DOWNSTREAM INDIA

History of Downstream Petroleum Industry

An ONGC Group
Golden Jubilee Publication

The story of downstream Oil Industry in India began with the import of Kerosene for illumination/lighting in the late 1800's.

However, the discovery of crude oil in Digboi and the commissioning of the world's oldest operating refinery there in 1901, was the 1st significant landmark in India's Oil Industry.

After Independence, industrialisation and self reliance were the abiding national sentiments.

The period 1947-1960 saw the commissioning of three indigenous refineries built by STANVAC, BURMAH SHELL and Caltex. It also saw the birth of the public sector Oil Industry (ONGC, Indian Refineries Ltd, Indian Oil Company). Before the end of the 1960's, five public sector refineries had been commissioned and Indian Oil Corporation had become the largest oil refining and marketing company in India.

Contd...

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History of Downstream Petroleum Industry

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Dedicated to the Memory
of the Architect of India's Oil Industry
Shri Keshav Dev Malaviya

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FOREWORD

The Oil industry in India started from the scratch in the post independent era, after having remained dormant during the colonial rule. Oil and Natural Gas Commission was established in the mid-fifties, and was later mandated to concentrate in the upstream segment. The downstream efforts initially began with foreign help but Indians were quick to learn. By the sixties, the Indian Downstream Industry began to be dominated by the public sector Indian Oil Corporation.

The first Oil Shock of 1973 troubled the western world. In India, it triggered the conversion of Exxon, Caltex and Burmah Shell into public sector moulds of Hindustan Petroleum and Bharat Petroleum respectively through negotiated purchase by the Government of India. Thus, nearly the entire downstream petroleum industry found itself in the public sector.

Thereafter, for nearly a quarter of century, the public sector Downstream Industry not only protected the nation from subsequent oil-related shocks, but also strengthened the national exchequer. In the process, the industry matured, acquiring the technical and professional skills to manage a globally-recognised Downstream Oil Industry.

With the winds of liberalisation blowing through India since 1991, the emergence of World Trade Organisation (WTO) and consequent globalisation, the Downstream Oil Industry was opened up to private entrants. Unlike the fifties, the private sector Oil Industry is now dominated by Indian entrepreneurs, though quite a few joint ventures with multinational corporations have also emerged.

The story of Downstream Oil Industry brings out the wisdom and pragmatism of independent India's policy-makers who continuously demonstrated an open mind, from the Industrial Policy Resolution of 1948 onwards, following the course of action which was in the country's best interest, without letting rigid ideology take the teeth out of commercial prudence.

Today, the Downstream Industry has come of age. The refining sector not only meets the entire domestic demand, a substantial proportion gets exported. Among exports, petroleum products constitute the second-largest earnings segment. Due to highly prospective geophysical location, India is well poised to emerge as an export refining hub. The marketing segment is, however, under acute pressure due to steep increases in the prices of crude oil in the last couple of years. The consumer prices of sensitive petroleum products having been administratively contained at lower levels, the oil marketing companies are experiencing huge under recoveries.

On an overall perspective, the industry is up against challenges. The silver lining is that challenges never come without opportunities. Going by the lessons of history, the nation reposes confidence in the ability of the industry to overcome the challenges and seize the opportunities, ushering in a brighter tomorrow.

R. S. Sharma
Chairman and Managing Director
Oil and Natural Gas Corporation Ltd.

ACKNOWLEDGEMENTS

The adventure associated with the Upstream sector is matched by the exuberance inbuilt in the operations of the Downstream sector in India. The growth and development of India's Downstream Oil Industry complemented the early success' of ONGC, both envisioned by the architects of India's Oil Industry, Pt. Jawaharlal Nehru and K.D. Malaviya.

It is an historic coincidence that the first 100 tonnes of crude oil from Ankleshwar field were ready for dispatch for refining by August 15, 1961, five years after the birth of ONGC. However, ONGC's symbiotic relationship with the Downstream sector started on September 1, 1961 when the first rack of Ankleshwar crude left the railway sliding at Panauli Station, Gujarat for the refinery destination at Mumbai. The umbilical connection ushered recognition much later when ONGC acquired MRPL in March 2003. Today, as an integrated energy major, the Upstream achievements of ONGC support the strategic growth plan of the Corporation in the Downstream sector.

Documenting India's Downstream petroleum sector and recounting its long history and growth with all its evergreen interventions carried out for the country's industrial and social transformation is considered to be a veritable marathon. The story with an innate rhapsodic charm had for long remained hidden in scattered memoirs, reports, balance sheets, articles, journals, managerial contributions and other publications.

We were privileged to have the indulgence of one of the Doyens of India's Downstream Oil Industry, B.K. Bakhshi, former Chairman of IndianOil for accepting and completing the task of documenting and editing the ***Downstream India*** as Chief Editor. Bakhshi carried out the stupendous task of creating and presenting the history with zeal and passion. He generated an infectious inspiration among the individuals who worked with the project receiving unstinted cooperation, data and documents for tracing the developments of the Oil Industry. The contents, are no doubt richer, with the association of Bakhshi.

Downstream India remain indebted to the zest and passion of Subir Raha, former C&MD of ONGC. Singularly, Subir Raha provided the road map for the book, demanding a level of excellence rarely seen in the Industry. We gratefully acknowledge his vision in conceiving and formulating the publication. The Chief Editor constituted a project set with the approval of the Chairman, MRPL to serve as a resource group, sounding board and an active tool during the preparation period.

We greatly appreciate the efforts, of this group of dedicated senior officials from MRPL which includes P.K. Atreya, J.M. Gugnani, R.K. Madan, N.K. Puri, A.Soni, S.C. Tandon and Veena Swarup. Avinash Ahluwalia, IndianOil (Retd.) as Member Secretary of the Project provided splendid coordination, leveraging his decades of Downstream experience. Associated with this project from the very inception was Raghavendra Rao, IndianOil (Retd.) who painstakingly helped in editing the entire material which has gone into the book.

Others who contributed in one way or the other towards the successful implementation of the project and worthy of appreciation are: P.K. Agarwal, V.K. Anand, P.V.R. Aiyar, A.K Arora, A.P Arora, K.M Bansal, B.M Bansal, Rahul Bali, D.J Barua, A.K Bhatnagar, S.C Bose, Rajiv Bakshi, Arun Balakrishnan, U.K Basu, H.S Bawa, P.Banerjee, Jayanta Bhuyan, R.M Bhatnagar, Prabhir K.Bora, V.K Chawla, Dilip Kumar Dash, Ashok Dhar, KK Dhingra, BK Das, Fakira Singh, PK Goel, BD Ghosh, G.P. Gupta, I.B Gulati, D.C Garg, L.K Gupta, BD Gupta, Mohan Guruswamy and his team, I.H Hashmi, T.L Jain, PK Jhulka, S.K. Jain, Jauhari Lal, Jaspal Singh, Rajesh Jhingan, CP Joshi, Suresh Kohli, TK Kumar, DV Satya Kumar, Sanjeev Muttoo, RK Malhotra, AK Mehta, Suresh Mathur, Leena Mehendale, KK Malhotra, RK Mitra, MP Modi, MA Mohammad Ali, Somaya Motwani, PK Mukhopadhyay, BB Munshi, J.K Nobis, R. Narayanan, JR Nanda, SB Nandi, R. Rama Krishna, R. Rajamani, P. Raghavendran, Ravi Chandran, S. Ram Mohan, Abhijit Roy, N.Srikumar, P.Sudarsnam, VC Sikka, Rajesh Sharma, SC Sharma, Sivanand Raja, Y. Sahai, C. Shankar, CK Sreemohan, SK Swaminathan, Gaurang Sinha, Shanti Narain, RK Sabharwal, CB Subramanian, VK Talithiya, AK Tare, BR Tyagi, N. Venketramani, G.Vasudev and Tapan Kumar De.

We would also like to gratefully acknowledge the untiring help provided by the MRPL secretarial staff.

Given the sheer dimension and logistical complexity of the project, the number of individuals are so large that there are bound to be some inadvertent omissions in acknowledgement. We think of those individuals as the real heroes of ***Downstream India***.

Dr. A.K. Balyan
Director (Human Resource)
Oil and Natural Gas Corporation Limited

EDITORIAL GROUP

In order to provide strategic guidance for the work to begin on ***Downstream India***, the CMD, ONGC, invited distinguished members of petroleum and allied industries to be a part of a special Editorial Group. All of them are well known personalities in their field of specialisation and their advice during the three editorial group meetings were invaluable. They are:

P P Bagchi, Ex-ED, Oil Coordination Committee.
Late R M Bhandari, Ex-CMD, HPCL.
Shashi Budhiraja, Ex-MD Marketing, IndianOil.
K L Goyal, Ex-Director (F), IndianOil.
Shanti Narain, Ex-Member, Railway Board.
Vineet Nayyar, Ex-CMD, GAIL.
A Aftab Niazi, Ex-CMD, IBP.
G K Pandey, Journalist.
Prabir Sengupta, D.G., Indian Institute of Foreign Trade
and Former Secretary Petroleum.
Dr S Vardhrajan, Ex-Chairman, IPCL.
H L Zutshi, Ex-CMD, HPCL.

The Editorial Group was the main guiding spirit behind the birth of ***Downstream India***. But for its valuable suggestions, comments and contribution during the various editorial meetings, this work would not have seen the light of day.

A special tribute is due to R M Bhandari, former CMD, Hindustan Petroleum who suddenly passed away when this work was under progress. He was one of the most active members of the Board and made valuable suggestions during the first and the only meeting he could attend.

For his invaluable guidance and contribution, a special appreciation is due to Subir Raha, former Chairman & Managing Director, ONGC, for not only presiding over the Editorial Group meetings but also for his studied suggestions even as work on the book steadily progressed. Many thanks are also due to Dr A K. Balyan, Director, Human Resource, ONGC, for his unstinted support and valuable suggestions throughout the course of compiling this book.

New Delhi
March 8, 2006

- B. K. Bakhshi

ABOUT THE CHIEF EDITOR

He is a man who gets passionately involved in whatever he does. At a time when he could have opted for a comfortable life working for any multinational of his choice in the USA, he chose to return to his motherland so that he too could take part in the industrial resurgence of building a strong and free India. No better opportunity could have knocked his door than to serve the fledgling public sector, IndianOil, for which he served in key posts for 31 long years. This, in brief, describes Bhishma Kumar Bakhshi.

Born in Peshawar in an undivided India, Bakhshi had his early education in the Doon School, Dehra Dun, and then went to USA from where he graduated in Chemical Engineering from the Oklahoma Agricultural and Mechanical College, Stillwater. Thereafter he obtained his Masters degree in Industrial Engineering and Management from the Oklahoma State University.

Joining IndianOil in 1963 after a short stint with Caltex, Bakhshi held senior positions in Operations, Personnel, Supply & Distribution, Shipping Engineering and Commercial Engineering and headed three out of four Regions of IndianOil's Marketing Division. He became Director (Marketing) in 1984 and was IndianOil's Chairman when he layed down office at the end of July in 1994.

Widely travelled both in India and abroad, Bakhshi, a multifaceted personality nurtures a deep interest in history, literature, music, art, cultural activities and sports. Reading and writing is yet another passion with him.

The present ONGC Golden Jubilee commemorative volume you have in your hands is the outcome of Bakhshi's life-long experience in the oil industry coupled with his more than 16 months of intensive study and research into the global complexities of oil economies and the dynamics of international politics.

As all of us are well aware that in today's world, oil and international politics cannot be separated. Hence, the story of the Downstream Petroleum Industry in India, prior to and after Independence was no different. It is an engrossing saga of how Indians took on immense challenges against heavy odds, building grass-root refineries, fighting market wars and evolving strategies against political machinations.

This is a book written keeping the lay reader in mind with contents enough to inspire a serious scholar for further research on the subject.

PROLOGUE

The material gathered and compounded in this book captures the history of Downstream Oil Industry in India as it unfolded over a period of little more than a century. An attempt has been made here to relate this long and complex story as simply, accurately and objectively as possible. This exciting saga with all its highs and lows, reveals how the Indian oil industry was born, nurtured and groomed to take up challenges by means of technological advancements so as to suit the needs of India's economy for the general economic development of the country.

The story begins long before India's Independence when Kerosene was imported in the late 1800's mainly for the purpose of illumination, a purpose for which it is still used today by majority of India's rural population. It was the discovery of oilfields around Digboi in Assam that opened the chapter on the history of Petroleum in India. This epoch-making event led to the setting up of India's and the world's oldest running refinery at Digboi in 1901 with a modest refining capacity of 25,000 MTPA. Over the years, i.e. by 1940, the capacity was raised to 500,000 MTPA.

However, the demand for petroleum products in India by far outmatched the capacity of the Digboi refinery. The shortfall had therefore to be met by importing oil from overseas. This was done mostly by various Anglo-American entities and subsequently a Dutch enterprise. Whereas Rockefellers' Standard Oil was in the Indian market from the very beginning the various British-Dutch interests consolidated themselves to form Burmah Shell in 1928 while Caltex commenced its operations in India in 1937 after it took over the business of the Texas Company.

On the eve of India's Independence the Downstream Oil Industry was entirely in the hands of the multinationals. AOC/BOC was the country's first and only vertically integrated oil company, while Burmah Shell, Standard Vacuum (Stanvac), Caltex and IBP were the main oil marketing set-ups. No new refinery was built in the country for over five decades, even though the demand for petroleum products had grown four to five times the size of Digboi's refining capacity. Perhaps the multinationals found it more advantageous to export petroleum products to India from their refineries in the Middle East.

In 1947 India inherited a largely agrarian, feudal society. Industrialisation, growth with social justice, self-reliance and modernisation was the abiding national sentiment after Independence and consequently there was a powerful consensus in favour of developing and building indigenous refining capacity.

The future of the Downstream Oil Industry was most significantly affected by the formation of the Industrial Policy Resolution of 1948 which, while envisaging a Mixed Economy consisting both of the Public and the Private sectors, had reserved the Oil Industry for the former. However, the Resolution was pragmatic enough to mention that if the State found it necessary it could secure the cooperation of the private sector dealing in Oil.

On 26th January 1950, India—the world's largest Democratic Republic, came into being with an avowed aim of building a Sovereign, Socialist, Secular Republic. This was quickly followed in March 1950 with the formation of the Planning Commission, as already envisaged by Pandit Jawaharlal Nehru and Netaji Subhash Chandra Bose in the 1937-38 Congress Working Committee Resolution.

This event led to the formulation of the Five-Year Plans - the First-Five Year Plan came into being in April 1951. On the basis of the advice of the Planning Commission and the experience gained since 1948 a new Industrial Policy Resolution was framed in April 1956. While retaining the concept of a Mixed Economy, the new policy laid even greater emphasis on the Public Sector, including the Oil Industry. It also highlighted amongst other things the need for reducing regional imbalances and industrial disparities. India's desire for self-reliance was clearly reflected throughout, both in the letter and spirit of this Resolution.

The period (1947- 60) was a watershed in India's Oil Industry. These thirteen years saw important developments in the Oil Industry all over the world, particularly Prime Minister Mohammad Mossadegh's nationalisation of the Oil Industry in Iran in 1951. In India this was followed by the emergence of three new coastal refineries in the private sector set up by the multinationals—Stanvac, Burmah Shell and Caltex which gave a major impetus to the development of indigenous skills and know-how in refining technology.

This period also saw the formation and the birth of the public sector oil companies in the form of ONGC (Upstream), Indian Refineries Ltd (IRL) and Indian Oil Company Ltd. (IOC) for marketing — and India's first R&D effort for the Hydrocarbon industry with the formation of Indian Institute of Petroleum (IIP) at Dehra Dun. These developments laid down the preliminary format and the foundation of a National Oil Industry.

Finally, it was during this era that the Oil Price Enquiry Committee was set up under the chairmanship of K.R. Damle which ultimately led to the establishment of a rational pricing mechanism for petroleum products in India. Thereafter, the initiative on the pricing of petroleum products shifted from the hands of the multinationals to the Government of India. As has been demonstrated in this narrative, the Damle pricing formula ensured a reasonable return to the Oil Industry while building in very strong incentives for economy and cost reduction. All these developments played a crucial role in India's march towards industrialisation and self-reliance.

If the period 1947-60 was a watershed in the story India's Downstream Oil Industry, the period 1961-73 saw the bud flowering into full bloom. While inaugurating the 2.0 MMTPA Burmah Shell Refinery in March 1955, India's Vice President Dr. Sarvepalli Radhakrishnan in his inaugural speech described the new Refinery as an illustration of international cooperation. He, however, added a note of caution saying "...but if there is no cooperation, if there is any kind of snag then possibly the Government may be induced to revise its policy".

Similarly, in his inaugural speech while inaugurating the Caltex Refinery at Visakhapatnam on 30th November 1957, N. Sanjeeva Reddy (the then Chief Minister of Andhra Pradesh, later President of India, 1977) appealed to the Indian employees of CORIL to give "Total Cooperation" in making the venture a success and stated that India's prosperity depended upon industrial development and that the country needed the goodwill of foreigners. This clearly revealed India's readiness to cooperate with the multinationals, commensurate with India's "National Interests".

The discovery of crude oil in Assam (Moran and Nahorkatiya) in 1956 triggered off the building of the Guwahati and Barauni refineries in the Public Sector by IRL. Similarly the discovery of crude oil in Ankleshwar in 1960 became instrumental for setting up of the Koyali Refinery near Vadodara. While inaugurating India's first Public Sector Refinery built with Rumanian technical support at Guwahati on 1st January 1962, India's first Prime Minister Pt. Jawaharlal Nehru made the prophetic statement, "We are beginning the new year with an auspicious ceremony—which will usher in a new Era in India and our Industrial life". In the meantime, with the merger of IRL with the Indian Oil Company Ltd, the IndianOil Corporation Ltd., came into being on 1st September 1964.

The Koyali Refinery was formally inaugurated by the President Dr. Sarvepalli Radhakrishnan in October 1966. In his inaugural speech the President strongly emphasised the need for self-reliance and India's ability to convert her resources for products useful to society. It was during this period that in an effort to develop indigenous design skills the Central Design Organization (CDO) was formed in Vadodara. The CDO not only designed the third one million metric tonne unit for the Koyali Refinery within the original budget but also designed the third one million metric tonne unit for Barauni Refinery. The CDO was to later provide a sound foundation to Engineers India Ltd. — India's premier consulting organisation in the process Industry.

As the demand for petroleum products in India grew year after year, the indigenous refining capacity needed to keep pace, theoretically requiring a new 2.0 to 3.0 MMTPA refinery every year. There was also a strong feeling in the country that future refineries in India should incorporate the latest state-of-the-art technology.

Two 'such' stand-alone coastal refineries were soon commissioned. The first was in 1965 at Cochin (Kochi) and the second was commissioned in 1969 at Madras (Chennai). While both were in the Public Sector, both were also unique Joint Ventures with multinationals. In the case of the Cochin Refinery 53.83 % of its equity was owned by the Government while Phillips Petroleum held only 26.4%. In the case of MRL, while the Government owned 74% of the equity the balance was divided equally between the technical collaborators, AMOCO (a subsidiary of Standard Oil of Indiana) and the National Iranian Oil Company, the crude oil supplier.

While inaugurating Cochin Refinery in September 1966 the then Prime Minister Mrs. Indira Gandhi stated *inter alia*, "We must work for the time when India can design and build complete refineries and other chemical plants indigenously". This was partially achieved, when the main process design for MRL was carried out through EIL who at that time had a partnership with Becthel International; and almost fully achieved its goal when EIL designed and built the additional 3.0 MMTPA crude distillation unit for the Koyali Refinery in 1977 as a part of its expansion plan, which included a state-of-the-art FCCU as a secondary processing unit.

The commissioning of MRL (now Chennai Petroleum Corporation) was an important landmark in the history of Indian refinery technology. Apart from being the country's first Lube Integrated Refinery, according to Amoco, it was the best refinery east of Suez and thereafter all subsequent refineries built in India were second to none in refinery technology anywhere in the world.

Whereas five Public Sector refineries were commissioned during the period 1961-1973, five Joint Ventures with the multinational oil companies (IOBL, CRL, MRL, Lube India and Lubrizol) also emerged during this time. This event not only demonstrated the pragmatism in India's conduct but also demolished the canard that India had a 'closed' economy as far as the oil Industry was concerned.

The Yom Kippur War in October 1973 between Israel on one side and Egypt with Syria on the other, and the subsequent oil embargo had major repercussions for the International Oil Industry, including the downstream Oil industry in India. The crude oil price initiative shifted from the so-called Seven Sisters to the OPEC, who announced an increase in the price of Marker crude from $3.0 per bbl to $5.0 per bbl on 13th October 1973, and a further price increase to $11.60 per bbl after its meeting in Tehran on 22nd December, 1973. The era of cheap oil had obviously come to an end for all time to come.

The most immediate fiscal impact on India after the sky-rocketing crude price was the phenomenal jump in her import bill, which pole-vaulted from Rs.207 crore in 1972-73 to Rs.1181 crore in 1974-75. A more important long-term effect on India of the Yom Kippur War was the accelerated desire on the part of Burmah Shell, Esso and Caltex to sell their assets to the Government and quit India. The general environment in India at that time also favoured such a development. This led to the acquisition of these companies by the Government of India through an amicable negotiation and the emergence of Hindustan Petroleum Corporation (of what was former Stanvac/Exxon and Caltex) in March 1974 for Esso and end 1976 for Caltex and Bharat Petroleum Corporation the former Burmah Shell in December 1975.

By September 1981, Assam Oil Company (AOC) (downstream) merged with IndianOil, whereafter the entire oil Industry (downstream) came under the national fold. After these events there were two other important consequences for India. First was the beginning of a serious movement for the Conservation of Energy followed by the emergence of Petroleum Conservation Research Association (PCRA). The second event was the acceleration of R & D efforts in India and the coming up of R & D activities by EIL and IndianOil.

With the acquisition of the multinationals by the Government of India, the Oil Industry became truly Indian in character and ownership. Since the President of India was the common owner, there was an obvious need for far greater Inter-Oil company cooperation, coordination and consolidation, than had been the case hitherto. In addition to IndianOil, HPC and BPC (the new PSU's) had also become publicly accountable. Simultaneously public expectations of the Oil Industry had also gone up very considerably. While duplication and wasteful investments had to be avoided, the Industry had to ensure that every nook and corner in the country, especially the less developed and remote areas received their full requirement of petroleum products. Also the Administered Pricing Mechanism(APM) had to ensure company-wise viability so that adequate funds were available for the investments needed (including expansion of the existing refineries and the building of new refineries) especially for the new PSUs (HPC/BPC) who had seen little growth and almost nil investments since 1965.

A new pricing policy also appeared to be unavoidable. Fortunately the 4th Oil Price Committee under the Chairmanship of Dr. S. Krishnaswamy was constituted by the Government of India on 16th March 1974 just around the time that it had acquired 74% of the equity of ESSO and the buying over of Burmah Shell and Caltex was quite on the cards. The new Price Committee could not have come at a more appropriate time and took care to address all issues relevant to the oil industry in the public sector as highlighted above. In its interim report in January

1975 the OPC recommended the formation of the Oil Coordination Committee as the principal agency of the Government to provide central direction to the Oil Industry in the national interest and ensure Inter-Oil company coordination.

This recommendation was accepted and the OCC came into being in July 1975. Although the OCC was a Government body reporting to the Ministry of Petroleum, it was manned by officers from the Oil Industry. The above was a unique innovation which helped considerably in building an Oil Industry team spirit and a cohesive approach to solve problems. In a major departure from the import parity principle, the OPC in its report recommended that each refinery become a uniform pricing point and introduced the Retention Price/Retention Margin concept, stipulating that each refinery and marketing company to earn a gross return of 15% on capital employed.

This clause enabled Oil Companies to invest capital for expansion and yet remain viable. The final report by OPC was submitted in November 1976 and implemented by the Government on 15th December 1977. In another very significant recommendation, the Krishnaswamy Committee recommended the pooling of all available products and sharing the same amongst the Oil Companies (who except for AOC were all PSUs) according to what was called the Sales Plan Entitlement (SPE).

These principles were further updated and fine-tuned by the Iyer Committee (Oil Cost Review Committee) which was formed by the Government in 1983. In its report submitted to the Government in July 1984, while broadly following the same principles and concepts of Krishnaswamy's OPC, the OCRC reworked the Retention Margins to enable an 11% post-tax return on net worth. These recommendations remained in force till the final dismantling of the APM.

There was some valid criticism over a period of time that the Retention Price/Margin concept was a cost-plus formula without adequate incentives for cost reduction. However, on the whole it can be stated that the public sector oil industry gave an exemplary performance, not only in terms of financial viability but in ensuring steady supplies, allowing no breakdowns anywhere during all internal and external crises or national disasters the country had to face. The Industry also demonstrated its deep commitment to its social responsibilities. Under the guidance of the Ministry of Petroleum, the industry reserved a very substantial number of dealerships and agencies for candidates from weaker segments of society, ex-servicemen, physically handicapped etc.

The narrative in this work reveals the sterling role played by the doyen of the Oil Industry, late K.D. Malaviya, Minister of Petroleum. During his first tenure (1952-1963), Malaviya was responsible for the formation of ONGC, IIP, IRL and the Indian Oil Company. During his second stint in the Ministry (1974-1977), he presided over the amicable conversion of Burmah Shell, ESSO and Caltex into BPC and HPC, respectively. The Oil Industry owes a deep debt of gratitude to this great pioneer and the father of India's Oil Industry.

It would be in the fitness of things, and the right place to also acknowledge the invaluable help, cooperation and technical assistance the Downstream Oil Industry in India received from the erstwhile USSR. It was they who first supplied petroleum products to the Indian Oil Company not only on Rupee payment but also on very favourable commercial terms. The arrival of the first Soviet tanker *UZHGOROD* on 17th August 1960 with a modest cargo of 11,000 MT of HSD was the harbinger of IndianOil's vast marketing network. For more than 30 years the USSR and later on Russia remained the main supplier of deficit products to India regardless of all the International political turmoil, including the First Gulf War. It was the USSR which helped the fledgling IRL and Indian Oil Corporation to build three refineries i.e. at Barauni, Koyali and Mathura.

One important reason why the Soviet offer was accepted over the others for the building of the Barauni Refinery was because the Soviets agreed to transfer technology, while others did not. Similarly during the construction of the Koyali Refinery, Soviet engineers readily agreed to associate 35 Indian engineers who formed the core team of the CDO and shared with them whatever they knew. This was a major step forward in developing indigenous know-how and ability of Indian engineers to absorb any foreign technology. It would be no exaggeration to state that the USSR played the most significant role in helping build IndianOil and thereafter in maintaining a steady supply of deficit products to the country.

Up to the time of the commissioning of the Mathura Refinery the gap between India's demand for petroleum products and its refining capacity was manageable and was bridged through imports. However, from the mid-1980s onwards this gap became dangerously wide in a progressively deteriorating international political situation. The year 1991 was more than eventful for the oil industry from several points of view. The Iraq-Iran war had hardly ended in August 1988, when Iraq invaded and occupied the prolific oil producing Sheikhdom of Kuwait in August 1990. This was followed by the First Gulf War in January 1991. Earlier the fall of the Berlin Wall in November 1989 triggered off a chain of events leading to the collapse of the USSR by 31st December 1991 and the emergence of a uni-polar world.

Having broken the shackles of only 3.5% growth per annum (the so-called Hindu rate of growth) from 1975 onwards, the average growth of India's economy jumped to 6%. However, this was no way near the economic growth of similarly placed countries in the neighbourhood, particularly China. With the coming up of the WTO, the accompanying globalisation was clearly on the cards. Time had come for India to re-examine and re-orient its industrial policies. From the year 1991-92 onwards the era of economic reform and the liberalisation of economic policies commenced; and as far as the Oil Industry was concerned it culminated in ending of the APM and the dismantling of the OCC with effect from 1st of April 2002.

India, however, remained a Mixed Economy as it had been when it first began its process of industrialisation from 1948 onwards. During the period often called the Era of Liberalisation, Privatisation and Globalisation (LPG); oil companies in the private sector emerged and several Joint Ventures between multinational oil companies and Indian oil companies were formed. The late 1990s saw the coming up of the Joint Venture MRPL Refinery (March 1996), the commissioning in July 1999 of the private sector Reliance Refinery at Jamnagar (now operating at 33.0 MMTPA), the commissioning of Panipat, Numaligarh and Tatipaka Refineries (all in the Public Sector) in October 1998, April 1999 and September 2001, respectively. Thus the benefit of India's liberalised economic policies was taken by all the Oil Companies, public and private sector alike.

The year 2005-06 may possibly be the third year in a row in which the Indian economy grew at more than 7%. India is now poised to emerge as a major economic giant in near future. It is now no longer a case of lack of resources or lack of technical know-how or lack of skilled and experienced human resources or presence of policy inhibitions; it is now a case of excellence in governance and management.

Despite the fact that oil's becoming a scarce resource, with increasing international demand, the future holds many challenges and opportunities for the downstream oil industry in India, including the immediate challenge of the phenomenal rise in the price of crude oil. It is expected that the Industry will again rise to the occasion and successfully meet this challenge.

CHAPTER I

First Era: Pre-1947

This period marks the pre-Independence period of India's Oil Industry, including the emergence of India's and Asia's first Refinery at Digboi.

Oil Through Ages Up to Independence of India (1947)

The story of oil is as old as the story of civilisation and stands at the very dawn of recorded human history. About 4,000 years ago, the ancient Sumerians inhabiting the fertile valleys between the Tigris and Euphrates Rivers (now in modern-day southern Iraq) began building *Ziggurats* (pyramidal temples) around 2100 BC at Ur, their capital, and became the first human beings to use hydrocarbon in its natural form. The Sumerians, who were also responsible for inventing the written word, built their *Ziggurats* with burnt bricks; each of them numbered in the cuneiform script, and then they firmly bonded them with, guess what, natural asphalt!

In India it is said that the bottom of the Great Bath in Mohenjodaro (of the Indus Valley Civilisation) was kept water-tight with 2.5 cm thick skin of Bitumen seale between two layers of brick. In addition, we had Natural Gas from the earliest times. At Jwalamukhi near Kangra, natural jets of combustible gas spewing from the bowels of the earth is still believed to be the manifestation of goddess Durga. People, it is said, knew the fires of Jwalamukhi, right from the days of the *Mahabharata.*

The earliest recorded reference to petroleum and its uses in India, strange to say, is not found in any Indian epic but in a Persian one! The great Persian poet Firdausi in the epic *Shah Nama* describes how Alexander the Great during his invasion of India in 326 BC spread panic amongst the war elephants of Porus (Paurava) by unleashing a thousand thundering horses each strapped with a blazing naphtha container.

Although oil was used to keep fires ablaze in early human history, its importance in the world economy evolved slowly. Prior to oil, it was either wood, coal or cowdung that was commonly used in India for heating and cooking. But in the month of August 1859, in far away USA, a 'Colonel' Edwin Drake drilled the first successful oil-well in Titusville, Pennsylvania, USA with an antediluvian derrick meant for striking water below the surface of the earth and to his pleasant surprise struck oil at the depth of 70 feet. Drake thus became the first man to launch the 'Oil Rush' in Titusville and set the ball rolling for what would in the course of time revolutionize the economy of the entire world.

Only seven years had passed since Col. Drake's discovery when Mr. Goodenough of McKillop Stewart Company in India drilled a well near Jaypore in upper Assam and struck oil in 1866. Mr. Goodenough, however, failed to establish a good enough production. By 1882, the Assam Railway & Trading Company (ARTC) acquired rights for the exploration of about 48 square kilometers in the same area. With the success of historic "Well No.1" in the wilderness of Digboi in 1889, the venture became a viable proposition for the commercial production of crude oil in Upper Assam. Thus unobtrusively and unbeknown to many, in a quiet corner of Assam began the saga of the oil industry in India.

In 1893, rights were granted to the Assam Oil Syndicate which erected a mini-refinery at Margharita (probably because it was the headquarters of the ARTC) to process crude oil from Makum and Digboi. For six years the oil from Digboi and Makum was transported to Margharita by rail in tank wagons. The refinery produced only Kerosene, lube oil and wax.

In 1899, the petroleum interests of ARTC were taken over by the Assam Oil Company (AOC) and a refinery designed to process about 500 barrels per day (BPD) was commissioned at Digboi in 1901 supplanting the earlier one at Margharita. The Digboi oil refinery thus became India's first and the only operating Refinery in Asia at that time.

Simultaneously several developments were taking place the world over, giving birth and the impetus for the growth in the demand for petroleum products. In 1876, Nicholas Otto built the first practical four-stroke spark ignition engine ultimately leading to the mass production of Henry Ford's famous Model 'T' cars. This not only revolutionized road transportation in the USA but also generated a huge demand for Motor Spirit and spearheaded a veritable revolution in the manufacturing industry in the United States of America.

It was also around this time that the famous brothers Wilbur and Orville Wright flew their first aircraft (1903) setting off a demand for Aviation fuels. In 1898, Busch Sulzer built the first American compression ignition (Diesel) engine. In 1904, the United States Navy experimented with oil engines in Torpedo gunboats and the Nobel brothers introduced the first diesel-fuelled 120-horse-power oil tankers (*Vandal and Sormat*).

With all these rapid developments originating in the United States, India's and Asia's first operating refinery at Digboi could not have sprung up at a more opportune time marking the first major step in the downstream oil industry in India. Considering the development of the oil industry in countries across the globe and the fact that oil had come to stay, India could proudly rank herself among the front-runner countries.

Just around late 1860s saw the arrival of a new illuminant in India - Kerosene. Imported mostly either from the USA or U.K., Kerosene began illuminating the lives of the people mainly living in metropolitan cities of Bombay and Calcutta. Only the rich could afford Kerosene to light up lamps in their homes. The poor had the luxury of having their streets illuminated by Kerosene lamps.

In 1880-81, Bombay had 224 Kerosene street lamps, while gas lamps numbered 3,177. In 1882, some 740 Kerosene lamps lighted the streets of Calcutta. This was just a small beginning. Soon by the end of the 19th century, Kerosene had penetrated deep enough to illuminate even the humble huts in the villages of India.

American Kerosene dominated the Indian market. But in 1885 the Americans got a jolt. Russian Kerosene began arriving at Indian ports in small consignments. In 1886, the trickle became a flood, as there was a big spurt in the crude output from the Russian oilfield in Baku. The production touched a whopping one million tonne. That year, 1,577,000 gallons (6,000 metric tonnes) of Russian Kerosene arrived in India; and the "very first cargo brought to Bombay by *Rimpha* was an outstanding success. Fresh orders came pouring in at once." And Russian Kerosene "took a firm hold of the market." Russian Kerosene drew its strength not only from its ample availability ex-Baku, but also because of the steep, favorable price difference because of the short haul, which made Russian Kerosene far cheaper than the American product, which had to come from a place very far off than Baku.

The Rothschilds, founders of the world famous private merchant banking empire, became the largest exporter of Russian Kerosene to Europe and the East, which included India. American oil tycoon John D. Rockefeller's Standard Oil, which had become the largest manufacturer of illuminating oil (Kerosene) in the world, soon realised that the cheaper Russian Kerosene posed a serious threat to American Kerosene, which till then had dominated the Indian market.

Exports of American Kerosene to India which had peaked at 29.14 million gallons (88,900 metric tonnes, approx.) in 1886-87, drastically dropped to 20.65 million gallons (63,300 metric tonnes, approx.) in 1888-89. In order to counter this challenge, Standard Oil imported into India of 35.9 million gallons, (110,000 metric tonnes, approx.). Standard Oil had also decided to launch a price war so as to keep Russian oil out of the market.

In the United Kingdom, Marcus Samuel set up his "Shell" Transport and Trading Company in 1897. In collaboration with the Rothschilds he controlled a group of Russian refineries and producers. He then began to export Kerosene to the Eastern markets from Batum. Earlier in 1892, Marcus Samuel had successfully persuaded the Governors of the Suez Canal to permit the passage of illuminating oil in bulk under strict regulations. By obtaining this concession, Russian Kerosene scored over American Kerosene even more because, 'Petroleum travelled from Batum to India in 30 days, compared with the passage of four-and-a-half months from Eastern Coast of the United States.

Marcus Samuel was smart. He simultaneously obtained a long, ten-year commitment from the Rothschilds on Kerosene supplies. In 1893, consumption in the six chief markets of the East — Bombay, Calcutta, Hong Kong, Shanghai, Java and Japan — had already reached the level of 25 million cases, with an annual increase of three million cases. By 1899 Russia's share of world production was 50.3 percent, while that of the USA was 43.5 percent.

During this period of the Russian-American price war, what perhaps turned out to be of far greater importance and significance was the birth of the Royal Dutch Company in 1890 under Henri Deterding. His company soon grew into an empire in no way smaller than Rockefeller's Standard Oil. Henri Deterding achieved success far more spectacular than either Rockefeller or Marcus Samuel. This happened after Deterding successfully forged an alliance on 27th June 1902, between the Royal Dutch, Shell and the Rothschilds combining the threesome to form a new single giant group, the Asiatic Petroleum - which was primarily set up to tackle marketing operations in India and the East.

Another British giant to enter the Indian market was the Burmah Oil Company (BOC), which was founded in 1886. The company began with "a syndicate of Scotsmen" who although between them had very little capital, which was offset by a far greater determination. Their major area of interest was Burma, where they operated the first machine-drilled oil-well, and set up two refineries one at Dunniedew and the other at Syriam near Rangoon.

Much before the arrival of BOC in Burma, an enterprise known as the Rangoon Oil Company had operated a refinery from 1870 to 1876. The BOC arrived in Assam around 1911. In 1921, BOC purchased all the shares of Assam Railway & Trading Company and took over the Assam Oil Company. Burmah Oil's production from its oilfields in Burma had more than trebled from its production in 1893 to over one million barrels in 1901. BOC also had access to crude from the Persian Gulf from its interest in British Petroleum (BP).

The Burmah Oil Company enjoyed two great advantages. The first was its proximity to the vast potential market in India. Secondly, between 1899 and 1900, the company acquired two tankers of 2,000-ton each "for the run from Rangoon to the Indian river ports." The company also built "a marketing network based on all the main Indian ports", and "soon expanded its operations over the whole of the sub-continent." In Eastern India, the BOC sales seriously affected the interests of Shell, Royal Dutch and Standard Oil. By about 1900 the BOC was "successful to a great extent in ousting Russian oil from the Valley of the Ganges."

The second singular advantage BOC had was the patronage it enjoyed from the British Government. There had been, for instance, a tariff protection since 1888. Shell, Royal Dutch and Standard Oil demanded doing away with the "discriminating treatment", so that they all could "compete on equal terms" with BOC. Standard Oil even lodged a protest through the American Consular Service and the State Department. The British Colonial Government summarily rejected their proposals.

Price wars and internecine rivalry between the three main adversaries—Standard Oil, Asiatic Petroleum and BOC raged unabated. One aspect of this price war was the introduction into India of cheaper and the lower quality Inferior Kerosene. The oil companies used this product in cutting into each other's market share. In October 1905, Asiatic and BOC—finally called a truce and came to a market sharing arrangement and signed a product exchange agreement. Standard Oil, however, was left out of this arrangement.

Prices and supplies stabilised from 1911 onwards after Abadan became the main source of supply of petroleum products into India. By 1910 Standard Oil had recovered from the setback it had earlier suffered at the hands of Marcus Samuel. But its conflict with Asiatic and BOC — escalated further and peaked in 1927 when Standard Oil once again and resolutely returned to the "battlefield".

The cause of the 1927 market battle was Russian oil once again. Asiatic Petroleum and BOC branded the product as 'tainted oil.' Interestingly this was the same stand the three multinational companies (Esso, Shell and Caltex) took in 1965 by refusing to market Soviet Petroleum products by branding them as "Red Oil". Standard Oil backtracking from its earlier stand to Russian oil defied Asiatic by importing cheap Russian oil into India. Anglo-Dutch interests dubbed it as "pilfered" or "stolen". This was a baseless accusation and happened to be an extension of the previous "price wars". From India, Deterding took the "war" to Standard Oil's turf in USA, while Standard Oil did the same to them in U.K. Since none could have made any substantial gains, a stage was set in 1928 for "an international live-and-let-live policy" for the international giants to pursue.

