of the Managing Board, the main constraint of the Centre is stated to be lack of interaction between the industry and the Centre. The main reason for this is stated to be the structure of the industry. Mainly the precense of foreign

partners who have well developed facilities in R + D and it is the party which handles the R + D requirements of the plants.

However being aware of the importance of developing national capabilities, the Centre has a joint venture with a German University to carry out research on a catalytic process of producing various liquid petroleum products from the national gas resources of Quatar. As part of this project a pilot plant is build in Germany and students from Quatar are working for PhD degrees on the process utilizing the pilot plant. When these students finish their PhD work, the pilot plant will be disassemled and brought to Quatar to train more students from Quatar. It is stated that although a new process development is the ultimate goal, training Quatar nationals in the catalytic processes of petroleum and petrochemistry is one of the other main purposes of the joint venture. The cost of the project is shared by the German University on the basis of 50 % cost sharring. Total budged of the project is about 7.5 million DM.

The Centre enjoys full facilities of the University of Quatar including library and technical information facilities which is told to be fully computerized with on-line connections to various data banks and information networks abroad. For process design and engineering also, capabilities of the Chemical Engineering Department of the University of Quatar is told to be utilized by the Centre.

For regional cooperation there seems to a general tendency- However it is stated to be too early to specify.

5.3.4. QGPC (Quatar General Petroleum Corporation)

Technical Department of QGPC at the headquarters of the corporation in Doha was visited by the consultant. The communication details are as follows.

QGPC (Quatar General Petroleum Corporation)
Headquarters
Technical Department
P.O.Box 3212
Doha - QUATAR
Tell : 831209, 491288

Telex : 4343 Petcor DH

Manager : Abdulaziz Hamad Al Dulaimi

The consultant was kindly recieved by Mr. Al-Dulaimi.

QGPC is the main organization in Quatar for petroleum, gas and petrochemical activities. Here too, it is stated that establishment of plants are turn-key procedures with a foreign partner which doesn't give way to local R + D activities. The main activity taking place in the technical department which is some what related to R + D activities is the technology evaluation done for the new investments. This activity is carried out mainly on the information obtained from the licensers.

The Department is well aware of the scientific & Applied Research Centre and It's project concerning the catalytic process investigations on a pilot scale unit. As a matter of fact they are planning to train some of their engineers on the unit when it is brought to Quatar from Germany. It is also stated that local R + D activities are expected to develop, as more students from Quatar get interested and/or envolved in the subject. From this point of view, the pilot plant is stated to be a usefull tool.

5.4. Conclusions:

Majority of facilities seems to be present except local men power in Quatar. In line with this set-up, in-house R + D seems to be starting by some recent efforts. In this contex, Quatar can give cooperation in the area of technical information, if ofcourse GOİC or the University can be envolved and can recieve cooperation in training of national R + D staff in other areas.

6. KUWAİT

6.1. General Outlook of the Petrochemical Industries

Petrochemical Industries Co. K.S.C. (PIC) is the only and major producer of petrochemicals in Kuwait. Studies for expensions, new production areas etc. are also carried out by this company. In fact studies on various petrochemicals were done in the past. However, they are all not realized. At the present studies on production of polypropylene is being carried out and ammonia, urea, ammoniumsulphate, salt, chlorine, costic soda, hydrogen and sodiumhypochloride solution are produced as petrochemicals.

6.2. R + D facilities Present for the Petrochemical Industries

At the production site of PIC there is a small group as part of Quality Control and Technical Services Department which is stated to be envolved in R + D activities. At the Head Office, under Planning, Projects and Financial Affairs, there is a Department colled Research and Management Services which is to coordinate the R + D activities of the Company. However it is stated that most of the R + D needs are referred to Kuwait Institude for Scientific Research (KISR).

KISR is the main organization in Kuwait to carry out R + D work, national wide and on contract basis to various industries present in the country. Through KISR, University of Kuwait is stated to be envolved.

6.3. Institution Visited by the Consultant

The consultant visited Ministry of Commerce and Industry, Petrochemical Industries Co. (PIC) and Kuwait Institude for scientific Research (KISR).

