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MODERNIZATION OF ENGINEERING DESIGN AND CONSULTANCY SERVICES

DP/IND/78/054

INDIA

Terminal report

Prepared for the Government of India
by the United Nations Industrial Development Organization
acting as executing agency for the United Nations
Development Programme

Based on the work of the project management

United Nations Industrial Development Organization
Vienna

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Explanatory notes

The monetary unit in India is the rupee (Rs).

Besides the common abbreviations, symbols and terms, the following have been used in this report:

EIL	Engineers India Limited
R and D	research and development
TTRM	terminal tripartite review meeting
IPCL	Indian Petrochemicals Corporation Limited
RRLB	Regional Research Laboratory, Bhubaneswar

Mention of the names of firms and commercial products does not imply endorsement by the United Nations Industrial Development Organization (UNIDO) and the United Nations Development Programme (UNDP).

ABSTRACT

The project "Modernization of engineering design and consultancy services" (DP/IND/78/054) was approved by the United Nations Development Programme (UNDP) in July 1979 and the United Nations Industrial Development Organization (UNIDO) designated as executing agency. The project became operational in January 1980 with the arrival of the first item of equipment and will be terminated in June 1985.

The immediate objective of the project was to bridge technological gaps in the engineering design and consultancy capability of the Engineers India Limited (EIL). To this end, five experts in different fields of specialization were fielded for a total of 29 man-months, 26 national staff participated in fellowship training programmes or study tours, and a wide range of equipment was supplied. The UNDP contribution to the project totalled $US 986,137. As a result of that assistance, EIL now has a computer centre and is involved, jointly with other institutions, in technology development programmes for the cracking and oxidation of hydrocarbons as well as in long-range research and development activities concerning slurry transporation, extraction of metals and polymerization.

It is recommended that EIL continue its research and development efforts in the above-mentioned areas. To make optimal use of the interactive graphic system supplied under the project, EIL staff should receive training in graphic applications in piping, structural engineering and in basic graphic software. The expertise provided under "pyrolysis process design engineer" should be utilized to set up a demonstration cracker facility, and the unutilized part of that activity relating to subcontracting for pyrolysis process design should be carried over to the next UNDP project.

CONTENTS

INTRODUCTION

In order to enhance the Indian engineering design and consultancy capabilities in the field of basic areas of petroleum refining, petrochemicals and its derivatives, fertilizers and chemicals, offshore petroleum production etc., as a part of the policy of the Indian Government to maximize the reliance on indigenous technology in these fields, the Government requested assistance from the United Nations Development Programme (UNDP) in 1978. The objective of the project was to build up sufficient expertise at Engineers India Limited (EIL), New Delhi, in the above-mentioned areas, and, accordingly, a project document was prepared and submitted to UNDP in November 1978 for a project with a duration of five years. The project "Modernization of engineering design and consultancy services" (DP/IND/78/054) was approved by UNDP in July 1979, but became operational only in January 1980 with the arrival of the first item of equipment at the project site. It is expected that the project will be terminated in June 1985.

The UNDP contribution envisaged was $US 739,850 and the envisaged inputs by the Government of India were Rs 20,111,000. During the course of the project, which was rephased to reflect the actual expenditure, the budget was further increased to $US 942,385 and once more in 1983, as a result of the decision taken during a tripartite meeting held in March 1983. The increases covered additional equipment and fellowship training. The UNDP contribution to the project finally totalled $US 986,137.

Termination of the project

While all project components have been implemented as scheduled and the objectives achieved, one expert assistance in the field of pyrolysis process design could not be found. The provision of expert assistance was then converted into a subcontract, which UNIDO is in the process of finalizing. EIL has already approved the list of concerned technical firms and it is expected that the subcontract would end by May/June 1985 which would result in an extension of the duration of project by six months, i.e. it would be terminated in June/July 1985 instead of January 1985.

RECOMMENDATIONS

1. Research and development efforts should continue in the following areas:

   (a) Thermal cracking for olefins production

   (b) Slurry transportation

   (c) Extraction of metals and

   (d) Polymerization

as part of a continuous research and development (R and D) programme to consolidate the capabilities of EIL.

2. The expertise provided under "pyrolysis process design engineer" should be utilized to set up a demonstration cracker facility to consolidate the design capabilities of EIL. The unutilized part of that activity relating to sub-contracting for pyrolysis process design should be carried over to the next UNDP project.

3. To make optimal use of the interactive graphic system, EIL staff should be trained in graphic applications in piping, structural engineering and in basic graphic software.