The year 1928 saw the formation of Burmah Shell Oil Storage & Distributing Company of India a 50:50 partnership between Burmah Oil Company (BOC) and the Royal Dutch Shell group. It was incorporated as a private limited company on January 6, 1928 in England with its registered office in London. It took over the marketing operations of Burmah Oil Company Ltd. and the Asiatic Petroleum Company (India) Ltd, in India. The latter became known as Shell Company of India Ltd., a wholly-owned subsidiary of Shell Petroleum Company Ltd., UK.

Burmah Shell's marketing operations covered the whole of India, including Jammu and Kashmir, except Assam, Manipur and Tripura, an area that was reserved for the Burmah Oil Company (India Trading) Ltd., a wholly-owned subsidiary of Burmah Oil Company Ltd. The British majors had thus joined hands and synergized to pool in their considerable individual strengths.

The need for cooperation between the oil majors was recognised by them especially at a time when there were major oil discoveries in the Middle Eastern countries of Bahrain, Kuwait and Saudi Arabia, whose uncontrolled production would have proved a recurring source of instability in world oil markets resulting in frequent price-cutting wars. Consequently Deterding invited Walter C. Teagle, President of Standard Oil, and Sir John Cadman, Chairman of Anglo-Persian, to his castle at Achnacarry in Scotland. An agreement was reached around August 1928 and was termed: "As is Agreement of 1928" that laid the foundation for control and command over the world of oil outside the USSR by the oil majors.

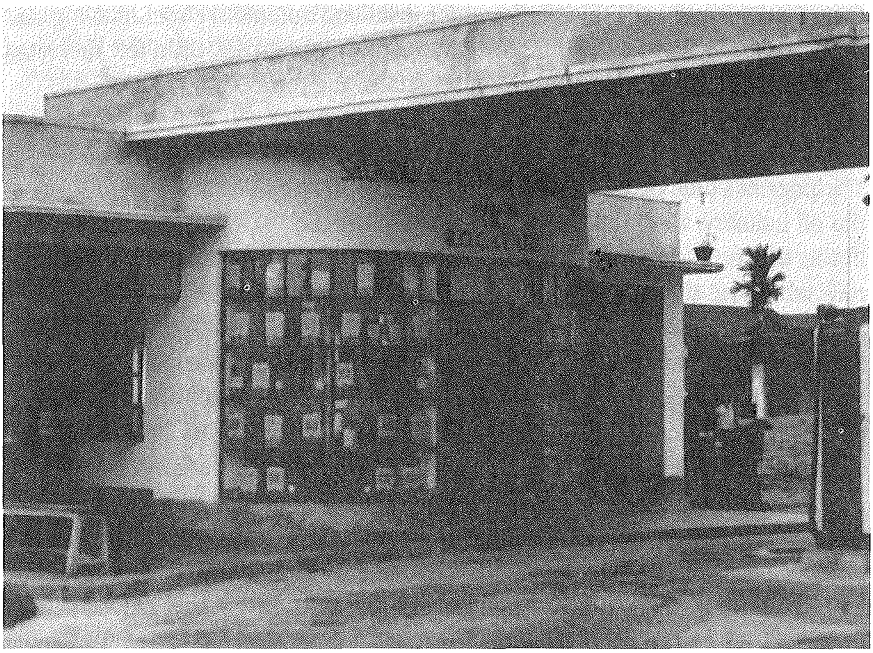
This historical document bore the title of "Pool Association". Out of this association was born the International Petroleum Cartel, which maintained peace through controlled production and fixing of prices over the next half century, or even more, until it was challenged in 1959 by a similar association of the oil-producing countries of the Middle East in the OPEC (Organization of Petroleum Exporting Countries). While the OPEC failed to achieve success over the next decade and a half, during and after the Arab-Israel War of October 1973, price initiatives passed on to the OPEC nations. With that the sun began to set over the oil empire of the Seven Sisters.

Very soon this select band of vertically integrated western oil companies popularly known as the "Seven Sisters" began dominating the petroleum industry in all spheres of exploration, production, refining and marketing all over the world. Their dominance continued well through the 1950s.

In 1928, through the 'Achnacarry Agreement' the oil companies evolved seven principles to govern group action lending credibility to the Seven Sisters being called a 'Cartel'. In 1950, they controlled 85% of crude oil production, 75% of refining in the world outside USSR. The Standard Oil Company (which later became ESSO in India) had commenced supply of Kerosene in India as early as 1882. In 1901, the Asiatic Petroleum Company entered the Indian markets, to be replaced by Burmah Shell in 1928, while Caltex started their operations in 1937 by taking over the business of Texas Company (India) Ltd.

At the time of India's Independence, companies that were marketing petroleum products in India were: Burmah Oil Company (India Trading)/Assam Oil Company, Standard Vacuum (Stanvac which later became Esso) Burmah Shell, Caltex and Indo-Burma Petroleum Company. The last named company was founded in collaboration with Steel Bros in Burma in 1909 by an Indian entrepreneur named Abdul Karim Abdul Shakur Jamal for refining and marketing of petroleum products in the British Empire.

The company (IBP) had built and commissioned two refineries in Burma. They began operations through an office in Calcutta in 1909. In 1942, when the Japanese invaded Burma during the Second World War the company was forced to suspend its operations and obtained registration in India. Unfortunately from 1901 onwards, little progress was made in India in the field of refining as no new refineries were built thereafter till the mid-1950s possibly because India did not figure in global strategies of the 'Seven Sisters', as also because no new major oil resources were discovered in India till after India's independence.



Assam Oil's first Retail Outlet operated by Saligram Rai Chunilal Bahadur & Co. (SRCB) at Dibrugarh in 1928

Basically, the 'Seven Sisters' kept themselves busy concentrating in exploration and discovery of cheap crude resources principally in West Asia, and other than in their own countries were busy investing money in building refineries only at those locations where they were in close proximity to oil producing centres like Abadan, Ras Tanura etc. Since Digboi produced only 10% of the country's requirement, the balance of more than 90% of India's oil growing needs of POL were met by products imported from the sources owned by the multinationals operating in India. One need hardly emphasise that at the dawn of India's Independence in 1947, international oil majors (part of the Seven Sisters) overwhelmingly controlled the oil industry in India.

In June 1947, the Government of India invited the cooperation of the oil companies operating in India through the Lawson Committee for establishing two small refineries say at Vishakapatnam and Bombay or other suitable ports. However, the oil companies concerned expressed "their doubts as to the economic and general desirability of erecting small refineries".

Kerosene and Motor Spirit was initially sold in packs. In most markets, they were sold along with other items of trade, as no petrol or service stations existed. As the demand for the products grew, barrels replaced jerry cans. It was in the late 1920s that manually operated pumps with underground tanks were installed at a few locations and with this the trend for installing automotive fuel retailing stations began. This led to the introduction of tank-trucks. In 1930s, a few fuel retail outlets were built with driveways set back from the roads.

Pricing Of Petroleum Products In Pre-Independent India

The price of crude oil and petroleum products obviously lies at the very heart of the oil industry. Until the advent of the Administered Pricing Mechanism (APM) in the 1960s, pricing was a tightly guarded secret of the multinational oil companies who were the only players in the Indian market. Kerosene then was by and large the main product of consumption in India supplied mostly by Rockefeller's Standard Oil. It has already been seen how the cost of Kerosene crashed after the import of Russian oil by British oil interests. This led to a major drop in Standard Oil's market share, which in turn fuelled a series of price wars between the oil companies not only in India but also in the USA and other western countries.

Opening up of the Suez Canal (1892) and the advent of ocean-going tankers were also responsible for bringing down the price of petroleum products. The last of these price wars as already mentioned escalated in 1927. This time, reversing their roles, it was Standard Oil that was keen to import the cheaper Kerosene from the USSR, while the British oil companies (Asiatic Petroleum and BOC) were more comfortable in importing products from the nearby Abadan Refinery and opposed to what they called the import of 'tainted' Russian Oil.

Finally, the international oil companies cartelised through the Achnacarry Agreement of August-September 1928 put an end to their internecine price wars and gave birth to the 'Seven Sisters'. Thereafter the prices paid for products imported into India were based on posted prices at the Gulf of Mexico plus notional freight from there to Indian ports, plus normal and war risk insurance.

Quoted below are extracts from the book, *Oil Rich Man Poor Man* by S S Khera, former Cabinet Secretary to the Government of India and Secretary to the Ministry of Oil, Fuel, Coal & Chemicals (pages 52-53):

"In India, these arrangements were supplemented by local arrangements in the Department of War Supply. A Directorate of Petroleum was created, grouped with three other Directorates under a Deputy Director General of Supply, with a Director General of Supply in overall charge, under the Minister of War Supply. Administratively, however, the Petroleum Directorate was a sort of self-contained, isolated within the Department of Supply. Personnel drafted from Burmah-Shell manned it, and acting under the general directions of a Committee whose Chairman was the General Manager in India of Burmah Shell, which included members of other oil companies. This Committee worked out the average price of each product every six months, within an agreed formula and within the pricing parameters as already noted and subject to the nominal approval of the Indian

Government, but actually controlled from London. The actual distribution remained with the different oil companies, through their existing installations."

This arrangement was to last till the emergence on 1st April 1950 of what would be known as the Value Stock Adjustment, or in short, the VSA Agreement between Burmah Shell and the Government of India. Thus for all practical purposes this was a multinational oil company which controlled and managed the APM till the dawn of India's Independence and thereafter till the 1960s.

During the thick of the 1927 inter-oil company price wars, the Indian Tariff Board conducted an enquiry on the price of various petroleum products. The Board had as its Chairman P. P. Ginwala and members included Dr. John Mathai (who later became the Finance Minister in the Government of Independent India). The British oil companies had requested for new protective tariffs against the import of Soviet petroleum products into India.

Khera from the same book already noted. Ref. pp 49 had this to say on the subject.

"Mr. Ginwala made a number of far reaching, long-term recommendations. These included the setting up of refining capacity in the country; the containment in some form of the price cartel of the oil companies; the introduction of some effective measure of competition in the import and distribution of oil products; and a degree of government control over the trade in oil. Mr. Ginwala even went so far as to say that imports of oil and oil products should be canalised through a company based in India, with a mandate to tap the cheapest sources of oil, and should not be left to the foreign oil companies operating in India. But Mr. Ginwala's was a cry in the wilderness; although the future was to show how right he was. It was not the policy of the British ruling power to encourage major industrial development in India. Since practically all major industry and foreign trade of India was in any case in the hands of British companies, there was no great urge on the part of the government to do other than leave things to their care. The country had to wait two decades, until after independence, for things to change in the direction recommended by the Tariff Board Chairman in 1928".

Initially the main product sold in India was Kerosene. Inferior and Superior Kerosene oil were basically used as illuminants. Kerosene agents also sold Light Diesel Oil (LDO) for stationary low rpm engines (pump sets). It was only during the second decade of the century that marketing of Motor Spirit began. Only HSD had no market up to the middle of the century.

Before 1947, the entire Aviation industry (including the Royal Indian Air Force (RIAF) fighter planes) in India comprised piston-engine aircraft consuming various grades of Aviation Gasoline. Aviation (Turbine) fuel appeared in the market in India only in the late 1950s when the turbo-prop aircraft such as 'Bristol Britannia' and jet planes were introduced. As of 1947, more than two-thirds of the total energy consumption of India comprised non-commercial fuels such as firewood, residual vegetable waste, animal-dung etc., while coal, electricity and oil shared the balance. Total consumption of petroleum products in 1947 was around 2.5 MMTA being only one-third of the total commercial energy produced in India.

An event of far-reaching significance occurred in 1937-38, which was to have a lasting impact on the economic and industrial policy of independent India. Apart from his known socialist beliefs and mindset, India's first Prime Minister, Pandit Jawaharlal Nehru, was highly impressed by the Soviet Five Year Plans. An influential minority in the Congress, including Jai Prakash Narayan and Netaji Subhash Chandra Bose, also shared these views.

Consequently the Congress Working Committee adopted a resolution in their meet at Wardha in August 1937 recommending that the Congress Ministries in the provinces should set up expert groups to identify their burning socio-economic problems, solutions for which were to be considered in any scheme for National reconstruction and social planning. The concept and process of 'Planning' was formally accepted by the Congress despite the widely divergent views of individual leaders of the party.

When the Congress Working Committee met again in July 1938 under the then Congress President, Subhash Chandra Bose, it observed that little or no progress had been made on the August 1937 Resolution. The Committee then decided to convene a meeting of the Provincial Industries Ministers in Delhi during which a National Planning Committee was set up followed by an All India Planning Commission covering the entire country. During its first meeting on December 17, 1938, it identified essential and large-scale industries like Defence and public utilities as also seven 'key' industries including fuel, coal, firewood, and mineral oil, which were to be either State-owned or State-controlled. The National Planning Committee then appointed sub-committees to take care of the various facets of India's economy.

For details of the proceedings regarding the sub-committee for oil, quoted below are extracts from the book, *K.D. Malaviya and the Evolution of India's Oil Policy* by H.N. Kaul (Page x)

"(1) All power and fuel resources of the country should be regarded as 'national property', and should be fully conserved, scientifically developed and utilised with a view to placing power, particularly electrical power, at the service of all for domestic and industrial use at the cheapest rate. (2) The State should establish an ecological prospecting department with modern equipment and skilled staff and carry out an intensive search for petroleum resources in the country."

The earliest model of a policy for planning and development was done during the Viceroyalty of Lord Wavell when Sir Ardeshir framed the British Indian

Government's policy on planning and development. It provided for public sector enterprises, perhaps in recognition of the British Government owning the railways and the British Indian Government a host of ordnance factories that were manufacturing defence equipment.

All these developments were precursors to the formation of the Planning Commission of Independent India in 1950.

Handing over the first Oil produced from Bombay High to the Chairman of HPCL, Shri Krishnaswamy, by Shri H S Cheema, Group General Manager, ONGC, Bombay Offshore Project, at a ceremony on 'INS Poshak'

Digboi Refinery

The Digboi refinery located in the State of Assam ranks among the oldest running refineries in the world! What is now probably the only one of its kind anywhere in the globe, this unique refinery, which is more than 100 years old, went on stream way back in 1901. With a process capacity of 500 barrels per day or 25,000 metric tonnes per year it used a process, naturally outdated now, known as Retort Distillation. Interestingly, this refinery today has the unique distinction of employing one of the most advanced technologies for distillate recovery, viz Short Path Distillation (capacity 20,000 MTPA), only one of its kind globally. To start with, a small refinery did exist at a place called Margharita, which was then shifted to Digboi by the Assam Oil Company that had just taken over all the oil interests of the Assam Railways and Trading Company.

Thus, in far away Digboi in Assam oil refining in India took root, leading to an all-India refining capacity of 112.54 mmtpa 100 years later. As the production of Digboi oilfield rose, the processing capacity of Digboi Refinery kept pace and steadily increased accordingly.

In 1921, the management of Assam Oil was taken over by Burmah Oil Company (BOC). This takeover provided Assam Oil with better financial support, better expertise and management control, better marketing background, and the use of improved technology. Soon thereafter the refinery was almost completely re-built and its capacity was augmented in 1923 and by 1926 the refinery processed 76,269 metric tonnes. Between 1922-40 further additions were made. Apart from the Crude Distillation Unit, a Coker, KTU, a Wax Unit, a boiler and a power plant were added.

Gradually, the refinery's capacity was expanded to 0.50 million metric tonnes per annum and by the time India attained Independence in 1947, the Digboi refinery in all had processed a total quantity of just around 5.8 MMT only. But at that point of time no other refinery existed in India. Its capacity became standstill till it became a part of IndianOil in 1981.

Almost everything one sees in this *numero uno* refinery at Digboi is of vintage charm. Before its modernisation, although the refinery was producing 0.50 million metric tonnes per annum it was doing so with the most outdated equipment in the world, whose working itself was nothing short of a miracle. This was because of the meticulous importance given by the refinery engineers to the aspect of regular maintenance.

Digboi then as now was a remote location. Some seventy years ago it was the 'back of beyond'. All the components required for the refinery's maintenance had either to be imported from abroad or brought in from far-off places like Calcutta or Bombay. This compelled the refinery to become innovative and self-reliant. It set up a small foundry and a forging shop to meet emergency requirements. Thus nearly all the skills required to operate and maintain the refinery were made available at Digboi. During the Second World War, Digboi being very close to the war zone of Burma, the refinery engineers raised solid firebrick walls around the storage tanks with bricks imported from UK to protect them against enemy attacks.

The British who set up the refinery could not believe that it was still running! Likewise a German engineer came all the way from Germany to cross-check whether the refinery was, in fact, still in operation. This happened when the Digboi Refinery had placed an order with his firm for an obsolete spare part and when they received the request, the Germans could not believe that a refinery of such vintage could still be functioning.

Dr. Rajendra Prasad, first President of India, being shown various products at Digboi Refinery in 1954. The insignia of India in wax mould

In 1936, the Foster Wheeler Distillation Unit Bench "C" was commissioned to bring the capacity to 0.25 MMTA. With the commissioning of Lummus Crude Distillation Unit, Bench "G" (capacity 0.25 MMTPA), the total refinery capacity was raised to 0.50 MMTPA in 1940.

The Assam Oil Company Ltd. and the Burmah Oil Company (India Trading) Ltd., who were 100 percent subsidiaries of the U.K., based Burmah Oil Company Ltd. were operating Digboi Refinery till September 14, 1981 when the historic refinery along with all its marketing assets were merged with Indian Oil Corporation Ltd., by an Act of Parliament and became IndianOil's Assam Oil Division (AOD), thereby ending the more than a decade-and-a-half of stagnancy which the refinery had to face.

IndianOil gave AOD a fresh lease of life by investing around Rs.1400 crore in upgrading the refining capacity and Rs.400 crore in modernising and strengthening the marketing set-up. The refining capacity was increased from 0.50 MMTPA to 0.65 MMTPA. The proposed modernisation and expansion scheme enabled the production of high quality fuels and the maximisation of middle distillates. This was achieved by the commissioning of the Catalytic Reformer Unit in 1997 and the commissioning of the Wax Hydro-Finishing Unit in 1998, as also the commissioning of new Delayed Coking Unit in 1999.

The age-old labour intensive technology of wax extraction was replaced with Solvent De-waxing Unit commissioned in 2003. The Unit now has an improved wax production, both for quality and yield and at the same time produces the feedstock for the production of Micro-Crystalline Wax in the Wax Hydro-finishing Unit.

Apart from the majority of products — MS, SKO, HSD, LDO and FO—Digboi also produces specialties like Wax, Aromex, Raw Petroleum Coke, Bitumen and LVI lubes. At one time it produced a range of 100 petroleum products. It is the only refinery in India that produces 40,000 tons of best quality wax every year.

The Digboi Refinery played a historical role in placing India on the Refining map of the world as early as 1901. Had this initiative been matched with the setting up of additional refineries within the country before or during the first and Second World Wars — the story of refineries in India would have had a different ending.

CHAPTER II

Second Era: 1947-1960

India inherited a largely agrarian feudal society at the time of Independence. Industrialisation, growth, self-reliance and modernisation with social justice were the abiding national sentiments after Independence. It was during this Era that India formulated its Industrial Policy through the Industrial Policy Resolutions of 1948 and 1956 by broadly aiming for a mixed economy and rapid industrial development of the country with large expansion of employment opportunities in a democratic, socialistic society.

This period saw the birth of three new coastal refineries in the private sector set up by the multinationals, Stanvac, Burmah Shell and Caltex. This gave a major impetus to the development of indigenous skills and know-how in refining technology. It also saw the formation and the birth of the Public Sector oil companies in the form of ONGC (Upstream), Indian Refineries Ltd (IRL) and the Indian Oil Company Ltd. (IOC) for marketing — and India's first R&D effort for the Hydrocarbon industry with the formation of the Indian Institute of Petroleum (IIP) at Dehra Dun laying down the preliminary formats and foundations of a National Oil Industry.

Finally, it was during this era that the Oil Price Enquiry

Committee was set up under the chairmanship of K.R. Damle which ultimately led to the establishment of the APM for petroleum products in India. All these developments played a crucial role in India's march towards industrialisation and self-reliance.

Historical Background (1947-1960)

Soon after India attained Independence, Pt. Jawaharlal Nehru, the first Prime Minister of India, wanted to live up to the promise he had made in his famous 'Freedom at Midnight' speech, when he had said, "*Long years ago, we made a tryst with destiny and now the time comes when we shall redeem our pledge, not wholly or in full measure, but very substantially.*"

This promise in a way came in the form of the Industrial Policy Resolution laid down on April 6, 1948. The Resolution spelt out the Government's intention *inter alia* to establish a social order where justice and equality of opportunity was secured to all people most of whom lived below subsistence levels and to set up a National Planning Commission in order to formulate plans for development and to secure its implementation as envisaged in the 1937-38 Congress Working Committee's Resolution to which reference has already been made in the previous chapter.

The Industrial Policy Resolution of 1948 laid down plans for encouraging a Mixed Economy, although certain industries like the manufacture of arms and ammunition, atomic energy and oil would be the exclusive monopoly of the Central Government, "except where in the national interests, the State itself finds it necessary to secure cooperation of private enterprise subject to such control and regulation as the Central Government may prescribe."

The Policy while reserving its right to nationalise any existing industrial undertaking it expressed the Government's intention of allowing existing industries to develop for a period of 10 years. Even Mountbatten, India's last British Viceroy, in his farewell advice to the Government of India, said, "Unless India can produce and exploit natural sources of oil, she will always be vulnerable to physical blockade in war and economic blockade in peace. No single development could contribute more to the prosperity of the country as a whole."

The 1948 Industrial Policy Resolution was a surprisingly pragmatic document, the concept particularly of a '**Mixed Economy**' coming at a time when the Cold War and its ideological conflicts were just beginning to hot up. The Policy also had the potential of catapulting India forward towards industrialisation to achieve maximum success in alleviating the country's heart-breaking poverty.

In June 1948, the Government of India once again asked the multinational oil companies to consider setting up refineries of at least one million metric tonne capacities each on the west and east coasts. The five oil companies concerned were: Burmah Oil, Standard Vacuum, Caltex, Anglo-Iranian and Shell.

A Technical Mission arrived in India about mid-October 1948. The Mission studied the prospects over the next three months and came to the conclusion that "were a refinery to be provided for the west coast of India it could be best placed at Bombay, which is the focal point of oil distribution on this coast and which has an excellent harbour adaptable to the needs of necessary marine terminal and the preferred site for a refinery at Bombay would be on Trombay Island, to the north of the harbour". The Mission suggested Vishakapatnam and Chennai on the east coast with preference to Vishakapatnam although in their report to their principals they concluded that there was no economic justification for setting up refineries in India.

Enterprises like the Anglo-American oil companies had set up huge refineries in the Middle East like the one at Abadan, which had a capacity of 25 million metric tonnes per annum and was among the largest in the world. No new refineries were set up in India right from 1901 until the 1950s because other than in their own countries, the multinational oil companies' philosophy was to build refineries at the crude producing centres and then import refined products into the country, which definitely for them was a more profitable proposition. Independent India, however, was keen to have refineries on her own soil, not for economic reasons alone but in pursuit of its policy of self-reliance and industrialisation.

In early 1951, Iranian Prime Minister Dr. Mohammad Mossadegh nationalised the Iranian oil industry leading to the closure of the Abadan Refinery. In the wake of this drastic development, the Seven Sisters decided to diversify the location of their future refineries. It was primarily because of this development and India's determination to industrialise that towards the end of 1951 the multinational oil companies agreed to set up refineries in India and succeeded in getting significant concessions from the Government of India through the Refinery Agreement, which allowed the oil companies to reap huge profits for more than two decades. Thus Stanvac commissioned a 1.2 million metric tonne per annum capacity refinery at Trombay in 1954, Burmah Shell commissioned its 1.75 million metric tonne refinery in 1955 also in Trombay followed by 0.75 million metric tonne refinery commissioned by Caltex at Vishakapatnam in 1957.

As mentioned earlier, after the Achnacarry Agreement the prices of imported petroleum products in India were based on posted prices in the Gulf of Mexico plus the notional freight from the Gulf of Mexico to Indian ports, although in reality most of the product was being brought from West Asia (Abadan). Even products refined in Assam were priced on this unfair basis. It was like as though the multinationals oil companies were not only having the cake but eating it too. From India's point of view, this import parity principle was pretty much a skewed policy and highly unfair to a poor country, as India was, with a measly per capita income of less than $60 per annum.

With USA becoming a net importer after 1945 and under pressure from the British Government, some relief was provided when the oil prices while still based on the Gulf of Mexico postings, the freight payable was from the port of loading in West Asia. Thus, at least the notional freight element from the Gulf of Mexico (giving adventitious gains to the multinationals) was saved although prices based on the more expensive Gulf of Mexico postings were still grossly unfair to the Indian consumers. Well, the multinational oil companies could still have their cake.

In April 1950, a major change came about in the pricing policy with the Valued Stock Adjustment Agreement (VSA) between the Government of India and Burmah Shell. Regardless of nuances, skewed or otherwise, until the implementation of the 'Damle Formula' with effect from October 1, 1961, the multinational oil cartels administered a cost plus price formula, which lent itself to severe inefficiencies and higher costs since higher the cost higher were their profits.

Quoted below are extracts from the book, *Oil Rich Man Poor Man* by S.S. Khera, Page 57): "However that might be, it was soon apparent that the VSA arrangement bred inefficiency and extravagance in costs without any sufficient control over accountability."

With the commissioning of the three new refineries, at least some of India's objectives were met. Whatever the flaws of the Import Parity pricing principles, India was now importing the lower cost feedstock (raw material) rather than the more expensive refined products leading to a saving of at least Rs.100 crore per year in foreign exchange. India had also built up internal refining capacity nearly equal to its then demand of approximately 4 million metric tonnes.

The establishment of refineries in India also helped to develop Indian skills in Refining Technology, which was rapidly absorbed by Indian technicians and engineers. It went on to produce a host of home-grown engineers like C.R. Dasgupta, R.N. Bhatnagar, T.K. Sinha, K.K. Malhotra, K Krishnamurty, H S Bawa, V Srinivasan and K T Krishnamurty and many others who were subsequently to head and lead future public sector and even the privately owned Reliance Petroleum. The multinational oil companies soon recognised the skill and competency of their Indian engineers and technicians, whose services they very fruitfully utilised in building their new refineries in other parts of the world.

The three new refineries were built on the basis of Refinery Agreements between the Government of India and the oil companies which *prima facie* appeared to be very favourable to the multinational oil companies. Although each multinational oil company (Burmah Shell, Stanvac and Caltex) signed these agreements separately the main clauses and features were common as noted below:

—The oil Companies were free and entitled to import without any customs duty crude oil from their own sources. However, they were obliged to process indigenous crude oil available subject to technical feasibility. Likewise the Government of India could impose customs duty if required to protect indigenous crude.

—The oil companies were entitled to transport their crude in their own tankers and the Government of India would provide foreign exchange for the marine freight on crude oil, materials and supplies and for the transhipment of the finished products; for all operating supplies, equipment and raw materials imported by the company; for all engineering services, technical information services, royalties, licence fees, and the company's New York expenses on the refinery account; for the remittance of all dividends and all profits in foreign exchange, for the cost of construction equipment, supplies and services purchased abroad, exchange for this purpose being furnished from the accruals of the refinery's depreciation fund, and all such depreciation funds to be repatriated in foreign currency; and for interest on overseas loans, if any.

— Prices of refined products were to be based on the import parity principle, that is, at the same level as the landed cost including wharfage, landing charges and import duty of the equivalent products.

— The refineries were assured Duty protection for 10 years from the date of commencement of full-scale production or until December 31, 1965 whichever came earlier. They could recover notional Customs Duty on the basis of the 'Import Parity' principle for refinery product, and retain the difference between notional import duty and the excise duty thereby enhancing their revenues considerably. This amounted to two annas (1/8 of rupee) per imperial gallon for Motor Spirit and a bit lower for other products.

— Burmah Shell and Stanvac voluntarily gave up their duty protection on Motor Spirit with effect from October 1, 1956 and on diesel oil, furnace Oil and Bitumen on July 1, 1959 by Burmah Shell and on November 15, 1959 by Stanvac. Caltex surrendered duty protection in respect of Motor Spirit only with effect from October 1, 1959.

— Assurance was given by the Government that they would not nationalise the refineries for 25 years and if nationalised after that period a reasonable compensation would be paid.

— There was considerable criticism both in the Parliament and outside as regards the exceptionally favourable terms granted to the three foreign companies. As time went by, there was increasing political pressure on the Indian Government for the revision of some of the more unfavourable clauses. However, the arrangements survived until the foreign oil companies were bought over by the Government of India through bilateral negotiations.

– Clauses such as the 25-year non-nationalisation guarantee (as compared to 15 years in many neighbouring countries); inadequate control on price of imported crude oil and discounts available and duty protection attracted the maximum criticism within India. Another area of criticism against the foreign refineries was that they had raised their processing capacity to far beyond their licenced capacity. Whereas their licensed capacity totalled 5.1 million metric tonne in1960-61, around the time of their takeover by the Government their capacities had doubled to 10.25 million metric tonne per annum. Normally such an increase in capacities should have been welcomed. However, this was criticised in India because firstly it was felt that the Refinery Agreements should have been revised along with the expansions, purging them of the unfavourable clauses in exchange for enhancing the licensed capacities and secondly it was perceived as an attempt by the multinational oil companies to stifle the emergence of public sector refineries. Madhu Patwardhan, the first and the last Indian Chief Executive Officer of Burmah Shell in India, best articulated the foreign companies' point of view.

This is what Patwardhan wrote in his book, *Oil and Other Multinationals in India on page 38.*

"In a vertically integrated industry, it is not illogical for the investor to seek some stability by matching production with market outlets. This is particularly true in the case of a high-risk, extractive industry such as oil. The exploration end of the business is both high-cost as well as risk intensive. Once the oil has been found, it is desirable to have an assured outlet at hand for a proportion of the anticipated output. This requires further investment in transportation, refining and marketing. Conversely it would not be unreasonable for an investor in the latter group of facilities to seek a crude supply back-up so as not to face difficulties at the time of a crude oil supply shortage. This is the traditional rationale of vertical combination, but it applies with particular force to the oil industry in view of the high cost, high risk and long gestation periods before an oilfield is located and developed requiring planning a long period ahead."

Although the Refinery Agreements were negotiated on behalf of India by eminent civil servants like C. C. Desai and Raghavan Pillai, possibly they were not supported by experienced oilmen. In hindsight however, particularly looking backwards from post-1973 oil crisis vantage point, India was an overall gainer from her long-term point of view when these three refineries got built and saw the light of day. Perhaps they should have come a decade earlier.

The 1948 Industrial Policy Resolution had emphasised the importance to the economy of securing a steady and continuous increase in production and its equitable distribution, and pointed out that the State must play a progressively active role in the development of the economy and that the State would be exclusively responsible for the establishment of new undertakings in six basic industries which included the oil industry except where, in the national interest, the State itself found it necessary to secure the cooperation of private enterprise. The rest of the industrial field was left open to private enterprises though it was made clear that the State would also progressively participate in this field.

On November 26, 1949, the Constituent Assembly adopted and gave the nation its Constitution, and the world's largest Democratic Republic came into being on January 26, 1950. In its preamble, the Constitution of India declared that, "We, the People of India, having solemnly resolved to constitute India into a Sovereign, Socialist, Secular Democratic Republic and to secure to all its citizens.

Justice, social, economic and political;

Liberty, of thought, expression, belief, faith and worship;

Equality of status and of opportunity; and to promote among them all

Fraternity, assuring the Dignity of the individual and the Unity of the Nation."

In its Directive Principles of State Policy, it stated that,

"The State shall strive to promote the welfare of the people by securing and protecting as effectively as it may a social order in which justice, social, economic and political shall be uniform in all the institutions of the national life."

It further stated:

"The State shall, in particular, direct its policy towards securing:

a. that the citizens, men and women equally, have the right to an adequate means of livelihood;

b. that the ownership and control of the material resources of the community are so distributed as best to subserve the common good;

c. that the operation of the economic system does not result in the concentration of wealth and means of production to the common detriment;

d. that there is equal pay for equal work for both men and women;

e. that the health and strength of workers, men and women, and the tender age of children are not abused and that citizens are not forced by economic necessity to enter avocations unsuited to their age or strength;

f. that children are given opportunities and facilities to develop in a healthy manner and in conditions of freedom and dignity and that childhood and youth are protected against exploitation and against moral and material abandonment.

These basic and general principles were given a more precise direction when the Parliament accepted in December 1954, the Socialistic pattern of society as the objective of social and economic policy. Industrial policy, as other policies, had therefore be governed by these principles and directions.

In March 1950, the Planning Commission was set up as earlier envisaged by Pandit Jawaharlal Nehru and Netaji Subhash Chandra Bose in the 1937-1938 Congress Working Committee Resolution. The aims and objectives of the Planning Commission were defined as follows:

1. Make an assessment of the material, capital and human resources of the country, including technical personnel, and investigate the possibilities of augmenting such of these resources as are found to be deficient in relation to the nation's requirements.

2. Formulate a plan for the most effective and balanced utilisation of the country's resources.

3. On a determination of priorities, define the stages in which the Plan should be carried out and propose the allocation of resources for the due completion of each stage.

4. Indicate the factors, which are tending to retard economic development, and determine the conditions, which in view of the current social and political situation should be established for the successful execution of the Plan.

5. Determine the nature of the machinery, which will be necessary for securing the successful implementation of each stage of the Plan in all its aspects.

6. Appraise from time to time the progress achieved in the execution of each stage of the Plan and recommend adjustments of policy and measures that such appraisal may show to be necessary.

7. Make such interim or ancillary recommendations as appear to it to be appropriate either for facilitating the discharge of the duties assigned to it; or, on a consideration of the prevailing economic conditions, current policies, measures and development programmes; or on an examination of such specific problems as may be referred to it for advice by Central or State Governments.

The first Five-Year Plan came into being on April 1, 1951, during which period the total investment in the public sector was only Rs.29 crore through five public sector undertakings. The petroleum sector saw investments only in three private sector refineries. Rapid industrialisation of India required massive investments in core industries, including steel, shipping, chemicals and fertilisers, oil, heavy electricals, engineering, heavy machine tools etc.

Experience since 1947 revealed inadequate private investments in these industries, mainly because such industries were very capital-intensive and required long gestation periods. Also possibly Indian entrepreneurs and industrialists were finding it difficult to raise enough capital for the purpose and hence preferred investing in industries that could give quicker returns. Guided by the Directive Principles of the Constitution, the need for building a socialistic pattern of society, the advice from the Planning Commission and the experience since the Industrial Policy Resolution of 1948 and other relevant factors, the Government of India confirmed a new Industrial Policy on April 30, 1956.

The New Resolution divided industries into three broad categories. Schedule "A" being the first category, listed 17 core industries of basic and strategic importance including oil, which would be exclusive responsibility of the State. The second category, Schedule "B" listed industries, including aluminium, road and sea transport, synthetic rubber etc which would progressively be State-owned and in which the State would generally take the initiative in establishing new undertakings but in which private enterprise would also be expected to supplement the efforts of the State of the 12 industries included in the second category. This distinctly emphasised the need for cooperation between the private and public sectors.

All the remaining industries would be undertaken ordinarily through the initiative and enterprise of the private sector, though it would be open to the State to start any industry even in that category as well. It would be the policy of the State to facilitate and encourage the development of these industries in the private sector, in accordance with the programmes formulated in successive Five-Year Plans, by ensuring the development of transport, power and other services, and by appropriate fiscal and other measures.

Further the State would continue to foster institutions to provide financial aid to these industries, and special assistance would be given to enterprises organised on cooperative basis for industrial and agricultural purposes. In suitable cases, the State would also grant financial assistance to the private sector. Such assistance, especially when substantial amounts were needed would preferably be in the form of equity capital.

In that sense the 1956 Industrial Policy Resolution went one step ahead of the 1948 Policy by stating that even in the sphere of the rest of the industries beyond category A and B, the State could start new undertakings if required and found necessary in the public interest, or for the successful execution of its ambitious Five-Year Plans. The private sector in turn would rely for many of its needs on the public sector. Thus the categorisation of industries did not imply complete water-tight compartments.

The Policy made a special reference to the role of cottage and small-scale industries in the development of the national economy. The government appeared to be determined to coordinate the development of small-scale industries with large-scale production.

Great emphasis was laid in the Industrial Policy Resolution of 1956 in reducing regional imbalances and industrial disparities. One of the aims and purposes of National Planning Commission was to ensure the provision of adequate power, water, transport, and other infrastructural facilities in the industrially backward areas. Equitable development of all regions is obviously an important ingredient in maintaining the unity and integrity of the Nation.

The 1956 Industrial Policy Resolution did not vary substantially from its 1948 version. The 1956 Policy not only retained the Mixed Economy concept but also retained the pragmatic elements of its predecessor. It was, however, very strongly guided by the desire to help create a socialistic pattern of society and by the Directive Principles of India's Constitution. The Policy in its new *avatar* gave even greater importance to public investments and the public sector in an attempt to take Indian economy to greater heights.

India's desire for self-reliance was clearly reflected in the 1956 Resolution, which clearly stated, "Future development of the oil industry will be the exclusive responsibility of the State". This was also reflected by Pt. Nehru's statement in the Parliament on May 26, 1956 when he stated in no unequivocal terms: "Oil is of a vast importance. A country that does not produce its own oil is in a weak position. From the point of view of defence the absence of oil is a fatal weakness".

In all earnestness of what Pt. Nehru had declared in the Parliament, the curtain on the public sector oil industry had already been raised in October 1955 when the Oil and Natural Gas Division of the Geological Survey of India (GSI) came into being. The following year, in the month of August 1956 a separate and independent Oil and Natural Gas Commission (ONGC) was created through an Act of Parliament.

Three years before the formation of the ONGC, oil had been struck at Nahorkatiya (1953) and later in Moran (1956) by Burmah Oil Company and Assam Oil Company, respectively. The former company had a tentative plan to build a refinery at Calcutta and pump the crude through a pipeline from the oilfield to the refinery.

Reflecting the flexibility and pragmatism in India's oil policy, a promotion agreement was signed by the Government of India with Burmah Oil Company and the Assam Oil Company in 1958 for the formation of Oil India (Pvt) Ltd. This new oil company was set up for the sole purpose of exploiting Nahorkatiya and Moran oilfields. The new joint sector company was registered on February 18, 1959. The Government of India owned one-third of the total equity and the balance two-thirds by the above two oil companies.

Commissioning of Multinational Company Oil Refineries

Stanvac/Esso/HPC Refinery At Trombay

Within three years after the multinational oil companies had signed an agreement with the Government of India in the month of November 1951, the first 1.25 MMTPA Stanvac Refinery in the private sector went on stream in the month of July 1954. This was one of the most complex refineries constructed on a 321-acre plot of land in Trombay near Bombay.

Trombay, the northern suburb of erstwhile Bombay (now Mumbai) lying on the west coast of India just south of the Tropic of Cancer has a natural wide bay between the city and the mainland. Throughout its short history Bombay has been a natural harbour and a busy maritime and trading centre on account of its proximity to Africa and East Asia.

Stanvac's (later Esso and then HPC) brand new refinery at Trombay had a Crude Distillation Unit (CDU) and was also equipped with a Catalytic Cracking Unit (CCU) and a Thermal Reformer and other treating units.

The refinery was inaugurated by Girija Shankar Bajpai, Governor of Bombay of the then (combined States of Maharashtra and Gujarat) in the presence of a distinguished gathering of 1,000 guests. This event heralded a new era of cooperation between India and the multinationals, a journey, which would soon lead India to become self-sufficient in refining capacity of petroleum products.