6.3.1. Ministry of Commerce and Industry

Together with his collegues, the consultant was kindly recieved by Mr. Adel M.A. Al-Anzı Deputy Director of Industrial Development and Consulting Bureau. The communication details are as follows.

Ministry of Commerce and Industry
Industrial Development and Consulting Bureau
P.O.Box 2944, Safat KUWAİT
Tell : 2431168

At the ministry, information on the general outlook of the petrochemical industries and R + D facilities available and to be visited were obtained.

6.3.2. Petrochemical Industries Co (PIC)

During his visit to PIC, together with Mr. Saleh Al-Othman Senior technical planner, Mr. Nizar Al Nusif, Asstn. Man. for research and information and Mr. Kamal Abu Shaaban Ast. Man. for planning, the consultant was kindly recieved by Mr. Zubair A. Al-Jasem Alshareef, Manager of Planning Department.

The communication details of PIC are as follows.

PIC
Petrochemical Industries Co.
P.O.Box 1084
13011 Sofat, KUWAİT
Tell : 2445883, 2422141
Telex : 22024 KT
22134 KT

PIC is the main petrochemical company in Kuwait. It was established as a joint venture with foreign partners in 1964. Then foreign shares were bought by the state of Kuwait. Now it is a subsediary of Kuwait Petroleum Corporation. The company consists of Head Off Office, Fertilizer Division and Salt and chlorine Division.

R + D activities of the company is coordinated from the Head Office Through Research and Management Services Department which is part of Planning, Projects and Financial Affairs. At the production sites, as part of quality and process control activities, some R + D is carried out in the area of day-to-day problems of the plants, quality problems, catalyst testing and particularly environmental pollution and control. In addition as part of the Technical Services Department an engineering group carries out some process design and engineering activity for the daily needs. This group consists of about twenty persons majority of whom are engineers. For environmental pollution there is a separate group in the quality control laboratories which makes daily measuretemnts

for pollution control of particularly the waste waters and the effluent from the waste treatment unit. This group consists of about five technical staff who have carried out waste assesment and treatability work together with the National Pallution Control Bureau of the region and KISR.

Another area some R + D done on the site is corrosion, particularly that of sea water used as cooling media. In this line both laboratory tests and at the site inspections are done,

As stated before process design and engineering activities are limited to daily needs of the plants.

Quality control tests for catalysts are also done at PIC laboratories. However, if needed, more sophisticated work on the subject is refered to KISR.

For technical information the company has a classical library and doccumenttation centre. However there is an online connection to "Data-Star" of Switzerland and technical information facilities of KISR and University of Kuwait are made use off easily.

Feasibility studies for future investments are carried out by the Head Office. Coordination of R + D activities with KISR or other organizations like faculty of engineering and petroleum of University of Kuwait is also carried out by the Head Office.

Together with the staff in Head Office, Technical Services Departments of the plants and the Quality Control Laboratories, who are all indirectly envolved in R + D work, total number of staff envolved in R + D is stated to be 35, five of whom are being directly envolved.

All above activities are stated to be more on the side of development than research. Projects having more research aspects are stated to be contracted out to KISR.

In general PIC is not interested in joint R + D projects with the countries of the region. It is stated that KISR is to be the organization to handle their R + D needs either nationally or internationally. However PIC is interested in training their staff on various aspects of corrosion, catalyst testing and selection and Quality inprovement studies particularly concerning urea and

ammonium sulphate. Further more, they are more interested in training their operational staff in maintenance of fertilizer plants which includes methods, procedures, whorkshop activities particularly in the area of instrumentation and instrument maintenance.

PIC is enterested in having trainees from developing countries to train them at their plants on operation and at their quality control laboratories.

6.3.3. Kuwait Institude for Scientific Research (KISR)

KISR is located at safat. The communication details are as follows.

Kuwait Institude for Scientific Research (KISR)
P.O.Box 24885
13109, Safat, KUWAİT
Tell : 4816988, 4816989, 4816237
Telex : 22299 kısr - KT
Director General: Dr. Homoud A. Al-Rqobah

During his visit to KISR, the consultant was kindly recieved by Dr. George Hovakeemian, Department Manager of the Products Department of Petroleum, Petrochemicals and Materials Division and by Dr. Shawqui Lahalih, Programme Manager of the Products Department of Petroleum, Petrochemicals and Materials Division.