OVERALL ASSESSMENT

A. Objectives

The project was expected to bridge gaps in the engineering and design consultancy capability of EIL in the following way:

(a) Enhance the work of EIL in process technology development in the petrochemicals area, specifically in (i) oxidation of p-xylene to dimethyl terephthalate/terephthalic acid (DMT/TPA) and (ii) evaluation of design parameters for the cracking of hydrocarbons for the production of petrochemical feedstocks, by providing the required equipment and instrumentation;

(b) Strengthen the existing design capability of EIL as regards petrochemicals processes, exploitation of offshore oil reserves, slurry transportation and effluent treatment by providing six UNDP experts;

(c) Enable EIL to expand the existing computer facilities which was to lead to its optimum utilization for engineering design work;

(d) Train 11 senior engineers of EIL in the following specific fields:

(i) Offshore petroleum production, slurry transportation and hydrometallurgical plants;

(ii) Design and operation of effluent treatment and disposal systems;

(iii) Maintenance of large processing plants;

(iv) Design of polymerization reactors;

(v) Extraction processes in non-ferrous metallurgy.

B. Inputs

Equipment

All UNDP-funded equipment, with the exception of the air compressor, has been delivered. On the Government side, all the plant equipment was supplied during the first year of the project. Annex I is a list of all non-expendable equipment.

Expertise

Five international experts were fielded as a part of this project. Their names and main duties are given in annex II. Two of these experts were fielded twice. The provision of one expert in pyrolysis process design was converted into a subcontract. However, as there are difficulties to locate a suitable agency to undertake this activity, it is suggested that this provision be carried over to a future UNDP project.

The national staff working on the project is identified in annex III.

Fellowships

Details about completed fellowship training and study tours are given in annex IV.

C. Project results

Installation of an interactive graphic system

Through the installation of the interactive graphic system VAX-11/780, EIL could develop interactive graphic software in various disciplines of engineering. Two graphic application packages for piping isometric and for piping and instrumentation diagrams were developed, installed and put to use. Sophistications and modifications of these software packages are undertaken from time to time, depending on need and on the technological advancements in the available resources.

EIL is also participating in an effort to develop very sophisticated packages using graphics in a wide variety of engineering applications. Due to budgetary constraints EIL could acquire hardware only for the minimal working configuration of the VAX-11/780. At the same time, the system in its present form has helped in starting the development work in the envisaged areas. However, in order to meet the requirements fully, it is recommended to expand the present configuration and relevant proposals have been submitted separately.

The efficient usage of the system demands skills in specific areas, which could not be provided through relevant training at an earlier stage. It is therefore recommended that the staff of EIL be trained abroad in the following areas:

Subject of training	Number of persons	Proposed duration (months)	Man-months
Graphic applications in the area of piping	2	3	6
Basic graphic software	1	2	1
Graphic applications in the area of structural engineering	2	2	4

Equipment for the development of process technology

By providing equipment and instrumentation for process technology development in: (a) oxidation of p-xylene to dimethyl terephthalate/terephthalic acid (DMT/TPA) and (b) evaluation of design parameters for cracking of hydrocarbons for production of petrochemical feedstocks, experimental facilities were installed at the R and D Centre of the Indian Petrochemicals Corporation Limited (IPCL), as a joint EIL-IPCL R and D effort.

Expertise and fellowships

Twenty-six senior engineers of EIL have been trained abroad under the UNIDO fellowship programme and are now engaged in carrying out design and R and D activities in various areas. UNIDO also provided expertise in various specific areas which has helped EIL to consolidate its position. As a result of the training and expatriate assistance, EIL is carrying out joint development programmes with other research institutes in India in the following fields:

(a) Slurry transportation - joint development programme with the Regional Research Laboratory, Bhubaneswar (RRLB);

(b) Extraction of metals from complex sulphide ores - joint project with RRLB;

(c) Polyolefins technology development - joint development activity with IPCL, Baroda.

Therefore, as a result of the project, EIL complies with the objectives and now has:

(a) Joint development programmes with IPCL with regard to technology development for cracking of hydrocarbons and oxidation of hydrocarbons;

(b) A computer centre;

(c) Full involvement in long-range R and D activities with regard to slurry transportation, extraction of metals and polymerization.

D. Outputs

The project outputs were well defined and completed.

Output No. 1: "Establishment of experimental facilities at the IPCL R and D Centre at Baroda for joint development activities in the fields of thermal cracking for light olefins production and oxidation of hydrocarbons for production of fibre intermediates"

The experimental facilities for thermal cracking have been in operation for over two years and data on the cracking of naphtha are being generated at present. A trained team of at least six technical officers, including the team leader, are involved in undertaking research and development in this area. At present, data with various operating parameters are being generated. As a part of the joint development programme, this team will continue to work for a further period of two years on the collection of the necessary data.

With regard to the oxidation process, preliminary investigations up to 5 kg/cm^2 have been carried out. However, in the absence of the air compressor which was to be a part of the UNDP inputs, but the supply of which has been delayed, this activity has not yet taken off.

