EXECUTIVE SUMMARY

A. INTRODUCTION

1. A typical modern Petroleum Refinery comprises a variety of complex processes and plants depending upon the nature of crude oil being processed and the product slate. This study deals with the refining of crude oil and the production of various bulk petroleum products. Production and formulation of lubricating oils as also the manufacture of different petroleum based specialities becomes, by itself, a subject with extensive coverage. As such it was not found feasible to include them in this study.

2. The sources of information for international scenario and the state of art technologies have been the various renowned process licensors such as UOP, IFP, Shell and others for the domestic scenario, the information has been supplied by various refineries, Indian Institute of Petroleum (IIP). Indian Oil R&D Centre, Engineers India Ltd. (EIL). Centre for High Technology and others. Discussions were also held with the concerned organisations and experts in the area.

3. Included in the study report is an introduction to the various physical separation and conversion processes, stagewise development of certain key conversion processes upto the present day international status of technology. The results of a detailed survey of Indian refineries both through a questionnaire as well as through visits to certain typical refineries have been included with a view to identify technology gaps.

   The report deals with the extent of build-up of indigenous capabilities in regard to basic process design, detailed engineering, construction supervision and vendor development. Market data in so far as its impact on the kind of refining technologies needed for the future is concerned, is also included.

4. Research being conducted by the Oil companies and at various Research Institutes was determined in regard to its level and future direction. The same has been included in this report. Finally certain recommendations have been made.

B. INTERNATIONAL SCENARIO - STATE OF ART SCENE

1. With the exception of certain catalytic conversion processes such as Catalytic Reforming, FCC, Hydrocracking where import of basic engineering packages continues to be necessary, EIL has developed full competence in regard to the basic and the detailed engineering of refining process plants.

2. Whereas availability for import where necessary of State-of art technology for such conversion processes presents no problem in case of new plants, there exists scope for technology upgradation in case of earlier plants in Indian Refineries, since technology licensors have meanwhile upgraded such technologies. FCC, being by far the most important secondary process, offers scope for technology upgradation in our refineries. New features such as Feed distribution and lift gas conditioning, Vented riser, catalyst cooler and addition of a second regeneration zone present interesting applications. Likewise change to bi-metallic catalyst in case of Catalytic Reforming and Coil Soaker technology for Vis-breaking offer opportunities.

3. Further optimisation of energy and product yield continues to offer significant opportunities through plant modifications and process simulation techniques. Developed countries have achieved significant success in this area. Computerised process control has been successfully employed in other countries resulting in energy and yield improvements. Micro processor based distributed digital control system has enabled on-line process optimisation.

C. STATUS OF INDIAN INDUSTRY

1. Current crude refining capacity estimated at 51.85 million tonne/annum is spread over 12 refineries. Petroleum refining industry being entirely in the public sector, is close knit, with a high level of inter-refinery collaboration and information sharing through forum, such as the Oil Co-ordination Committee, the Centre for High Technology, inter-refinery meetings and others.

2. The Petroleum Ministry, Government of India likewise also plays

an active role in areas of common concern to the industry. For example, during the period 1982-85 there was a major expansion of FCC capacity in the Indian refineries with the installation of six FCC units. The Petroleum Ministry acted as a nodal agency, first to determine the most appropriate technology for Indian conditions and then to negotiate with the process licensor, UOP in this case, for most favourable commercial terms due to a number of repeat orders.

3. Through a study of petroleum product demand-supply scenario in India, two things become quite obvious which have a profound influence on refining strategies.

(a) Even if 85% to 90% of the product requirement is to be met through Indian refineries significant capacity augmentation is indicated.

(b) The increase in the % share of middle distillates over heavy ends (now a global phenomenon) demands not only appropriate technologies in the new refineries but also a concerted effort in the existing ones to revamp as extensively as techno-economically feasible, the existing FCCS and visbreakers to make use of State of the art features. This also explains the length to which this study has gone in covering the state of the art technology features of FCC.