KISR is Kuwait's national research Centre governed by a Board of Trustees which is chaired by the Minister of State for Cabinet Affairs. Twelwe members of the Board are top level managers from various ministries such as Ministry of Finance, Ministry of Elecricity and Water, Ministry of Education, Ministry of Planning, Ministry of Public Health and other institutions such as Agricultural Affairs and Fish Resaurces Authority, Kuwait Foundation for Advancement of Science, Kuwait Petroleum Corporation, The Industrial Bank of Kuwait and University of Kuwait. Director General of KISR is also a member of the Board of Trustees.

Organization Chart of KISR is given below. As seen from the chart, KISR consists of four main Dirctorates, headed by Deputy Director Generals, two for research, one for planning and development and one for administration, finance and support services. These are

- Life and Environmental Sciences
- Physical and Engineering Sciences
- Planning and Development
- Admin. Finance and Support Serv.

KISR have been developing in line with the five year plans prepared for the Institude. At the present about 1000 persons are employed by KISR of whom 4.9%, (43), in management, 34.6% (343) professionals, 132% (131) scientists, specialists, 16.8% (167) technicians, 15.8% (157) administrative, 11.6% (115) support and 6% (60) supervisers.

The budget of KISR is approximately 60 million US. $ per anum. About 25% of the budget comes from contracted R + D projects.

R + D areas and topics to be implemented or being implemented is reviewed by the KISR Advisery Scientific Research Council which consists of representatives from industrial and other sectors at the chairman and vise chairman level. For example, PIC is represented in this committee. The Committee meets every three months for periodical reviews of the R + D activities of KISR. In KISR R + D is carried out on project basis. Therefore for a particular project, facilities of various divisions can be utilized.

R + D work on petrochemical Industries is carried out mainly under the Directorate of Physical and Engineering Sciences in a Division named Petroleum, Petrochemicals and Materials. At the present, this division employs about 120 persons who are almost evenly distributed to the departments of the Division. About 10% of the budget of KISR is allocated to petroleum, Petrochemicals and Materials Division.

The Goal of this Division, according to the second five-year plan (1984-1989) is to establish a firm base for industrial-oriented R + D programmes that can serve the local and regional market. Accordingly, the Division concentrates on conducting applied research to meet industrial requirements in the following areas

- Catalysis and upgrading
- Crude and products evaluation
- Chemical processes and products

- Corrosion
- Reverse Osmosis

The Division has been in the catalyst evaluation area since early 1970. Chemical analysis, surface area and porosity determinations, x-ray fluorescence, x-ray diffraction, electron microscopy evaluations, density determinations, abrassion and crush strength determinations etc. can be performed on the catalysts with the present facilities. In addition, with the present catalyst screening-catalytic reactions units, various aspects of catalysts can be examined. The main areas of interest have been hydro treading, hydrogen generating, naptha reforming, cracking and ammonia synthesis catalysts. Recently there have been plans for getting in to the area of catalyst preparation.

As part of crude and products evaluation programme, crude asseys, enhanced oil recovery studies, crude blending, trouble shoating for oil companies etc. are aimed at. Together with the custumized 100 lt. pilot distillation unit the Division has the related facilities to carry out the task. Lubricants, marine fuels and fuel oil additives are also in the interest area of this programme.

The polymer technology programme is mainly concerned with polymer synthesis with special emphasis on the complete analysis, characterization and testing of various polymers. So far a superplesticizer for concrete from melamin - urea resins and their wastes have been developed. A modified polyester developed for green house applications is another issue of the programme. Work is planned on PP, PS and PVC particularly for their applications suitable for the needs of the Country. Recently PE coated urea have also been developed for slow release of fertilizer. Polymeric materials for petroleum drilling and enhanced oil recovery will also be part of this programme. To back up all above mentioned studies the Division has full facilities for polymer analysis, identification and testing, three pilot plants, one for condensation polymerization, one for fludised bad coating of urea with PE and one for polyester film casting. All three pilot plants are designed and partly erected in house.