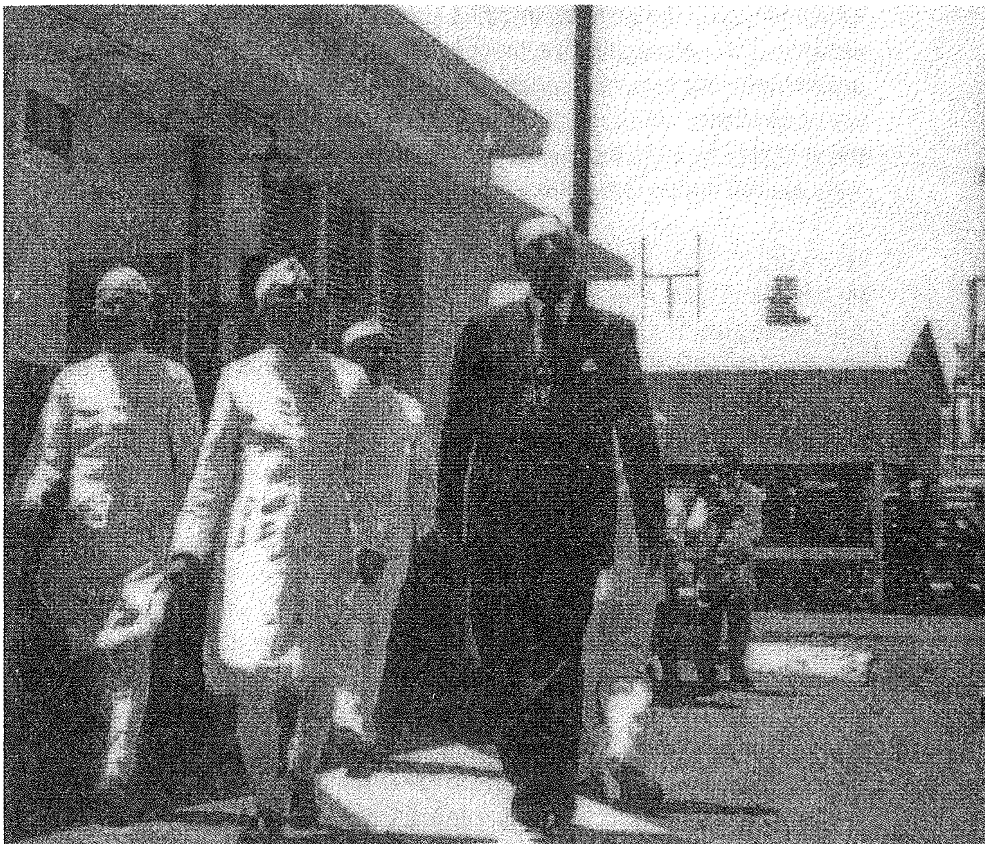
Over the years, the Esso Refinery expanded its capacity to a little over 2.52 MMTPA. With the formation of the Lube India Ltd, the Esso Refinery became the source of feedstock for India's first Lube Refinery commissioned in 1969.

After the take over of Esso by the Government of India and the formation of Hindustan Petroleum Corporation Ltd (HPCL) — the refinery's capacity went up to 3.5 MMTPA by 1978-79. A low-cost expansion of the fuels refinery was undertaken in 1985 whereby a separate Crude Distillation Unit and Vacuum Distillation Unit were installed with crude processing capacity of 2.0 MMTPA. It was the first 'swing refinery' of its kind in the country, which had the flexibility to process Heavy Lube Bearing High Sulphur as well as non-Lube Bearing Low Sulphur crudes of various types.

This particular unit called FRE (Fuel Refinery Expansion) gave the flexibility to process various types of crude enhancing its capacity to 5.5 MMTPA although it eventually went up to 6.0 MMTPA. Currently, the refinery is in the process of implementing the Green Fuels and Emission Control project, which besides envisaging an increase in refining capacity to 7.6 MMTPA will involve setting up the following new units:

- Naphtha HDS and CCR Reforming Unit.
- Light Naphtha Isomerization Unit.
- Prime G Plus Unit for treating FCC Gasoline.
- CFC Unit for treating LPG.

The most eloquent testimony on the genesis and character of this refinery came from K Krishnamurty, former Chairman and Managing Director of Hindustan Petroleum, who retired on February 28, 1986. Previously he had worked for IndianOil as General Manager at Barauni Refinery and General Manager at Koyali Refinery as well.



A visit by India's first Prime Minister Pandit Jawaharlal Nehru to the Stanvac Refinery at Trombay

Speaking on the occasion commemorating the Golden Jubilee of the HPCL Refinery Krishnamurty said: "My life is too closely woven around HPCL from the Lummus days when as a fresh engineering graduate from Guindy University, Madras, I joined as plant layout engineer in 1952 to the time I retired from HPCL as its Chairman and Managing Director. That itself should tell you how much a part of my very being this wonderful company is. I guess it's the great work culture that kept me engaged.

"Even then as is today, our communications skills and good command of English, together with our keen learning spirit, made absorption of highly technical subjects very quick. Of course credit for this must go to the 93-strong American start-up crew for their open-minded attitude and unselfishness in sharing knowledge. An equally refreshing approach was their attitude towards responsibility. When people were assigned responsibilities they were also given commensurate authority to take decisions, which encouraged a high sense of accountability in the long run. In 1980, I became a Director and in 1984 took over as Chairman & Managing Director of HPCL. Today I look back on those years as qualitatively, the best years of my life. Always learning and always raising the bar of excellence. HPCL taught me to explore life to the fullest. Yes, I retired from the company in 1986 but can never retire from the wonderful relationships that were kindled during those magnificent times."

BURMAH SHELL/BPC REFINERY AT TROMBAY

Within less than six months of the commissioning of the Stanvac refinery at Trombay, Burmah Shell too commissioned its own refinery very close to Stanvac's also at Trombay in 1955. This event had of special significance because Burmah Shell was then the market leader in India. The two million metric tonne per annum refinery went on stream on January 30, 1955 but was formally inaugurated on March 17, 1955 by India's then Vice President, Dr. Sarvepalli Radhakrishnan, in the presence of a galaxy of distinguished guests from all over India, including Ministers, industrialists, businessmen, top executives of Royal Dutch Shell, BOC from Netherlands and UK, respectively.

The importance of the function lay in Burmah Shell's pride in putting up the largest refinery in India (2.0 MMTPA as compared to Stanvac's 1.25 MMTPA) and in Shell's unique leadership of the oil industry in the country over the past two-and-a-half decades.

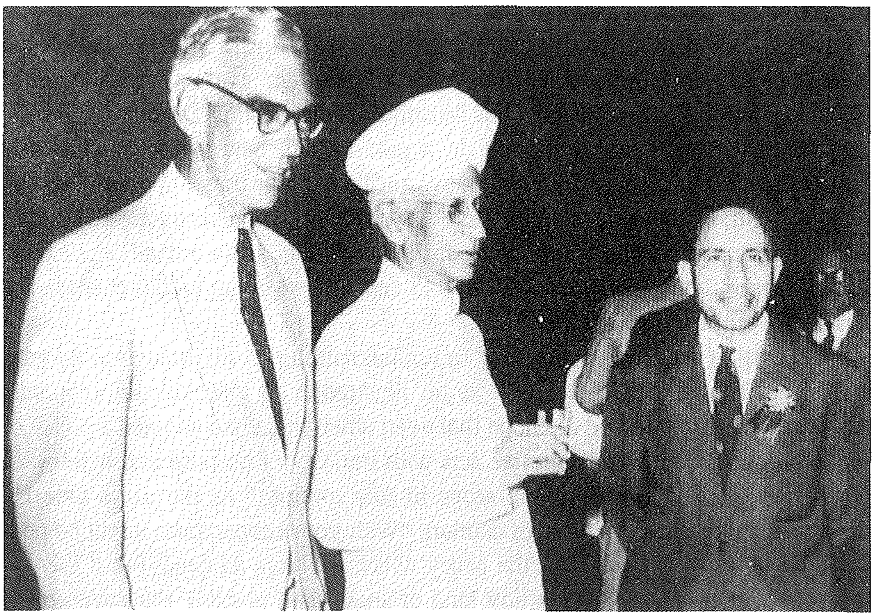
J F Sinclair the Chairman of the Board of Burmah Shell Refineries Ltd. in his speech said: "I see the value of this refinery, first of all, as a real contribution to what our Prime Minister (Nehru) has described as the exciting adventure of building a new India, capital formation on a grand scale, new skills technical and administrative, the possibility of new ancillary industries, opportunities of employment, all these have an absolute value not to be underestimated. But then I see it again, within the wider vision of the new India, as an outstanding example of what private enterprise, backed and encouraged by an enlightened democratic Government can achieve."

Concurring with this statement, Dr.Radhakrishnan in his inaugural address described Burmah Shell's refinery as an illustration of international economic cooperation. He expressed the hope that even when India had adopted a policy of mixed economy, "If free enterprise acts with honesty of purpose and a sense of social justice, it will have ample scope in this country." At the same time Dr. Radhakrishnan uttered a word of caution, "With your cooperation, it will be possible for us to go forward with the policy which we have adopted. But if there is no cooperation, and if there is any kind of snag, then possibly the government may be induced to revise its policy." Dr. Radhakrishnan clearly indicated India's expectation of cooperation from the multinationals.

Subsequently, the feed preparation unit was FPU for processing Long Residue was commissioned on March 31, 1955, the Catalytic Cracking Unit and Bitumen Blowing Unit were commissioned on April 21, 1955 and June 25, 1955, respectively. The Edeleanu Plant for treatment was commissioned on June 20, 1956 for production of Food Grade Hexane. A Platformer Unit to boost the MS Octane number was commissioned on July 1, 1957. The refining capacity was de-bottlenecked from 3.9 to 4.0 MMTPA by 1965 and further expanded to 5.25 MMTPA before it was bought over by the Government of India to become Bharat Refineries Ltd, which was subsequently christened as Bharat Petroleum Corporation Ltd (BPCL).

A Crude Modification Unit (CMU) was commissioned on December 28,1984 after provision of Pre-flash Column CO1, and new two Vertical Heaters serving as Charge Heater and Reboiler of CO1. Capacity of CDU was enhanced to 18,000 metric tonnes per day. With these modifications the refinery capacity went up to 6.0 MMTPA.

In the month of August 1991, a new Crude Distillation Column was installed with a facility to withdraw 7,500 metric tonne per day 'Special Cut Naphtha of 110-140 degrees centigrade cut' and the bottom stream of the new Column was further processed in the old Crude Distillation Unit. Crude processing capacity was



Mr. J.F. Sinclair, Chairman of the Board of Directors of the Burmah Shell Refinery, receives the then Vice-President of India, Dr. S. Radhakrishnan, on 17th March, 1955.

increased to 21,000 metric tonnes per day, taking the refinery capacity to 7.0 MMTPA. During 1994 the Unit was revamped and made as an independent Heavy Crude Processing Unit (HCU). Capacity of crude processing was enhanced to 24,000 metric tonnes per day, corresponds to 8.0 MMTPA in 1994.

During 1997, capacity of HCU was further enhanced to 4,800 metric tonnes per day along with capacity augmentation of the FCCU to 3,000 metric tonnes per day by revamping of its RR section and gas plant, thereby enhancing refinery capacity to 9.0 MMTPA by 1998-99.

During 2005, a new CDU/VDU as an independent Crude Processing Unit was commissioned on January 26, 2005 having capacity of 18,000 metric tonnes per day. Hydrocracker with capacity of 5,250 metric tonnes per day was commissioned in 2005 along with a new Hydrogen Unit with capacity of 49,500 metric tonnes per annum, as also a Sulphur Recovery Block comprising sour water stripping, Amine Regeneration and two Sulphur Recovery Units of 70 metric tonnes.

The refinery after this enhancement would operate on a sustained basis of 12.0 MMTPA. This would also help in operating the older units at somewhat lower sustainable capacity and at higher efficiencies.

Various projects and de-bottlenecking schemes for Euro IV Auto Fuels and residue upgradation are in the pipeline.

CORIL To HPC, Vizag

After Stanvac and Burmah Shell had commissioned their refineries in Bombay it was the turn of Caltex, USA who had agreed to put up the third refinery, preferably on the East Coast of India.

The site selected was the port city of Vishakhapatnam in Andhra Pradesh. Vishakhpatnam on the Bay of Bengal was known as the Gateway to the East Coast of India. It played a crucial role as the middle point distribution base for Southern, Eastern, Central and Northern states of India.

Keeping this in view, Caltex's Site Selection Committee after having studied several sites on the East Coast zeroed in on Visakhapatnam after considering various factors such as the nature of the draft of the harbour, availability of land, water, power, railway facility near the docks, soil engineering and proximity to major market areas etc. While the major market in Eastern India was still centered in and around Calcutta, its riverine harbour had severe debilitating draft restrictions.

Caltex Oil Refining India Ltd. (CORIL) was commissioned in April 1957 with an approved capacity of 0.675 MMTPA of crude oil processing. It was the first major industry in Vishakhapatnam and the first refinery in the East Coast. Although CORIL was a low capacity refinery it was amongst the most modern. In addition to a Crude Distillation Unit, the refinery also had Secondary Processing Units such as Fluid Catalytic Cracking Unit (FCCU), Propane De-ashphalting Unit (PDU) and Product Treating Units were designed and built by Foster Wheeler Corporation mostly in London. The Polymerisation Unit (for polymerizing Cracked Light Ends from FCCU) into Polymer Naptha, which was designed and ordered for Caltex's Bahrain Petroleum Corporation Refinery in Bahrain, was diverted to Visakhapatnam to save time. Caltex commissioned the Distillation Units in April 1957 and the Secondary Processing Units in August 1957.

While inaugurating the Refinery on November 30, 1957, N. Sanjeeva Reddy the then Chief Minister of Andhra Pradesh, in his inaugural address exhorted democratic nations of the world to help India develop industrially through democratic methods. "With all its poverty and illiteracy India was trying to develop through democratic methods, though other methods were also available to her," he said.

"The general elections we had in our country goes to prove that we have taken to democracy not only temporarily but permanently and it should be a great strength to other democratic nations in the world. This requirement of ours could succeed only through goodwill and cooperation of our foreign friends."

Appealing to Indians who were working in the refinery to offer their total cooperation in making the industry a success, Sanjeeva Reddy said that to attract more foreign industrialists to India, they had to create a sense of confidence in them. India's prosperity depended on its industrial development and for that the country needed foreigner's goodwill. He appealed to the foreign democratic nations to assist India industrially and lend her a helping hand to implement her Second Plan successfully. Reddy's address revealed the then expectations and sentiments in India of cooperation from the Democratic West to help her industrialise quickly in order to eliminate poverty.

Starting with its original capacity, CORIL gradually de-bottlenecked to 1.28 MMTPA by 1966. Over the years the refinery capacity was increased to 1.55 MMTPA by 1978-79 by which time it had already been taken over by the Government of India and had it merged with Hindustan Petroleum Corporation (HPC). At almost the same time appropriate modifications were made to enable the refinery to also use Bombay High crude.

The major refinery capacity augmentation was taken up in 1985 by commissioning separate (Grass Root) 3.0 MMTPA Crude Distillation Unit (CDU-II), Fluidized Catalytic Cracking Unit (FCCU-II), Crude Oil receiving facilities at high seas (Offshore Tanker Terminal) and associated tankage and product dispatch facilities. Thus by 1984-85, the installed capacity was increased to 4.5 MMTPA, with state-of-the-art control systems for better and efficient operation.

In order to cater to the increased LPG consumption in the region, the Refinery was instrumental in developing LPG import facilities on the East Coast in 1987. This enabled the handling of 35,000 metric tonnes of LPG tankers.

The port further augmented facilities, the first of its kind, for crude oil handling enabling the berthing of 120,000 tonnes of crude oil super-tankers. This enabled the refinery capacity to be increased beyond 4.5 MMTPA. Simultaneously in order to match the processing capabilities and economies of world-scale refineries, the refinery implemented a low-cost expansion project for augmenting its crude processing capabilities.

By January 2000, after the commissioning of VREP-II Units, the refinery's crude processing capabilities increased from 4.5 MMTPA to 7.5 MMTPA. Facilities were thereafter put up for transporting products through pipeline from the Refinery Products Terminal to final destinations in Rajahmundry, Vijayawada and Secunderabad (Ghatkesar). In recent years, in addition to modernising various facilities, De-sulphurizers were added to meet Euro II, and in the near future Euro III Standards for Diesel and Petrol.

In order to adhere to stringent environmental norms, the refinery had set up a well-designed and modern Effluent Treatment Plant (ETP) in 1993 and Sulphur Recovery Unit (SRU) in 1994 etc. ETP-I was augmented with additional surge capacity and a Bio-treatment facility to meet MINAS in post VREP-II scenario at a project cost of Rs.4.85 crore. ETP-II was augmented with additional facilities to meet MINAS in post VREP-II scenario at a project cost of Rs.7.25 crore. Additional facilities include Sulfide Treatment for combined stream with Hydrogen Peroxide, Granular Activated Carbon Filters for final polishing of effluents with Dual Media Filters and so on.

CONCLUSION OF MULTINATIONAL REFINERIES

At one stage many serious questions were raised in India about the several adverse clauses in the Refinery Agreements with the multinationals as also on the pre-Independence and post-Independence pricing mechanism for petroleum products — basically administered not by the Government of India but by the multinational oil companies themselves. All these had serious disadvantages as far as India was concerned

However, when it came to building and commissioning of the three private sector refineries at Trombay and Visakhapatnam there were many plus points, as they (the multinationals) left no stone unturned in providing all the three refineries with the best technologies and know-how available with them at that point of time. Standard Vacuum (Stanvac) later Esso Refinery at Trombay for example was nearly a replica of a similar refinery commissioned by them in Antwerp, Belgium. As a matter of fact Indian engineers were sent to Antwerp not only for training but also to learn from the mistakes made while building commissioning and operating the Esso Refinery there.

One must also not forget the wealth of worldwide knowledge and experience, which was available at the international headquarters of Burmah Shell, Stanvac/Esso and Caltex, which was eventually made available to Indian engineers and managers at their refineries in India. Thus there was free transfer of technology to Indian refineries on a continuous basis.

Soon after these refineries were commissioned, Indian engineers and managers tookover most of the responsible positions. Dr. Cama was the first Indian head of the Esso Refinery a position he tookover in mid-sixties. V.Srinivasan took over as the first Indian head of Caltex at Visakhapatnam (CORIL) in mid-seventies and Joe Mullick took over as the first Indian head of Burmah Shell Refinery just before the Government of India purchased the refinery.

This learning and experience by Indian engineers was gainfully used over the years when they were able to expand and de-bottleneck the capacities of each of the three refineries from a total of 3.95 MMTPA to a total of 10.5 MMTPA by the time they were purchased by the Government of India in the mid-seventies. These refineries are now processing almost 25.0 MMTPA of crude (assuming Bharat Petroleum will go up to 12.0 MMTPA in 2005-06).

One of the most significant contributions of these three refineries was to give birth to a rich crop of young Indian engineers — many of whom later on went on to build and operate refineries for IndianOil. In the long run these three investments in private sector refineries were extremely beneficial to the country. However, one would have wished that the multinationals had come up with these refineries earlier with more favourable commercial terms. Had they done so, economically it would have meant a great deal to India.

BIRTH OF PUBLIC SECTOR DOWNSTREAM

BIRTH OF INDIAN REFINERIES LTD AND INDIANOIL

Having formed the ONGC in August 1956, Keshav Dev Malaviya turned his attention to the obvious need for building Refineries in the public sector. Burmah Oil Company and the Assam Oil Company (BOC and AOC) had already struck oil at Nahorkatiya in 1953 and at Moran in 1956. BOC thought that this was a good opportunity to set up a refinery. Not allowing for such an opportunity to slip out of its hands BOC submitted a proposal to the State Government seeking permission to build a refinery at Calcutta. The company proposed to pipe the crude that was available at the above two oilfields to Calcutta.

Burmah Oil's application to build a Refinery, for some reason, was rejected by the Government of Assam. This was followed by tension between the Government of India and Burmah Oil especially when the latter dragged the Assam Government to court. This ugly development strengthened Malaviya's resolve to build oil refineries in the public sector.

The bitter feelings between Burmah Oil and the Government did not last long. In fact, the former extended its hand of friendship to the Government when it came forth with a proposal to set up a new joint venture company (Oil India Ltd.) to develop and exploit the crude potential of Nahorkatiya and the Moran oilfields.

With the birth of Oil India Ltd., Malaviya saw no reason why he should not go ahead with his plan of setting up refineries in the public sector. He had however shrewdly excluded the clause of building any refinery based on Assam crude in the JV agreement he signed with BOC and AOC.

As luck would have it the Prime Minister of Rumania was on a State visit to India in the month of February 1958. The Government's desire to set up an oil refinery was discussed with him. The Rumanian PM readily agreed to extend all support in terms of providing the entire gamut of oil refining technology to India. Having received this green signal from the Rumanian Government, India did not lose time and quickly established Indian Refineries Ltd. (IRL) in August 1958 with Feroze Gandhi as its first Chairman. Soon thereafter Malaviya flew to Rumania in the month of October 1958 and signed an agreement with the Rumanian Government for the building of a wholly Government-owned refinery at Guwahati in Assam.

Under Malaviya's direction, the Government was taking one step at a time in the field of petroleum industry. First, it formed the Oil & Natural Gas Commission (ONGC) to explore and produce indigenous crude on August 14, 1956. The Government then founded IRL on August 22, 1958 under whose aegis two new refineries were to be set up at Guwahati and Barauni, respectively. Once the refineries were commissioned, their products would require distribution and marketing. Hence there was a dire need to set up a public sector oil marketing company. This had to be done before the Guwahati Refinery came up.

It was very clear that without a proper marketing network, it would be impossible to run the new refineries smoothly on a continuous basis, although it was generally felt in Government circles that no particular skill was required to run an oil marketing company.

International experience, however, had clearly established that no manufacturing unit could run profitably without an efficient and effective marketing set-up. It was a tribute to K.D. Malaviya's foresight and the credit entirely goes to him that within 10 months of the formation of IRL, the Indian Oil Company Ltd (IOC) was formed on June 30, 1959, the first and original public sector oil marketing company.

The first Chairman of the newly-formed Indian Oil Company Ltd was S Nijalingappa (MLA) and in a note dated September 8, 1959, he received from K K Sahni, Jt. Secretary, Ministry of Steel, Mines & Fuels, clearly spelled out the Government's objectives for the new company. These were as follows:

a. The company shall take necessary steps to ensure that, within the shortest possible time, it is in a position to arrange for the supply of all petroleum product requirements of all Government organisations (Central and State) all over the country.

b. With a view to be able to handle ultimately at least half of the trade in imports of deficit petroleum products, the company shall take necessary steps to build up storage and other facilities so that, wherever advantageous, imports can be effected not only from sources already availed of by the trade but from alternative sources as well.

c. The company shall build up, as far as possible, such additional distribution facilities (including retail outlets) as may be warranted by the growing demand for petroleum products.

d. The company shall take over at the refinery points the entire output (totaling about 2.5 million tonnes of petroleum products) of the two refineries that the Indian Refineries Limited shall construct at Noonmati (Guwahati) in Assam and at Barauni in Bihar.

e. The company shall sell at the said two refinery points (or at such other points as may be mutually agreed upon) to other marketing companies, for distribution and sale through their own distribution facilities, such part of the output of the aforesaid refineries that the Company would not be distributing through its own facilities.

f. To attain the objectives stated in the foregoing sub-paras, the company shall endeavour to enter into product exchange arrangements with other marketing companies (and other refineries associated with such other marketing companies) so that, against the supplies (from the output of the Noonmati and Barauni refineries and from the imports the company shall make on its own account) the company makes available to the other marketing companies in some areas, it receives in exchange (for distribution through its own outlets and for supply to Government organisations) supplies from the other marketing companies (from the output of the refineries associated with such other companies and from the imports such other companies may make on their own account).

This was followed up by another note addressed to Bhishma Arora, Managing Director of the Indian Oil Company, dated August 8, 1961 under the signature of S.D. Bhambri, Deputy Secretary (P)., (later to become IndianOil's first General Manager in 1966) who clarified a few additional points:

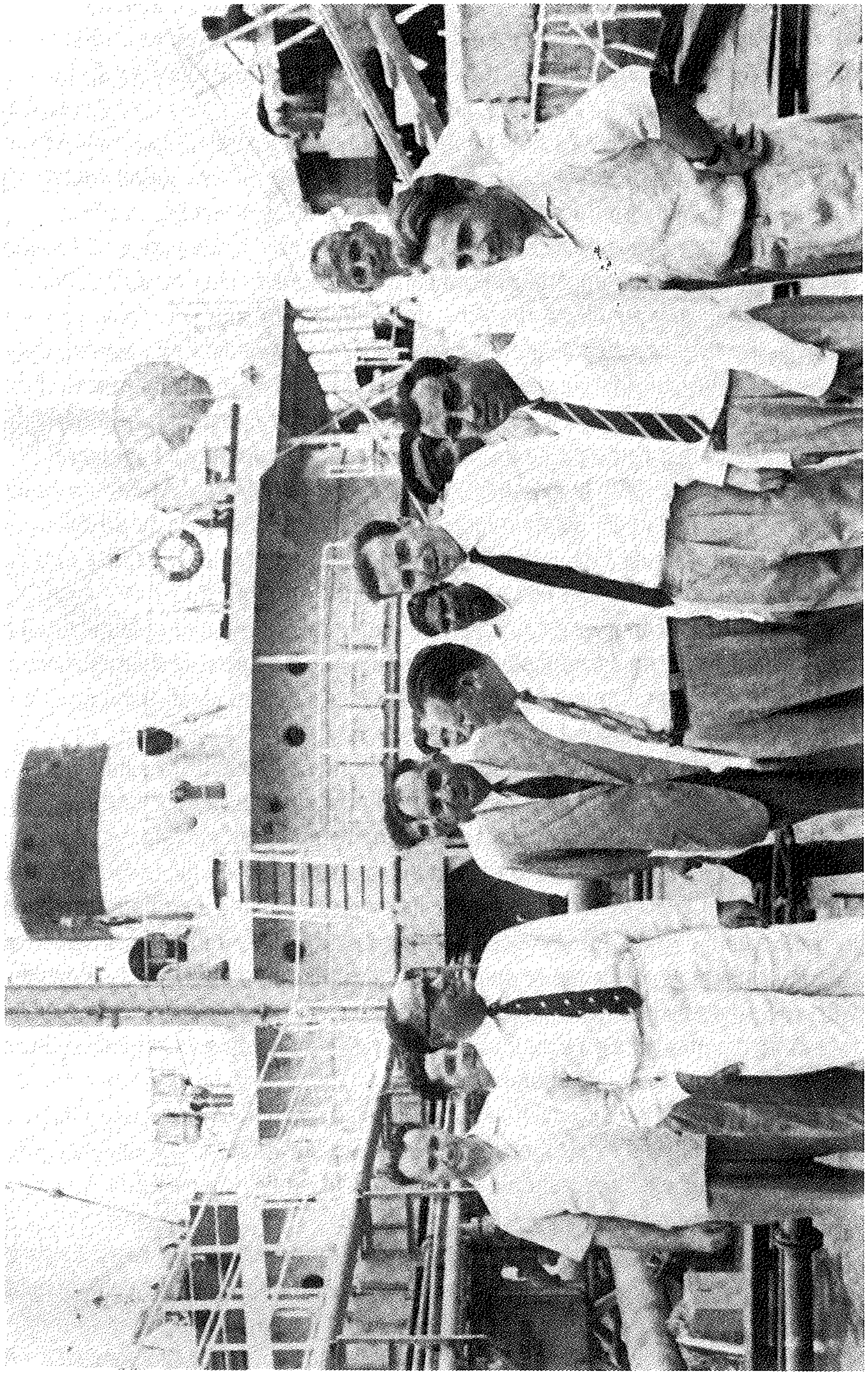
a. Under the Refinery Agreements, Government is committed to allow the foreign-owned marketing companies to distribute the products of their associated refineries, that commitment will be honoured at the level of the production already permitted to each of those refineries.

b. The Indian Oil Company should distribute, directly through their own organisation or of quantitative equivalents by product exchange arrangements with the other marketing companies, the refined products of each new refinery as it comes into production. But, to the extent the resources available to the Indian Oil Company do not permit it to increase its own storage and distribution facilities in the economic supply areas of the existing private sector refineries as much as this principle may otherwise require, the Indian Oil Company should so arrange with the private sector companies that the latter will market part of the equivalent exchange products on behalf of the Indian Oil Company on payment of a certain return to the Indian Oil Company.

c. In view of the extremely difficult foreign exchange situation, which is unlikely to be relieved over the next few years, imports of deficit products on payment of foreign exchange should be replaced as quickly as possible by their imports on rupee payment.

d. Any increased imports of deficit products that may be necessary to cover increase in domestic consumption, should be made only against rupee payment so as to avoid increasing the outgo of free foreign exchange.

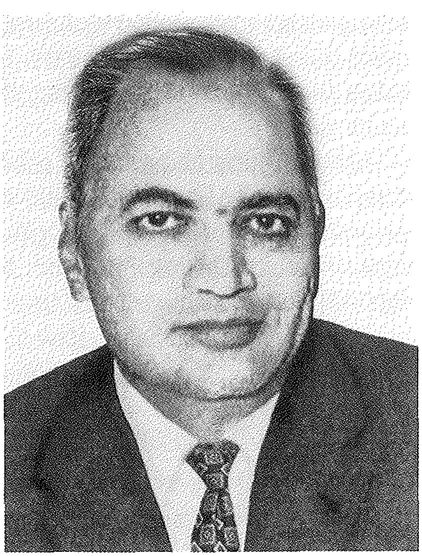
e. The Indian Oil Company should distribute all the deficit products that are



imported on rupee payment from USSR, Rumania and any other non-Western sources, the private oil companies are not willing at present to handle products imported from such sources but, if they later agree to do so on mutually acceptable terms, they will also be allowed to share the distribution of imports made through Indian Oil Company on rupee payment.

The newly formed Indian Oil Company began marketing petroleum products in India by importing the same from the USSR on rupee payment under the Indo-USSR trade pact even before the commissioning of IRL's first refinery at Guwahati on December 24, 1961. This was a very appropriate strategy because the company had to begin seeding the market *Now* and make its presence felt in order to be able to market product availability expected *Later* from the Public Sector Refineries then under construction. The first cargo of product for Indian Oil Company (IOC) arrived at Bombay's Pir Pao Jetty aboard the 145 metre long Soviet Tanker ***Uzhgorod*** on August 17, 1960 with a cargo of 11,930 metric tonnes of HSD. With the successful discharge of its first tanker of Diesel, Indian Oil Company made history. It was a small step for India but a giant leap for IndianOil as it was all set to grow and become the largest oil marketing company in the country.

This process of selling POL and gaining market acceptability was not easy. Basically Indian Oil Company had to overcome and remove adverse market perceptions about the quality of products, service and safety of a public sector oil company. This required performance and effectiveness, not rhetoric. Apart from the various actions taken by IndianOil the 'Inter Oil Company' product exchange arrangement proved to be the indelible equalizer. This was because most of the product sold by the Oil Industry in Eastern India was refined by IndianOil Refineries (Guwahati and Barauni), conforming to the relevant BIS specifications; while most of the product sold by the oil Industry in Western India came from ESSO and Burmah Shell Refineries conforming to the same BIS specifications.



Left: Historic photograph taken on board the first Soviet Oil Tanker Uzghorod received by Indianoil on August 17, 1960. In the picture: Bhishma Arora (third from left), Indianoil company's first Managing Director, the Russian Trade Representative (third from right) and master Captain K.V. Koshelyaev (left)

Right: P.A. Gopalkrishnan, Indian Oil Corporation's 1st Chairman

In order to achieve greater efficiency and viability major oil companies the world over are generally vertically integrated, combining under one umbrella all activities in the oil industry "Upstream" (crude oil exploration, drilling, production) and Downstream" (refining and marketing). In India, however, all these activities were conducted by separate organisations (ONGC/IRL/IOC) even though the Ministry of Petroleum attempted to play the role of a holding company.

After a few years of experience, it was realised that there was an urgent need for greater coordination in policy-making and more efficient operating practices and economic working between IRL and Indian Oil Company. The Government of India therefore decided to merge IRL into the Indian Oil Company to form the Indian Oil Corporation Ltd. on September 1, 1964.

The man who took over as the first Chairman of the new Company was P.A. Gopalakrishnan an ICS from the UP Cadre. The appointment was made through a Gazette Notification by the Ministry of Finance, Department of Revenue and Company Law, Company Law Board, through an order called the Petroleum Companies Amalgamation Order, 1964. The Gazette Notification, *inter alia*, stipulated that for the purpose of securing coordination in policy and the efficient and economic working of companies responsible for refining and distribution of petroleum products in the public sector in India, it was essential in the public interest that both Indian Refineries Ltd. and Indian Oil Company Ltd. be amalgamated into a single company.

Within less than a decade Indian Oil Corporation was to grow to become the largest Downstream (Marketing & Refining) Oil Company in India, the largest commercial enterprise in the country based on turnover, and ranked topmost among India's most profitable undertakings overtaking all the private and public sector undertakings in the country. For several years, IndianOil was the only Indian enterprise to be listed in the 'Fortune 500' list of the world's largest corporate giants.

Although India had achieved political Independence in 1947, no nation can claim to be really free until it achieved an acceptable degree of economic independence and self-reliance. According to many Western economists a country must control its banking, insurance, shipping and oil industries to be really economically independent.

INDIAN INSTITUTE OF PETROLEUM

With the emergence of the Public Sector Oil Industry (ONGC, IRL and IndianOil,) the first task before the planners was to establish an institution which could address the entire Hydrocarbon sector, i.e. by establishing the demand for various petroleum products, assessing feasibility and its production within the country, site selection and logistics, technology selection, providing technical back-up, conduct Research and Development and training facilities etc. With this backdrop and purpose the Indian Institute of Petroleum came into existence at Dehra Dun as a National Laboratory under the Council of Scientific and Industrial Research (CSIR).

Consequently the Indian Institute of Petroleum was established through an Act of Parliament in the year 1959. The following year it started functioning from New Delhi but in 1963 it moved to Dehra Dun. The CSIR then entered into a technical collaboration agreement with the *Instut Francais du Petrole* (IFP), (the premier institute of its kind in France and possibly in Europe in the petroleum sector) for organisational and technical support in setting up the IIP and in training some of its scientists under the UNESCO programme during the years 1960-64.

The IIP performed its assigned roles with distinction. It seeded all major Hydrocarbon projects in the country and over a period of time also helped train manpower to sustain the seeded projects. It must go to the credit of IIP that when it found that the Industry had matured to determine its future growth trajectory it recast its role primarily as an R&D institution dedicating itself to the development of appropriate technologies for the sector.

As the only centre for R&D in the Downstream oil sector, during the sixties IIP rendered yeoman service to the Industry by doing some great pioneering work in the field of Petroleum Refining and Marketing. Today IIP has become one of the leading constituent laboratories of the CSIR. It has a dedicated, experienced and qualified staff of 465 out of which 132 are R&D scientists supported by 208 highly skilled technical personnel. It is equipped with comprehensive state-of-the-art R&D facilities, including pilot plants. The annual budget of the Institute, currently, is around Rs.18 crore.

The Charter of the institute is to provide research, development and technical back-up for the growing refining industry in the country and to provide specialised training to its engineering cadres. With this Charter the specific objectives of IIP are:

▪ Development of processes for petroleum refining, petrochemicals, petroleum products and application.

▪ Technical assistance to the refineries in the selection, and adoption of technologies and optimisation of their unit operations.

▪ Evaluation of crudes and petro products.

▪ Technical Services.

▪ To conduct techno-economic feasibility studies and market demand surveys of petroleum products.

▪ Impart training to personnel in the oil and petrochemical industry.

▪ Assistance to BIS in formulating standards for petroleum products.

▪ Applied research leading to the development of technologies, products and processes in the area of petroleum refining, petrochemicals, specialty chemicals, internal combustion engines and combustion.

Right from 1961 onwards, IIP played a major role in providing technical backup to the new refineries that were being set up in the public sector. Starting from Guwahati Refinery to Barauni and Gujarat Refinery (Koyali), the Institute did extensive work for optimisation of processing, product quality improvement, operational problems and valuation of various indigenous and foreign crudes procured for refining.

It spearheaded the drawing of national specifications by Bureau of Indian Standards (BIS) for various petroleum products and monitored their quality as an independent body on behalf of the Government.

The Projects Division of IIP carried out feasibility studies for the Ministry of Petroleum & Natural Gas, for setting up refineries in South India, a job which resulted in the setting up of Madras and the Cochin Refineries. Later, extensive pilot plant work was done for setting up of the Lube Block in the Haldia Refinery.

In the early sixties, the IIP along with France's IFP prepared the first detailed report on Development of the Petrochemical Industry in India; a study which prepared a road map for setting up petrochemical units resulting in the establishment of complexes of Nocil in Mumbai and the IPCL at Vadodra.

MAJOR ACHIEVEMENTS

❖ The Institute has developed a large number of processes and technologies. Thirty-eight technologies having a licensed capacity around 25 million tonnes per annum have been transferred to the industry.

❖ Most refineries in the country have some technologies license by IIP verifications.

❖ Test techniques developed for evaluation of petroleum products include BIS specifications.

❖ Established global tie-ups for contract research and technical services.

- IIP has filed 185 patents in India and 29 patents abroad.
- PhD degrees awarded to about fifty research fellows and scientists of the Institute by various universities.
- A large number of research papers published in reputed international and national journals.

Recognition Awards

The IIP was bestowed with many prestigious awards in recognition of excellence in various fields, some of which are listed below:

Excellence in Technology (Ministry of Industry) - For production of Benzene and Toluene production through sulfolane extraction (1988)

National Research Development Council / Invention Promotion Board Awards in the years 1968, 1969, 1972, 1985, 1986 and 1987 for the following developments:

- Reflux Splitter.
- Vacuum Guard.
- Reforming of Lomax.
- FIA Grade Silica Gel.
- Benzene and Toluene Production.
- Low Air Pressure Film Burner.

CSIR Technology Awards

Since the initiation of Awards and Recognitions by the CSIR from 1990 onwards, the following awards were given to IIP by the CSIR

• Production of Benzene and Toluene through Sulfolane extraction.	1990
• Bimetallic Pt-Re Reforming Catalyst	1992
• Shield for process Technology of food grade Hexane	1993
• Low Air Pressure Film Burner	1994
• Business Development and Technology Marketing	1996
• Sulfolane Production Technology	1997
• Vis-breaking Technology	1998
• Propane de-asphalting of Petroleum Residue.	1999
• Shield for process Technology NMP based Lobs Production Technology.	2000
• Food and Petroleum Grade Hexane using NMP.	2001

Training

Development of Human Resource for hydrocarbon and related industries has been one of the major activities of IIP since its inception and remains so till today.

Accordingly, IIP has organised specialised training programmes for engineers (chemical and mechanical) and chemists in the Petroleum Refining, Petrochemicals, Power and Transport sector. It has imparted training to more than 5,000 personnel since its inception. During the past decade, IIP has organised more than 120 training programmes. It offers a variety of courses on scientific, technical subjects to personnel employed in petroleum refining and petroleum products user industry. These are moderately priced courses designed to impart the necessary knowledge and skills and are conducted by talented, highly competent and experienced scientists and engineers working in the respective fields of activity. Participants are provided ample opportunities to have state-of-the-art knowledge and hands-on experience. During the period 2000-2005 alone, 1,061 Managers from refining, petrochemicals and other user industries were given training through some 50 different courses.

CONSULTANCY

One of the main mandates of the Institute is to conduct market surveys and techno-economic feasibility studies for petroleum products, and to assist Bureau of Indian Standards (BIS) in the formulation of specifications for petroleum products. Accordingly, IIP has taken up the following studies:

- Survey of the quality of fuels in the Indian Market.
- Market survey for product demand and forecasting.
- Pre-feasibility for project planning and investment decision for diversification.
- Assist industry for identification of process licensor and selection of technology.

The IIP licensed over 16 technologies to the oil industry some of which are listed below:

1. Aromatic Extraction for production of Benzene and Toluene (IIP-EIL)
2. Food- grade Hexane (IIP-EIL).
3. Vis-breaking of Petroleum Residual Fractions Soaker Mode.
4. Catalytic Reforming (including Naphtha Pre-treater).
5. Pyrolysis Gasoline Hydrogenation.
6. Diesel Hydro-desulphurisation.