Output No. 2: "Enable EIL to take full advantage of the installed computer system."

The interactive graphic system VAX-11/780 was found to be most suitable. It has enabled EIL to take full advantage of the installed computer system by developing interactive graphic software in various disciplines and putting it into use.

Output No. 3: "Establishment at EIL of a cadre of trained engineers in various areas of specialization"

The following areas of specialization were called for: reactor design of polymerization systems; extraction processes in non-ferrous metallurgy; off-shore engineering; slurry transportation, maintenance engineering services

for refinery and petrochemical plants; effluent treatment; hydrometallurgical process plants; operation of plants for production of copper/lead/zinc concentrates from complex ores and beneficiation of phosphate ores.

Full advantage has been taken of the training provided in the case of polymerization, extraction in non-ferrous metallurgy and slurry transportation by way of undertaking long-term R and D programmes in collaboration with other national research institutes. The expertise provided by UNIDO with regard to slurry transportation was found to be extremely useful in setting up the slurry transportation facility. The expert provided his input when the facility was in the planning stage and again when it was being commissioned. He has made specific recommendations which will be implemented.

Annex I

NON-EXPENDABLE EQUIPMENT

A. Supplied by UNDP

Quantity	Description
1	Alphanumeric/graphic 19" CRT display terminals, with accessories
1	PRX-300 printer plotter, complete
1	Drum plotter, complete
4	Thermo-electric multipoint recorder, type REC-54006, range 0-600°C, 600-900°C, 400-700°C
1	Fisher relief valve, type 98 H 1/4" NPT serial No. 8069747
1	Automatic gas chromatograph system:
	1 Microprocessor model 6750, with accessories
	4 Recorder, L + N model H
	1 Teletypewriter KSR 43, complete
	1 Analyzer for gas stream, C1/C2, complete
	1 Analyzer for gas stream, C3/C4, complete
	1 Analyzer for naphtha analysis, complete
	1 Analyzer for liquid phase naphtha, complete
	1 Cable, analyzer to processor
	1 Cassette loader
	1 Electronic temperature transmitter, Optonix 430, range 100-350°C FECT
	1 Electro-pneumatic transducer, Optonix 466
	1 Electronic temperature transmitter, Optonix 430, range D-400°C FECT
	1 Electro-pneumatic transducer, Optonix 466
1	Computer system (5)

Annex I (continued)

Quantity	Description
1	VAX-11/780 CPU with: - 256 KB ECC MOS memory - 8KB bipolar cache memory - Controller and two RK07 - DZ11-A 8 line async EIA multiplexer - LSI-11 microcumputer based front end
1	Diagnostic control and LA120 180 CHAR/SEC matrix printer terminal - VAX/VSM operatng system with macro assembler - Fortran IV plus optimizing complier
1	Additional 256KB ECC MOS memory (brings system to a total of 512KB)
1	Alphanumeric CRT display terminal 24 lines by 80 columns or 14 lines by 132 columns
14	Spare 28 MB disk cartridge
1	Computer accessories: 1 9-track cipher MAC tape drive 1 Coupler for MAC tape drive
1	Sigma specific gravity recorder, complete, Temperature controllers: 6 30428-0-0317421/331 335 INDICOMP 2 EX 6 30428-0-0317421/332 335 INDICOMP 2 EX 4 30428-0-0317421/333 335 INDICOMP 2 EX Temperature recorders: 2 40711-0-4611310 POLYCOMP 2 EX
1	Model 755 oxygen analyzer
1	Model 864 CO analyzer
1	Model 864 CO_2 analyzer
1	Model 8710 A recorder
1	Model 8720 A recorder
1	Sample handling system
1	Lauda heat-transfer system ITH 309 with explosive protection according to DIN 4754
1	Heat exchanger 0.5m^2, three-way control valve

Annex I (continued)

B. Input by the Government of India

Quantity	Description
	Locally fabricated items:
2	Storage tanks
4	Vapourizers
2	Superheaters
2	Reactors with thermo-wells
1	Tar pot
1	Condensor
2	Separators
1	Knockout drum
1	High-temperature reactor furnace
1	High-temperature preheater furnace
2	High-temperature vapourizer furnaces
2	Metering pumps
6	Temperature indicators and controllers
1	Voltage stabilizer
6	Flow meters
1	Gas chromatograph

Annex II

INTERNATIONAL STAFF

Name	Specialization	Duration of assignment	Man-months
C. A. Shook	Slurry pipeline technology	April-June 1982	3
		April-May 1984	1
R. A. King	Pyrolysis process design	December 1981-May 1982	6
R. T. Aliev	Petroleum process engineering	February-July 1982	6
C. L. Bretschneider	Physical oceanography	November 1980-March 1981	4
		February-July 1982	5
A. Margola	Effluent treatment	December 1981-March 1982	4