Corrosion studies is part of the programme of this Division. Corrosion of various materials by both elecrochemical and mechanochemical techniques are studied. Industry is being helped for material selection, additive usage, evaluation of additives etc. Development of a corrosion and/or scale inhibiter blands for cooling water, evaluation of corrosion inhibiters for MEA for CO_2 removal, investigations of material failiers can be given as some examples of the work carried out in this area. The Division is fully equipped for this purpose.

To back up all above mentioned studies, the Divisian makes use of Central Analytical Laboratories which is fully equipped with sophisticated equipment such as GC/FT-IR system, miroprocesser controlled continious flow analyser, GC/Mas System, plasma-atomatic emission spectrometer, x-ray fluorescence, electron microscope etc.

The Division is also envolved in desalination processes. There has been a programme which is in cooperation with the Gulf Countries and Germany and Studies in this line still continue to better the results achieved so far .

Although three pilot plants present in the Division were designed by the staff of the Division, process design and engineering activities in the modern sence seems to be lacking.

For technical information, the Department makes use of the facilities KISR has in this area. For this purpose KISR has very well developed facilities. As seen from the organization chart, information Centre of KISR is under the management of the Directorate of Planning and Development. In fact this information Centre is Kuwait's national infocentre and called National Scientific and Technical Info Centre (NSTIC). At the present, 1800 journal titles, whenever possible with their back volumes on microfishes, are subscribed for. 60.000 books are available. 500.000 NTIS reports and US patents starting from 1980 have also been obtained by NSTIC. NSTIC enjoys full computerization of library services, database creation and literature search. The softwere used for this purpose is the inhouse modified version of Stairs. Computerized literature search using online access to international data bases such as Lackheed, SDC, BRS, INPADOC and EURONET is also available. Besides full library services, publications such as current avareness

bulletins are also made. NSTIC have developed and organized a special collection on Kuwait including studies, reports, books, periodicals and other related doccuments. KISR reports have also been organized and maintained as an integral part of Kuwait Information Collection (KIC).

KISR is heavily envolved in environmental studies through the Division of Environmental and Earth Sciences . Main areas of focus are Environmental Protection and management and hydraulics and coastal engineering.