In addition, IIP licensed following products to the Industry:

- Lap Film Burner.
- Kerosene Wick Stoves.
- High Efficiency LPG Stoves.

The IIP has not only provided the original R&D inputs to the oil industry from 1960 onwards and remained the sole R&D institution till the founding of IndianOil's R&D Centre at Faridabad, but also during the crucial decade of the 60's developed and generated the most valuable indigenous experience and know-how backed whenever needed by the *French Institut Francais du Petrole* in Paris.

When IndianOil's R&D Centre came into being in 1972, several IIP scientists migrated to join the former. This included its first head, Dr. Joginder Singh Ahluwalia. In many ways it was really IIP who helped build and consolidate IndianOil's R&D effort.

Today IIP still remains a premier R&D institution in the Downstream oil industry and has to this day the versatile capabilities to provide valuable knowledge and innovative services to the industry. The credit goes to Dr. M.G. Krishna, the second Director In-charge (1963-74), for laying the foundation of the Indian Institute of Petroleum as also for developing the work culture and for consolidating the Institute. The IIP has an even more crucial role to play in the years to come especially in frontier areas of knowledge and renewable sources of fuels.

CHAPTER III

Third Era: 1961-1973

This was intended to be a period of intensive development and growth particularly in basic Industries leading to a self-reliant and self-generating economy and strengthening of Democracy. However, the country had to face two hostilities in the sixties followed by two bad harvests and the devaluation of the Rupee in June 1966. Despite these events the 'Green Revolution' was launched during this period.

The Downstream oil industry saw tremendous growth in this Era with the commissioning of the Public Sector Refineries at Guwahati, Barauni, Koyali, CRL and MRL, the merger of IRL with the Indian Oil Company, and the formation of the Indian Oil Corporation Ltd. It also saw the domination of India's Oil Industry by the Public Sector which during this Era was only ONGC (Upstream) and IndianOil (Downstream).

Simultaneously, it also saw three new joint ventures between the Government and the multinationals — i.e. Indian Oil Blending Ltd.(IOBL) a 50:50 JV between IndianOil and Mobil, for blending of the world famous Mobil Lubricants, Lube India Ltd (LIL) between the Government (50%) and Stanvac/Esso (50%) for the production of Lube Base Stock indigenously and Lubrizol India Ltd. Government (60%) and Lubrizol Corporation USA (40%) for the manufacture of world class lube additives in India. It was during this period that the first real thrust was made towards the emergence of a petrochemical industry in India (IPCL/GSFC etc.)

This was the Era that saw India's indigenous process designs skills and ability emerging through the Central Design Organization (CDO) and Engineers India Ltd (EIL). This was among the most significant of eras in the history of Downstream oil industry in India. Most importantly, it saw the world's most major oil crisis as a result of which the price of crude oil went up from \$3.0 a barrel to \$11.6 per barrel and the initiative for international crude oil prices shifting from the multinationals (Seven Sisters) to the oil-producing countries (OPEC). The International Oil Industry changed and restructured itself drastically — never to be the same again.

Refinery Commissionings

Guwahati Refinery

The genesis of the building of India's first refinery in the public sector at Noonmati near Guwahati in Assam was born on account of the discovery of crude oil in Nahorkatiya and Moran in 1956 and the formation of Indian Refineries Ltd. in August 1958. Guwahati was selected as it was the biggest city in Assam and is often called the Gateway to North-east India. Located on the banks of the mighty Brahamaputra River, Guwahati presently is the largest commercial, industrial centre of the region.

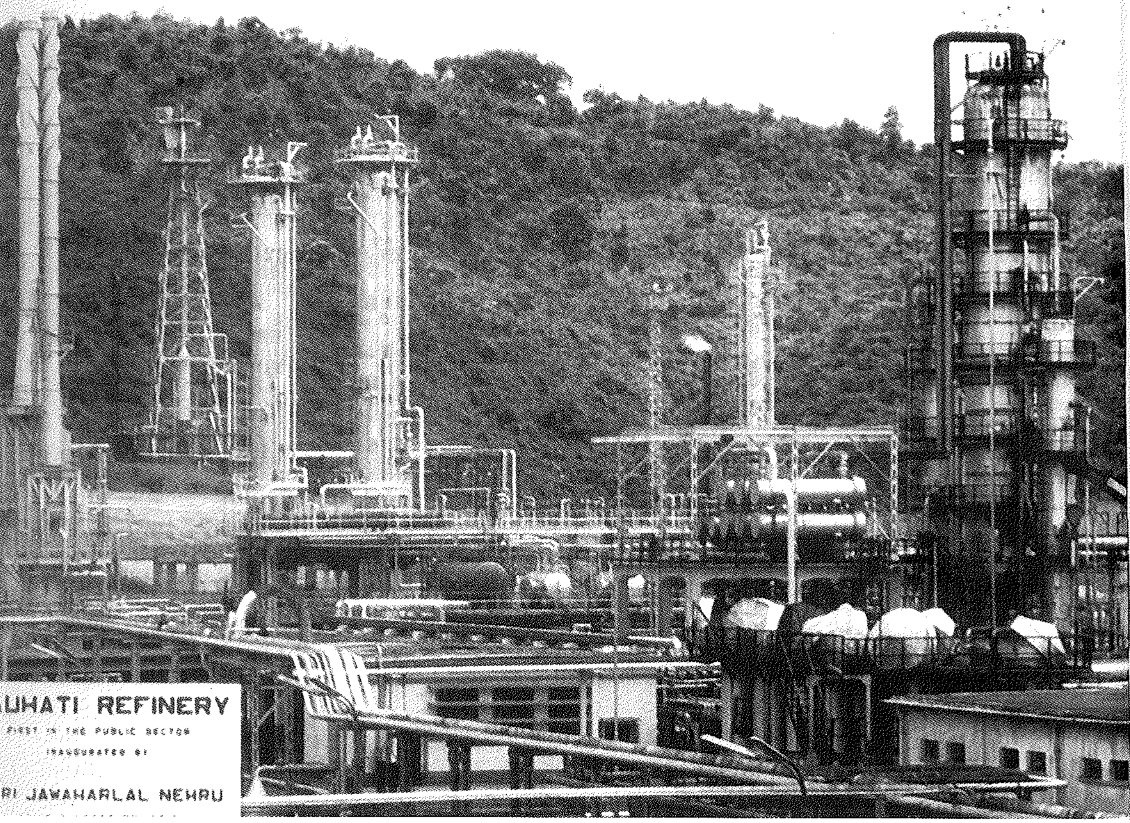
To get on with the refinery story, late in October 1958, Keshav Dev Malaviya, Union Minister of State, Ministry of Steel, Mines & Oils/Fuels, went to Rumania and on 20th of October signed a Supply and Technical Assistance Contract with the Rumanian Government for the construction of the Guwahati Refinery at a total cost Rs.16 crore. The foundation stone for the refinery was laid in1959.

Once the agreement was signed, work started immediately amidst aspersions being cast on the logic and wisdom of setting up a refinery in the public sector on a site in the State of Assam where there was practically no demand. The logic, according to some, was skewed. What was the point in putting up a refinery in Assam when the petroleum market and demand centre was located in the greater Calcutta industrial belt? The Government of India, of course, had its own reasons, and its judgment proved right.

With Indians having little experience in building refineries, the work involved, was of a massive magnitude and very complex. "Except for sand and cement, everything else had to be brought from Rumania, including manholes," said one observer. In view of the absence of technological infrastructure, the building and operations passed through many errors, trials and tribulations. Both the Rumanians as well as Indians were, however, dauntless in their resolve and relentlessly pursued the task on hand with unprecedented zeal and dedication.

The Rumanians faced the challenge with enthusiasm, as it was the first refinery they were building in India. For them it was a mission and they were determined to complete it successfully. Anticipating the requirement of skilled Process Engineers, the Government in 1958 selected five Chemical Engineers for under-going one year's Post-Graduate Course in Petroleum at IFP, France on the subjects of Petroleum Engineering and Refinery Technology.

On successful completion of the course, they were directed to proceed to Rumania for on-the-site refinery training for one year and subsequently posted to carry out the construction of the refinery at Guwahati. Coinciding with the commencement of the project a large batch of around 50 engineers from different disciplines most of whom were young, fresh from engineering colleges, with no experience whatsoever were sent to Rumania for a one-year training programme. In January 1959, M Ramabrahmam joined the Indian Refineries Ltd., at Guwahati as the head of construction and later on rose to become the Chairman of Indian Oil Corporation. To ensure smoothness in construction operation, a time-bound protocol was signed in the month of October 1959 with the Rumanians spelling out duties and responsibilities on both sides.



Guwahati Refinery, first in the public sector, inaugurated by Pt. Jawaharlal Nehru in January 1962

S K Mallick (ICS) was the first General Manager of the Refinery. General Sardanand Singh, a dynamic army man, replaced him in 1960. Both, Sardanand Singh and Ramabrahmam synergized excellently and competently led their teams which built and commissioned the Refinery nine days ahead of schedule (December 24, 1961) in a record time of just 30 months. Ramabrahmam who was the No.2 man nostalgically recalled, "You cannot imagine the enthusiasm when in the early hours on December 24, 1961 before dawn about three or four o'clock in the morning there was a knock on my door. When I opened it, two officers—one a Chemical Engineer and the other a Mechanical Engineer—were standing outside. They presented me with two bottles, one was filled with Petrol and the other contained Kerosene and both were collected from the 1st Unit of the refinery, which had started production a little while earlier."

For Ramabramam, it was like a father receiving the news of the birth of the first baby in the family. Beaming with smiles and hardly able to contain their joy, the Engineers simultaneously burst out with a sense of pride and satisfaction, "***Sir, we have done it!***" "Ramabrahmam further recalled, "We all felt that one of our long cherished dreams had been fulfilled. That hour was the moment of our glory. That one-day before Christmas in 1961 was a great day for all of us at Guwahati Refinery." The Refinery, however, made product available two days later on December 26, 1961.

The timely commissioning of Guwahati Refinery was primarily due to the exemplary leadership of Gen. Sardanand Singh, which goes a lot to say for the camaraderie and the cohesive teams he had built up. Soon after taking over the Refinery in December 1960, the indomitable General declared rather arbitrarily that the Refinery would be ready for inauguration on the New Year Day, i.e. January 1, 1962, and he ensured that everything was ready by that date. Then came the Red Letter Day when India's first Prime Minister, Pandit Jawaharlal Nehru, inaugurated what was India's first Public Sector Refinery on the January 1, 1962.

Sardanand Singh's success lay in his meticulous planning and drive, coupled by a relentless pursuit of target dates. He left no stone unturned to achieve his goal. A wall-chart in his room spelt out cut-out dates on every phase of the refinery to indicate the days passed and the days left for the completion of the job. He inspired people to work hard with a missionary zeal. Outside his office his name-plate too was unique. It had just two capital letters boldly symbolising the relationship he had with those who worked with him. These two magical letters were ***EB*** - "Elder Brother".

Pt. Nehru in his inaugural speech said, "We are beginning the New Year with an auspicious ceremony which will usher in a New Era in India and our industrial life." Also on the occasion, Malaviya reiterated his philosophy by saying, "There can be no freedom for a country's economy, or her Defence, unless the oil industry is owned and controlled by the State." This philosophy was fully vindicated during the 1962 Chinese Aggression, as also by India's rapid industrial growth under the Five-Year Plans.

Thus on the New Year Day, India had her first indigenous refinery with a capacity of 0.75 million metric tonnes per annum.

No doubt there were a few logistical problems. For example, the Oil India's crude pipeline from Nahorkatiya and Moran to Guwahati was not ready till February 1962. Meanwhile, to meet the refinery's requirement, crude oil was brought in by tank wagons. The refinery topped up its crude storage tanks by December 31, 1961 to enable the uninterrupted running of the refinery from 1st of January to the end-February 1962. The other problem was that filled tank wagons had to be ferried across the Pandu Jetty for several months until the bridge across the Brahmaputra could be commissioned in 1964.

The best tribute for running the Refinery against such heavy odds came from Suresh Moolgaonkar of Caltex, who was then his company's Chief Representative at Guwahati charged with the responsibility of securing Caltex's share of its product. On being asked by his colleagues how the refinery was running, he remarked, "I don't know all the details except the inefficient Pandu Ferry which carries filled railway tank-wagons across the Brahmaputra River in the absence of a railway bridge. However, we get the entire product, which is committed to us on time. What's more, if we ever have a problem we can go straight to General Sardanand Singh, who on hearing of our problems and quickly grasping them, immediately lifts the phone then and there and gives the necessary instructions right in front of us. He seldom lets us leave his room without solving our problem and in any case satisfying us and making us feel comfortable. One thing very interesting is that whenever we entered his room we never saw a single piece of paper on his desk except the table calendar on which he scribbled his time-bound targets. When we asked him how he managed to keep his table so free of paper, he shot back, 'We have hired enough people to do the paper work. The day I am submerged with paper I will get up and go home'. I was very much impressed," Suresh Moolgaonkar concluded with a smile.

For Gen. Sardanand Singh's role in the building and commissioning the Guwahati Refinery, the President of India subsequently honoured him with the *Padma Bhushan*, which he richly deserved.

The first major revamp and de-bottlenecking of the Refinery was undertaken in 1983-84 onwards as a result the capacity of the Refinery was enhanced from the initial 0.75 to 0.80 million metric tonnes per annum and subsequently to 1.00 million metric tonnes per annum. De-bottlenecking covered many Energy Conservation and Operational upgradation projects, which improved the operational efficiency of the Refinery. Some of the important projects were LPG recovery from Coker to reduce flare loss, DCU revamping etc.

Guwahati Refinery was the first refinery to produce Needle Coke in India. Presently, the refinery processes only indigenous crude oil from Assam oil fields. With its main secondary processing unit, the Coker produces middle distillates from heavy ends and supplies petroleum products to North-Eastern India and surplus products onward to Siliguri in West Bengal. Facilities for production of unleaded Gasoline using ISO SIV process from UOP was also implemented during the year 2003-04. A Hydro-treater Unit for improving the quality of diesel was installed and commissioned in November 2002 followed by Sulphur Recovery Unit in December 2002. The refinery has also installed in June 2003 Indmax Unit, a novel technology developed by IndianOil's R&D Centre for upgrading heavy ends into LPG, Motor Spirit and Diesel Oil.

BARAUNI REFINERY

IndianOil's Barauni Refinery in Begusarai, Bihar, was the second public sector refinery built in collaboration with the erstwhile USSR and with a limited participation of Rumania. The refinery built in 1964 is located in the Gangetic plain right amidst the agrarian region of North Bihar where agriculture as an industry predominates.

The story of Barauni Refinery, however, begins some time after the finalisation of 0.75 MMTPA Guwahati Refinery in 1958 when it was discovered that there was unutilised availability of Assam crude. Even as the Guwahati Refinery was being planned in 1958, a second public sector refinery outside Assam was already very much on the cards immediately after the formation of Indian Refineries Ltd

Firstly, there were regional and political push and pulls on the selection of location for the second public sector refinery, the choice (as in the case of Guwahati refinery) veering between the demand centre at Calcutta and a far-off inland location. Free India's first President, Dr. Rajendra Prasad, was very keen to have the refinery located in North Bihar and Barauni found favour with him as it was located near to his ancestral village.

Locating the refinery at Barauni had several advantages. Firstly, petroleum products from here could be distributed not only within the State of Bihar but also to the State of Uttar Pradesh across the hinterland through product pipelines and Railways, as both BG and MG sidings were available at Barauni. One more reason, in favour of an inland refinery was that whereas the petroleum needs of the Calcutta supply area could always be augmented by coastal movements, logistically it was far more difficult to reach products to the North and North-west India from Calcutta.

The second important decision that needed to be taken was on the choice of collaborators. There were several foreign parties interested in the project; they included Rumanians, Austrians, Italians, the USSR, even the Americans and the British. There were serious internal arguments about the superior Western Technology as compared to the not-so-modern Soviet technology.

Finally, Malaviya short-listed the Soviet and the Austrian offer. The Austrians were not only willing to give credit at 9% interest, but were also willing to agree to a Rupee payment system. This was almost like matching the Soviet offer. The clincher however in favour of the Soviets was their offer for the transfer of technology, a secret the Austrians were not willing to share. Time, however, was running out and there was an obvious need to take a firm decision very quickly in order to mop up indigenous crude availability in shortest possible time.

The Government of India finally decided in favour of the Soviets and an agreement was signed in 1959 for a two-million tonnne refinery to be built at Barauni at a total cost of Rs.35 crore. This was augmented to three million tonnes after the Chinese War. The Central Design Organisation (CDO) of the Gujarat Refinery designed the third million metric tonne Atmospheric Unit (AU).

Thus Barauni Refinery was to become India's sixth refinery and the second one in the public sector. President Dr. Rajendra Prasad laid the foundation stone in 1959. Work at the site began in early 1961. Serious problems had to be countered and overcome and various natural calamities had to be faced. The ground level of the site was 1.6 metres below the minimum flood level of the River Ganga, which had to be raised by 1.8 metres. There were unprecedented floods, thrice in the course of fifteen years — first in October 1961, the second in October 1962 and the third in 1976.

On the first occasion, there was a torrential rainfall of twenty-four inches within a matter of thirty-six hours; and on the second it was eighteen inches in fourteen-and-a-half hours, of which twelve inches fell in just three hours. Two other problems encountered and solved were: the dust-like sand strata at the base of the foundations, the foundation work lay in sub-soil water conditions. Although, time-consuming as these problems were, they provided valuable experience to our Indian engineers.

Barauni Refinery provided a sound technical knowledge to its engineers in building a refinery in India. This was achieved by not only on-the-job experience during construction work, but also by having as many as eighty-three engineers and foremen trained in various branches of oil technology at the Ufa Refinery in the Bashkir Republic of the USSR.

The first batch of twenty-two trainees were Electrical, Mechanical and Chemical Engineers. The second batch of thirty eight specialised in process engineering, planning and coordination; and the third comprising twenty-three Chemical Engineers (including Ms Maitry Choudhuri, the first lady Chemical Engineer in IndianOil) were inducted into production, process engineering and laboratory work. On return from USSR, these engineers and foremen were, "able to participate in the construction work far more effectively and fruitfully than would have been possible otherwise. Later on, when the units began functioning this training proved to be of invaluable use in refinery operations."

Finally, the refinery was formally inaugurated by then the Minister of Petroleum, Prof. Humayun Kabir on January 15, 1965. This was how the

Indianoil News described the event: "January 15, this year, the day on which our Union Minister for Petroleum and Chemicals, Professor Humayun Kabir, formally declared open the oil refinery at Barauni in Bihar, will go down as a red letter day in the annals of the development of public sector oil industry in India. The silvery-white towers reflecting the winter sun provided a fitting backdrop for the elaborately executed inaugural ceremony of the sophisticated refinery, the second in the chain of public sector units.

Described as a "boon to industrially-backward North Bihar," the Barauni refinery designed for a processing capacity of two million tonnes a year was likely to change the entire industrial complex of Bihar State. Soviet and Rumanian aid had flowed into the Barauni Refinery. Professor Kabir called it a "truly international effort". The ties of friendship and international cooperation in the economic field serve as "bastions of peace," he said. At Barauni, someone eulogistically put it, "the Volga came to meet the Ganga", and the confluence of the two happily resulted in the consummation of Indo-Soviet friendship.

It had been the aspiration of the local people as also of the politicians that the coming up of Barauni Refinery would trigger a very significant industrial development in that area and rightly so. As a matter of fact the Minister of State, O V Alagesan, in his speech endorsed the public request made by the then Chief Minister, K B Sahai, for a fertilizer plant in Barauni, and such a plant was indeed commissioned in due course of time by the Fertilizer Corporation of India. A thermal power plant also was commissioned soon thereafter. The feedstock for both the units came from Barauni Refinery. Unfortunately, the fertilizer plant has since been closed down and the Thermal Power Plant is operating at a very low power load.

At the time of its commissioning Barauni was a rather complex refinery. It had several secondary processing units such as 0.6 million metric tonnes per annum Coker and a Lube Oil complex with a De-waxing and Phenol Extraction Unit. The Russian designed equipment were sturdy and effective. The refinery was operated without any major technical problem except for the lube complex. The last Russian expatriate left only at the end of 1972.

Other facilities included the first Coke Calcination plant designed by EIL was set up in 1973 to produce 'Anode Grade' calcined coke for aluminium industries. The second 0.5 million metric tonne capacity Coker Unit was installed in 1986 in order to augment the Secondary Processing capacity. The Coker Unit of Russian-make was further revamped in 2002 to process High Sulphur Vacuum Residue. While doing so, the furnace efficiency was improved to 90 per cent.

Barauni Refinery never reached the rated capacity of three million metric tonnes of crude processing mainly because of inadequate availability of Assam crude for which the refinery was designed. Subsequent to 1979, crude supply was badly interrupted and later completely dried out between December 1979 and January 1981 on account of the Assam Agitation. Thereafter, as a fallout of the Assam Accord, the expansion of the Bongaigaon Refinery and marginal increase of processing capacity at Guwahati, crude supply to Barauni refinery had to be switched over to an alternate source.

In fact, it was decided to feed Barauni from Haldia through pipeline. Accordingly, a 498-km pipeline of 4.2 million metric tonnes capacity per annum was laid between Haldia and Barauni (HBCPL) and the same was commissioned in February 1999. The pipeline was subsequently upgraded to 7.5 million metric tonnes to cover the partial requirement of BRPL also. Meanwhile, arrangements were made to transport 0.5 million metric tonnes per annum of crude oil by tank-wagons from Haldia to Barauni from October 1994 right till the pipeline was commissioned.

Based on the carrying capacity of Haldia-Barauni crude pipeline and its tentative date of commissioning, Barauni Refinery carried out revamps of their AVU-1 and AVU-2 to two million metric tonnes each and the AVU-3, to three million metric tonnes making the total operational capacity to 6 million metric tonnes. Matching Secondary Processing facilities were also added, that is, Reformer at Rs.150 crore in April 1997. The RFCC of 1.73 million metric tonnes capacity along with Hydrogen Unit, Diesel Hydrotreater, (2.70 MMTPA) Sulphur Recovery Unit, for Rs.1,800 crore were commissioned progressively for matching the primary units' requirements.

From its very inception IndianOil had made the offer of the product exchange facility to multinational oil companies in order to eliminate infructuous expenditure on freight because of cross-movement of product. The terms and conditions of this exchange were covered under the Noonmati Product Exchange Manual. In due course it was discovered that there were number of clauses unfavorable to IndianOil in the said manual. The major negative clause was that for the product purchased by the multinationals ex-Guwahati Refinery — they would pay IndianOil only the lower Bulk Loading Charges, against IndianOil's entitlement of higher Main Installation Charges (MI Charges).

With the commissioning of the Barauni Refinery the multinational oil companies wanted the extension of the same clause for the products from Barauni also. IndianOil turned down their demand. After a major stand-off they finally agreed to pay full MI Charges to IndianOil and the clause was modified to IndianOil's advantage.

Future plans for the Barauni Refinery envisages the supply of distillate products not only to Eastern India but also to Northern India through a product pipeline to Kanpur in Uttar Pradesh.

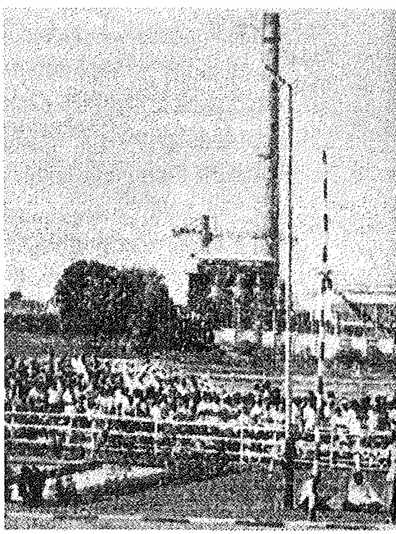
KOYALI REFINERY

IndianOil's largest refinery at Koyali near Vadodara in Gujarat was commissioned in 1965. Vadodara (former Baroda) is known as the 'Cultural Capital of Gujarat.' Baroda was the Western derivative of 'Vadodara,' meaning 'City of Banyan Trees'.

The discovery of Ankhleshwar Crude in 1960 revealed that it could easily feed a two million metric tonne refinery in the State of Gujarat. This was followed by the discovery of crude oil in Kalol. The Third-Five-Year Plan (1961-66) had already included the third public sector Refinery at Koyali based on Ankhleshwar crude. The refinery was to be built under the aegis of the ONGC.

On account of their role in helping discover crude oil in Gujarat, it was decided to entrust USSR with the responsibility of building Koyali Refinery. Accordingly, an Indo-Soviet agreement was signed on February 21, 1961, providing *inter alia* for the establishment of a two-million metric tonne refinery in Gujarat. A site at Koyali near Vadodara was selected in the month of April 1961. A contract was signed between the ONGC and Tiajprom Export, Moscow for the preparation of a Joint Project Report.

In the meantime, Ankhleshwar Crude had already begun flowing to the Burmah Shell and Esso Refineries in Bombay by tank-wagons since 1962. After the Chinese Aggression, however, there was some serious rethinking by the Government of India as to whom to entrust the job of building the refinery. Some Ministers felt that the Gujarat Refinery should be entrusted to Burmah Shell. Malaviya, however, persisted in going forward in building the refinery at Koyali with Soviet help. Accordingly, Prime Minister Nehru laid the foundation stone of Koyali on May 10, 1963, barely a month before Malaviya was eased out of office.



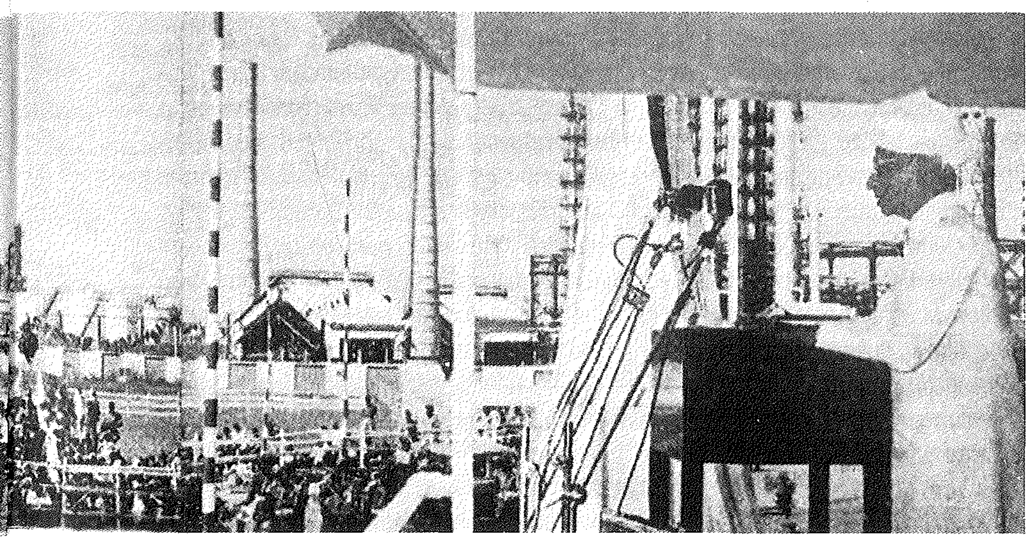
During the function, Pt. Nehru paid a handsome tribute to Malaviya for founding the ONGC, which had discovered oil both in Assam and Gujarat. He went on to mention that Koyali was the "Symbol of growing friendship and cooperation between India and the Soviet Union." He reiterated India's Oil Policy stating that, "We will take help from foreign oil companies but we will develop the Oil Industry mainly in the public sector as oil is such a vital necessity".

On June 29, 1963 a contract for the supply of equipment and material was signed between the ONGC and Tiajprom Export. Work, however, on the site commenced from the month of October 1963 that is after the end of the monsoon season. In June, General Sardanand Singh, builder of Guwahati Refinery, joined the ONGC as General Manager for the Koyali Refinery Project. During the year 1964-65, the Union Government transferred the Management and Control of the Gujarat Refinery Project from the ONGC to IndianOil.

With the addition of Koyali Refinery, the Refineries Division of IndianOil would be owners of three Refineries, i.e. one each at Guwahati, Barauni and now Koyali. General Sardanand Singh continued as the head of the project and was designated Director-In-Charge. In contrast to Guwahati and Barauni Refineries, where 100% of all working drawings were prepared in Rumania and the USSR, in the case of the Koyali 40% of the design work for the two million metric tonne unit was done by Indian engineers. In addition 100% of the design work not only for Koyali's third million tonne unit, but also Barauni's third million tonne unit was done by the Indian engineers of the Central Design Organisation (CDO) at Vadodara.

The first million tonne unit of the refinery went on stream on October 11, 1965, stabilising to its full production capacity by December 6, 1965. Thereafter,

Standing from an elevated rostrum ,President Radhakrishnan addressing a huge gathering at the formal inaguration of the Koyali Refinery at about 7 miles from Baroda



Indian engineers took charge of this unit. The second one million metric tonne unit went on stream on May 26, 1966 and was officially taken over from Soviet experts in the month of November 1966.

About 60% of the equipment and material was procured indigenously leading to a considerable cost reduction and a ten per cent saving on the original budgeted cost of Rs.30.21 crore. Gen. Sardanand Singh used these savings (Rs.3 crore) from the budget to build the third million tonne unit, which was designed by the Central Design Organisation. This unit was commissioned on September 28, 1967 and the unit stabilised by December 1967. The refinery was able to enhance its capacity by 50% within the original budgeted amount of Rs.30.21 crore—a most creditable achievement.

Koyali Refinery was formally inaugurated in October 1966 by President Radhakrishnan. In his inaugural speech, the President strongly emphasised need for self-reliance and the ability to convert resources to products useful to society. The Udex Unit (whose general facilities were designed by the CDO) for the manufacture of Benzene and Toluene of high purity were commissioned in December 1968. After the successful completion of trials, the products were accepted from Italian manufacturers in March 1969.

The successful commissioning of the first one million metric tonne per annum portion of the refinery in only two years, the second one million metric tonne per annum unit seven months later and the addition of the third million metric tonne per annum unit 16 months later (within the Rs.30 crore budget) was achieved again through the inspiring leadership of Gen. Sardanand Singh, ably assisted by his DGM, C R Dasgupta, who was later to retire as the first 'home-grown' Chairman of IndianOil.

The experience gained by Gen. Sardanand Singh in Guwahati was not only replicated at Koyali, but he went several steps further. Firstly, he strongly emphasised indigenisation of equipment and material and secured significant savings in foreign exchange through import substitution. Secondly, he facilitated the formation and creation of Central Design Organisation (CDO), which helped design the third million tonne unit not only for Koyali Refinery but also for Barauni Refinery, a task entirely carried out by Indian engineers. This later went on to flower and merge with the Engineers India Limited, the foremost Engineering Consultancy and Project Management Organisation for the Chemical and Process industries in India.

Thirdly, during the construction period, Sardanand Singh banned the cutting of trees on the refinery campus, an exception, however, was made for the operational area. While inspiring his team and instilling the spirit of teamwork, he powerfully propounded his unique '4-P' philosophy, i.e. '*People Pehle, Paper Peechay*' (People first, paper afterwards!).

After the departure of Gen. Sardanand Singh as Managing Director, R&P; C R

Dasgupta succeeded him in the month of September 1967 as the head of the Refinery as General Manager. By 1969, through simple de-bottlenecking, Dasgupta increased the refinery's capacity to 4.3 million metric tonnes per annum.

With the discovery of Bombay High crude in 1974, it was felt necessary to expand the capacity of Koyali Refinery. Consequently in 1978, the Refinery was expanded to 7.5 million metric tonne per annum with the addition of another single 3 million metric tonnes per annum Distillation Unit designed entirely within the country by EIL with a Vacuum Distillation Unit. A Visbreaker Unit was also added. Crude was piped from Salaya via Viramgram to Koyali.

Thus the refinery developed the crucial flexibility of also being able to process imported crude. A Fluidised Catalytic Cracking Unit was added to the refinery in 1981 to increase distillate yield, such as SKO, HSD and LPG. The capacity of the refinery was further increased to 9.5 million metric tonnes per annum by 1990 through low-cost revamping and de-bottlenecking.

Around 100 Russian engineers were associated during construction and start-up of the Refinery in 1965-66. During its expansion in 1976-81, except for Process Licensor Engineers, no foreigners were involved. India's first Hydrocracker commissioned at Koyali in 1994-95 resulted in further maximisation of middle distillates. Subsequently, the crude capacity was increased to 12.5 million metric tonnes per annum in September 1999 by addition of new 5th Atmospheric Unit of 3.0 million metric tonnes per annum, along with revamp of the FCC unit.

The capacity has since been increased to its present capacity of 13.70 million metric tonnes per annum by low-cost de-bottlenecking. For many years, until the commissioning of Reliance Petroleum's Refinery at Jamnagar in 1999, Koyali was India's largest refinery. The refinery also produces a wide range of specialty products like Benzene, Toluene, MTO, Food Grade Hexane, Solvents, LABFS, etc. The Koyali achieved the distinction of becoming the first refinery in the country to have completed the DHDS (Diesel Hydro De-Sulphurisation) project in June 1999, when the refinery started production of HSD with low sulphur content of 0.25% wt. max.

The commissioning of the Koyali Refinery led to several positive spin-offs. The first was the germination of refining technology, which took root at Gujarat and spread from there to other refineries. This placed India in an enviable position in two respects. Firstly, her capability in constructing a refinery on her own, of any size and design and secondly, her capability to export her expertise to third world countries by loaning the services of her oil technocrats for countries such as, Sri Lanka, Bahrain, Nigeria, Kuwait, to mention just a few.

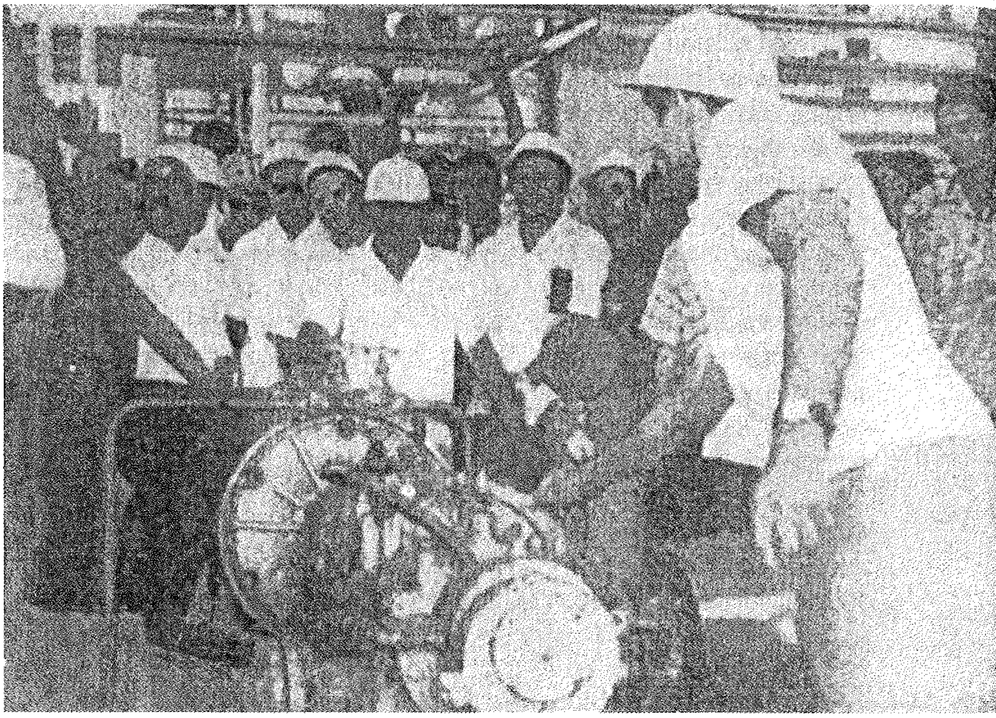
Koyali Refinery also enabled the emergence of fertilizer plants in Vadodara

(GSFC) and the largest petrochemical complex in the world, that is, IPCL and GNFC at Bharuch, Petrofils and Gujarat Petrosynthesis. It also played an important role in becoming a catalyst for the growth of the process industry in the Ahmedabad, Vadodara, Bharuch and the Hazira belt right up to Vapi.

Concept of value addition in IndianOil was first initiated at Koyali Refinery by sending cracked LPG from FCCU and Xylene Reformate from Platformer to IPCL across the boundary wall for recovery of valuable petrochemical feedstock by IPCL and obtained the return stream for further processing at the refinery

The latest in the line is a project for production of high value LAB (Linear Alkyl Benzene) from Kerosene streams has been implemented. Last but not the least, in order to meet the future MS quality improvements as stipulated from time to time by the Government, infrastructure to incorporate the same has been planned for 2006.

From its very birth, Koyali Refinery became and remained for many years a 'Mother Refinery' as also the pride and showpiece of IndianOil.



At the refinery start-up October 11, 1965, Maj. Gen. Sardanand Singh (Retd.), Director-in-charge, Koyali Refinery, turned the wheel to take the first crude into the Atmospheric Unit No.1. Picture shows the Soveit and Indian technicians feeling the pulse of the pump

KOCHI REFINERIES LTD

Kochi Refineries Ltd, formerly known as Cochin Refineries, is one of India's major regional refineries. The company's refinery complex located at Ambalamugal in Kochi, and commissioned in 1966 has a refining capacity of 10.5 million metric tonnes per year. At present Bharat Petroleum holds 54.8 % of Kochi Refineries.

The discovery of crude oil in Assam and Gujarat by the ONGC had actually led to the Government's plan of setting up and commissioning of refineries at Guwahati, Barauni and Koyali. These refineries were put up to keep pace with the growing demand for petroleum products in India. Obviously, it was far cheaper for the country to import crude oil instead of refined products, the latter being more expensive.

While the USSR came to India's assistance, by helping out not only in building refineries but also by supplying the country with deficit petroleum products on a rupee payment basis, at the same time serious doubts were being expressed about the efficiency of Soviet and Rumanian Refinery Technology, which apparently was much behind that available in the West. Consequently, a firm decision was taken that all future refineries in India must be built with the latest state-of-the-art technology. The Kochi Refinery was a result of this decision.

An offer to bring in the latest technology came from Phillips Petroleum International of America who agreed to a majority holding by the Government of India (53.83%) with its own equity holding of only 26.4% along with Duncan Bros Ltd., who were their Indian associates with 2% equity, the Government of Kerala 7.14% and the rest of the equity shareholding to be held by UTI, LIC, KSIDC, Mutual Funds, Employees, Corporate Bodies and the Public etc. Accordingly, an agreement was signed on April 27, 1963. Three years later, Kochi Refineries went on stream on September 23, 1966.