4. The status of development of various petroleum refining processes of interest in India is covered in Chapter-4. In regard to the design and construction of future plants, Engineers India Ltd. (EIL) has developed full competence to carry out basic engineering (with the exception of certain catalytic conversion processes), detailed engineering and project execution. Present gap is in the field of catalytic processes including the development and production of catalysts. Whether India should aim at total self reliance in development of basic engineering is debatable since the cost of developing processes such as FCC and Hydrocracking can be enormous, such as cannot be justified except through exploitation of global markets. And this is most difficult in the face of competition against multinational companies in this field with decades of experience. Catalyst development and production, however, is of prime importance to enable process optimisation keeping in view the specific needs within the country.

Activities currently being carried out in the field of catalyst development are covered.

3. Considerable progress has been achieved in regard to indigenisation of plant and machinery. The items needed to be imported are either of a proprietary nature or those where indigenous manufacture, though possible, is not taken up due to limited offtake or short delivery periods, asked for.

D. TECHNOLOGY ABSORPTION GAPS AND THRUST AREAS

1. In response to a questionnaire, apart from other information, each refinery has detailed the actions already taken or being taken in regard to technology upgradation of the existing plants.

2. A study of this nature can, at best, directionally indicate the areas of interest in regard to technology upgradation because each proposal has to be examined in depth first in regard to the technological feasibility in a given case and then has to be economically justified. For licensed processes it is generally advisable to seek assistance from the process licensor in regard to what modification/addition can be made. Some of the areas which need further attention are given below :

(a) While product yield and energy optimisation will offer continuing scope for improvements and also recognizing the fact that most refineries have already taken certain action towards improvement of preheat, better waste heat recovery and installation of modern high efficiency heaters and furnaces in place of the old ones, companies in developed countries claim to have achieved significant savings in fuel (in excess of 25%). Certain technology vendors have developed software programmes to determine the minimum energy requirements with the best technologies available. This in turn enables a detailed case by case review of the changes that can be considered and their economic justification.

One such study was conducted by Messrs KBC of UK at the Mathura Refinery. A proper assessment of its usefulness has not been undertaken in this study. Perhaps it may be useful to discuss the Mathura Refinery experience at some industry forum.

Process simulation techniques using computer softwares currently available, that carry out heat and mass balance calculations should prove useful in debottlenecking plants and optimisation of energy use and product yields.

(b) Distributed digital control systems (DDCS) have been installed in some plants. To get full benefit of the DDCS, on line computer control of the process becomes a corollary. Madras Refinery has already commissioned such a system using the software of M/s Set Point Inc. It is learnet that substantial savings through on-line process optimisation is anticipated.

While Cochin Refinery is in the process of installing a similar system, other refineries could likewise on a crash basis implement similar programmes.

(c) Secondary processing capacity is a limitation in a number of Indian refineries. In view of the future trends for yet higher middle distillate demand, capacity augmentation on the one hand and feedstock maximisation through the possibility of processing more contaminated feedstocks on the other could be studied. Where an economic size of a secondary processing plant cannot be justified, inter-refinery transfer of feedstock between two refineries with an economic size plant located at one of them could be considered.

(d) Use of bimetallic catalyst in catalyst reformers and change over to soaker technology in vis-breakers is planned for certain refineries. These programmes could be implemented on an urgent basis. To derive full benefits from the use of bimatellic catalyst low pressure operation becomes necessary. This in turn may necessitate certain hardware changes in the plant which need to be carefully considered. Soaker technology in vis-breakers should enable operation at higher severities. This coupled with much longer cycle lengths should result in lower demand for cutter stocks in regard to furnace oil blending. Higher middle distillate yields can thus be expected.

(e) Whereas the mono-metallic reformer catalyst has already been developed and satisfactorily commercialised at IPCL,

added thrust on development of certain catalyst is indicated.

(f) Safety deserves a special mention. Use of state of art methodologies for identification of hazards and risk reduction is recommended.