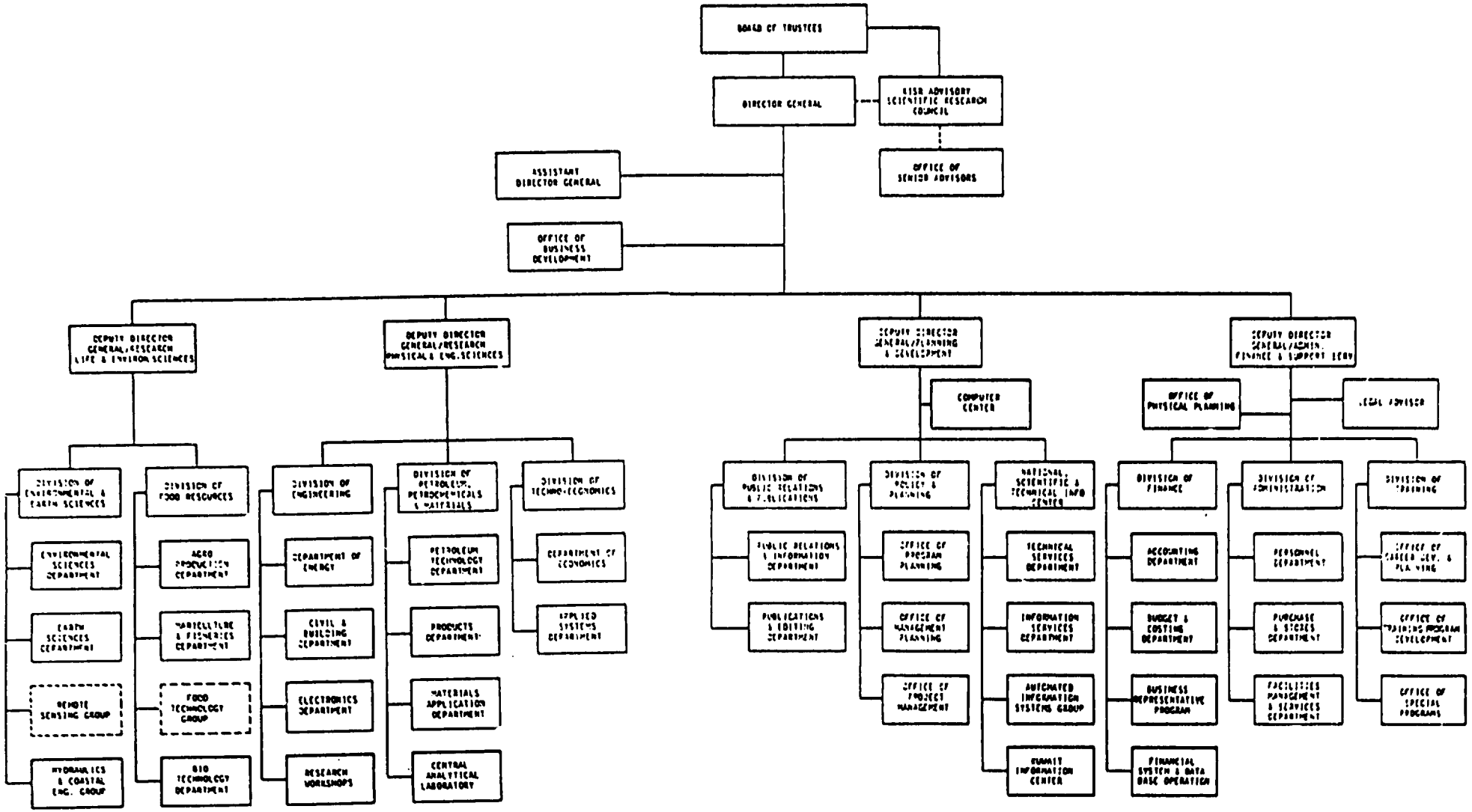
Because the couses of pallution in Kuwait stem from her oil industry, many KISR projects deal with oil related seawater pallution. Dust fallout and sand movements are also investigated. In the area of air pollution,serveys had been conducted and an air pallution pridiction model has been developed by KISR. In another study on air pallution, diesel exhaust emisions from public transport buses and diesel trucks in Kuwait and the factors effecting these emmissions are being assesed. industrial and non-industrial sewage are other areas of concern for KISR . To further improve national expertise in environmental studies, Kuwaities are being trained in geologycal and geomorphological research techniqies also. As mentioned before, Hydraulics and coastal engineering are also covered as part of environmental studies.

It is stated that KISR has already been in cooperation with various institudes in the region and out of the region. This cooperation has been in the areas of joint projects and trai ing. There has been quite a nember of examples. It is stated that as long as the subject area is of interest to KISR and the related party, coorepation channels are always there and open on the KISR's part. In addition it is stated that KISR organises international seminars, symposiums and workshops on various subjects like the on-coming one on catalysis which is stated to be open to all interested parties.

6.4. Conclusions

As can be concluded from above information, Kuwait can offer cooperation, through KISR, on various aspects of petrochemical R + D such as catalysis, polymer identification-analysis and testing, corrosion, information science etc. On the other hand Kuwait might recieve cooperation on modern aspects of process engineering and design.

KISR ORGANIZATION CHART - KUWAIT



7. IRAQ

7.1. General Outlook of the Petrochemical Industries

At the present the main petrochemical company of Iraq is the State Enterprise for Petrochemical Industries (SEPI). SEPİ is state owned and reports to the ministry of Industry and Military Manufacturing. SEPİ has a petrochemical Complex in Basrah (PC1) consisting of ethylene, VCM, PVC, HDPE and LDPE plants which are being prepared for start up through a very intensive programme. There are plans to establish a second petrochemical complex (PC 2) near Baghdad. A special organization as part of the Ministry of Industry and Military Manufacturing called Technical Corps for Special Projects, TECHCORP, has been established to implement PC 2. PC 2 will have 32 units which are ethylene, aromatic centre, PE, PP, styrene, PS, EO/EG, MEA, rubber, MTBE, alkylation buten-1, ABS, Cl_2/Coustic, PA, butadiene extraction, ACN, terephthalic acid, cyclohexene, caprolactam, ethanol, phenol/Aceton, acetic acid, carbon black, maleic anhydride, propylene oxide, cumen, vinyl acetate, bisphenol-A, phenol formaldehyde, VCM and PVC.