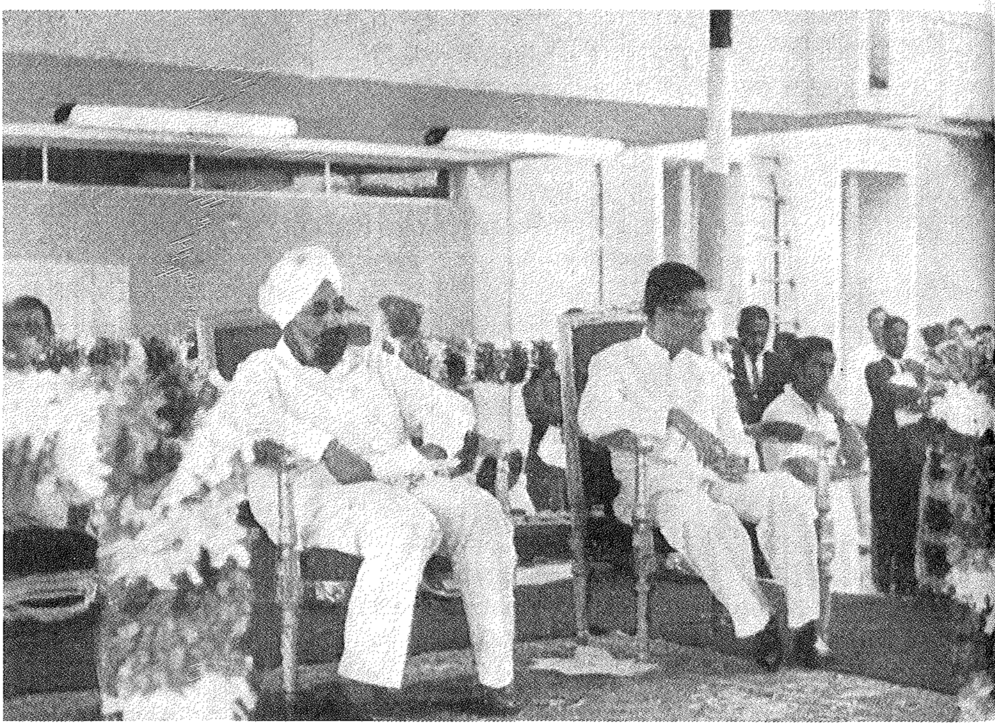
All this did not happen as easily as it appears. There was an intense backstage drama before the Kochi Refinery saw fruition. In early 1962, Burmah Shell, Esso and Caltex who had a refinery each in India, put forward a proposal to allow them to either expand their existing refineries or permit them to set up refineries in the South. Phillips Petroleum, in comparison with the Seven Sisters, was a small American player in the international oil market. When Phillips put forward a proposal through their associate Duncan Bros to set up a refinery in Cochin with a minority equity holding, the Government was pleasantly surprised. The other oil majors invariably insisted on controlling rights.

After a preliminary study, at the fag-end of 1962 when Phillips submitted a proposal to the Government of India, the latter was in for yet another surprise. Phillips offered to market products from their proposed refinery as per the norms laid down by the Damle Product Pricing Formula. This formula was something that Shell, Esso and Caltex were very reluctant to implement at that point of time.

When Shell, Esso and Caltex came to learn about Phillips' tempting offer; the threat seemed formidable, as this small, comparatively insignificant American oil company was attempting to make a foray into their own citadel.

Shell tried its best to scuttle Phillips from landing on the shores of India. It now made an offer to build a 2.5 million metric tonne refinery for only Rs 9 crore. Anybody could see through the offer, which was far too unrealistic, since Shell itself had built its refinery at Trombay in 1955 for Rs.26 crore. How could they possibly build a refinery for less than half the cost, when prices had escalated during the last eight years?

Actually, Shell's offer was not without a catch. They were, in fact, tempting the



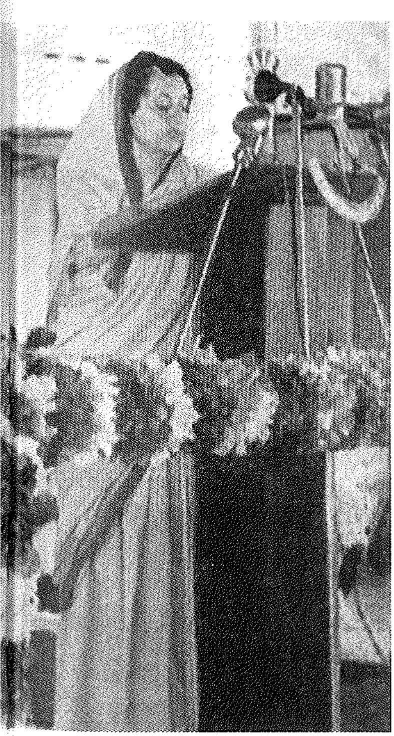
Indian Government by the above proposal hoping that the Government by swallowing the bait would grant them permission to expand the capacity of their existing refinery at Trombay. At the same time Shell offered another compromise. They surprisingly expressed their willingness to modify their original Refinery Agreement of 1951, which was heavily loaded in their favour. But the final catch to all these inducements came with a demand that should they be allowed to build a refinery in Cochin, it must be only in collaboration with interested local private industrialists, as it was contrary to Burmah Shell's worldwide policy to have the Government as a partner.

Since the last condition violated the principles of the Industrial Policy Resolution of 1948/1956, the Government could not accept Shell's proposal for building the refinery at Cochin, and all attempts made by Shell from preventing Phillips from entering India proved futile.

With Shell out of the fray it was Caltex's turn to throw its hat into the ring. It did so by its willingness to offer a 50 per cent stake to the Government in their refinery at Visakhapatnam, but this magnanimous offer, once again was not without a catch. The catch in simple terms was that the Government should permit them to expand the capacity of their refinery at Visakhapatnam and Phillips not be allowed an entry into India. Obviously the oil 'major' did not want a 'minor' in the 'India League'.

There was a great deal of internal debate and discussion within the Government of India on the above proposals, coupled with a lot of lobbying on the part of Shell, Esso and Caltex. In spite of all the string-pulling, the strings snapped and eventually Phillips Petroleum clinched the deal by sticking to its offer of building a refinery in the public sector and an agreement was duly signed in the month of April 1963 by the Government with Phillips and Duncan Bros Ltd. Thus Phillips Petroleum became the first foreign oil company to come as a minor partner in an oil project owned exclusively by the Government.

The equity for the refinery was split in the ratio mentioned earlier. The authorised capital of the refinery was fixed at Rs.15 crore. The interests of Phillips Petroleum were to be guaranteed against nationalisation for a peri-



Prime Minister Indira Gandhi delivering the inaugural address at the Cochin Refinery. On her right seated: N.N. Kashyap, ICS, Chairman of the Cochin Refineries Ltd., Sardar Iqbal singh, Dy. Minister for Petroleum & Chemicals.

od of 12 years, as against the-25-year guarantee extended to the cartel company refineries at Bombay and Visakhapatnam.

Crude to be supplied to the Kochi Refinery by Phillips was to be at lower than the international prices, or the posted prices, at which cartel companies supplied crude to their Indian plants. Phillips also agreed to import oil products at discounted prices as determined by the Damle Committee. Further, they also delinked themselves from distribution of products imported into or refined in India, unlike the other major oil companies. Their share of the capital invested in the refinery was to be paid back to them in kind, in motor gasoline, surplus to India's needs. The refinery was to be worked by Phillips on a commission basis.

The stand-alone Kochi Refinery was duly registered on September 6, 1963. The land at Ambalamugal became available for construction in March 1964. The actual construction time to complete the refinery took only two-and-a-half years. The design of the refinery was such that it could achieve a low cost expansion to 3.5 MMTPA as and when required.

The coming up of the Cochin Refinery was a bold new venture both by Phillips and the Government of India, and the agreement set a good precedent, as both took care in protecting their mutual interests. Kochi was the first public sector refinery whose shares went up on the country's Stock Exchange.

Kochi Refinery Ltd was formally inaugurated in the month of September 1966 by the then Prime Minister Indira Gandhi. In her inaugural speech, she made several significant points some of which are reproduced below:

"Cochin Refineries Limited is the first joint venture in the refining field. It has, moreover, the Central Government, Phillips Petroleum Company, the Kerala Government and India's investing public as partners. As such this is a unique experiment.

The two enterprises illustrate the amplitude of India's Industrial Policy to promote the growth of the oil industry under State auspices, but with cooperation from others, where necessary".

"We must work for the time when India can design and build complete refineries and other chemical plants indigenously". (This was achieved with the EIL designing the 3.0 MMTPA crude distillation unit for Koyali expansion in 1978).

"It so happens that Phillips Petroleum, which is a partner in the Cochin Refinery, is also a partner with the Government of India, the Oil and Natural Gas Commission, and the Italian State-owned company ENI, in exploring an Iranian concession. I hope that these efforts will be successful". (This subsequently led to the discovery of the Rostam Crude).

The Minister of Petroleum, O V Alagesan, in his speech highlighted the fact, when he said, "Our partner Phillips Petroleum Company have also undertaken to export surplus products such as Naphtha and Motor Spirit. This will secure maximum possible foreign exchange for the country. In due course, the refinery will undoubtedly diversify its yield pattern so as to make its operations more flexible and more profitable." (This foreign exchange in fact was to pay for the funds in foreign exchange invested in building the refinery).

Like at other refinery locations the commissioning of the Cochin Refinery triggered off a string of ancillary industries in the neighbourhood, including the emergence of FACT at Ambalamedu next door. These were the exact sentiments expressed by Indira Gandhi quoted below during her inaugural speech.

"The Cochin Refinery is not just a project in itself. It is a trigger. It will stimulate regional development. It will provide the feedstock for a large fertilizer plant and gas for a 55,000-kilowatt thermal power station, which will give Kerala a very useful backing of firm power." (Gas is not subject to seasonal fluctuations like hydro-electric power)

Since its inception, the Kochi Refinery ran efficiently. The refinery underwent many revamps, modernisations and expansions from its original 2.5 MMTPA to 4.5 MMTPA in the month of November 1987 to 7.5 MMTPA in December 1994 and at present it has a capacity of 10.5 MMTPA. The share-holding pattern too has undergone several changes from time to time. Its product was marketed and distributed through IndianOil until it was eventually taken over by Bharat Petroleum in 2001.

Kochi Refinery commissioned its Aromatic Recovery Unit with a design capacity of 87,200 tonnes of Benzene and 12,000 tonnes of Toluene in 1989 making the Refinery's entry in petrochemicals. A Light End Feed Preparation Unit (LEFPU) to supply Polybutenes feedstock to a Poly Iso Butene plant was commissioned in March 1993. The Kochi Refinery also set up a Raffinate Purification Unit (RPU) for production of 8,800 tonnes of Petroleum Hydrocarbon Solvent in January in 1994 using its own in house R&D technology. The production of MTO and Mixed Aromatic Solvent started in March 1995 and March 1996. In order to meet the environmental norms, 2.0 MMTPA DHDS Units were set up in 2002.

MADRAS REFINEREIS LTD.

Madras now known as Chennai became the location for the fifth refinery in the public sector. The story of this refinery begins on November 18, 1965 when three partners in this joint venture, namely: the Government of India (74%), the National Iranian Oil Company (13%) and AMOCO (13%), a subsidiary of Standard Oil Company of Indiana, signed a Formation Agreement for the establishment of an Oil Refinery at Madras with a initial capacity of 2.5 MMTPA. At that point of time, Madras Refineries Ltd was amongst the most modern. According to AMOCO, Madras Refinery was the best Refinery East of Suez at least up to 1969.

The National Iranian Oil Company (NIOC) and AMOCO who jointly owned the Darius oilfields in Iran decided to position Darius crude for the proposed Refinery at a low price never seen before. Thus two international oil companies had taken over the responsibility of supplying crude to the Madras Refinery at very economical and competitive rates.

The Madras Refinery project was the outcome of extensive cooperation between a major oil-producing country, Iran and an important oil-consuming nation, India; in collaboration with AMOCO, a leading American oil company. This tripartite cooperation was unprecedented in the history of the Oil Industry anywhere in the world. The unique feature of this venture lay in the fact that, it was the first example of direct collaboration between Iran and India.

On April 14, 1966, the Tamil New Year's Day, the Government of Tamil Nadu handed over the site to the tripartite consortium for construction of the refinery. After completion of field investigations and the process design, a contract was entered into on November 25, 1967, with Snam Progetti of Italy, on the basis of competitive international bids, for the engineering, design and construction of the process units just a little over one year from the date of signing the Formation Agreement.

On January 6, 1967 Prime Minister Indira Gandhi, while performing the ground breaking ceremony, said, "A large refinery like this is really "A Mother Plant". Its first child will be the Madras Fertilizer Project, which will use Naphtha from the refinery as feedstock. At a later date this refinery like the others will also probably be in a position to support a considerable Petrochemical Complex". The Chennai Petrochemical Complex Ltd (CPCL) has more than fulfilled its mission.

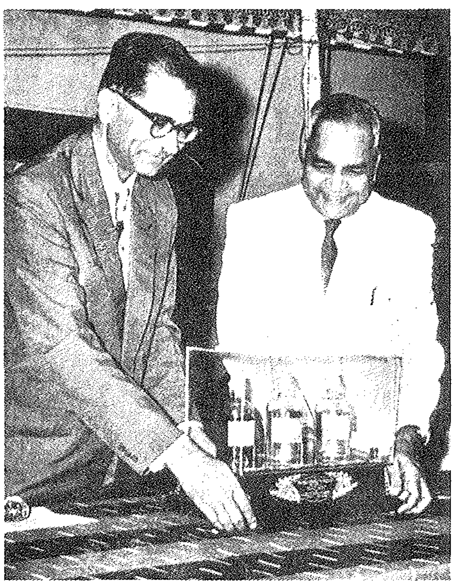
A few months later, the first step in foundation work of the refinery commenced. By April 1969, i.e. approximately 24 months from the commencement of the construction activity, the Refinery was almost complete and in June 1969 the first batch of products for marketing was made available to IndianOil, who were then the sole marketers of products coming out of MRL, barring Naphtha that was directly supplied to the Madras Fertilizers Ltd., (MFL).

The President of India, V V Giri, formally inaugurated the Refinery on September 27,1969. The President while inaugurating said, "There is a deep sense of fulfillment. It is indeed a red-letter day in the history of the industrial development of this city and this region, for it marks a qualitative change. This State has entered in a big way into the petrochemical field. It is the dream of a developing region to enter this field and that dream has now come true as far as Madras is concerned."

The President's words were almost prophetic. Within a short time MRL rapidly stimulated industrial development in the South. Madras Fertilizers Limited, a Transformer Oil Plant and a Petrochemical Complex sprang up. In addition, from the feedstock supplied by the refinery many other ancillary industries also took birth.

In his inaugural address, M. Rama Brahamam, Chairman and Managing Director quoted O V Alagesan, the Minister for Petroleum and Chemicals who said at the Ground Breaking Ceremony on January 6, 1967, "It will be another important milestone in the industrial progress of the State of Madras. I hope the industrialists of Madras who have already proved their mettle will start planning several downstream units and complete the enterprise begun by the Government."

Not many may know that the Madras Refinery has many firsts to its credit. It is India's first Lube Integrated Refinery capable of producing 11 different grades of Lube Base Stock totaling to 200,000 metric tonnes per annum at the time of commissioning. Beyond the 11



N.N. Kashyap, Chairman of Indial Oil corporation, receives samples of petroleum products of the first batch produced by Madras Refinery Ltd., from M. Rama Brahamam, Chairman and Managing Director of MRL.

grades of Lube Base Stock and ATF, the Madras Refinery also produced the largest range of petroleum products in comparison to other refineries in India. It was also the first Refinery to have its own Hydro-desulphurisation units giving it tremendous flexibility in its ability to process a wide range of high sulphur crude oil. It is also the first refinery to upgrade furnace efficiency close to 90% in the 80s by implementing Air pre-heater technology.

A large number of Indian contractors and fabricators were also involved in the venture and for the first time an appreciable extent of such sophisticated equipment was fabricated in the country. The bulk of the storage tanks, rotary vacuum filters, steam generators and nearly half of the electric motors, process control instrumentation and the like were acquired from indigenous sources.

Besides, all electrical transformers, switchgears, cables and such similar items that were procured for the refinery were 100% Indian. This enabled the country to save nearly 10 million US dollars in foreign exchange. In fact, the foreign exchange element of the cost was contained to only 40% of the total estimated project cost of Rs. 45 crore.

Both in the design and the construction of this refinery, adequate care was taken for having maximum participation of indigenous talent and maximum use of indigenous equipment. The success of the same can be gauged by the fact that, for the first time in India the refinery had a process licensed through the Indian Institute of Petroleum working jointly with the Institute of French Petroleum (IFP).

The main process design was carried out through Engineers India Limited with whom Bechtel International was in partnership at that time. Engineers India Limited had also designed and executed all the off-site works, that is all the works outside the main process unit blocks. In addition, Engineers India Limited had also participated in part of the engineering designs for pipelines, and other items in the process units themselves in collaboration with Snam Progetti.

During the inaugural function, J E Swearingen, Chairman, Standard Oil Company, Indiana, USA, in his speech made a special note of commendation to Ramabrahmam, the CMD of MRL and his associates, for the part, they had played in the process. "Rama Brahamam's role in the selection and training of the people who would run this enterprise in the years to come has been a major factor in our progress to date and in our expectations for the future," said Swearingen.

Unlike the case of Cochin Refineries Ltd., MRL was under Indian control under the leadership of M Rama Brahamam, who joined MRL as MD in the month of November 1965. He most notably and efficiently replicated the experience he had gained in building the first public sector refinery at Guwahati. He also brought with him a number of bright young IndianOil engineers into MRL.

Like Gen. Sardanand Singh (while building Guwahati and Koyali Refineries)

Ramabrahmam too inspired dedication and teamwork amongst all involved in building the refinery. For his outstanding performance in building this unique Refinery, the Nation honoured him with a *Padma Bhushan*, which he received from President V V Giri in 1970.

To Ramabrahmam must also go the credit for creating an extremely harmonious working atmosphere in the refinery. The IndianOil employees who were responsible for evacuating MRL's product were made to feel that they were an integral part of MRL and the two sets of people from MRL and IndianOil worked together most cohesively.

The capacity of the refinery was enhanced to 2.8 MMTPA through low-cost in-house de-bottlenecking. Originally designed to process Middle East crude, the refinery was configured for processing Bombay High crude. Thereafter the refinery after having remained at 2.8 MMTPA for 16 years was expanded to 5.6 MMTPA in March 1985 with the FCC unit. This was further expanded to 7.50 MMTPA in 2003 by de-bottlenecking.

An additional 3.0 million tonne Distillation Unit was set up to take the refinery's capacity to 10.5 MMTPA in 2004, along with Once Through Hydrocracker costing Rs.2,361 crore. On completion of the expansion and Once-Through-Hydrocracker the secondary processing capacity exceeded 45% of the expanded 10.5 MMTPA capacity. This enabled the refinery to produce Bharat Stage II and Euro III quality products ahead of April 2005, the target date.

The Chennai Petrochemical Complex was always ahead of others to produce value-added products. In this endeavour they set up Paraffin Wax Plant in 1984 and Poly Propylene Plant with initial capacity of 17,000 MTPA on March 3, 1988. The refinery was first to produce Petrochemical feed stock LAB, C3 & C4 stream.

On discovering oil in the Kaveri Basin by ONGC, a small refinery was established near the oilfield at Narimanam to process 0.5 metric tonnes of crude oil. The basic objective to have a refinery near the oilfield was that the quantity was not large enough to carry the crude oil to the refinery in Chennai on a continuous basis. Presently, it is operated at 0.66 MTPA basis.

The Chennai Petroleum Corporation along with the Kaveri Basin Refinery became a subsidiary of IndianOil in 2002, on acquiring 7,72,65200 equity shares of Rs.10 each which amounts to 51.88% of the total equity.

Conclusion

From Guwahati Refinery in 1962 to Madras Refineries Ltd. (MRL) in 1969, a total of five public sector refineries were commissioned with a combined refining capacity of 10.75 MMTPA. Today the combined capacity of these five refineries has quadrupled and stands at 42.2 MMTPA. In this exciting journey of a little more than four decades, refinery technology saw steady improvement and the refineries continued to be technologically upgraded from time to time.

MRL for example became India's first Lube integrated refinery, and both CRL and MRL were infused with the latest refinery technology of its time. This experience revealed the vision and wisdom of India's industrial policy, which envisaged promoting the growth of India's Oil Industry albeit under State auspices, at the same time without hesitating to seek help wherever needed from the multinationals in India's overall interests.

It was during this period that EIL emerged as the major process engineering company in India, which readily provided designs, engineering and construction management for future refineries in India.

The commissioning of MRL marked a watershed in India acquiring and absorbing the latest that was available in refining technology. All refineries built in India thereafter were second to none as far as the state-of-the-art refinery technology was concerned. Apart from K.D. Malaviya, it was P.R. Nayak (ICS) and Secretary (Petroleum) who played the most significant role in the development of refineries during this era, gave shape to K.D. Malaviya's vision of India's Oil Industry in the National sector and provided the necessary leadership for the construction and commissioning of IRL's Guwahati and Barauni Refineries. P.R. Nayak first as MD, IRL (1960-64) and later on as Secretary, Petroleum, piloted the commissioning of Koyali, Cochin and Madras Refineries. Even the approval for building the Haldia Refinery was secured by him during his tenure as Secretary (P). The country owes this individual a great debt of gratitude for his sterling contribution to the Oil Industry.

Oil Price Policy In India

The oil pricing formula adopted by the multinational oil companies operating in India was classified information and it remained opaque for a long time. The secrecy enabled them to make enormous profits at the cost of Indian consumers. Their halcyon days finally came to an end in the year 1961. The Government of India decided to put their pricing formula under the scanner by setting up a body known as the Damle Committee.

Damle Committee Report

K R Damle, ICS, Secretary to the Government of India, Ministry of Food & Agriculture, was directed to conduct an enquiry into the pricing formula adopted by the multinationals. The sanction to set up such a committee came under Memorandum No. 101(M)/60-PPD dated 2 August 1960 of the Ministry of Steel, Mines & Fuels, Department of Mines & Fuels.

The three-member Committee known as Oil Price Enquiry Committee (OPEC) was asked to examine *inter alia* the cost at which crude oil and various refined oils could be imported into India in line with the existing Refinery Agreements with the multinational oil companies i.e. in what manner the product price ceilings ex-refineries be fixed, keeping in view the need to conserve foreign exchange, and to what extent the price of petroleum products could be used to influence production, transportation, distribution and consumption patterns

After a detailed study and a comprehensive review and analysis, The Damle Committee submitted its report to the Government on July 19, 1961. This was a seminal work, which ushered in the era of the Administered Pricing Mechanism (APM) for the next 41 years, until it was finally dismantled on March 31, 2002. The pricing principles evolved by the Damle Committee and implemented with effect from October 1, 1961 were to guide petroleum product price ceilings in India up to the month of July 1975 when the first interim report of the Krishnaswamy Oil Pricing Committee submitted its report to the Government.

Prior to the OPEC formula, the prices of all petroleum products in India except lubes and bitumen were determined on the basis of Valued Stock Account (VSA) procedure adopted by Burmah Shell and approved by the Government of India with effect from April 1, 1950. This was basically a cost-plus formula based on import parity, that is, on the posted price of product on date of loading initially

Free On Board (FOB) at the Gulf of Mexico, subsequently FOB Ras Tanura to which were added all elements of cost such as Ocean Freight from Ras Tanura to Indian ports, Insurance, Ocean loss, Remuneration (service charges) at 10% of the CIF, that is Cost, Insurance and Freight. Finally, Import Duty, covering interest at two-and-half percent and all other charges from CIF to the Installation.

The other multinational oil companies, Stanvac and Caltex had no such agreement with the Government of India. They, however, "cartelized" and agreed to charge the same price as Burmah Shell, whose official quotation to the DGS&D (certifying that product price quoted therein was in conformity with the VSA formula and all over and under recoveries were correctly accounted for) became the price of bulk petroleum products in India. The price of products refined by Burmah Shell, Stanvac and Caltex were governed by the same principles.

This agreement (VSA) did not provide for any Government audit and thus it was impossible to judge the propriety or the quantum of charges added in the price build-up. Theoretically, it meant, that under this system, higher the cost, higher the remuneration to the oil company. The Government of India in May 1958 rightly terminated this procedure by mutual consent. The oil marketing companies thereafter announced an *ad hoc* price reduction, which was mopped up by the Government of India through enhanced Cstoms Duty, Excise Duty and price with effect from May 20, 1958, leaving unchanged the selling price to the consumer. The VSA formula in reality boiled down to an administered pricing mechanism, administered by Burmah Shell.

Subsequently, the Chief Accounts Officer to the Government of India was asked to recommend a new pricing formula, which was submitted by him to the Government on March 28, 1959. The multinational oil companies did not accept this. In turn they made a counter-proposal on September18, 1959 resulting in an *ad hoc* price agreement with the Government in October 1959. The Damle Pricing Formula finally replaced this *ad hoc* price agreement with effect from 1st October 1961.

As far as crude was concerned, its import was covered by the Refinery Agreements entered into by Burmah Shell, Stanvac and Caltex with the Government of India permitting the multinational oil companies the freedom to import from their own sources along with duty exemption unless this was required for the protection of indigenous crude.

The cost of imported crude depended upon the arrangements between the coastal refineries and their suppliers, discounts prevalent from time to time on posted prices and the type of crude required and purchased for the refinery concerned. All the three multinational oil companies were importing crude at the posted price (Platts Oilgram) on the date of loading from various locations in the Middle East and all of them falsely claimed that no discounts were available.

When the multinationals were asked to come out with the truth, Burmah Shell sheepishly announced in June 1960 that 8% discounts were available on the posted prices; Stanvac soon followed suit in July and Caltex fell in line with the others in August. Surprisingly, these discounts were declared just when the Government of India asked them whether they would be interested in importing Russian crude on rupee payment and refining it from their coastal refineries. The Government very well knew that Russian crude was anathema to the multinationals.

The Damle Committee by now was armed with enough data to prove that discounts available were actually much higher than 8% as claimed by the oil companies. Consequently the Committee recommended that while allocating foreign exchange for crude imports, the available discounts on the posted price were compulsorily to be declared by the multinationals.

Since the product prices were based on import parity it was equally important to determine the discounts available on their posted prices. The Committee vide paragraph 6.14 stipulated the percentage discounts applicable on FOB price while granting import licences. These discounts were 5% for MS, 10% for ATF, Kerosene and HSD, 9.3% for LDO and 3% for Furnace oil.

While determining the base cost (FOB) price the lowest posted price in Abadan as applicable on May 24, 1961 and reported in the Platts Oilgram of May 25, 1961 was fixed. All other cost elements from FOB to CIF such as Ocean Freight as per AFRA rates, Isurance, Ocean Loss, basic Customs Duty and Surcharge, Wharfage, Freight charges and other compulsory Landing Charges, Marketing and Distribution charges, profit and the dealer/agent's commission wherever applicable were fixed by the committee on a normative basis.

Since Burmah Shell and Stanvac put together had 80% market participation, most non-statutory cost elements, including marketing and distribution charges were based on a weighted average of their actuals. Similarly, the profit element was based on the capital employed by both Burmah Shell and Stanvac and their expected future sales with a return of 12% on capital employed was permitted.

In the case of lubes, greases and specialties, Burmah Shell, Stanvac and Caltex, all three multinationals handled 89% plus of the market and the balance by large number of small companies. Because of multiplicity of products and applications it was not possible, as had been done for bulk fuels, to arrive at a pricing formula for these products.

Taking all these factors into consideration including the need to exercise price control even on lubricants the Damle Committee recommended a "block control system" under which a ceiling was fixed for marketing charges and profit margins over and above the actual cost incurred such as on blending, packaging etc. These ceilings were marked at Rs.123.02 per kl for lubes and greases and

Rs.31.28 per kl for specialties. The price for Assam Oil Company (AOC) products (indigenous) were determined on the basis of import parity with prices FOB Calcutta subject to differential maintained for lower diesel index for HSD ex-Digboi.

The Damle Committee price ceiling had built-in incentives for the oil companies to increase their gross profits by lowering their costs. On the other hand, the benefits of lower costs could then be passed on to the consumer through subsequent price committees.

Talukdar Committee Report

The prices of POL were based on ceilings recommended by the OPEC chaired by K R Damle and were to be valid up to March 31, 1965. Accordingly, on May 12, 1964 the Ministry of Petroleum set up a Working Group on Oil Prices (WGOP) under the chairmanship of J N Talukdar, former Chief Secretary, Government of West Bengal. The Working Group was required to examine and report on:

I) The manner of determination of ex-refinery prices of the petroleum products, including bitumen, produced by the refineries.

II) The manner of determination of landed prices in respect of similar products, which may be imported.

III) Determination of marketing and distribution charges of products mentioned in (I) and (II).

IV) Determination of ceiling prices in respect of lubricants, oils and specialties.

The working group finalised its report by August 1965. The Ministry of Petroleum decided to accept and implement the report, with a few amendments, effective February 1, 1966 and would remain effective up to December 31, 1967 to begin with, although the Government of India could extend it for subsequent periods.

Broadly speaking, the Talukdar Committee extended further the basic concepts laid down by the Damle Committee, that is, prices were to be based on the principle of import parity with a fixed formula to build-up up to the CIF costs. For this purpose, the lowest of Platts Oilgram's FOB posting at Abadan (with discounts) as well as Marine freight as per Inta-scale (with AFRA variations) as in force on May 18, 1965 was to be applicable. The price formula was firm and reasonable.

Additionally, it had the potential for a lower cost basis for fixation of marketing margins in the future. In other words, as the oil companies succeeded in lowering their costs in order to maximise their net gain, the lowered costs would then become the basis for future price formulations. By this method, the consumer was assured of getting POL at the lowest possible price on a continuous basis on the one hand and it encouraged the oil companies to improve their profitability by lowering their operating costs, on the other.

According to Para 26, Chapter 20 of the Talukdar Committee Report, the marketing and distribution charges allowed by Talukdar were based on the data obtained from the multinational companies. Thus, IndianOil's cost data had not been included in the recommendations made. This was inherently unfavourable to IndianOil in as much as most of IndianOil's facilities were brand new attracting the highest depreciation cost, whereas the facilities of the multinational oil companies were almost fully depreciated and stood at near Nil book-value.

In a way this was good because IndianOil would be forced to exercise rigid cost control and show greater economy if it was to make any profit. This was a worthwhile challenge for IndianOil, since cost-cutting exercise and consequential increase in profits would benefit the public exchequer and hopefully the people of India. IndianOil met this challenge resoundingly as will be seen in chapters that follow.

The working group revealed in clear, stark terms the main weakness of IndianOil. As of March 31, 1964, whereas IndianOil was comparable with the multinational companies in most facilities as well as sales, that is, seven terminals as compared to seven to eight terminals of others, 103 depots against. 146 of Burmah Shell sale of 1.2 million kl, against 1.97 kl of Caltex. However, IndianOil had only 171 retail outlets as compared to 1,364 owned by Caltex the smallest multinational oil company. Thus in Retail Marketing lay IndianOil's main weakness.

One consequence of this lacuna was that until 1972-73, IndianOil would be obliged to sell its growing availability of MS ex-refineries to the multinational oil companies and along with it lose the appropriate marketing margins, some of which would be repatriated abroad in foreign exchange by way of profit.

The cost of imported crude oil had serious repercussions on the outflow of foreign exchange at a time when India was going through a severe foreign exchange crunch; so severe was the situation that the country had to devalue the rupee in 1966 against the dollar by nearly 50%.

Earlier, the multinational oil companies were unwilling to disclose the full extent of discounts they were able to secure on the crude oil imported by them. The Seven Sisters, the main producers in the Middle East, were caught on the horns of a dilemma. On one hand, they were under pressure from the oil producing countries to support higher posted prices of crude, on the other, importing countries like India demanded a fair share of the discounts available on crude oil in the market.

On the basis of a deep analysis and a well-documented evaluation, the Talukdar Committee laid down minimum discounts for different types of crude oils imported into India on the basis of which alone the Government of India would release foreign exchange to the multinationals for import of crude oil (Chapter 20, Para 5).

These discounts were 21 cents per barrel on Safaniya, 30 cents per barrel on Kuwait and Khursaniyah, 40 cents per barrel on Light crude such as Agha Jari/Aramco, 45 cents per barrel on lighter crudes such as Murban. In addition, the Committee recommended the discontinuation of import of the expensive Minas crude from Indonesia by Caltex because of low sulphur Fuel Oil made available by IndianOil ex-Barauni, unless Caltex matched the CIF costs of equivalent Agha Jari crude (Chapter 20, Para 7).

In the light of the self-imposed constraints on their growth by the multinational oil companies, read with the varying marketing margins permitted by the Talukdar Committee ranging from Rs.60.22 per kl for MS, Rs.46.92 per kl for HSD, Rs.35.23 per kl for Kerosene and Rs.11.98 per metric tonne for Furnace oil, Rs.24.6 per kl for LDO, they were subsequently motivated to resort to what is called selective marketing, that is, withdraw from the marketing of low margin products (Furnace Oil and LDO) and attempt to grow in the high marketing margins products principally, MS and HSD. The vacuum thus created would necessarily have to be filled by IndianOil because the needs of the community could not be abandoned.

Shantilal Shah Committee Report (Oil Price Committee, October 1969)

From the recommendations made by the Talukdar Committee on August 18, 1965 among those that were accepted by the Government of India were valid up to December 31, 1968 or for such other period as was to be decided by the Government.

The Oil Price Committee (OPC) under the Chairmanship of Shantilal Shah was then constituted to submit its report by December 31, 1968. The Committee was charged with the responsibility of determining the ex-refinery price of petroleum products (POL), the determining of landed prices of imported POL, the feasibility of making all refineries (including inland refineries) as pricing points, the determining of marketing and distribution charges and profit on marketing operations product-wise, and the determining of dealers' commission for MS, HSD, SKO and LDO.

Initially, the Committee was expected to submit its report by December 31, 1968. This was the third in the series of comprehensive oil price enquiry reports commencing with the Damle Committee Report and was eventually submitted to the Government on December 31, 1969. The Committee's recommendations were implemented with effect from June 1, 1970 and were to be valid initially for a period of three years but was further extended from time to time until the implementation of the next Oil Price Committee report.

The Shantilal Shah Committee made an in-depth study of the oil industry both in the public and private sectors. For the first time an Oil Price Enquiry Committee had performance and cost data from IndianOil which excellently served the purpose of comparing the same data with that of the multinational oil companies. Like the other two Price Enquiry Committees before it, the Shantilal Shah Committee had to battle with the question of determining the real cost of crude imported by the multinational oil companies because this had a direct impact on the outflow of foreign exchange, which had by then become a very critical issue particularly after the devaluation of the rupee on June 6, 1966.

Everyone knew that the multinationals were always under pressure from the host producing country to maximise the sale price of crude, because their national revenues were directly linked to it. Being vertically integrated cartels, it hardly mattered to the multinationals whether it tapped the profit upstream or downstream. Most often profit manipulation was determined on the quantum of taxation in the oil companies' parent country.

Although most of the petroleum products marketed in India were now being refined indigenously and most of the net imports of deficit products were brought in by IndianOil on rupee payment from the USSR, yet the question of notional cost of imported refined oil products was of prime importance, since the price of crude oil and refined products in India was still based on the principle of "Import Parity". The Shantilal Shah Committee recommended the continuation of this principle albeit most reluctantly, as quoted in Para 8.10 -" *It will be seen from our comments above that we do not at all regard import parity to be a sound basis of price fixation in the present circumstances. We are nevertheless forced to adopt import parity only because of Government's commitment to the oil companies.....*".

For lubricants and greases, the Shantilal Shah Committee recommended the continuation of the existing system of Block Control (para 13.13). To that extent this committee also extended the pricing principles enunciated in the Damle Committee.

The price of imported crude boiled down to a realistic determination of discounts available on posted prices in the Gulf for crude oil and refined products.

The committee made the most revealing comment (para 5.12) that within three months after formally committing to the Committee, the multinationls had failed to secure any discounts on the price of crude oil, Burmah Shell informed the Government that its suppliers had offered a discount of 4 US cents per barrel. Esso and Caltex offered similar discounts also. This revealed that the multinational oil companies were earlier concealing the discounts they were receiving and therefore inflating the cost of imported crude oil. In order to rationalise to the extent possible, the availability of discounts, the following recommendations were made by the Committee:

Type	Posted Price (US$/ barrel)	Recom-mended discounts ($/barrel)	Net FOB Price ($/barrel)
Iranian Light Agha Jari (34 to 34.9 deg API)	1.79	0.51	1.28
Arabian Light (34 to 34.9 deg API)	1.80	0.51	1.29
Arabian Medium (31 to 31.9 deg API)	1.59	0.34	1.25
Arabian Heavy (27 to 27.9 deg API)	1.47	0.37	1.10
Iranian Heavy (31 to 31.9 deg API)	1.63	0.43	1.20
Kuwait Heavy	1.59	0.38	1.21
Darius (34 to 34.9 deg API)	1.63	0.38	1.25

On Product prices, a 4% discount on posted prices was stipulated. If the discount on Agha Jari crude increased then the POL discounts would increase by 4% for every 10 US cents per barrel for extra discount on this crude.

Industry LPG sales had shown an approximate 30% increase per annum during the last three years (1966, 1967 and 1968) as compared to an overall increase of approximately 6% per annum of all petroleum products put together during the same period. This was a welcome trend, thanks to IndianOil's policy of promoting LPG for domestic cooking by maximising LPG production, minimising cost and reserving its entire LPG availability for domestic consumption. This had the main advantage of displacing Kerosene, a deficit product, which was being imported. Out of the total industry sale of 99,950 metric tonnes, the multinational oil companies sold 15,409 metric tonnes of LPG during the calendar year 1968 for non-domestic use. Had this been reserved for domestic consumption, 16,000 metric tonnes of SKO could have been reduced from the SKO import bill. Notwithstanding this, the Shanti Lal Shah Committee recommended the following reductions:

Price	Burmah Shell	IndianOil
Existing Price (Rs. Per 14 kg LPG cylinder)	7.07	6.21
Proposed Reduction (Rs. Per 14 kg LPG cylinder)	3.00	2.14
Net Price (Rs. Per 14 kg LPG cylinder)	4.07	4.07

This was a welcome step for the promotion of LPG sale for domestic cooking purposes because it directly displaced imported Kerosene.

Considering the production from inland refineries to the extent of one-third of the total refining capacity in the country, and also interests of the consumers in the vicinity of such refineries, the Committee recommended that all inland refineries should also be considered as main pricing points along with major points in the country.

The Shantilal Shah Committee recommended the introduction of a Freight Surcharge Pool (FSP) at Rs.7.05 per KL. This was the first time such a recommendation was made by any Oil Price Enquiry Committee. The oil companies could then be compensated for their transport under recoveries especially on coastal movements.

For IndianOil the crowning glory of the Shantilal Shah report came in para 18.4 and 18.5. In para 18.4, the Committee reported that the average cost of selling in Rupees per kl was the lowest at Rs.20 per kl for the IndianOil while for the multinational oil companies this figure ranged from Rs.34 to Rs.37 per kl.

In para 18.5, the Committee noted that the productivity of IndianOil marketing was 40% higher than that of multinational oil companies. These findings exploded the myth that IndianOil as a national undertaking could never be as cost effective (Rupees per kl) efficient (productivity in kl per person) in comparison the multinationals. This was a fitting recognition for the hard work and effort put in by the pioneers of IndianOil.

This data had established that not only was IndianOil the market leader in terms of sales but it was also the most productive and cost-effective marketer. IndianOil had thus acquired quantitatively as well as qualitatively leadership of the oil industry.

With the closure of Suez Canal, shipping companies jacked up their freight rates as oil tankers carrying imported crude had to take long detours. To insulate the Indian consumer from frequent price fluctuations as a result of this eventuality, the Government founded a Cost and Freight Adjustment Account, on May 1, 1968 whereby variations in freight rates were adjusted, and to compensate for the net under-recoveries, a C & F surcharge was levied on the sale of petroleum products.

Subsequently, the scope of C&F surcharge was expanded to include under or over-recoveries on several other account heads in the oil industry. As an example, to meet the deficit, some of the products that were being imported, were sold at the rate that was applicable to indigenously produced products. This also happened with the price of packed Bitumen the cost of which was established as per formula, although there were frequent price fluctuations in the cost of drums.

To conclude, the Shantilal Shah Committee succeeded in fixing the ex-refinery price, and the landed price of imported POL. It also made all refineries, including inland refineries as pricing points and fixed the marketing and distribution charges and profit on marketing operations product-wise, as also decided on dealers' commission on MS, HSD, SKO and LDO.

ALL PRODUCT IMPORTS GO TO INDIANOIL

Between the years 1965 and 1966 for various compelling reasons India was going through a severe foreign exchange crisis. She was finding it difficult to pay for the import of crude oil and POL, which the multinational oil companies were importing from dollar and pound sterling sources in the Middle East. In addition, a major Indo-Pak skirmish had erupted in April 1965 in the saline wilderness of the Rann of Kutch in Gujarat bordering India and Pakistan and a full-scale war was feared after the end of the monsoon season.

Much earlier Burmah Shell, Esso and Caltex turned down a very attractive proposal from the Government of India offering them Soviet crude oil on a rupee payment. The multinationals not only rejected the proposal, but at the same time accused USSR of offering India a "Political Price." To justify their action they brought to the Government's attention clauses in the Refinery Agreement, which entitled them to import crude from their own sources on payment of foreign exchange.