Annex III

NATIONAL STAFF

Name	Post designation	Involvement in project
R. S. Grover	Project director	Part time
J. R. Prasher	Project director/co-ordinator	Part time
S. Malkani	Project co-ordinator	Part time
P. K. Mukhopadhyay	Manager of R and D	Part time
D. N. Rihani	Project leader	Part time
D. Maha	Engineer	Full time
K. N. Ponnani	Project leader	Part time
M. S. Tadkase	Engineer	Part time
M. R. Pathak	Operator	Full time
D. B. Pathak	Operator	Full time
V. K. Parmar	Operator	Full time
S. Ramachandran	Project leader	Part time
M. R. Pandya	Technician	Part time
S. K. Ghosh	Project leader	Part time
S. Govindan	Engineer	Full time
S. Sarath	Engineer	Part time
A. Datta	Project leader	Part time
R. Prasad	Engineer	Full time
H. Lakshminarayanan	Engineer	Full time
S. J. Chopra	Project leader	Part time
S. Kumar	Engineer	Full time
P. K. Sen	Engineer	Part time
G. Rajan	Engineer	Part time
S. Krishnamurthy	Manager	Part time
H.M.M. Swamy	Project leader	Part time
G. M. Deshpande	Project leader	Part time

continued

Annex III (continued)

Name	Post designation	Involvement in project
R. R. Nargundkar	Project leader	Part time
J. L. Angra	Senior mathematical analyst	Part time
A. K. Malhotra	Project director	Part time
S. K. Basu	Project co-ordinator	Part time
P. J. Nandapurkar	Engineer	Part time
J. Vishwanathan	Engineer	Part time
G. Rao	Engineer	Full time
G. M. Asirwatham	Project leader	Part time
N. Raman	Engineer	Part time
N. R. Krishnan	Engineer	Part time
K. K. Ganpathy	Engineer	Part time
G. N. Thadani	Project co-ordinator	Part time

Annex IV

FELLOWSHIP TRAINING AND STUDY TOURS

Name	Duration	Man-months	Area of training	Country
S. K. Gosh	September-December 1982	3	Slurry transportation	Canada
R. S. Rohella	September-December 1983	3	Slurry transportation	Canada, United States
S. Govindan	September-November 1983	3	Slurry transportation	Canada, Federal Republic of Germany, United Kingdom, United States
S. J. Chopra	June-December 1982	6	Extraction process in non-ferrous metallurgy	United States
Satish Kumar	July 1983-January 1984	6	Extraction process in non-ferrous metallurgy	United States
A. Datta	March-September 1981	6	Reactor design of polymerization and condensation systems	United Kingdom, United States
R. Parsad	May-November 1983	6	Reactor design of polymerization and condensation systems	United States
C. J. Moorthy	November 1982-February 1983	3	Base facilities for ship building and repair	Singapore
P. K. Mukhopadhyay	October-December 1983	2	Maintenance engineering	Austria, Federal Republic of Germany
G. Sharma	November 1983-January 1984	3	Hydrometallurgical process plants	Canada, United States

continued

Annex IV (continued)

Name	Duration	Man-months	Area of training	Country
R. K. Bhuyan	November 1983-January 1984	3	Hydrometallurgical process plants	Canada, Finland, United States
Suresh Kumar	March-May 1982	3	Beneficiation of phosphate ores	Brazil, France, United States
R. G. Gurlhosur	August-November 1982	3	Production of copper/lead/ zinc concentrates from complex areas	Canada, United States
S. Anand	January-April 1982	3	Slurry transport engineering	United States
K. N. Goswami	June-September 1984	3	Maintenance engineering	United Kingdom
S. Kaul	March-May 1982	3	Hydrometallurgical process plant	Canada
A. Kochhar	August-November 1982	3	Hydrometallurgical process plant	Canada, United States
D. V. Bhatnagar	September-December 1982	3	Production of copper/lead/ zinc concentrates from complex areas	Canada, United States
S. Roychoudhry	April 1980-April 1981	12	Offshore structural engineering	United States
B. K. Raut	October-December 1981	2	Maintenance engineering	Austria, Federal Republic of Germany, France
T. K. Nandy	May-July 1981	3	Hydrometallurgical process plant	United States

continued

Annex IV (continued)

Name	Duration	Man-months	Area of training	Country
S. S. Rao	August-November 1984	3	Slurry transport engineering	United Kingdom
G. L. Rajani	August-November 1980	3	Maintenance engineering	Austria, France, Norway
N. G. Deshmukh	February-April 1980	3	Beneficiation of phosphate ores	France, United States
A. D. Jalgaonkar	March-August 1980	6	Effluent treatment	Canada, United States
A. Srivastava	May-July 1984	2	Slurry transport engineering	United Kingdom, United States