Arab Company for Detergent Chemicals, ARADET is the second company in Iraq. ARADET is a joint venture of Iraq. The share holders are State of Iraq, Arab Petroleum Investment Company, State of Kuwait, Saudi Arabia (PETROMİN), Arab Company for Mining and Arab Company for Investment. ARADET produces benzene, toluene and LAB at it's plants in Baiji.

7.2. R and D Facilities Present for the Petrochemical Industries

At the present the only R + D facility available for the petrochemical industries in Iraq is the Petrochemical Department of the Petroleum Research Centre which reports to Iraq's Council for Scientific Research. Universities are also stated to be envolved in petrochemical R + D activities on contract basis or as national programmes are implemented. Establishment of a new Centre colled Polymer Research Centre is about to be finished. It is planned that it will be commenced in mid 1989. Process design and engineering capabilities which are planned to be developed at TECHCORP are also to be mentioned for future plans.

7.3. Institutions Visited by the Consultant

TECHCORP and Petroleum Research Centre were visited by the consultant.

7.3.1. Technical Corps for Special Projects (TECHCORP)

TECHCORP is in Baghdat at the Ministry of Industry and Military Manufacturing. The communication details are as follows.

Technical Corps for Special Projects (TECHCORP)
Ministry of Industry and Military Manufacturing
Baghdad - IRAQ
Tell : 5383121
Telex : 212850 Petro.
Director : Mr. Osama A.R. Hamadi

Together with Mr. O.A.R. Hamadi, during his visit to TECHCORP, the consultant was kindly recieved by Mr. A.M. Khidher, R + D manager of PC 2, TECHCORP.

TECHCORP is a state company to implement special projects. As part of its activities TECHCORP is responsible for the implementation of PC-2. As mentioned before PC-2 project envolves 32 petrochemical plants to be erected near Baghdat at Musayyib. Establishment of the new compelx will be realized with maximum national input. In this sence all process and detailed engineering of the 32 plants will be carried out by an engineering company recently established for this purpose, To carry out this very important task which covers all aspects of engineering including besic design and optimization together with detailed engineering, procurement etc., about 120 engineers of various diciplines work for the engineering company. It is expected that this figure will reach to about 200 by the end of 1983. Furthermore, specialists from abroad will be hired when deemed necessary. The company is stated to have all modern facilities including computer applications. In addition it is stated that, in Iraq Universities also have design officess which carry out work mostly on contract bases.

In Iraq every establishment has R + D facilities and activities by low. Each establishment prepares yearly R + D programmes and send them to the Ministry of Industry and Military Manufacturing for consolidation thus for preparation of yearly national programmes. In addition, every three months, advancement reports are also sent to the Ministary for periodical reviews. In this contex SEPI has some R + D facilities at Basrah as part of Quality Control and

Technical Department. However, it is stated that these facilities are planned to be utilized mostly for the day-to-day runing of the plants because SEPI is expected to refer its R + D needs to the Petroleum Research Centre, to the newly established Polymer Research Centre and to the Universities in Iraq. As a matter of fact there has been a special agreement between SEPİ and the Petroleum Research Centre to give priority to SEPI's requests.

To coordinate the R + D activities between Universities and the Industry, there is a National Committee which guides industries to the propper and available universities on the R + D topic handled and controls Universities on their activities in cooperation with the Industry.