As everybody knew, if the multinationals really wanted to help, there were umpteen methods, including very attractive switch-deals vide which such an attractive Soviet offer could easily have been clinched to the mutual advantage of both India as well as the multinationals. But they had their reasons, by and large political, the same they were accusing India of. Hence their refusal was not surprising. The negative response from the multinationals almost amounted to the pot calling the kettle black.

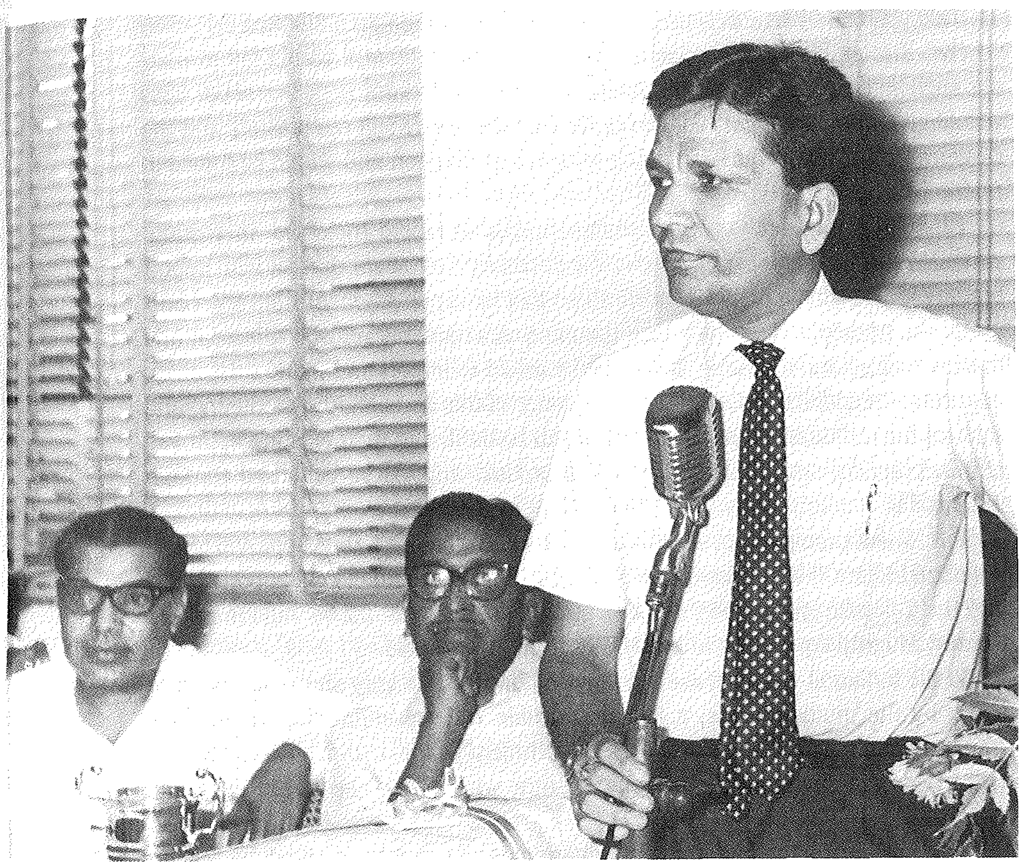
During the ongoing critical situation, when India was cash-strapped for foreign exchange, friendly USSR magnanimously agreed to supply India's entire deficit requirement of petroleum products on rupee payment. The Ministry of Petroleum readily placed this proposal before the multinationals giving them a chance of displaying their goodwill towards the country during her hour of crisis and also the opportunity to meet their own deficit requirements. It was, in fact, a win-win situation for them. P R Nayak, Secretary Petroleum, asked his Deputy Secretary, S D Bhambri to fix a meeting with the chief representatives of the multinationals so that a proposal to this effect could be put forward.

Bhambri advised the Secretary Petroleum that it would be prudent to first call IndianOil to get an assurance from them that should the need arise they would be able to handle and market additional quantities of POL currently being imported by the multinationals. If the multinationals were to reject the Government's proposal of uplifting Soviet petroleum products on rupee payment, IndianOil would inevitably be asked to market the entire lot. This volume was nearly equal to IndianOil's total sale at that point of time. To market this additional quantity overnight would be a Herculean task for the fledgling Indianoil.

In other words, if IndianOil said "Yes" to the Secretary Petroleum's proposal and if the multinationals said "No," then in one stroke the country's foreign exchange problems on account of POL import would be solved to a very large extent and concurrently IndianOil's sales would simply double. As for the multinationals, their sales would then be restricted to their own currently approved refining capacity.

As per plan, in the month of June 1965, P R Nayak called P A.

S.D. Bhambri, GM, Indian Oil Marketing, with T.Kumaran and J. C. Goyle, both DGMs, IndianOil. The latter was the author of 'SERVO'.



Gopalakrishnan, Chairman, IndianOil, for a meeting. On his behalf, Gopalakrishnan deputed P K Samal (Coordination & Sales Manager) along with Harshad Patel (Operations Manager) for the meeting. Nayak put the proposition forward before the IndianOil team who confirmed and said that if required IndianOil was competent enough to handle the additional quantity of petroleum products currently imported by the multinationals. While making this commitment Patel had done no '*Hisaab Kitaab*' (mathematical calculations). He was only aware of what had to be done and was determined to do it.

Nayak then gave Bhambri the green signal to fix a meeting with the multinationals for the final *coup de frappe*. Bhambri requested Nayak that he be allowed to personally handle the issue, to which Nayak readily agreed. When Bhambri called the representatives for a meeting and put forward the proposal to the three multinationals, as anticipated, they summarily turned down the Government's offer. All the three multinationals claimed that it was against their laid down policy to market "Red Oil".

This was hardly true because they had, and still were handling "Red Oil" elsewhere. The multinationals were almost certain that IndianOil would fail to handle such massive additional volumes, and inevitably land in a big soup. This would give them an opportunity to prove that they were still the masters and the Government of India was soon going to regret its decision and would be forced to maintain *status quo*.

Bhambri immediately got the multinationals to record their '**No**' in writing. Armed with this, he put up a note to the Secretary Petroleum that all POL import requirements of India would henceforth be met by rupee payment from the USSR under the trade pact and that since the multinationals had refused to accept and market their share in writing, IndianOil be asked to import and market the entire quantum. In addition, as a direct consequence of this decision, the marketing and sales of the multinationals would henceforth be limited to their existing approved refining capacity and that henceforth all product imports be canalised through IndianOil.

P R Nayak promptly got the Minister's (Prof. Humayun Kabir) approval to this note and IndianOil was informed accordingly. The quantum of POL imported during the calendar year 1964 by the multinationals was 2.264 million metric tonnes, roughly equivalent to IndianOil's then annual sale.

While Indianoil was to make a quantum jump by this very short-sighted view taken by the multinationals, it left an indelible adverse impression about them (the multinationals) in the mind of the Government Of India, which was now convinced that the multinationals were not in tune with India's needs, concerns, and interests.

This mistake on the part of the multinationals was clearly admitted by Madhu

Patwardhan, CEO of Burmah Shell, on page 48 of his book *Oil and other Multinationals in India.* He wrote: "The Government did not accept this argument and decided to go it alone by relying entirely on IOC. It is to their credit that despite some initial dislocation, IOC coped with the task with Government's help.

"Apart from a great deal of adverse Press and Parliamentary criticism the disagreement with the Government over Russian oil did considerable damage to Government-company relationship and the feeling developed that the companies needed to be 'tamed'. The Government also decided to canalise virtually all future product imports, Russian as well as others, through IOC. This meant that the imports of refined products by the foreign companies stopped for all practical purposes thereby not only eliminating the outlet for affiliates but also the local marketing margin for Burmah Shell, whose sales volume declined sharply.

"Had Russian product imports been handled, the later eventuality would have been put off at least for a time. The Company's decision in respect of Russian oil, which seemed perfectly sound on commercial grounds at the time, marks an important landmark on the path to a decline and fall of its fortunes. With the efflux of time, the international attitudes towards the Russian competitor changed and what was regarded at one time as virtually 'untouchable' oil with absurd connotations in day-to-day handling arrangements in inter-company product exchanges became perfectly respectable."

Sure enough the second Indo-Pak conflict took place in the month of September 1965 and ended with the Tashkent Agreement signed on January 10, 1966 followed by the untimely and sudden death of the Indian Prime Minister, Lal Bahadur Shastri on the same night after the signing of the historical pact.

As a direct consequence of this decision IndianOil sales grew by leaps and bounds. By April 1, 1968 it had become the largest oil marketing company in India with a sale of 6.40 million metric tonnes with market participation of 42.5%. As of 1st of April 1970 by virtue of its market participation of 51.4%, its sale of 9.21 million metric tonnes exceeded those of all the multinationals put together. And finally on the eve of its buy-over by the Government of India and the conversion of Esso to a National undertaking, Hindustan Petroleum Corporation Ltd. (HPCL), IndianOil's market participation peaked at 65.4 per cent with a sale of 14.36 million metric tonnes for the year-ending March 31, 1975. (Reference Table 14 Chapter ix of "Report of the Oil Prices Committee" November, 1976).

CENTRAL DESIGN ORGANISATION/ ENGINEERSINDIALTD.

The Central Design Organization (CDO) took birth almost unheralded with only 35 Indian engineers and draftsmen. The CDO was formed with the intention of meeting the design and construction needs of the entire oil industry in India. This was another bold step taken towards the country's goal of self-reliance as echoed in Prime Minister Indira Gandhi's speech when she inaugurated the Cochin Refinery in September 1966. She said, "We must work for the time when India can design and build complete refineries and chemical plants".

A month later, President Radhakrishnan voiced the same opinion while inaugurating the second one million metric tonne Atmospheric Unit at Koyali in Gujarat by emphasising India's need for self-reliance.

As already mentioned, the CDO began with only 35 Indian engineers and draftsmen who initially worked alongside Soviet engineers. With the formation of Indian Oil Corporation Ltd., (the merging of Indian Refinery Ltd. with Indian Oil Company Ltd the first public sector oil marketing company in India) on September 1, 1964 the Koyali Refinery of ONGC became a part of the Refineries Division of IndianOil.

The credit for formation of the CDO must go to M.S. Pathak, an electrical engineer from the Massachusetts Institute of Technology, USA who had worked as a design engineer in UK for Caltex. From UK he was later transferred to Visakhapatnam for the construction of Coril (the Caltex Refinery at Visakhapatnam). He was a man who was well-versed in the nitty-gritty engineering side of refinery construction.

Later on Pathak happened to join ONGC during the initial stages of the construction of the Koyali Refinery. He met P.R. Nayak, then Secretary Petroleum, and mooted the idea of the creation of a design group to be associated with the Soviet design team and subsequently he hoped that this design group would undertake the design of some of the refinery units in India.

Accordingly, a new organisation took birth, which later was to become the Central Design Organisation whose primary task was to meet the design construction needs of the entire oil industry in India even though it was then part of IndianOil and its Koyali project. It was initially housed at Bahadurshah Zafar Marg in New Delhi and subsequently shifted to Vadodara and finally to the refinery site at Koyali in Gujarat.

By 1966 the CDO shifted to Vadodara as a part of IndianOil and had a staff of

100 engineers and draftsman and became the precursor for the eventual emergence of the Engineers India Ltd. (EIL). While only 40% of the design for the first two million tonne units of the Gujarat Refinery was made by Indian engineers of the CDO, the third million tonne units at Koyali and Barauni was entirely designed by team of the engineers of IndianOil, CDO.

Quite separately on March 15, 1965, Engineers India Ltd was formed as a Government-Bechtel joint venture with the specific purpose of developing indigenous skills and know-how for the refining and process industry.

Engineers India Ltd (EIL) started with only three employees, with a capital of Rs. 25 lakh and had some office space in a Golf Links house in Delhi. Lack of operating funds resulted in delayed salaries for several months. The actual business potential did not meet Bechtel's initial expectations and two years later they pulled out of EIL leaving a force of 67 engineers to fend for themselves. The CDO eventually got merged with EIL in 1968.

In spite of having successfully completed off-site engineering construction for the Madras Refinery and Esso's lube refinery, EIL was far from being considered competent. A proposal was even mooted by the Ministry to shut it down.

With no work whatsoever, EIL's only hope lay in the award of Barauni's Coke Calcination project. The award was made at a meeting taken by the then significantly lower quote than its competitor and thereby they successfully completed the job. EIL survived to live another day. For Pathak, it was the fulfillment of a ten-year-old dream to set up refinery design capability in India.

The field of petrochemicals was in its infancy in India when EIL's association with this industry began in the late sixties. EIL's first assignment in Petrochemicals was the Aromatics Complex of the Indian Petrochemicals Corporation Limited at Vadodara. EIL was subsequently involved with the setting up of mega petrochemical projects built in the country covering both Naphtha and gas cracking and various downstream units.

Major petrochemical projects executed by EIL include Naphtha Cracker and Downstream plants of IPCL at Vadodara; Maharashtra Gas Cracker Complex at Nagothane near Mumbai; the integrated Refinery-cum-Aromatic based Petrochemical plant at Bongaigaon for the Bongaigaon Refinery and Petrochemicals Ltd; the Gandhar Petrochemical Complex of IPCL, Auraiya Petrochemical Complex of GAIL (India) Limited.

EIL's entry into the high-end process design area could not be stopped when the company bid against IIP for the process design of Haldia's Atmospheric and Vacuum units free of charge. EIL's entry into the field of ports and harbours was made possible only by the support of the celebrated economist V K R V Rao, the then Minister for Transport.

In 1974, with the discovery of oil at Bombay High, EIL became a consultant to ONGC for their offshore activities in the Bombay High area and subsequently for several offshore fields both on the west and east coast of India. EIL provided its services for over 200 offshore platforms and 3,500-kilometer pipeline network (infield and trunk pipelines) for oil well fluids, water injection and gas lifts. Furthermore, EIL developed indigenous technologies to design offshore platforms and capabilities at the fabrication yards to manufacture and install platforms up to water depth of 80-100 metres, which in those days was considered a very significant depth.

EIL entered the fertilizer field with the award of the Bhatinda and Panipat projects. This was in the face of stiff opposition from FCI. Successful completion of the projects was EIL's most effective response.

Today, Engineers India Ltd. is one of the largest engineering companies in the oil refining sector with experience in executing 40 major refinery projects with combined refining capacity of 100 million metric tonnes per annum (two million barrels per day). EIL has an impressive record in implementing about 10,000-kilometer long distance cross-country and submarine pipeline projects, including the longest LPG pipeline of GAIL from Jamnagar to Loni, a distance of nearly 1,298 kilometers. In addition, EIL has so far executed a large number of revamps/modernisation projects for most of the refineries in India.

With the availability of modern technologies, equipment was being fabricated within the country, thus saving foreign exchange besides providing opportunities to the indigenous fabrication industry to take up fabrication of equipment for overseas projects. In fact, by now, as a very modest estimate, EIL would have saved foreign exchange of well over Rs. 5,000 crores by virtue of indigenisation of process plant equipment for the various projects it has handled.

So far, EIL has an envious record to its credit and has successfully completed projects in areas such as Fertilizer, Paper, Non Ferrous Metals and Heavy Water. It has till date successfully completed more than 4,300 assignments, including 320 major projects, all over India and abroad and is well experienced and equipped to face the challenges of increasing globalisation in the coming future.

In February 1967, while laying the foundation stone of Madras Refinery Ltd., at Manali in erstwhile Madras, Prime Minister Indira Gandhi said, "I am glad that these projects are being designed and built by our own technicians. We are in the process of establishing some plate and vessel shops in the country so that in another few years from now we should be in a position not only to design and engineer larger fertilizer complexes but also other chemical projects and also fabricate most of the equipment for them. This will be in a key step in attaining self reliance in the key field of the chemical Industry". The above statement of the Prime Minister represented the general sentiments for technological self-reliance then pervading all over the country.

INITIAL JVs

INDIANOIL JOINS HANDS WITH MOBIL

No company marketing petroleum products can call itself complete unless it has lubes in its marketing repertoire. In addition, no oil marketing company can sustain itself without adequate participation and expansion in retail trade and in order to do so, a market-acceptable brand of automotive lubricants is an absolute necessity. That is why, the generic acronym for petroleum products is POL, i.e. Petroleum Oils and Lubricants.

When IndianOil started marketing petroleum products, it had no brand of lubricants of its own. However, a small amount of lube oil was being imported and sold in barrels from a relatively unknown US based organisation called ICPA (International Co-operative Petroleum Association). IndianOil was also importing a non-branded axle-oil for the Railways. Soon after IndianOil came into existence, it became clear to its management that if the company was to make any progress in penetrating India's rapidly growing retail market it would have to blend automotive lubricants and package them in small containers for marketing in the retail outlets.

Stanvac had begun marketing Mobil lubricants as early as 1904 and in a span of a few decades, Mobil had become the most popular brand of its kind in India. Mobil — the name itself had become a generic for truck drivers in India who referred to any lube oil used in their vehicles as "***Mobil Oil***". When the new, posh and the centrally air-conditioned Stanvac (a 50:50 joint venture with Esso and Mobil) office building was commissioned in Bombay, adjacent to Marine Drive, in the mid-1950s it had on top of the building a huge neon sign, a replica of Mobil's 'Pegasus' (Flying Red Horse) which was the logo of Mobil lubricants. During the years 1960-61, there was a corporate divorce between Esso and Mobil. Stanvac was replaced with Esso. The common joke in Bombay was that the 'flying red horse had simply flown away'.

On the other hand, having parted company from Esso, Mobil could not afford to ignore the Indian market, particularly when their lubricants had become so popular in the country. In order to maintain their clout in India, Mobil approached IndianOil and enquired whether the company would be interested to market their lubricants. This was a blessing in disguise and a golden opportunity for IndianOil who jumped at the offer.

A partnership between IndianOil and Mobil was a strategic need of the hour for both organisations. Setting aside ideological and political differences for awhile, IndianOil signed an agreement with Mobil strictly in the interest of mutual commercial benefit. The agreement was signed for IndianOil by Chairman P A. Gopalakrishnan and for Mobil by their President V.A. Bellman for import of Mobil lubricants into India and the formation of a 50:50 Joint Venture called "Indian Oil Blending Ltd." (IOBL) with an authorised capital of Rs.20 lakh with the express purpose of blending and packaging all types of lubricants embossed with Mobil's famous 'Pegasus'. This JV was incorporated on March 25, 1963. The appropriate note from the 1962-63 Annual Report of Indian Oil Company Ltd is quoted below:

Partnership With Mobil

"Your Directors are glad to inform you that contracts for the import of premium grade lubricants from Mobil Petroleum Company Inc., New York, and for setting up of two blending plants for the manufacture of lubricants were finalised in November, 1962. During the close of the year, the company had received consignments of lubricants and greases. In terms of this agreement, the company has been appointed exclusive distributors of premium grade industrial and automotive lubricants. A new Company - Indian Oil Blending Limited, which will undertake the construction of the plants at Calcutta and Bombay for blending industrial and automotive lubricants, was incorporated on 25 March, 1963 with an authorised capital of Rs.20 lacs to be subscribed equally by Indian Oil Company Ltd., and Mobil Petroleum Company Inc. New York. Mobil's contribution to the equity capital be in U.S. Dollars, which will be utilised towards financing the foreign exchange component of the equipment to be imported".

Thus, in one stroke, IndianOil became a major player in the lube market. This collaboration between IndianOil and Mobil obviously constituted a very major threat to Esso, whose brand of lubricants although renowned elsewhere in the world, was little known in India. Apart from the fact that this partnership would ultimately put IndianOil in the forefront of marketing of lubricants in India, it would also stand as a tribute to India's concept of a mixed economy (Private Sector coexisting with the public sector for the benefit of the country) and a clear rebuttal of charges made by the West against the so-called "Fortress India".

This act proved that India was open and willing to cooperate with anybody from the erstwhile USSR, other socialist countries on one hand and with the international oil majors on the other as long as it was in India's national interests. Equal credit must go to both the organisations for making this very correct strategic judgment at a time when this was considered as an equally enormous risk for both — Mobil for agreeing to join hands with a Government owned public sector undertaking, and for IndianOil in collaborating with a multinational, when these companies (other than Mobil) were doing their best to scuttle IndianOil soon after its birth.

Since the Mobil-IndianOil was a 50:50 tie-up, the new company, i.e. IOBL, was technically a private sector undertaking and therefore it enjoyed all the freedom and the flexibility of a private enterprise. However, because of IndianOil's 50 percent equity, the new company would never be allowed to swerve away from India's overall national interests.

As per the IndianOil-Mobil agreement, two state-of-the-art Lube Blending plants were to be built by IOBL. Accordingly, the Bombay plant with a blending capacity of 75,000 kl per year on a one-shift basis was commissioned in March 1964 while the Calcutta plant with a blending capacity of 100,000 kl per year on a one-shift basis was commissioned in June 1964.

In the first year itself (1964-65), the two plants were able to blend 96,000 kl of lubricants. However, IndianOil's Chairman P.A. Gopalakrishnan ensured that the recruitment and training thereafter, was done much in advance of the plant commissioning. In the month of January 1963, he roped in K.Sita Rama Rao as Chief Technical Engineer. Sita Rama Rao had nearly 20 years of solid experience of marketing Mobil lubricants with Stanvac behind him. He thereafter formed and nurtured the Technical Services team in IndianOil.

Both the new IOBL plants were the most modern and technically advanced not only in India but perhaps east of Suez. Mobil itself had only one or two such sophisticated plants elsewhere. The blending of lubes was not only a continuous process but it was also programmed and controlled by digital computers. Most plants of the other oil companies in India then had only batch blending systems, although there were a couple of plants with a mechanically operated continuous blending procedure through proportionating positive displacement pumps. Thus the IndianOil-Mobil collaboration through IOBL had brought into the country the latest technology available.

The Paharpur IOBL plant was formally inaugurated by the Minister of Petroleum, Prof. Humayun Kabir, in the presence of P.A.Gopalakrishnan, Bellman, and Matson — the first Managing Director of IOBL in September 1964. On behalf of the Government of India, Humayun Kabir, welcomed the setting up of the two blending plants — the first of their kind in the eastern hemisphere; "in particular the participation of American private enterprise with the public sector". As a result of this collaboration, Kabir stated, "IndianOil will now be in a position to meet the requirements of automotive, industrial and marine lubricants needed for the country's economic and industrial development."

On behalf of IndianOil, Chairman P A Gopalakrishnan said, "We welcome the opportunity to participate with Mobil in this business venture. Their products, bearing the Flying Red Horse trademark have been sold in India since the turn of the century and our studies show that the consumer, who has come to depend on them, wants them to continue in the Indian Market."

In his speech, Matson said, "IndianOil and Mobil are equal partners in this endeavour to provide a progressive and technically advanced blending of lubricants and manufacture of greases to cater to the ever-increasing demands of industries in India. The efforts of the IndianOil to procure indigenous base stocks, as also imported base stocks from all available sources are being complemented by Mobil. Our modern world of machines move on lubricating film.......the complex manufacturing equipment for various industries, the network of transportation for movement of goods - be they farm produce or machine for building machines - depend on lubricants made to suit the operating requirements....evaluation, either on actual service conditions or laboratory scale, was not as simple as it looked and continuous research was being employed."

In a span of less than 10 years, IOBL was to become the largest lube oil blending company in India. It was actually Matson who was chiefly responsible for motivating his principals (Mobil, USA) to go forward with the joint venture. It was he who pioneered the agreement, which led to the formation of IOBL. Sita Rama Rao was responsible for creating the initial technical services team of IndianOil. Will Risk, a trainer from Mobil, USA was responsible for conducting a series of training programmes for IndianOil's marketing personnel.

Finally, after the termination of the IndianOil-Mobil Agreement in 1974, IOBL became a wholly owned 100% subsidiary of IndianOil.

LUBE INDIA LTD

Any country in the world would like to conserve its foreign exchange in the interests of its economy. In the 1950s, importing lubricants from foreign sources was a huge drain on India's foreign exchange reserves. The Government of India rightly felt that it was high time to develop indigenous production facilities to meet this requirement. Consequently in late 1959, the Government of India invited tenders for construction of a Lube Refinery in Bombay. Out of the proposals it received from several companies, the Government found the offer made by Esso Standard Eastern Inc., worth considering. Accordingly, an Agreement was signed between the Government of India and Esso on September 15, 1965.

This Agreement provided for the formation of a company jointly owned by the Government of India and Esso on a 50: 50 basis. The company was to construct and operate a lube refinery for the manufacture of high and medium viscosity index lube base stocks. The Agreement also stipulated that the products be shared on 50:50 basis between the two partners. According to the Agreement, the Board of Directors would consist of eight members — four nominated by the Government and four by Esso. The Chairman and the Financial Director would be from among the Government nominees and the Managing Director would be an Esso nominee.

The new Joint Sector company, Lube India Limited (LIL) was incorporated on April 4, 1966. Situated on a 60-acre site adjacent to the then Esso Refinery in Trombay, the plant modern in all respects, was built at a cost of Rs.17 crore. The company eventually helped save a substantial amount of foreign exchange for the country.

The two shareholders equally subscribed the equity capital of the company of Rs. 4.8 crore - Esso subscribing Rs. 2.4 crore in dollars and the Government subscribing an equal amount in rupees. The company negotiated for a loan of Rs.5.6 crore (in dollars) with the Manufacturers Handover Trust Company, New York, to provide additional foreign exchange needed for the project. The project was also financed by a loan of Rs. 6.4 crore (in rupees) from the U.S Agency for International Development (Cooley loan). The shareholders were advised to advance Rs. 60 lakh of rupees each to meet further costs.

Process engineering and basic design of most of the onsite and offsite facilities was provided by Esso Research & Engineering Company, Florham Park, New York, U.S.A. The Hydrogen generation plant was designed and built by Selas Corporation of the Netherlands.

Snam Progetti of Milan, Italy, was awarded the contract for detailed engineering, procurement, expediting and construction and their Indian associates were Engineers India Limited. During the construction of the plant, maximum use was made of local materials and services. Imported equipment was limited to that which was not manufactured or available in India. Many local sub-contractors under the technical supervision of Snam Progetti carried out actual field erection.

The plant was designed to produce 164,000 metric tonnes per year of lube oil base stocks. Most of these were motor oil base stocks of high viscosity index and the remaining base stocks had good colour but lower viscosity index and were utilized for industrial grades. Included in the above capacity was 17,000 tonnes per year of a de-waxed light distillate used as feedstock for the manufacture of transformer oil at a neighbouring plant of Power Cables Pvt. Ltd., now Apar Ltd.

Half of the base stocks produced went to the designated representative of the Government of India, i.e. IndianOil and the other half initially to Esso, and later HPC both of whom presently blend and market their respective brand of lubricants. The principal feedstock to the Lube Refinery was reduced crude as well as certain light hydrocarbons, furnished to the lube plant by the adjacent HPC Refinery, earlier Esso. Unused byproducts of the lube operations were returned to the refinery. The plant went into commercial production in the month of December 1969. Lube India Ltd. was fully taken over by the Government of India in 1975 and merged with HPCL.

As the demand for Lube oil base stocks went up further, a Vacuum Distillation Unit was installed in 1977 and commissioned. In 1983, the Lube refinery processing units were de-bottlenecked and the capacity was increased to 2,65,000 tonnes per annum to meet the growing demand of Lubricants.

Lube Oil Base Stock (LOBS) production got a fillip with the commissioning of Lube Refinery Expansion Stage-II in 1994-95 when the following facilities were added: Propane De-asphalting Unit (PDA), Solvent Extraction Unit III (with NMP as solvent), Second Stage Dewaxing facility of PDU, and a Hydrogen Generation Unit -II

After this expansion the capacity of the Lube Refinery has presently gone up to 3,35,000 metric tonnes per annum of LOBS as compared to the initial capacity of only 164,000 metric tonnes per annum.

LUBRIZOL OIL INDIA PVT. LTD.

Oil companies cannot do without additives, as they are an essential part of lubricant formulations. As an ongoing quest and desire for achieving self-reliance, in the field of chemical additives, India was looking for a strategic partner and had zeroed in on Lubrizol Corporation of USA, a world leader in the additive business who came forward to offer the much needed technology in this field.

On December 2, 1965, an Agreement was signed between the Government of India and Lubrizol Corporation of USA, with the Government of India holding 51% of the shares and the balance 49% by Lubrizol. Subsequently, Lubrizol India Ltd. with an authorised share capital of Rs. 75 lakh was registered in the State of Maharashtra on July 20, 1966.

In 1979, the equity of the company was expanded to Rs. 480 lakh and the foreign participation was diluted to 40%, the remaining 60% being vested with the Government of India. The equity base was further raised to Rs. 960 lakh in 1989 with participation in the same proportion. Land was acquired in early 1967 and the plant was mechanically commissioned for production. Eventually, the plant was formally inaugurated on January 16, 1969. The strategic partnership between Lubrizol India and Lubrizol Corporation USA during the last four decades has proved to be a successful venture, achieving the desired results for the marketing of additives in India.

Lubrizol India's range of chemical additives include the following: Sulfonates, Antioxidants, Phenates, Viscosity Improvers, Dispersants and Flow Improvers

The product range of additives includes products for automotive lubricants such as: heavy duty diesel engine oils, passenger car engine oils, two-stroke engine oils, motorcycle oils, automotive gear oils, automotive transmission oils and farm tractor oils etc. Industrial lubricants and products are as follows: hydraulic oils, industrial gear oils, compressor oils, metalworking oils, greases and rust preventives etc. Lubrizol India also markets specific products for use in different fuels such as High Speed Diesel, Motor Gasoline, and Heavy Fuels etc.

The main manufacturing operations of the Lubrizol India is located in Thane-Belapur industrial belt of Navi Mumbai, Maharashtra and the company is the proud recipient ISO-9002 Certificate from the BVQI and ISO-14001 accreditation for Environmental Management System.

The major customers of Lubrizol India are IndianOil, HPCL, BPCL, Castrol and IBP etc. In fact, Lubrizol India is also exporting Additives. Despite liberalisation, globalisation and the increasing competition in the Additive market, Lubrizol India still holds the number one position in the Indian Market.

The company had an average turnover of about Rs. 300 crore for the last five years and has consistently been a profit-making company since its inception in 1968-69 with zero-debt ever since.

On August 25, 1979, a new Technology Transfer Agreement and Trade Marks Agreement were signed between the Lubrizol Corporation, USA and Lubrizol India Limited, replacing the earlier Technical Service Agreement and Trade Marks Agreement, which formed a part of the Formation Agreement of December 1965. Under the new Technology Transfer agreement, which was for an initial term of eight years, Lubrizol Corporation was to provide formulation technology as also R&D assistance for the manufacture of Chemical Additives. As a consequence the Formation Agreement was also suitably modified.

The company with the approval of the Government of India entered into a new Technology Transfer Agreement effective from January 1, 1988. Under this agreement the company acquired formulations and manufacturing technology for higher performance additives and chemicals.

Lubrizol India became a joint venture company in the year 2000. The agreement between Lubrizol Corporation, USA and Indian Oil Corporation Ltd, with both the partners holding 50% equity in the Company.

R&D - EIL/IOC

R&D - ENGINEERS INDIA LTD.

In almost all developed countries engineering companies seldom have their own in-house dedicated R&D centres mainly because infrastructure and issues requiring specialised skills for resolution are outsourced very conveniently. In India, especially in the 1960s the situation was quite different. The country's industrial base was very weak, technical manpower skills though available had limited hands-on experience and R&D institutions, least to say were in their infancy.

Under these circumstances, EIL was not only entrusted with the task of acquiring and absorbing technology but was also entrusted with the mission to build design capabilities and rise to fulfill national objectives of achieving self-reliance in refining and associated technologies by providing technical know-how for building sophisticated process equipment within the country. The mandate given to Engineers India Ltd. (EIL) was a big challenge.

The EIL picked up the gauntlet very courageously. It started by first setting up its own R&D activities in 1970 and within five years of its inception, simultaneously adopted a two-pronged strategy for achieving its goal. The state-of-the-art technology available then were acquired through overseas tie-ups with global leaders like Technip, Lummus, Foster Wheeler etc., and by means of close interaction with process licensors like UOP, IFP, Stone & Webster Scientific Design etc. While frontline design engineers absorbed the operational aspects, the R&D Division did the consolidation.

The EIL's R&D division started modestly with desktop students and 10 to 12 relatively young engineers who were given a very small budget to start with. But gradually, in spite of numerous hurdles the Division expanded to include about 20 engineers - a 100 percent increase in the strength of technically qualified men. Appropriately, with constant interaction with various Design Engineers Division of EIL, the areas for development were identified and concrete work plans were prepared in the field of: Liquid-Liquid Extraction Processes, Thermal Conversion Processes, Distillation Engineering, Vapour and Liquid Equilibrium, Multi-stage Multi-component Computation, Column Internals, Vacuum Technology, Fired Heaters, Sulphur Recovery Process, Scale-up of Laboratory Scale Processes, Thermal Cracking of Naphtha and Gas, Polyolefins-pilot Scale Development, Ethylene Oxide and Slurry Transportation.

Having identified the areas to concentrate on, it became a massive task for EIL to mobilise resources and carry out development at a minimum possible cost. The R&D division of EIL was merely a desktop organisation having no laboratory to speak of. Consequently, the CSIR laboratories were approached for collaboration in sponsoring research activity. Accordingly, Memorandums of Understanding (MoUs) were simultaneously signed with IIP, NCL, CMERI and RRL, Bhubaneshwar for carrying out research work. The identified field for each of the MoUs were as follows:

IIP	-	Thermal Conversions
CMERI	-	Vacuum Ejectors
RRL	-	Slurry Transportation
NCL	-	Ethylene Oxide and Column Packing(Random & Structured)

Thus in the 70s the R&D of EIL pioneered a novel concept of collaborative R&D. The model adopted by them was found to be extremely fruitful, as a number of technologies were developed and commercialised in the course of time. However, it must be mentioned that this collaborative research was primarily restricted to pilot and bench-scale studies.

The scalability and customer acceptance became a major issue for EIL in the absence of a suitably equipped pilot plant for demonstration. Thus, to start with, the R&D Division of EIL created pilot plants in the CSIR laboratories and elsewhere. For example, pilot plants for Ethylene Oxide and Regular Packing were created at NCL at a cost of Rs.50 lakh and Rs.20 lakh, respectively. Similarly a Polyolefin and bench-scale Naphtha Cracker pilot plants were created in IPCL.

The EIL obviously felt the pressing need to own a fully equipped R&D facility thereby relieving them of depending on others. This took some time, but finally EIL did build their own massive R&D Centre at Gurgaon near Delhi where various large-scale demonstration and pilot plants were set up over an area of 39 acres at a cost of Rs.25 crore. This R&D facility became operational in 1988-89.

Over a period of 35 years, the R&D of EIL has carried out a large number of developmental projects, many of these were subsequently commercialised and most of the projects were of national importance and helped EIL expand its technology portfolio. Today EIL can offer number of refinery process technologies as a result of their sustained R&D efforts.

Some of the landmark achievements of R&D of EIL are:

i) In 1973-74 for the first time in India, Vis-breaker basic process design was made for IndianOil's Gujarat Refinery expansion project. The unit is under operation now.

ii) The basic process design of SO2 extraction unit for Bongaigaon Refinery was carried out. The unit is operating satisfactorily.

iii) Technology of light aromatics extraction with sulpholane was developed under joint R&D programme of Engineers India Ltd. and the Indian Institute of Petroleum, Dehra Dun. The commercial plants based on the above technology are in operation.

iv) Subsequently in 1983-84, sulpholane technology for light aromatics extraction was developed jointly with IIP, and commercialised by BPCL. The technology was further developed for food-grade Hexane. Altogether there were seven applications of R&D EIL which continued to work in extraction processes. They also developed propane de-asphalting, TEG process and finally NMP process for lube extraction.

v) Thermal conversion processes, that is, Delayed Coker and Vis-breaking, has been the area of specialisation of EIL's R&D.

vi) The R&D of EIL has also specialised in Sulphur Recovery processes with Sulphur recoveries of greater than 99% to match customer needs.

Recognition and Awards

The R&D wing of Engineers India Ltd. has received many awards for its contribution to the process industries. Some of the major awards and recognition received by them are in the following fields of refinery technology:

- NRDC-Light Aromatics Extraction.
- ICMA-Furnace Efficiency Improvements Study.
- NPMP-Creativity & Innovation.
- CSIR-Visbreaker Technology.
- CSIR-PDA Technology.
- CSIR Technology Shield -for Development in Extraction Technology.
- DSIR-Gas Sweetening (CATSOL Process).
- ICMA-Continuous Film Contactor and NPMP-Improved Steam Trap.

Today the Research & Development wing of the Engineers India Ltd has come a long way and it can proudly claim to be one of India's premier research institutes in the field of refining technology. The EIL has made a very significant contribution in fulfilling the country's dream of self-reliance advancing from a stage of only 10% indigenous availability to over 90% today.

R&D - IndianOil

Making a quiet and unobtrusive debut in 1972, with nothing more than an unimpressive whitewashed edifice, standing almost like an apology for a laboratory on a barren snake-infested tract of land at Faridabad near Delhi were the beginnings of the ambitious Research and Development Centre of Indian Oil Corporation Ltd. On the face of it the lab hardly looked like being a serious contender to the sophisticated research laboratories owned by the multinational oil giants abroad.

Be that as it may, hidden behind this uninspiring outward symbol that eventually grew into a world class R&D Centre winning a bag-load of accreditations and awards was manned by a dedicated team of researchers and scientists who meticulously chalked out a formulated action plan, which was to transform this unpretentious debutant into a major trailblazer in the years to come. This dramatic transformation was brought about by men driven by an overwhelming patriotic zeal and passion for creation of path-breaking innovations in the field of hydrocarbon formulations.

IndianOil's decision to set up its own R&D Centre came at a time when the Indian lubricants' market was entirely in the hands of reputed multinational oil companies and just as in the case of refinery building, indigenous know-how was inadequate. IndianOil at that point of time was marketing ***Mobil*** lubricants through the joint venture company Indian Oil Blending Limited (IOBL).

The JV was time-bound and IndianOil realised that a time would eventually come when it would have to market its own brand of lubricants. Accordingly, such a decision was duly taken — a decision that was basically prompted by an urge to attain self-sufficiency in a strategically vital sector of petroleum marketing. To begin with in 1970, IndianOil's Marketing Division prepared a feasibility report for setting up a full-fledged, sophisticated R&D Centre. This worked out to an initial estimated cost of Rs. 254 lakh, which was subsequently revised and finally firmed up in 1973 to Rs. 484 lakh.

The man who prepared the feasibility report was Dr G. Jayrama Rao of IndianOil's Marketing Division, who later became the first person to join the R&D Centre as its manager. Thereafter a global hunt was launched to recruit the first head for this Centre. As luck would have it, IndianOil found its man in Dr J S Ahluwalia. This dedicated scientist had a enviable *curriculum vitae* for he had the privilege of working at the celebrated *Instut Francais du Petrole* (IFP) in Paris, France, the number one petroleum research laboratory, the only one of its kind in Europe at that time.

Armed with a doctorate in Chemical Engineering, Dr. Ahluwalia was earlier at the National Physical Laboratory, New Delhi. Subsequently, he was at the Indian Institute of Petroleum, Dehra Dun for several years before he joined IndianOil's R&P Division as its Technical Advisor. Dr. Ahluwalia took up his appointment at Faridabad as the Head of IndianOil's R&D, and the Centre was eventually born on March 10, 1972 with Dr. Ahluwalia and Dr. Jayarama Rao formally forming the nucleus.

The next task was to acquire a suitable piece of land near Delhi for setting up the Research Centre, which was duly secured at Faridabad through the efforts of the then IndianOil Chairman, N N Kashyap (ICS). A global search for additional experienced scientific personnel to be included in the team was carried out simultaneously in India and abroad with potential candidates working in reputed academic and industrial labs abroad. They were screened and interviewed in London and some like Dr. R K Gupta, Dr. K.C Tripathi and N. R. Raje agreed to join the Corporation's research team. The bulk of the manpower, however, came from other well-established Indian R&D organisations like Indian Institute of Petroleum (Dehra Dun), Defence Research & Development Organisation and other CSIR labs. Raje later on rose to become the first internal scientist to become Director In-charge of IndianOil R & D Centre in January 2003.