Establishment of the Polymer Research Centre has been part of the responsiblities of the R + D Management of TECHCORP. It is stated that Polymer Research centre will have bench to pilot size polymerization facilities to serve both PC-1 and PC-2 for production and quality problem solving and new developments on various aspects of polymerization processes. The Centre will also have polymer processing facilities to act as a technical service department for after sales, again for both PC-1 and PC-2. In addition the Centre will produce specialty items made of plastics or rubbers for sale to support it's activities of R + D. It is stated that the Centre is expacted to make 500.000 U.S.$ in 1989 and 2 million U.S.$ in 1992 from the sales of the goods to be manufactured there. Thirty persons will be working at the Polymer Research centre when it starts functioning in mid 1989. The number is expects to reach to 92 ultimately.

No process engineering and design group is planned for the Centre. it is expected that the engineering needs will be covered by the engineering company established for PC-2. Technical information needs will also stated to be covered by the library of the Petroleum Research Centre. Again, since Polymer Research Centre covers only polymers, R + D work concerning monomer production is also expected to be covered by the Petroleum Research Centre

7.3.2. Petrochemicals Department of the Petroleum Research Centre of the Council for Scientif Research of Iraq

Petroleum Research Centre is in Baghdad. The communication

details are as follows.

Council for Scientific Research
Petroleum Research Centre
P.O.Box 10039
Jadiryah, Baghdad, IRAQ
Tell : 7760023
Telex : 2187
Director General: Dr. Abdul-Halim Abdul-Kerim Muhammed

During his visit to Petroleum Research Centre, together with Dr. Muhammed, the consulted was kindly revieved by Dr. Mustafa M.F.Al. Farrah, head of Petrochemicals Department and his colleauge Dr. Riadth J.A. Shalash.

Petroleum Research Centre is one of the research centres the Council for Scientif Research of Iraq has. Patroleum Research Centre has there main Departments. These are Refining, Chemical Industries and Petrochemicals. A little more that 100 scentists and professionals work at Petroleum Research Centre. Its 1988 investment budget was 0.7 million Iraqi Dinnars(1U.S.$ = 0.31 I D). About 1/3 of the scientists work at the Petrochemicals Department 6 having PhD. 8 M sc and 9 Bsc. degrees. In this Department there are unofficially integrated there divisions. At the polymer testing division mechanical and physical testing, specification determinations to gether with molecular weight ones and rheologycal studies are carried out. Polymerizations in batch reactors upto 20 lt capacity for stereo polymerizations with alkyl litium and Ziegler type catalysts for liquid polibutylenes, polyisobutylenes, polyisoprene etc. and solution polymerizations for polyesters are carried out in the Polymerization Pocesses Division. At the Polymer Processing and Compounding Division various polymeric compounds and extrudates are prepared for polymer evaluation and product development. New Divisions for polymer blends and conductive polymers are being started.

Besides polymerization studies mentioned above, on contract bases from customers, the Department also carries out some product quality improvement work like studies on rubber stability improvement, various fillers for PVC, different ways of reinforcements for reinforced plastics particularly for polyesters etc.

The Department is stated to be well equipped for petrochemical R + D work concerning polymers. However, R + D for other petrochemicals such as monomers are not carried out. For example R + D on catalysis is stated to be carried out by the Refining Department. Catalysis Division of the Refining Department is stated to have been envolved in R + D particularly on hydrogenation and dehydrogenation areas. The division is stated to be well equipped for catalyst characterization and catalytic reaction investigations. At the present about 16 professionals work at this Division 4 having PhD, 4 having MsC and 8 others.

Environmental protection studies are also not handled by the Department.

Process design and engineering is not covered by the Department. It is expected that this area will be covered by the engineering company established for PC-2.

For technical information the Department makes use of the library facilities of the Council through the Doccumentation Centre. Both the Library and the Doccumentation Centre, being partly computerized, are more on the classical side. However on-line connections to information networks abroad are stated to be available. It is also stated that at the library there is a special emphasise on journals and books on polymer science and technology.

There is a general affirmative approach for regional cooperation.

- Rubber polymerizations in bench or pilot scale to investigate the parameters effecting it and determination of propetries of rubber obtained.
- Preparation and characterization of thermoset plastics particularly polyester, epoxy, phenol-formaldehyde and alkyd resins
- Property and in-depth characterization of thermoplastics and polymer blends
- Degradation and Stabilization of polymers

are stated to be the areas of interest for joint R+D projects.

Although not specified, the Department is also willing to recieve experts to prepare new facilities and equipments for future expensions and send it's stuff or recieve staff from other institudes

for training on synthesis and characterization of Polymers. There is again an affirmative approach for the funding of such activities.

7.4. Conclusions

As can be seen from above information Iraq can offer cooperation on analysis identification and testing of polymers, particularly on polyesters. On the other hand can recieve cooperation on utilizing the present polymerization facilities to serve PC-1 and PC-2 better in the line of adopting them to PVC, HDPE, PP polymerizations for chemical and/or catalyst substitutions, production and product quality problem solving etc, on process engineering and design and perhaps on technical information.

GENERAL CONCLUSIONS

There are petrochemical R + D facilities and activities present in the Countries of Noth Africa and the Middle East. In some countries they are quite well developed, in some they are being developed and in some others they are just being started. There are some general areas which can easily be identified as areas of cooperation.

- Process design and engineering as part of R + D activities seems to be the first major area to be strengthed and to be an area of cooperation in the Region. Perhaps UNIDO can play an important role to demonstrate how important it is to have process engineering and design groups as part of R + D departments to serve and improve present and operating petrochemical plants, to put R + D results in to practice and to help selecting more suitable technologies. In the region there seems to be very limited expertise awaileble.

- In the area of identification, analysis and testing of polymers there are some very well developed facilities and some expertise in some of the countries of the region on the other hand in some others there are needs for training and exchange of experience to help them start or improve such activities.

- Bench or pilot scale polymerizations of polymers such as PVC, HDPE, PP or thermoset polymers for operation and quality problem solving seems to be another area of cooperation. Some of the Countries of the region could exchange experience, formulate joint R + D projects or exchange researchers particularly for that of PVC, HDPE and PP polymerizations.

- The very same argument can be made in the area of catalysis. However, this area is usually under petroleum departments rather than petrochemicals and due to lack of expertize in mathemathycal modelling and process design and engineering activities it is not aimed at the petrochemical processes as it should be. Again this area can be one of the major areas for cooperation or excharge of expertices.

- Corrosion particularly that of due to utilization of sea water as cooling media seems to be the common interest of some of the countries in the region. There seems to be individual efforts in the area. This common problem area might be an area of joint efforts.

- On environmental pollution almost all of the countries visited are doing essays and survays. Perhaps due to lack of process engineering

and design activities there has not been process developments and improvements.

There has to be some joint efforts in this area also.

-Desalination R + D activities seems to be common to some of the countries of the region. There has been individual and some joint efforts. This area might also be interesting for cooperation for the countries envolved.

- In the area of technical informaton there are some vary well developed examples in the area while there are some efforts just to start such activities. This area seems to be one of the areas for exchange of experience and knowledge and certainly cooperation

- last but certainly not the least, there has to be considerations and discussions to evaluate the petrochemical R + D activities to see if the present ones are directly serving the petrochemical production, process improvement and expension activities. There are various organizations and approaches for this purpose in the region. Discussions an/or exchange of experience in this line might help to stimulate more applied R+D in the region.

After having discussions with the persons envolved, the consultant has the notion that there is more desire to exchange researchers and/or trainees rather than joint projects to start cooperation in the region. It is generally believed that joint R + D projects might follow up as interaction between the countries of the region, through exchange of staff and experience, is increased. Periodical meetings for exchange of information is also stated to serve this purpose. In line with this suggestion, many of the people suggested that, it would be very useful if participants to the next meeting to be arranged by UNIDO, presented papers eloborating on the facilities and activities on the above mentioned general areas or some of the areas of their interest to give way to more detailed bilateral or group cooperations in some of the areas.

ACKNOWLEDGEMENTS

The consultant would like to thank UNIDO Headquarters in Vienna and UNDP offices in the countries visited for the arrangements made and for their help and support. Special thanks goes to all the persons met for their kind cooperation and for the time they spared for him.