By 1974-75, an excellent team of scientists and researchers was in place under leadership of Dr J S Ahluwalia, who meticulously planned activities and facilities, designed the organisational structure, and laid the foundation for a promising future for IndianOil's R&D.

The Centre also had Dr. S P Srivastava, then a promising young recruit in the R&D Centre who later rose to become its Executive Director (R&D). Dr Srivastava had the experience of having worked in well-known Indian institutes such as the Central Fuel Research Institute, Dhanbad and the Regional Research Institute, Jorhat as also at the Allahabad University. This is what Dr. Srivastava had to say recalling his early days: "The first thing I remember was a product knowledge course on lubricants which was done with the help of our Marketing Division Technical Services group. This was attended by all of us, including our head. We learnt as to what performance characteristics a lubricant is supposed to have and we also had an encounter with customer-related issues that could crop up during the lubricant application. This was a very dry subject from the angle of science and I wondered what a scientist could do in applying a thin film of oil between two moving surfaces. But as we proceeded further and read about the subject, interest developed and we could visualise the potential of this subject"

The immediate challenge at that time was to find substitutes for the full range of ***Mobil*** lubricants. This was no easy task. IndianOil was then marketing ***Mobil*** products and the agreement was due to end in 1974. Dr S P Srivastava and J R Nanda were given the task and responsibility of studying the data available at IOBL, Mumbai. They were instructed to suggest suitable recipes for substituting ***Mobil*** automotive lube formulations to match with IndianOil's brand by then named ***Servo***.

To achieve this goal, the duo was sent to Mumbai for a period of three weeks. With the help of information from additive suppliers and scientific literature, the twosome successfully finalised formulation details of some important products. Dr Srivastava related his and J.R. Nanda's experience in the following words: "We had the full support of technical officers from IOBL and the marketing Technical Services group. ***Mobil*** started destroying all the formulation documents for obvious reasons. We finalised the brand names of all the ***Servo*** grades and allotted new codes to additives. We took up recommendations from the all the additive manufacturing companies especially from Lubrizol India Ltd. From this and whatever little work we had done in R&D by that time, we could finalize the formulations of about 120 grades in those three weeks or so. This was a Herculean task but we were ready for the switchover to ***Servo*** much before the stipulated deadline with full documentation. This was the time when IndianOil's Marketing Division had not seen a lubricant formulation of any kind. When we submitted our documentation they were ecstatic and thrilled to see so many formulations for the first time."

The now famous ***Servo*** brand, which today is synonymous with highest international quality standards, remains a demanding customers' choice who insist on lubricants of world class quality. ***Servo*** was thus born and with it also took birth the confidence that IndianOil's R&D and its products could match those of anyone, anywhere in the world. At this stage, the R&D's objectives were very clear, i.e. to develop products equivalent to all ***Mobil*** grades marketed by IndianOil at that time. By August 1, 1974, the Centre had issued more than 260 formulations covering automotive industrial, metal working oils specialties and marine oil formulations.

However, the formulations of several critical grades of products such as railroad, marine, certain defence grades and some specialized industrial oils e.g. Morgan Bearing, Compressor Oils, critical Hydraulic Oils etc could not be finalised. Dr Ahluwalia realised that there would be difficulties in developing critical and new grades of lubricants which would also require the difficult task of approvals by Indian and foreign OEMs. To hasten this process, a Technical Collaborative Agreement was signed in 1976 with Castrol, UK who agreed to provide and part with entire lubricant formulations in their possession and also obtain OEM approvals.

This also gave IndianOil great opportunity to learn. The training worked as a catalyst to develop IndianOil products. The agreement with Castrol, however, did not last long and was terminated in 1979. This opportunity definitely gave the inputs needed for developing commercial lubricants.

By early 1980s, with new infrastructure and facilities in place, the R&D Centre had developed into a modern research institution with an extended team of scientists, staff members and several sophisticated equipment. Scientists at the Centre were ready with high quality Servo grades of turbine, hydraulic, compressor, gear, metalworking, and specialty defence grades and some specialised industrial oils (Morgan Bearing Oil, Compressor Oils, Critical Hydraulic Fluids and several others). The path to move to this level of customer confidence was not easy. There were several challenges and were met with confidence but not without hard struggle.

Historically, India's Defence Services had procured all kinds of military hardware from the West as well as from the erstwhile USSR and quality parameters for the products and approval procedures for such a wide-range of armaments were not only widely divergent but also equally complex. Moreover, a very small quantity was required for some of these applications. This made all the time, money and effort economically unviable. However, realising the importance of these strategically important products in the service of the nation, IndianOil's R&D gave equal emphasis on development of all Defence products and got the required approvals after exhaustive trials and data validations for even products with very complex specifications such as OMD-113, XG-271, OEP-70, PX-27, CIATIM-203 etc. Mainly J.R. Nanda did this work. This kind of support evoked enough mutual confidence between IndianOil's R&D and India's Defence Services.

J.R. Nanda, one of the first Research Scientist in the R&D centre holding a masters Degree in Organic Chemistry and now the CEO of IndianOil-Balmer Lawrie JV 'Avi-Oil', had this to say, "*I was in the batch of first six "Research Scientists" (that was the designation) of those who joined the nucleus of the R & D Centre in 1972). One of the clauses of the feasibility report of the Centre which attracted my attention was that the Centre had a mandate to work for the Defence sector in order to make it self-reliant for its requirements of lubricants. This eventually led to my efforts for indigenisation of several lubricants for aviation and military use, and in a spin off to the formation of the joint venture "AVI-OIL'-two decades later. The initial zeal to replace the Mobil branded lubricants by the R & D Centre's formulated 'SERVO' brands was so great, that the team worked day and night to see that the formation and other manuals were prepared and made available before the midnight of 18th July 1974.*"

In the first decade, that is Phase I of its operations the R&D Centre was devoted to understanding and mastering the complexities of lubrication science and technology, ie. 'Tribology' and through a process now called reverse engineering, that is knowledge gained through collaborations. It succeeded in its goal of self-reliance and achieved almost total indigenisation of lubricant technology.

The Nutan wick stove was developed in 1975 by R&D with thermal efficiency more than 60% over the existing 35 to 40% efficiency resulting in saving of 30% SKO. The R&D Centre also brought out an innovative Nutan LPG Stove which was developed in 1983 with an efficiency of 70% against the existing 60% saving fuel to the extent of 10% LPG. The period from 1985 to 1995 (Phase II) saw a thrust in new emerging areas of lubrication technology and on refining processes covering a wide range of refinery operations like fluid catalytic cracking, (FCC), catalyst development, hydro processing etc. Some of the more important innovations in refining technology were: Development of Indmax, which helped conversion of heavy residue to high value LPG and the development of Indalin which helped conversion of surplus Naphtha to LPG.

IndianOil's R&D also expanded its work in Pipeline operations and technology such as:

- Research studies on the archeological characteristics of crude oil from differ-

K.D. Malaviya, Minister of Petroleum, reviewing the fuel-efficient Nutan Gas Stove, developed by the R&D Division of IndianOil. Picture shows J.S. Ahluwalia, first Head of IndianOil R&D (extreme left). C.R. Das Gupta is seen standing behind the Minister ent sources and petroleum products aimed at the development of drag reducers and flow improvers.

Instrumented pig is a hi-tech computerised pipeline probe to monitor the health of crude and product pipelines, which at present is available only in a few developed countries. IndianOil's R&D Centre developed this sophisticated technology in association with the Bhabha Atomic Research Centre (BARC) and set up a wet pipeline test loop to evaluate the performance of the prototypes of this device.

In Phase III, that is, 1995 onwards restructuring of R&D was undertaken to meet the challenges of the deregulated scenario and to support the corporate goal of becoming a global energy company. Closer linkages with international research institutions began to be developed along with increased communications with global experts. Young scientists and engineers were encouraged to undertake novel research projects and be globally competitive in quality work. This was made possible by encouraging creation of academic and research societies which, through active participation helped Indian scientists, in interacting more closely with users, equipment manufacturers, technology, licensors etc. The first in this series was creation of the Delhi Chapter "Indian Society of Analytical Scientist" in 1992 with Dr. A K Bhatnagar as its founder secretary and IndianOil's R&D Centre as its Secretariat.

Another initiative taken by the R&D was to start a new series of conferences, International Seminars on Fuels and Lubricants (ISFL) which has now become a unique international forum, patronised by all industries and national and international community of scientists engaged in research in lubes, fuels, tribology, analytical sciences, chemistry, biotechnology etc.

In yet another breakthrough, it was discovered that for longer than one could remember, companies manufacturing additives tended to recommend higher dosage of additive packages for obvious reasons. And for many years because of inadequate competition they were recovering very high service charges. Often they would attempt to dissuade the R&D Centre from undertaking any research work in the area of additives for obvious reasons.

This only renewed the R&D Centre's determination to pursue research work in decoding of commercial packages, development of novel chemical additives, the development of high value and volume formulations such as Railroad Oils, Automobile Engine Oils, Industrial Oils etc, on the unique 'component' based approach. A successful result finally not only led IndianOil to meet the needs of prestigious customers including the Railways but was also able to give a fitting reply to many doubting Thomases.

In yet another innovative development was the remarkable achievement of Dr. A M Rao and Dr S K Mazumdar and his team, which virtually created a big *hungama* (sensation) in the Indian lube and additive market. This was the development of a new generation component-based Railroad Oil for General Motors' ALCO locomotive engines. Component approach, using the concept of additive and additive interactions, for the first time led to development of a new formulation, which was both economical and superior in performance. After exhaustive trials on locomotives, running the product for thousands of hours, hauling millions of tons of cargo over period extending several years the Railways finally approved the product which would enable them in turn to save more than Rs.170 crore of diesel annually besides saving in input costs on lubricants and maintenance.

The period beginning late '90s was highly crucial for the oil industry. Environmental pollution on account of voluminous use of liquid petroleum products particularly diesel, was being strongly debated. The Supreme Court intervened and made it compulsory to upgrade fuel quality to match European specifications and the use of Compressed Natural Gas (CNG) in commercial vehicles was made mandatory in Delhi and other metros through a court order.

Earlier in the year 1980, extensive field trials were conducted on two wheelers, passenger cars and Defence vehicles using 10% and 20% blends of ethanol in gasoline by IndianOil R&D in collaboration with IIP, Dehra Dun. It was then established that 10% and 20% ethanol blend in gasoline could be used in petrol driven vehicles without any modifications or problems. Though the field trials were successful, ethanol blends could not be commercialised because of inadequate availability of ethanol. Interest in use of ethanol gasoline blend was revived once again in the year 2000 because of the reported surplus capacity of the distilleries in the country. The Ministry of Petroleum & Natural Gas decided to commission three pilot projects — one in U.P. and two in Maharashtra to establish the effect of using ethanol gasoline blends. The Ministry also advised IndianOil R&D to undertake studies using alcohol-gasoline blends on new generation two wheelers and passenger cars.

After extensive trials conducted by the R&D Centre, oil companies started conducting trial marketing with 5% ethanol gasoline blends at the pilot projects located at Miraj, Hazarwadi, Manmad, Panewadi all in Maharashtra; Bareilly and Aaonla in Uttar Pradesh in 2001. A few mechanical problems were encountered during the trials. They were, however, solved after discussions with the manufacturers. After the success of the pilot project, the Government of India issued a notification on September 12, 2002 mandating supply of 5% ethanol blended petrol in the nine sugar producing States of India.

It is well-known that crude oil which took millions and millions of years to form under the earth's crust is not going to last forever. Man is fast exhausting this vital non-renewable source of energy. Scientists all over the world today are desperately searching for some alternative, preferably renewable source of energy and presently have zeroed in on Hydrogen. It has the potential to provide clean, environment-friendly, reliable, affordable and renewable source of energy for meeting the growing future needs of the country and the world. Hydrogen can be used in a wide range of applications including power generation, heating, transport and even aviation. Major oil and gas companies all over the world are assiduously engaged in research on the use of Hydrogen as transport fuel.

Consequently, the Ministry of Petroleum has taken a decision that IndianOil R&D co-ordinate the Hydrogen Research Programme on behalf of the entire public sector oil and gas sector in the country. IndianOil R&D has been identified by the Ministry as the nodal agency for Hydrogen research activities within the oil and gas sector in India. A road map for taking up research activities and a green signal has duly been given by the Ministry. This will require IndianOil R&D to develop Hydrogen research projects leading to creation of Hydrogen infrastructure for production, storage, distribution and utilisation. This will also involve demonstration projects that have been planned and will help IndianOil R&D to gain experience with Hydrogen — the world's fuel of the future.

IndianOil (R&D) is also presently setting up of a fueling infrastructure for demonstrating the use of 10% to 30% H_2-CNG mixtures in automobiles for trial runs in Faridabad, Delhi; Mathura and Agra at a cost of Rs.25 crore. The H_2 - CNG dispensing facilities at IndianOil's R&D Centre has been commissioned in November 2005.

A National Hydrogen Energy Board has also been set up by MNES with the involvement of industry market leaders like Tatas, Mahindra & Mahindra and IndianOil along with academia and research institutions in India. IndianOil's R&D is actively associated in the groups constituted for the use of Hydrogen in the transport sector and have been entrusted with the responsibility to plan and set up the infrastructure for supply of Hydrogen to about 1,000 Hydrogen-fueled vehicles expected to be put on the road by Indian automobile majors within three years. The target set is 2008.

Similarly, work on Bio-fuels also continues to be vigorously pursued at the R&D Centre. Bio-diesel is an eco-friendly, renewable alternative diesel fuel prepared from domestic renewable resources i.e. vegetable oils (edible and non-edible) and animal fats. It contains no petroleum, but can be blended at any level with HSD. Many countries in the world, especially South Africa, Europe and North America, are using Bio-diesel blended with varying amounts of petro-diesel.

In the U.S., Bio-diesels are mainly derived from soyabean oil and in Europe from Rapeseed and Sunflower oil. However, as India is deficient in edible oils, non-edible oils such as *jatropha* and *karanjia* are the choice for producing Bio-diesel. The R&D Centre is engaged in the study of the complete value-chain of Bio-diesel. The Bio-diesel produced at IndianOil R&D has been tested as per ASTM D-6751 specifications. As also various blends of Bio-diesel with HSD have been tested as per the requirements of diesel fuel specifications IS-1460: 2000.

IndianOil R&D has also undertaken Bio-diesel project work on collaborative basis with several agencies as listed below.

- An MOU with Indian Railways for *jatropha* plantation on 500 hectares of land provided by Indian Railways. As part of the MoU, the work-order for plantation of *jatropha curcas* on 70 hectares of Railway land has been awarded and plantation activities have been initiated on the site. Identification of rest of the land is being done at present. In addition the tests have also been conducted with 5%, 10% and 20% blends of *jatropha* Bio-diesel on 16-cylinder-ALCO diesel locomotive engines for power, specific fuel consumption, firing pressures and exhaust gas temperatures. Trial runs on *Shatabdi* and *Jan Shatabdi Express* trains have been carried out at 5% and 10% Bio-diesel. In the near future, five trains are to be introduced. They will be fueled with10% Bio-diesel.
- Similarly a Memorandum of Collaboration (MoC) was also signed with Escorts Tractors, Faridabad, for conducting low temperature startability tests at 5 degrees centigrade with Bio-diesel blend on tractors. Performance, emissions and durability tests on tractor engines have also been conducted.
- A joint programme has been initiated for testing of Bio-diesel up to 20% on Tata Motor vehicles. It is also planned to run 150 employee buses of Tata Motors in Pune very shortly on 10% Bio-diesel.
- A pilot project for using 5% Bio-diesel blends in diesel has been undertaken from April 2004 in collaboration with Haryana Roadways at the Gurgaon Bus Depot to assess the performance of 5% Bio-diesel/diesel blend on buses to study field operability.
- Recently in March 2005, GSTRC buses began to ply between Gandhinagar and Ahmedabad on Bio-diesel.

Apart from being a renewable source of energy Bio-diesel has several other advantages. Some of them are: Bio-diesel has a higher Cetane number than regular HSD. Consequently adding just 20% Bio-diesel to regular diesel improves the diesel's Cetane rating by three points, which makes it a premium fuel. Bio-diesel fuel being a good lubricant it helps extend engine life. The fuel also has a high Cetane rating, improves engine operation and performance. It burns completely and has absolutely no sulphur content. *Jatropha* can be grown on absolutely unused dry wastelands and in the long run could also become an important source of rural employment.

One more milestone was reached when a subsidiary company named Indian Oil Technologies Ltd., was set up in 2003 with Dr. D K Tuli as its first Chief

Executive Officer with the sole purpose of marketing technologies developed by IndianOil's R&D to companies in India and abroad.

When one looks back now it is difficult to imagine how a decrepit, white-washed edifice in 1972 set up as a temporary lab in Faridabad has through the course of less than 35 years evolved to become a centre of excellence in research and development, virtually becoming the pride of India. Today that bare snake-infested, tract of land is unrecognisable as it now can well be called the "Mughal Gardens" of Faridabad. J.R Nanda made the following nostalgic comment:

"Looking back at nearly three decades of service at the R & D Centre, it gives me a great pride to recall the transformation of a barren piece of land (66 acres with only one tree!) into a premium storehouse of knowledge and expertise with an ambience and environment which could be the envy of the best gardens in the country."

From a humble investment of Rs.34 lakh in 1975-76, by the year 1991-92 the investment had crossed Rs. 36.18 crore and Rs.443.50 crore in 1999-2000 and Rs.669 crore in 2002-2003. The people here who came from all walks of life, with varied experience and skills, occupied senior or junior positions, but they all initially toiled unremittingly in an inhospitable environment and almost lived like Spartans with minimum facilities at their disposal coupled with long hours of work. But this did not deter them in the least and all of them continued with their mission with a united zeal and determination to finally match and outdo the multinationals.

Dr. J. S. Ahluwalia, the doyen and the first head of R&D (1972-81), planned and executed Phase I of R&D projects and programmes. We have already seen how superbly qualified he was for the job. His contribution is still remembered by all who worked under him. He demonstrated exemplary leadership qualities and left an indelible mark on people who worked with him.

Dr. P.K. Mukhopadhyay took over the R&D Centre from 1983 to 1993. He was the first R&D head who was on the Board of IndianOil. A Chemical Engineer from Jadavpur University, he earned a Ph.D., in Technology from Gubkin Petroleum Institute, Moscow and subsequently founded EIL's R&D Centre in 1970 where he continued till his appointment as Director, IndianOil (R&D) Centre in 1983. It was Dr. Mukhopadhyay who pioneered the setting up a new Petroleum Refining R&D Laboratory with focus on FCC and Hydrocracking in addition to giving a new direction in existing areas of IndianOil's R&D such as fuel quality, next generation lube development, laboratory automation, R&D on Pipelines, failure analysis, etc. In 2005, he received Petrotech's life-time achievement award for his invaluable contribution in the field of Hydrocarbon research and in bringing technological self-reliance in the industry.

Dr. Mukhopadhyay was succeeded by Dr. A K Bhatnagar. A Ph.D. in

Chemistry from Lucknow University, he came to IndianOil in 1985 with several years of experience of research in highly reputed national and international institutes. This included research at the MIT in USA followed by teaching-cum-research at the University of Wisconsin, Madison, USA. After joining IndianOil as DGM he rose to become the Director in short span of ten years. His invention of Titanium Complex Grease in 1996 has been acclaimed as an outstanding breakthrough in the history of greases, and was conferred with four prestigious national and international awards.

This is not exactly the end of IndianOil's R&D story. The Centre's best is yet to come. As of now the challenges it has set for itself are one too many. Needless to say that the future of IndianOil's R&D is extremely bright and today it is all set to climb many more peaks of glory.

THE STORY OF SERVO

The intricate nature of the lubricants business involves several complex functions that oversee the process of a barrel of crude getting transformed into a can of lubricating oil or grease. The main process includes base oil manufacture and blending, packaging and distribution and not to say the least — endorsements for the use of the 'branded products' by equipment manufacturers.

During the 1950's, lubricants were blended by multinational oil companies operating in India using imported base oils and additives, adopting the formulations supplied by their principals. These products were sold under international brand names, and having been developed abroad in reputed research and development laboratories, enjoyed worldwide acceptance by equipment manufacturers as well as by end-users. Adequate technical service was rendered by local subsidiaries in consultation with their parent companies.

Realising the importance of a brand name and to hasten the pace of capturing a sizeable market share for lubricants, IndianOil in 1962 entered into a 'Marketing-cum-Distributorship' Agreement with Mobil Oil Corporation of USA. Mobil was a market leader and their containers emblazoned with the celebrated logo of the flying red horse (Pegasus) was a name to reckon with. Other players in the market were Shell, Esso and Caltex.

As a result of this Agreement, a Joint-Venture subsidiary "Indian Oil Blending Ltd.' was set up which established two blending plants one each at Mumbai and Kolkata for the exclusive manufacture of Mobil lubricants. Later in 1967, a grease-manufacturing unit was also added at Mumbai.

When IOBL was formed as a 50:50 joint venture with Mobil, it was nothing short of a major coup by IndianOil creating a sensation in India's lube oil market once dominated by Esso. IndianOil had suddenly walked into the void created by Mobil's exit out of India when it divorced Esso and separated from Stanvac. The proverbial "Flying Red Horse" had taken to its wings and flown out of India.

IndianOil was responsible for Pegasus's return flight to the Indian market. The brand had over the past several decades established among majority of the truckers a mindset — the name 'Mobil' itself had become a synonym for lube oil of any make. This fact was more than proved because in less than eight years i.e. by March 31, 1972 IndianOil had captured 50.4% of India's Lube Market with Mobil products blended at IOBL.

Kamaljeet Singh, first MD, Marketing Division, IndianOil and the first Chairman of IBP after it became a PSU

Although, lube business then represented only two to three percent of the entire POL consumption, it represented approximately 30 percent of the total POL turnover, because it was a high-value product. It was thus a very important segment of POL business. At that point of time, lubes were the only branded products sold by the oil industry in India. All other fuels, even specialty products (Benzene/Toluene etc.) were sold as per of BIS specifications.

No oil company worth its salt could consider itself complete without its own brand of lubricants. IndianOil was tied down to the joint venture agreement. Since the Indo-Mobil joint venture (IOBL) was valid for 10 years i.e. up to 1974 IndianOil, during this period it could not market any brand of lubricants, including its own.

Just at this time a new problem cropped up. A very sizeable additional quantity of indigenously produced base stock was available to IndianOil. Over 200,000 metric tonnes of high-grade base stock was being produced at MRL and with the commissioning of Haldia Refinery in 1974 another 200,000 metric tonnes of lube base stock would become available.

In addition, Lube India Limited a 50:50 collaboration between Esso and the Government of India had been formed in 1960 with an annual capacity of 164,000 metric tonnes of high grade lube base stock inclusive of 17,000 metric tonnes of de-waxed distillate for the manufacture of transformer oil and finally Lubrizol India, a joint venture between the Government of India (51% equity) and Lubrizol (49% equity) began producing 6,000 metric tonnes of Lube additives for automotive lubricants, industrial oils, specialties, gear and crank case oils, auto transmission oils etc.

By 1968, IndianOil envisaged the dire need to have its own brand of lubricants to mop up the increasing indigenous availability of indigenous base stock and develop indigenous know-how in formulations of various types of lubricants in order to meet the ever increasing demand of the Indian market and the industry.

Although the Indo-Mobil venture enabled IndianOil to be in the lubricants business, there was very little it knew about the formulations, as there was no technical interaction, and transfer of technology from Mobil since there was no such clause in the agreement. The sentiments of self-reliance (*Swadeshi*) had always been very strong in India right from the beginning. The coded formulations were classified information and the property of Mobil. For any technical service to be provided, IndianOil had to rely on Mobil, its product literature and manuals. The technical staff of IndianOil or IOBL., had no access to the know-how or the methodology used by Mobil in arriving at product formulations, as they were closely guarded secrets.

Around 1970-71, IndianOil, strongly supported by the stalwarts of the Oil Industry—Dr. M G. Krishna (Director IIP); Loveraj Kumar (Advisor, MOP) and Dr. J. S. Ahluwalia — decided to launch IndianOil's own brand of lubricants. The product would be blended to IndianOil's own specifications and formulations at its new lube blending plant at Madras(Chennai) commissioned in 1970. It was also decided (in view of the sanctity of the Agreement with Mobil) to market the same through IndianOil's newly acquired subsidiary—the IBP. This move in no way would violate the IndianOil-Mobil Agreement and Mobil would not be able to find grounds for any complaint.

Formulation technology or the development of product chemistry is very much an interdisciplinary skill which called for competence in basic scientific and engineering knowledge. In addition, it required sophisticated research, testing and performance evaluation facilities, and a massive research and development programme was needed to keep pace with the changing trends in the chemistry of base oils and additives and in the design of the operation of engines and machines.

It was under this scenario that IndianOil's 'Research & Development Centre' was conceived and set up, whose story has already been told. The launching of ***Servo*** was indeed a watershed in the history of lube marketing in India for it introduced for the first time lubricants produced with Indian technology based on formulations invented in India.

Servo was formally launched by Kamaljit Singh, Managing Director, IndianOil, who was also Chairman of IBP on August 15, 1972 coinciding with the 25th Anniversary of India's Independence. Announcing this at a press conference, Kamaljit Singh stated, "For the first time our cars and trucks are being offered a high grade lubricant formulated by Indians for meeting Indian conditions. Quantitatively, lubricants form a very small part of the total petroleum consumption. But technologically this is one of the most sophisticated areas of know-how. Lubricants play a vital role in the economy of a country in the form of maintenance and running of transport and industrial machinery. Growth of electric power and development of new machines depend to a very large extent on the availability of suitable lubricants."

Further, Kamaljit Singh made the significant observation: "This is a milestone in our endeavour for self-reliance in one of the most complex technologies i.e. the automotive oil technology and we are proud of it. This is a beginning. We will be able to market indigenously-formulated lubricants for many other uses in the near future."

IBP (then a subsidiary of IndianOil) played a very significant role in strategising and promoting the sale of Servo products and making the 1st "Indian" brand of Lubricant acceptable to the Market. To S.B. Budhiraja, the first and the last IndianOil-nominated MD of its subsidiary IBP, goes the credit for making the launching, marketing of Servo Lubricants (while Mobil Lubricants were still available) a grand success.

Eventually, in 1974 the IndianOil-Mobil joint venture agreement expired. IndianOil purchased Mobil's equity and from then on IOBL became a wholly owned subsidiary of IndianOil. Once again the flying red horse took off and flew away from its favourite market i.e. India but this time there was no such void as Servo lubricants were already positioned in the market. There after IndianOil never looked back.

Within a short period, (from 1976 onwards) the R & D backed Servo became the largest selling lubricant in India; i.e. even before the buying over of the multinationals by the Government of India and thereafter up to the present day, selling no less than 1,000 different grades of Servo formulations for almost every conceivable application with more than 100 engine builders' approvals. The Servo brand was firmly fixed in the mind of the consumers. In addition, Servo is today being marketed in countries such as Nepal, Bangladesh, Sri Lanka, UAE, Mauritius, Reunion Islands and Malaysia.

The new brand name ***Servo*** was the brainchild of J.C. Goyle who at that time was handling dual responsibilities of Head of the Lube Marketing of IndianOil and the Managing Director of Indian Oil Blending Ltd. An interesting anecdote tells us that Goyle in his search for an appropriate name was one day diligently leafing through an old English dictionary and accidentally stumbled upon the word "***SERVO***". In the dictionary, 'Servo' means, a mechanism that controls a larger mechanism. The word sounded perfect to him as it also had the connotation of serving the Nation. Goyle thought it absolutely fit and perfectly in line with the motto of IndianOil which was also dedicated in the ***Service*** of the Nation.

Story has it that till quite some time, Goyle's well-thumbed dictionary with the word Servo underlined in pencil was very much in the possession of Pillai, his Secretary. To Jagdish Goyle goes the maximum credit for introducing ***Servo*** in to the Indian market. Additionally the initial synergy produced by the teaming up of Dr. Joginder Ahluwalia, the first head of IndianOil's Research & Development Centre and J C Goyle was instrumental in making IndianOil's R & D effort most sensitive to the needs of the market. This tradition was continued by Dr.Ahluwalia and Goyle's successors.

Strange, that a former professor of English literature in Government College, Lahore, in fact that is what Jagdish Goyle was, when he gave up teaching and joined Stanvac and began to master the literature of lube formulations and specifications. Finally, after joining IndianOil, Goyle made a name for himself in the esoteric science of manufacturing and marketing Servo lubricants in India.

PETROCHEMICALS 'CHILD OF OIL INDUSTRY'

What are Petrochemicals? The term ***Petrochemicals*** was coined some 85 years ago to describe chemicals obtained directly or indirectly from Natural Gas and petroleum hydrocarbons for further use in chemical applications. Petrochemicals took birth as an industry when large-scale production of isopropyl alcohol from propylene began. Today wide ranges of articles of day-to-day use are produced from products emerging from Petrochemicals. As its very name denotes, basically petroleum products and Natural Gas play a large part and are the most important source of feedstock for the Petrochemical industry.

There are three major groups of Petrochemicals, i.e. olefin-based Petrochemicals, paraffin-based Petrochemicals and aromatic-based Petrochemicals. From this range are produced a huge variety of commonly used products such as fertilizers, detergents, plastics, polyester fibre etc., that have revolutionalised our life-style.

Besides providing valuable products, the petrochemical industry increases the value in economic terms also. If a Refinery gives a value-addition of say $ 5/6 per barrel — primary Petrochemicals such as ethylene gives a value addition of over $30 per barrel! This further dramatically increases when finished products are made from primary Petrochemicals, in some cases giving a value-addition as high as $200 per barrel.

Petroleum refineries are the major source of raw materials for the manufacture of Petrochemicals. The key products are Naphtha, Olefins from residual cracking units, C2/C3/C4 gases, n-paraffins, aromatics such as Benzene, Toluene, Xylene etc. Hence oil refineries played a crucial role in the emergence of the Petrochemical industry.

Prior to Independence, in the absence of petroleum refineries in India (the sole exception being the Digboi Refinery in Assam), there was practically no chemical or Petrochemical industry in the country. In the absence of this industry, India was forced to import organic chemicals to the tune of Rs.30 to 50 crore annually during the second and third Five Year Plan period (1974 - 79).

The commissioning of refineries in Visakhapatanam by Caltex and in Trombay by Esso and Burmah Shell provided enough impetus for downstream Petrochemical units to come up. The Union Carbide plant at Trombay, the

Rashtriya Chemicals & Fertilizers Ltd. (RCF) plants at Trombay and the Coromandel Fertilizer plant at Visakhapatnam were the earliest Petrochemical plants, which used refinery feedstocks.

Realising the urgency for developing the Petrochemical sector, in the 1950s the Government of India appointed a committee under the chairmanship of Dr. G. P. Kane and the Committee submitted its report in 1961, which recommended the setting up of four steam-cracking units in order to meet the requirements of ethylene, propylene, butylene, butadiene, benzene, etc. "From economic consideration," the report observed, "it is essential to establish the steam-cracking units near the refineries. The first steam-cracking unit should be established near the Bombay refineries; the second near Barauni refinery, the third near Gujarat refinery, and the fourth near a refinery to be set up in South India."

The Petrochemical sector really got a big boost when it was proposed that a major Petrochemical complex should be set up next to IndianOil's refinery at Koyali (Vadodara) in Gujarat in 1969. This complex was initially proposed by IndianOil so that it could take advantage of the feedstock available from its Refinery located almost next door. The Government of India, however, decided to form the Indian Petrochemicals Corporation Limited (IPCL) to undertake this project and thus the Indian Petrochemical industry was born in 1969. Fertilizer plants such as Gujarat State Fertilizer Corporation (GSFC), Gujarat National Fertilizer Corporation (GNFC) etc. also came up in the vicinity of IndianOil's refinery taking advantage of the availability of feedstock from the nearest available source.

With the thrust given to agriculture in the first Five-Year Plan combined with the need for increasing domestic production of nitrogenous fertilizers, the task had become easy with new petroleum refineries in the public sector having come up at Guwahati, Barauni, Haldia and Mathura. Alongside most of these refineries, Naphtha based fertilizer plants for production of Urea also came up in the course of time and set the ball rolling for the green revolution that followed. Subsequently, with the commissioning of Madras Refineries and Cochin Refineries, more fertilizer plants such as FACT, SPIC and MFL came up.

When IndianOil commissioned Mathura Refinery, there was a substantial production of residual stock (LSHS). Capitalising on this product, National Fertilizers Limited was formed to put up large Fertilizer plants at Nangal and Bhatinda in Punjab and Panipat in Haryana with LSHS and Fuel Oil as the feedstock.

While the initial thrust for development of fertilizer plants paid rich dividends, the need for wider development of Petrochemical sector was felt since Petrochemicals were the basic building blocks in a wide variety of products of day-to-day use. While IPCL was producing key products such as polymers, LAB (required for manufacture of detergents) and DMT for production of synthetic fibres, a comprehensive policy initiative was required for the future. Accordingly, the Government appointed a committee under the chairmanship of Rakesh Mohan for recommending a comprehensive strategy.

This Committee after wide consultations, made extensive recommendations in restructuring the entire sector, which included restructuring the tariffs on feed-stock, finished petrochemicals products etc. The Committee also recommended measures to simplify the procedures for investments in the Petrochemicals sector.

Another important milestone was reached in the early 90s when the availability of Natural Gas took a big leap with the development of two complexes at Hazira in Gujarat and Uran in Maharashtra by ONGC for processing the Gas available from Bombay High and South Bassein gas fields. This coupled with formation of Gas Authority of India Ltd. (GAIL) which laid the first cross-country Natural Gas pipeline from Hazira in Gujarat to Jagdishpur in U.P, encouraged the sprouting up of many gas-based fertilizer and power plants in Gujarat, Rajasthan, M.P and U.P.

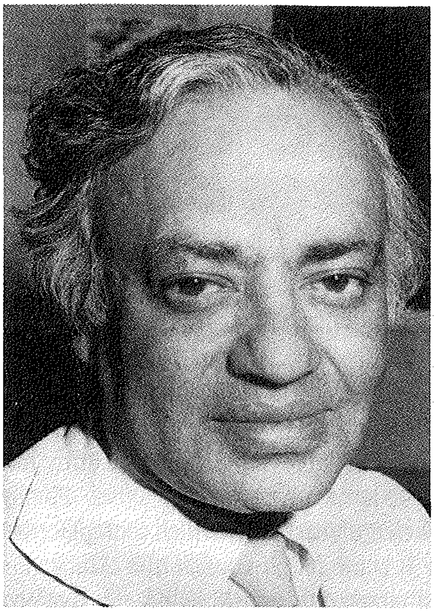
IPCL also took advantage of the Gas availability at Uran, by putting up the first Gas Cracker project at Nagothane in Maharashtra. Till then the Cracker projects were purely Naphtha-based, which is a more expensive feedstock as compared to Natural Gas.

In the late 90s in Maharashtra and Gujarat came the complexes of Reliance Industries Ltd. (RIL) of the Ambanis. There were also a host of small and medium plants producing a variety of both commodity and specialty petrochemicals. Today there has been a marked increase in the production of Petrochemicals with the commissioning of RIL's Naphtha/NGL dual-feed cracker of 75,000 tonnes per annum at Hazira in 1997-98, followed by the Gas Authority of India's cracker of 3,00,000 tonnes per annum at Auraiya (U.P.), ICPL's Gas Cracker of 3,00,000 tonnes per annum at Gandhar (Gujarat), and Haldia Petrochemical's Naphtha Cracker of 4,20,000 tonnes per annum in West Bengal. With these plants coming up, India entered the realm of putting up integrated plants of international standards and class.

Major investment by multinationals in the Indian Petrochemicals sector came by way of a major plant for production of Pure Terephthalic Acid (PTA) by Mitsubishi Chemicals of Japan, at Haldia.

Thus, it is evident that India's Petrochemical industry has made steady progress in the last four decades, and contributed significantly to the diversification of the economy by deepening the production processes downstream and adding colour and variety to the growing consumer goods industry.

As the time goes by, almost the entire output of the Refineries with the exception of cooking and transport fuels (LPG, Petrol and Diesel) will go for value-added chemicals and petrochemical production. The Natural Gasoline Liquid (NGL) coming out of ONGC's Natural Gas Processing plant at Uran and Hazira and from the future Gas Processing plants will give an immense opportunity to put this feedstock into use for the manufacture of Petrochemicals.



Dr S. Vardarajan, Chairman of IPCL

In all these developments, the contribution of IndianOil was immense. It was because of the formation of new refineries in the public sector in the sixties that gave a really big boost to the Petrochemical sector, which till then was languishing in its nascent stage. It was to a very large extent IndianOil's contribution that enabled the consolidation of all the segments of the value-chain that resulted in the formation of a single seamless unit in the field of Petrochemicals.

IPCL grew to become one of the largest Petrochemical complexes in the world under the able leadership of its Chairman, Dr. S Varadarajan. To him goes the credit for putting India on the world map of this industry.

The Yom Kippur War And The Oil Crisis October 1973

President Anwar Sadat of Egypt commenced "Operation Al Badr" on 6 October 1973 and crossed the Suez Canal in an attempt to evict the Israelis from Egyptian territory (the Sinai Desert up to the East bank of the Suez Canal) occupied by them after the 1967 Arab-Israel War. The Egyptians unleashed a full fledged war (also known as the Yom Kippur War) against Israel. After initial reverses the Israeli army hit back powerfully threatening Cairo on one side and Damascus on the other. Finally, the United Nations, USSR and USA brokered a Cease Fire, which took place between 26 and 28 October 1973.

During this conflict the Arabs, but more specifically members of OAPEC attempted to use Oil as an effective economic weapon to demonstrate its might. In the month of September 1973 during an OPEC conference in Vienna the oil companies proposed a 15% increase in the posted price of crude plus an inflationary adjustment versus an OPEC proposal of a 100% increase. Negotiations broke down only to resume once again in Vienna on October 11, 1973 by which time the Yom Kippur War had already begun.

Shaikh Ahmed Zaki Yamani, the formidable Oil Minister of Saudi Arabia, led the negotiations on behalf of OPEC, while George Piercy of Esso and Benard of Shell led the oil companies' team. No headway could be made. Even a late midnight dialogue failed to break the deadlock. "What next" asked the oil companies?

"Listen to the Radio," snapped Shaikh Yamani. These famous last words ended the oil company-OPEC crude price negotiation for all time to come.

Two days later, on October 13, 1973, OPEC in its meeting in Kuwait announced the price increase of Marker crude from $3 per barrel to $5 per barrel. On October 17, 1973 members of OAPEC decided on a crude oil production and export cut of 5% from the September levels to be raised by another 5% every month subsequently until such time as Israel vacated all Arab territories occupied by her since June 1967. In addition, an oil embargo was decided upon by OAPEC against USA and the Netherlands on October 19, 1973, this was after President Richard Nixon asked the US Congress to approve an emergency military assistance of $2.2 billion to Israel.

Furthermore, in November 1973 OAPEC decided in Kuwait to increase crude production and export cuts to 25%, although friendly countries like India would be given its September level off-takes. During its meeting in Tehran on December 22/23, 1973 OPEC decided to increase the price of crude oil from $5 per barrel to the then unheard of figure of $11.65 per barrel with effect from January 1, 1974. Across the Mediterranean the price of Nigerian participation crude went up to $22.6 per barrel. Libya declared a non-negotiable price of $21 per barrel and Iraq demanded $21.5 per barrel.

The most immediate impact of this on India was the phenomenal rise of her oil import bill which went up from Rs.207 crore in 1972-73 to Rs.1121 crore in 1974-75 constituting 10% and 30% of India's export earnings respectively. The Yom Kippur war between Israel, Egypt and Syria forever ended the era of 'cheap crude oil'. The 'La Belle Epoch' of the Seven Sisters appeared to have come to an end and the crude oil price setting initiative permanently shifted from the Seven Sisters to the OPEC.

These developments spurred efforts in India for finding more indigenous crude resources and with the discovery of Bombay High, India was able to indigenously meet 60% of its crude requirements by 1983. Simultaneously, there was a surge in demand of Indian professionals, vocational skilled workers by the "nouveau oil-rich" Arab countries, considerably boosting India's foreign exchange reserves during the 1970s, a process that still continues.

CHAPTER IV

Fourth Era: 1974-1977

The Fourth Era in many ways was an epoch making one. During this period the multinationals in India were purchased lock, stock and barrel by the Government of India through bilateral negotiations and the Oil Industry in India, which was almost entirely in the Private Sector up to 1960 was totally amalgamated into the Public Sector.

This era saw a major departure from all previous price enquiry reports as it finally dispensed with the import parity principle as a basis for calculating the price of petroleum products in India. Having come up with a new pricing policy, each refinery now became a uniform pricing point. Additionally, the Sales Plan Entitlement (SPE) concept with company-wise sales allocation was introduced during this period.

The above era also saw the birth of IndianOil's first Lube integrated Coastal Refinery at Haldia. It also saw the founding of the Oil Coordination Committee (OCC), which was to play a dominant role in India's Oil Industry for the next more than a quarter of a century.

The world oil crisis forced India to launch a Petroleum Conservation movement, which led to the formation of the Petroleum Conservation Research Association (PCRA). The consumption of Petroleum Products for the year 1974-75 was brought down to 72-73 levels whereafter there was nil growth till the beginning of 76-77. This era also witnessed the nationalisation of the Oil Industry in the Arab world.

Government Buys Multinationals

It was the Yom Kippur war of October 1973 which brought about the end to the long era of low-cost oil for all time to come. The price of the middle east marker crude selling at $3 per barrel in 1972-73 suddenly shot up to $5 per barrel on 13.10.1973 and then galloped past in a wild steeplechase leaping over the eleven dollar barrier to touch $11.65 per barrel with effect from January 1, 1974.

Burmah Shell, Esso and Caltex operating in India, after having had a re-look, reversed their earlier world-wide policy of expanding and finding new sources of proliferating, cheap crude oil and even at those types of crude sold at discounts on posted price. Now they decided to consolidate, pick and choose only those outlets of crude consumption that could optimise their profits.

Having operated refineries in India for around 20 years, the multinationals had extracted many times their original investment. By their wrong "India policies" they, in fact, unwittingly gave a boost to IndianOil's growth. Now they were not averse but perhaps keen to march out of India. In fact, they had already begun sending feelers to the Government informally and even formally over the possibility of a negotiated withdrawal. In 1973, Esso offered a 74:26 equity structure in favour of the Government of India. The offer was roughly similar to MRL pattern.

On the other hand, after the 1965 "Red Oil" and ATF production experience with the multinationals their inability to show flexibility in order to accommodate the concerns of the Indian nation, that is, their unwillingness to import crude from the most economical sources, adhere to their own profitable production patterns, and their continued policy of selective marketing and especially their withdrawal from difficult, inconvenient and non-profitable markets not only gave them a bad public image but also at the same time had not endeared them to the Government of India.

India's ability in 1973 to obtain crude on a Government-to-Government basis from the Middle East and with IndianOil consistently improving its performance during the intervening years, the Government seriously began thinking of bringing the multinationals into the State sector. The plan soon began to gather momentum at the official and ministerial levels of the Ministry of Petroleum as a note to that effect had already been initiated in the 1970s by B. Mukherjee, the last ICS Secretary (Petroleum).

Thereafter for some reason, between 1970 and 1972 no concrete move was made or action taken on Mukherjee's note although it did motivate the Minister of Petroleum, H.R. Gokhale to state that the Government of India had not abandoned the idea of nationalisation of the oil industry.

Public opinion in India specially among the Socialists (Left) and trade unions including INTUC began building up in favour of nationalisation, particularly after the nationalisation of banks on July 20, 1969 followed by the abolition of privy purses of Indian princes on September 7, 1970 by the then Prime Minister Indira Gandhi.

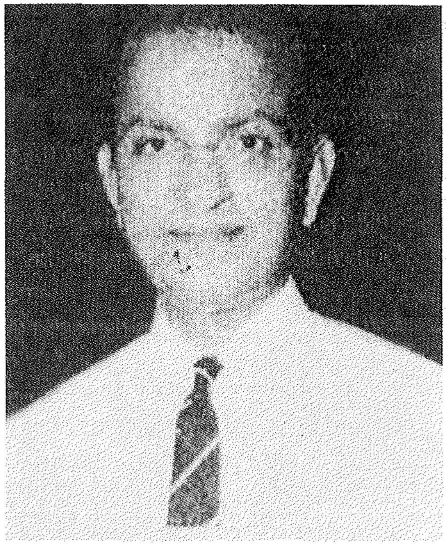
It was the famous Advocate, Rajni Patel who gave a clarion call by branding the multinational companies as 'vestiges of imperialism". Patel, a close confidant of Indira Gandhi was also a Board Member of IndianOil and the President of IndianOil Officers Association (August 1970).

The leaders of the Leftist parties both CPI and CPI (M) were vociferous in their demand for nationalisation of the multinational oil companies, a demand that progressively became stronger and gained momentum with the convergence of various international events such as, the birth of Bangladesh, the outbreak of Yom Kippur War and the American debacle in Vietnam etc. Even Raja Kulkarni, a prominent INTUC leader whose Union represented many workers in the oil industry including IndianOil openly came out with the suggestion that the Government acquire a majority stake in the multinational oil companies and INTUC be given a prominent role in management.

Thus, by the end of 1973 a consensus seemed to have been arrived at in India even by the management of multinationals themselves that their time was up and they were amenable for being bought over by the Government. In month of May 1973, P K. Dave took over as Secretary (Petroleum). Two months later, he started his follow-up on the note earlier put up by B. Mukherjee regarding nationalisation of the multinationals.

Esso was prepared to shed 74% of its equity to the Government. The latter in principle accepted Esso's offer, and took further steps to bring about a negotiated settlement. Dave suggested that an apex level committee consisting of Secretary Finance; Secretary, Economic Affairs and Secretary, Petroleum be constituted. This committee would then guide the talks through a negotiating team consisting of their respective Joint Secretaries who would then arrive at a final settlement.

It was around this time that the then Minister of Petroleum, Dev Kant Borooah when asked, made the statement, "Nationalisation was only a matter of time." The negotiating team finally recommended Esso being bought over by the Government Of India with 74% Equity on payment of Rs.18 crore, the remaining 26% was to be taken over in seven years during which period Esso committed



R.N. Bhatnagar, 1st full time Chairman BPC

that it would import and supply 13.75 million metric tonnes of Arabian Mix as feedstock for the refinery.

Recommendations of the negotiating team was endorsed by the Apex Secretary Level Committee and accepted by Borooah, which in turn was cleared by Prime Minister Indira Gandhi and approved by the Parliament in March 1974. Thus, Esso became the second national oil company in its new *avatar* as Hindustan Petroleum Corporation Ltd. (HPC). A.P. Verma, Joint Secretary Marketing, Ministry of Petroleum ably assisted P.K. Dave with the former playing an important and decisive role in the negotiations and the final take over of Esso.

To IndianOil goes the credit for building the Government's confidence to take the first bold step which inevitably and subsequently led to the negotiated purchase and take over of the other two foreign oil companies as well. Within two years of its takeover, in October 1976 the Government Of India bought out the balance 26% of Esso's stake whereby HPC became a 100% Government Of India Undertaking.

By this time, the Burmah Shell Refinery and the Burmah Shell Marketing had already been purchased by the Government of India and the third national undertaking was renamed Bharat Petroleum Corporation (BPC).

Burmah Shell following the footsteps of Esso had given the Government an almost similar offer in January 1974. But unlike Essso, the former preferred to fully withdraw from India for a total compensation package of Rs.74 crore. There were prolonged, often very tense negotiations. Their first and the last Indian CEO, Madhu Patwardhan, led Burmah Shell. Like a true Maratha warrior, he put up a stubborn fight, refusing to yield ground.

Finally, P.K. Dave went on the offensive and released the deadly *Brahamastra* by telling Burmah Shell in no uncertain terms that if they did not come to a reasonable settlement by December 31, 1975 the Government Of India would consider its outright nationalisation by an Act of Parliament.

This dire threat had the desired effect. Burmah Shell without losing any time returned to the negotiation table the same afternoon and indicated its willingness to come to an amicable settlement with the Government. A deal was struck in the form of a Memorandum of Understanding on November 25, 1975. An extract from Madhu Patwardan's message to all Burmah Shell employees is reproduced below from his work, ***Oil and Other Multinationals in India*** (page 93).

Burmah Shell, Bombay
27 November, 1975

Message from: Chief Executive/Chairman
To: Burmah-Shell Marketing/Refinery Employees

Dear Colleague,
A Memorandum of Understanding was signed yesterday between Government and representatives of the shareholders of BSM and BSR in regard to the 100% acquisition by Government of BSM's assets and liabilities and BSR shares. This will be followed by a formal agreement with a view to effecting the change of ownership by 31 December 1975. Negotiations for a crude supply arrangement will also commence shortly.

The Government have assured that employees of BSM and BSR including those on temporary assignment overseas will continue to be in the service of the newly formed company on their existing terms and conditions - these terms will be reviewed by the new company at the appropriate time. The new company will also take over all the obligations in respect of retirement benefits.

Sd/-
(Madhu Patwardhan)

The final agreement was signed on December 23, 1975 between Ministry of Petroleum and Burmah Shell whereby the Government of India would become 100% owners of Burmah Shell Refinery and Marketing for a net compensation of Rs. 25 crore. This was approved by the Parliament vide Burmah Shell Acquisition of Undertakings in India Act 1976 followed up by an appropriate notification dated January 24, 1976.

The financial implications were as follows: Burmah Shell Refineries - Rs.9.25 crore, Burmah Shell Marketing - Rs.27.75 crore, totaling Rs. 37 crore, out of the above Rs. 37 crore the Government treated Rs.11.28 crore as a repayable loan to BPCL, thus the net investment of the Government was only 25.72 crore. The name of Burmah Shell Refinery was initially changed to Bharat Refineries Ltd. and subsequently to Bharat Petroleum Corporation Ltd (BPCL).

On January 31, 1976, P.K. Dave relinquished charge as Secretary Petroleum,

K.D. Malaviya, Union Minister for Petroleum, presses the button to unveil the Bharat Refineries plaque at the inaugural function in Bombay. Seated on the left: N.M. Tidke, Minister for Industries, Govt. of Maharashtra and on the right: Mr. S. Krishnaswamy, Chairman

having amicably converted two multinationals into national undertakings not via nationalisation as in case of the private Banks, but through voluntary sale by the multinational oil companies carried out on the negotiation table. Some people were under the impression that this sale was manoeuvered by the multinationals themselves. While there may be some truth in this, there was absolutely no doubt and there was a national consensus in favour of the Government buying them over.

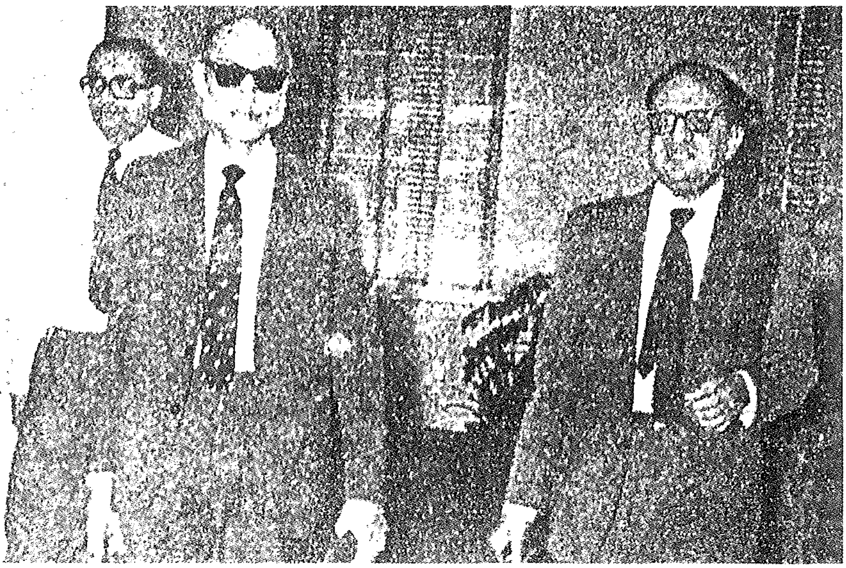
Although technically the book-value of the assets of Burmah Shell and Esso in India were by then close to nil, on the basis of replacement cost their value was many times higher than the price paid for their takeover by the Government of India. India's prestige in the international oil industry circles went up significantly as a result of this amicable settlement and takeover of the multinational companies in which all parties appeared to be satisfied.

Before the end of 1976, Caltex too was similarly bought over. For almost two years it operated in the name of the Vizag Marketing Unit (VMU), as a separate part of HPC. During this period teams separate from those representing HPC in various oil company meetings would represent VMU and they would often express independent opinions on various matters sometimes quite contrary to those of HPC. Interestingly, whereas the new National Oil Companies had Hindustan or Bharat prefixed to their names, IOC the original National oil company continued and still continues to retain its Anglisised name, that is, "IndianOil."

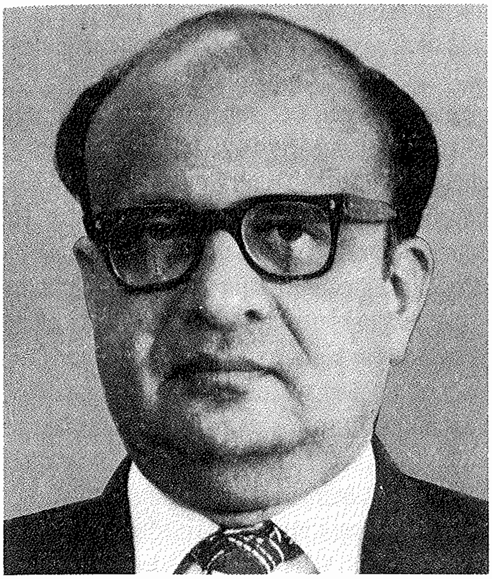
One contentious issue after the coming of Burmah Shell, Esso and Caltex into the national fold was the salary pattern of the employees, especially those of officers. Whereas the workers compensation and perks in IndianOil was equal or in some cases even better than those of the erstwhile multinationals, the salaries and perks of the management staff in the multinationals were much higher than those of IndianOil Officers. Besides, while IndianOil workers agreements were on an all-India basis all the three multinational oil companies had regional and in a few cases even location-wise (like for the Cochin workers) Agreements.

The Government of India now being the sole owner of the three oil companies was naturally under pressure to bring about wage uniformity in the oil industry. At the same time, while suddenly bringing down the perks of the officers of the new Public Sector oil companies would *prima facie* appear to be unfair to them, on the other hand, keeping the pay and perks of the officers of IndianOil at a level lower than the new converts HPC and BPC would also have been grossly unfair to IndianOil officers. Were the officers in the new national undertakings belonging to blue-blooded aristocracy to be given higher and better salaries and status for doing less work?

The problem with ex-Burmah Shell officers was even worse, in as much as they had a *pukka* caste system in their management staff. At upper elite level was the all-India Assistant like the former ICS officer in the Indian Administrative



On arrival at the Ballard Estate Office, Krishnaswamy is seen with Patwardhan, CEO, Burmah Shell (India) and Malik - Head of Burmah Shell Refinery



S. Krishnaswamy, first Chairman of HPC

Service. They were transferable anywhere in India or abroad expectedly with a higher salary and perks and in general with an overseas education often from Oxford or Cambridge. The second tier comprised local or Branch Assistants transferable only within the branch. They in general rose to their positions via internal promotions from the third tier i.e. Junior Supervisory Staff, that is, Foremen, Depot Superintendent, Sales Representatives etc. (many of whom had quit Burmah Shell and joined IndianOil).

The fourth tier was the white colour clerical workers whose compensations were much higher than the fifth level, that is, the blue-collar workers. Not only did the salary and perks vary between the tiers but for long they had separate washrooms, lunch facilities etc. P.K. Dave had assured pay protection to Burmah Shell and Esso officers at the time of the takeover. Ultimately, based on the guidelines issued by the Minister of Petroleum in July 1979 the officers were given retirement/terminal benefits as per their entitlement, establishing scale equivalents and laying down guidelines for purpose of fitment within, corresponding to IndianOil payscales.

Finally, an attempt was made to review the perks and benefits of HPC and BPC officers in order to bring them on line with those applicable to IndianOil officers. This was a very difficult task and was handled very well; although in the process BPC, HPC including VMU lost some of their star veterans. At the same time, quite expectedly until the salary structure of the officers of the new Undertaking was bought on par with IndianOil officers, there was great heartburning amongst them. IndianOil officers felt as though they had become second-class citizens. The emergence of an Officers Association in BPC and HPC in due course played an important role in bringing about some amity amongst the officers of the three oil companies.

The first Chairman of HPC, S. Krishnaswamy, was a bright, dynamic IAS officer. He played a crucial role in helping the HPC personnel in smoothly and effectively adjusting to their new role in a PSU. In due course, he also became the head of the new PSU, Bharat Petroleum for some time. During the period in which he headed both HPC and BPC he took several measures to facilitate greater synergy between the two new PSUs.

P.K. Dave was the Secretary Petroleum between December 1970 and January 1976. He led the Oil Industry to face and overcome the 1973 oil crisis in an outstanding manner. He not only brought stability in the sector by promoting awareness but also at the same time achieved greater oil security for the country. He not only managed the efficient and amicable buy over of the multinationals by the Government of India, but also encouraged greater commercial approach in the working amongst the oil PSUs. For this invaluable contribution Dave was given a Life Time Achievement Award by Petrotech in January 2005.

STUDY OF OIL PRICES - KRISHNASWAMY REPORT (OPC)

The Krishnaswamy Oil Price Committee was the fourth Oil Price Committee (OPC) constituted by the Ministry of Petroleum on March 16, 1974. It was formed just around the time the Government of India purchased 74% of Esso equity and was in the process of buying over the other two multinational oil companies, i.e. Burmah Shell and Caltex. The Committee was formed at the most appropriate time as the year 1973 saw an unprecedented hike in international oil prices.

Dr. Krishnaswamy submitted an Interim Report in January 1975 wherein he recommended *inter alia* the formation of an Oil Coordination Committee (OCC). He submitted a final report on November 27, 1976 by which time the Government of India made an outright purchase of Burmah Shell and Esso. This report made some drastic changes in the pricing structure of petroleum products. Making a major departure from all previous price enquiry reports, it primarily recommended the discontinuation of the principle of import parity principle as a base for calculating the price of petroleum products in India. In its stead the report recommended making each refinery a uniform pricing point.

These two steps per force had to be taken since the earlier contentious issue of the price of imported crude coupled with discounts was done away with after the formation of the Oil Coordination Committee (OCC). This was followed by the decision of canalisation of all crude imports and refined products through IndianOil.

KEY RECOMMENDATIONS OF THE KRISHNASWAMY REPORT:

Introduction of a 'retention price concept' and a 'retention margin concept', which would provide each refinery and its marketing company a gross profit margin of 15% on capital employed (para 8.22 of the OPC report). The money so earned would enable the oil industry to invest funds for expansion of infrastructure.

The committee also fixed the price of indigenous offshore crude (Bombay High), at Rs.391.64 per metric tonne and a separate price of indigenous crude onshore (Gujarat/Assam) at Rs.305.42 per metric tonne. A separate price for imported crude was fixed at Rs.623.50 per metric tonne. A Special Pool Account named Crude Oil Price Equalisation Account (COPE Account) was created into which the difference between the normative import price for crude and the appropriate indigenous price of crude was pooled in by the concerned refinery from which funds could be drawn in case the price of imported crude rose above the normative price. This enabled a refinery-wise stability in the price of crude.

Uniform selling prices were fixed at all the refinery points (coastal as well as inland). Port price differentials were established for non-refinery ports and these were added over the nearest port refinery to fix the ex-MI price at such non-refinery ports.

In paragraphs 9.5, 9.8, 9.9 of its report the OPC stipulated that the market participation of the new public sector undertakings, i.e. the erstwhile multinationals must be allowed to grow. As a result of this clause the market participation of IndianOil which was 65.4% in 1975-76 was to be reduced to 55% by the end of 1982-83. This enabled Hindustan Petroleum and Bharat Petroleum (HPC and BPC) to receive products in excess of what they themselves were refining. In other words, the industry product availability was to be pooled and shared between the oil companies under the new Sales Plan Entitlement (SPE) concept, with company-wise sales allocations enabling HPC and BPC to grow more rapidly than IndianOil.

The OPC deviated from the old dealer commission fixed for MS and HSD and introduced a new three slab system. This system would enable low selling outlets to become more viable.

In order to stabilise product selling prices, enhance market stability and provide funds to enable the growth of oil companies the OPC created six separate Pool Accounts to be administered by the OCC. These were COPE Account, Freight Surcharge Pool Account (FSP), Cost and Freight Surcharge Account (C&F A/c), Product Price Adjustment (PPA), Sales Tax and other Under Recoveries and Bombay Octroi surcharge.

Read vide para 8.7 of its report, the OPC advocated optimum utilisation of assets of all the oil companies on one hand and on the other it recommended Crude Tankage Reserves to cover 21 days and adequate upcountry storage (para 17.10) including a two-company concept for upcountry depots and mutual hospitality. The aim was to prevent dry-outs of essential products such as SKO and HSD.

Where as the OPC recommendations enabled the public sector undertakings, specially BPC and HPC to grow rapidly, the cost-plus approach gave little incentive for economy and reduction in unit costs. It, however, permitted the refineries to retain 50% of the savings if they bettered fuel loss norms as specified in para 17.15.

All said and done, the Krishnaswamy Report's major contribution was the abolishment of the import parity principle as a base to calculate the price of petroleum products.

HALDIA REFINERY

A 500-acre plot of land in the rural backwash of West Bengal was earmarked for building IndianOil's Refinery near the sleepy little village of Haldia. The spot selected was a barren piece of land lying near the confluence of Rivers Hooghly and the Haldi. Incidentally, the latter gives Haldia its name. If one rewinds four decades backward through time, firewood and Kerosene lamps were the only means of heat and illumination to the simple village folk of Haldia who were not even aware that electricity had just reached Durgachak, a village ten kilometers away from the proposed refinery site.

Similarly, the nearest railhead was at Mecheda, 70 kms away. Haldia then had no markets, schools or hospitals and even residential accommodation was non-existent. No one ever came here, even a visit by officials from the district headquarters of Midnapore was a rare event and the State capital Kolkata (140 kms away) was a place nobody had seen. The only Government Official who could be available in an emergency was posted at Tamluk, 40 kms from Haldia. This is what Haldia was some four decades ago.

Unlike the other refineries, the required size of land at Haldia could not be bought but had to be taken on lease from the Calcutta Port Trust (CPT) as CPT's policy did not permit selling of West Bengal's coastal land. The Refinery was built in technical collaboration with the French and Rumanians on very attractive terms. Both had agreed to sign Government-to-Government contracts. They had also agreed to maximise the use of indigenous equipment and material in their respective process units keeping their guarantees in tact.

After the commissioning of the Gujarat Refinery, K D Malaviya recommended that no new refinery should be set up until the Fourth Five Year Plan (1966-71) and that in the intervening period only the three public sector refineries at Guwahati, Barauni and Gujarat should be expanded based on availability of domestic crude. He also recommended that the gap between consumption and domestic production should be imported from the Soviet Union to meet IndianOil's requirements and the balance from Western sources to meet the demand of multinational oil companies.

Meanwhile, in June 1963, Malaviya resigned and his dream-child—the ONGC had discovered just enough crude oil to feed Koyali Refinery. After the commissioning of two Refineries in the South, IndianOil and the other oil companies contemplated a coastal refinery based on imported crude located on the East Coast. Burmah Shell proposed a Refinery at Haldia and adequately backed their justification. Malaviya had earlier opposed this proposal because he was not in favour of setting up a refinery using imported crude. He was very optimistic about India's oil industry and he once said, "Results of exploration efforts of ONGC and OIL are sure to bear fruit in the near future. Assam too is sure to give us much more oil."

Meanwhile, Prof. Humayun Kabir who took over as Minister of Petroleum & Chemicals, in place of Malaviya, and began using the expression "Joint Sector." Earlier the Industrial Policy Resolutions of 1948/1956 had stipulated that in future refineries should be in the Public Sector only. It obviously was applicable in case of Haldia also and therefore a refinery not in the public sector was not acceptable.

The Haldia Refinery project was a big departure compared to the earlier Russian and Rumanian contracts wherein the majority of equipment was supplied by the collaborators resulting in the accumulation of surplus items and construction equipment. Having decided to involve EIL in the project along with the two foreign collaborators, a very delicate situation had to be managed. People at the site were posted by 1968 and the foundation stone was laid on December 6, 1969 by Dr. Triguna Sen, Minister of Petroleum, Chemicals, Fertilizers & Mines. Construction activities of Haldia Refinery between different agencies were farmed out as under: The French contract was the for Fuel Oil Block against French Credit, through Technip Ensa and technology for the Reformer Catalyst came from IFP, Paris, France. The Rumanian Contract was for the Lube Oil Block including the Vacuum Unit was through 'Industrial Export' in Rumania and many parties in third world countries were involved.

Bharat Heavy Electricals Ltd (BHEL), another public sector undertaking, claimed that they had the necessary skill to build and erect Industrial Boilers and Electric Turbines although till that time BHEL had not supplied any Power Turbines. The Power plant construction contract was nevertheless given to BHEL and the turbines they eventually supplied were of Czechoslovakian make from their Hyderabad plant. The Boilers however came from the BHEL plant in Trichy, Tamil Nadu. Similarly a large amount of equipment and materials were supplied by other Indian manufacturers.

Construction of the huge storage tanks up to 35,000 kls capacity created major technical problem for the Designers and Foundation Engineers because of the very low load-bearing capacity of the soil at Haldia and the danger of future settlement. The conventional solution to this problem was to drive concrete piles in to the dense sand layer to a depth of 25 to 30 meters so that the structures were not exposed to undue settlement later on resulting in eventual damage or collapse. However, to provide such a foundation for all the 102 tanks having diameters ranging from 9 meters to 23 meters would have been prohibitively expensive. In order to save on project costs on tankages (nearly two-thirds) a new innovative cost effective approach called "Sand Wicking" invented by the Japanese was adopted. This process has stood the test of time for last 35 years (1970 to 2005) as there has been only one case of minor failure.

This procedure consisted of digging several, 10-12 cm x 20-25 meter bores in the Tank Foundation Area, 1-1.5 meters apart. Wicks made of jute fabric of the same diameter and depth of the bore, filled with well-grained coarse sand was introduced into the full depth of the bore. Thereafter the foundation area was pre-loaded with cheap river sand to a height that would simulate the maximum load that the foundation would be expected to carry. By this preloading of the tank foundation area — full settlement could be induced in 26-35 weeks. Thereafter the storage tanks could be built safely without any fear of future failure. This technique was successfully utilised in India for the first time at Haldia and by using jute fabric rather than porous paper was an improvement over the Japanese procedure.

The construction of Haldia Refinery was divided into two blocks of Process Units. The first was the Fuel Oil Block consisting of Crude Distillation Unit. This was originally designed by Technip-Ensa to process Light Iranian Agha Jhari crude. However, over the years due to the Gulf crisis and consequent crude oil shortage the refinery was successfully able to process as many as 35 different types of crude. The refinery management identified the crudes which were most suitable for maximising the production of Lube Base Stock.

N.S.V Shastri who later became the second General Manager of the Haldia Refinery joined the refinery construction site in the month of April 1970. Having worked at Barauni and MRL, he had the right experience for this assignment. The State of West Bengal at that time was facing political unrest due to frequent agitation of *bandhs* and *gheraos*. But Shastri along with D Mukherjee, a brilliant Civil Engineer, who was a tough and able administrator, nicknamed 'Royal Bengal Tiger', synergised excellently and guided various teams and organisations to ensure the uninterrupted construction of Haldia Refinery units. Subsequently, Shastri left Haldia on account of a serious cardiac problem. He was succeeded by Tarit Kanti Sinha as General Manager in the month of December 1973. A few months later, K K Malhotra joined IndianOil after leaving Esso refinery at Trombay in mid 1974 and was posted as DGM (T) at Haldia during the refinery's final stage of construction and commissioning period.

Haldia the fourth IndianOil Refinery, and the 10th in India was finally commissioned on August 6, 1974 by T K Sinha who later went on to become the Managing Director (R&P) Division of IndianOil. The Refinery was formally declared open for commercial production in the month of January 1975. This is a complex refinery, since there were nine major units, each related to the other, and each had to be commissioned one at a time in order to minimise problems and reduce the number of foreign expatriates. The last unit was commissioned in January 1977.

Petroleum products from Haldia Refinery are supplied mainly to Eastern India through pipelines as well as through rail wagons, coastal vessels and tank trucks. This refinery also produces Lube Oil Base Stock. Starting with a capacity of only 2.5 MMTPA, it can now process 6.0 MMTPA of crude.

As already stated that Haldia was a very complex Refinery, and at the time of commissioning sufficient trained engineers were not available. It became a challenging task to successfully commission the refinery on time. In this regard T K Sinha and K K Malhotra did an outstanding job in guiding and training the engineers and got the units ready for commissioning without any problem and minus the help of foreign experts.

It also may be highlighted that when the Visbreaker Unit, the first in the country was ready, the Rumanians refused to participate in the start-up with reduced crude as feed; they said the design feed (which was to come much later after full operation of Lube Block) was not available. The Haldia engineers led by Malhotra felt that they could manage the start-up immediately without the Rumanians. When this suggestion was put forward to IndianOil's Chairman, C R Dasgupta, he immediately advised R.N. Bhatnagar, Managing Director, IndianOil R&P Division to sign a protocol in Bucharest with the Rumanians absolving them of their guaranty. This was done and the unit was successfully put on stream thereafter.

Haldia was the first Lube Base Stock refinery of IndianOil and the third in the country. Consequently, one of the main thrusts was for the production of HVI grade Lube Base Stock which at that time was being imported. The configuration and product mix of Lube Block units was such that for the 'first time in India Bright Lube Base Stock of (BN) was produced at Haldia'. With the original capacity of the refinery being 2.5 million metric tonnes, 220 thousand tonnes HVI grade Lube Oil Base Stock could be produced.

During the Assam Crisis between the years 1977 to 1980, Haldia was the only IndianOil refinery in the Eastern Region which was operating 'full steam' in order to meet the requirements of the Barauni Supply Area also. The processing capacity of the Crude Distillation Unit was augmented through minor revamping to 2.75 million metric tonnes in the month of April 1989.

Haldia Refinery was designed to process high sulphur crude only. This forced the refinery to burn internal fuel and fuel-gas having a high sulphur content of 3.5% in the process heaters and boiler resulting in very high emission levels. How to reduce these emissions within the prescribed limit became a very crucial issue. A great deal of deliberation took place between the Ministry of Petroleum and

IndianOil whether to import low sulphur fuel like (LSHS) as a refinery fuel or go ahead with a low-cost expansion using low sulphur crude oil as a feedstock for the enhanced unit. Both alternatives could produce the desired results.

At last, an expansion of the refinery by one million tonne at a cost of only Rs 45 crore was approved on April 5, 1995 with a stipulation that the expanded unit must come on stream latest by March 31, 1997. This was a deadline given by the Supreme Court. The court was determined to ensure that the refinery emission levels were brought down within prescribed limits on a time bound basis.

This difficult task, which comprised designing, engineering procurement and commissioning to be completed within less than 24 months, was a daunting challenge. Since the time to comply given by the Supreme Court was too short, it was decided to undertake this job departmentally by the Refinery itself.

In order to expedite the work, which was undertaken on a war footing, a batch of 24 highly dedicated and extremely knowledgeable young engineers of the refinery were hand-picked from different disciplines and deployed to form a Special Project Cell (SPC), which started functioning from the very next day i.e. on April 6, 1995 in right earnest under the able leadership of Executive Director, Gauranga Sinha.

This team of young highly motivated engineers successfully completed the job on March 28, 1997 i.e. three days ahead of the deadline set by the Court. The IndianOil engineers successfully enhanced the refinery capacity by one million metric tonnes at a cost of only Rs.45 crore which ordinarily would have cost at least Rs.250 crore. While designing the Expansion Units, utmost care was taken by the SPC and the second Crude Unit could be operated at higher capacity at around three million tonnes in future with Resid Fluidised Catalytic Cracking Units (RFCCU). The young engineers from Haldia had demonstrated their ability to perform under a very tight schedule. All they needed was proper guidance and support to carry out their onerous tasks.

Concurrently, lot of de-bottlenecking operations were undertaken to ensure that the refinery should have trouble-free operation, and many offsite activities were undertaken and completed during this time. The first IndianOil NMP Unit was also set up in March 1999 to augment lube extraction. Offsite facilities were also augmented within the same period. To meet the matching secondary refining facility, the Resid Fluidised Catalytic Cracking (RFCC) Unit was commissioned in September 1999 along with the Diesel Hydro De-Sulphurisation Sulphur Unit.

Subsequently, the Second Vacuum Unit was also set up in March 2002 for Residue Upgradation and feed to the RFCC. The country's first Micro Crystalline Plant was commissioned in the month of March 2001 and India's first, Asia's second and the world's third Catalytic Iso De-waxing Unit was set up to produce special API Grade-2 Lube Oil and was put on stream in the month of March 2003 in order to meet the future fuel requirements. A facility for improvement in the quality of MS to meet Euro-III and Euro-IV specifications was commissioned in October 2005. As regards HSD, necessary investment decisions have been made to ensure availability of product conforming to Euro III and Euro IV norms by April 2009 well in time to fall in line with the Auto Fuel Policy of India.

The present capacity of the refinery is six million metric tonnes per annum. Haldia Refinery has also been producing since 1989 (for the first time in India) a special grade of Aviation Turbine Fuel for the Russian MIG fighters of the Indian Air Force.

Being a coastal refinery, the entire requirement of crude oil is received at nearby jetties and all modes of dispatches, viz. rail, road, pipelines, barges and tankers are deployed to evacuate the product. Lastly, Haldia is India's first Refinery to get an ISO 9002 accreditation in October 1994 and also an ISO 14001 certification in 1996.

INDUSTRY COOPERATION

THE BIRTH OF OCC AND ITS ROLE IN THE OIL INDUSTRY

Far-reaching changes took place in the ownership and control of crude oil resources in the oil producing countries soon after the world went through an unprecedented energy crisis triggered by the first oil price shock of 1973-74. Oil prices simply shot through the roof — not just doubled but quadrupled! This unforeseen, explosive price hike not only ended the era of cheap oil but also caused a global emergency by sending the economy of several developing countries like India into a tailspin. The production pattern of crude oil and its price hitherto under the influence and dictates of international oil giants had now for better or for worse shifted into the hands of the OPEC.

India, like many other countries in the world, was caught in this maelstrom of uncertainty of supplies, volatile prices and the vulnerability of her balance of payments. When the Oil Prices Committee (OPC) submitted its report, the Government in March 1974 had acquired the assets and operations of Esso in India and later in January 1976 that of Burmah Shell. The takeover of Caltex (India), Assam Oil Company and Oil India was just round the corner. The scenario had entirely changed ever since the oil industry in the country had fully fallen into the national fold.

With the acquisition of the multinationals, oil refining and marketing became truly Indian in character and ownership. Now that the entire operations fell under one umbrella, it became much easier for the Government to formulate plans and execute policies and programmes in India's national interest covering the entire range of activities in all sectors of the economy, i.e. domestic, transport, aviation, industry, agriculture and defence. This coordinated action helped to serve the needs of India especially her vast multitudes and gave a boost to all round economic development of the country.

All coordination and meticulous planning had to be done at some central point. It was then that the Government (on the recommendation of the Oil Prices Committee) saw the need to set up an Oil Coordination Committee (OCC), which was born through a Government of India (Ministry of Petroleum and Chemicals) Resolution dated July 14, 1975

The OCC was to become the principal agency instrumental for providing central direction and coordination. As per the OPC's recommendation accepted by the Government of India, the OCC was to be responsible for deciding on allocation of crude oil and monthly production patterns of the refineries based on oil imports and exports, national and regional demands, logistics of transportation and other allied subjects.

On the shoulders of OCC also fell the responsibility of administering the Oil Pool Accounts, coordinate arrangements for crude imports and coastal movements. This was to be an industry committee with a separate Secretariat and the expenditure of which was to be borne by the C&F Account. To ensure that the OCC performed these functions in an orderly and effective manner, the Government had empowered it with adequate powers and status. The OCC also had sufficient autonomy in the matter of employment of expert staff. (Ref: Recommendation No.4 page 169 OPC report).

The first head of OCC was S. Ketharaman (IndianOil's Transport Advisor) ably assisted by Pradipto Bagchi, head of HPC Planning. It was this team that laid the foundation of OCC and gave it character and defined its role. Bagchi took over as OCC's Executive Director after Ketharaman went to IndianOil as its Managing Director (Marketing) in May 1978.

The emphasis of the OCC was to maintain uninterrupted supplies to keep pace with the growing demands of economic activity by ensuring product availability at reasonable prices in all parts of India specially in the far-flung logistically difficult regions of the country. The OCC thus became an extended arm of the Government and the State's instrument in achieving certain national goals having in view the importance of oil as a crucial infrastructural input directly affecting the national economy. It was essential for the OCC to demonstrate flexibility in all aspects of the industries operations including the vital area in financial operations through the Administered Pricing Mechanism (APM).

According to the Government Resolution of 1975, the OCC was made up of the following members: Secretary Petroleum, (Chairman); a representative from the Ministry of Finance (Department of Expenditure) that is, the Financial Advisor to the Ministry of Petroleum. Chief Executives (CMDs) of IndianOil, HPCL, Burmah Shell (later BPCL), MRL, CRL and IBP, and lastly, the Joint Secretary, Department of Petroleum was (Member Secretary).

The Role of OCC:

- To provide intelligence and feedback from the industry and the market to the Government in order to facilitate better planning, coordination and strategic controls on an industry basis.
- To promote a national perspective in the oil industry through integration and optimisation:

- To implement policy and guidelines as instructed by the Ministry and oversee its implementation; and
- To coordinate the various aspects and activities of the downstream oil sector.
- To maintain a database and serve as the hub of an up-to-date information and communications system.

In order to enable it to discharge its responsibilities the OCC Secretariat originally consisted of four main wings — Financial, Technical, Operations and Systems — each under a Director. With subsequent enlargement in its scope of activities, growing work and responsibilities, the OCC Secretariat sanctioned a strength of 104 officers and staff, reorganised under the following departments: Operations, Marketing Coordination, Planning, Technical, Natural Gas, Computers and Communications Systems, Finance and Administration. The officers and staff were basically drawn from the oil companies on deputation, although as and when required, a few officers from the Ministry and also from the Shipping Corporation of India were deputed to the OCC.

Right from the start, it was emphasised that the primary responsibility for day-to-day operations lay with the oil companies. For this purpose, they were called upon to ensure that the zone-wise/customer-wise demands were properly tabled and taken into account in the monthly Supply Plan Meeting (SPM).

As mentioned earlier, the main functions of the OCC were to decide on allocation of crude oil, production pattern of refineries based on oil imports and exports, and national and regional demands, logistics of transportation and other allied matters, administering the pool accounts and coordinating transportation of crude oil imports and coastal movements.

A very effective tool evolved to help the OCC discharge its responsibilities was the Industry Coordination Meeting (ICM) that OCC organised right from its inception The meeting was attended by the industry unit representatives and Ministry officials and was presided over by Chairman, IndianOil or in his absence the senior-most CMD from BPC or HPC. The ICM would make a comprehensive review of the past month's performance vis-a-vis targets and fix plans and programme for the succeeding month.

The issues dealt with would range from indigenous crude production and imports, refinery-wise crude allocation and production pattern, supply and demand balances, impact of refinery shutdowns, individual product planning for sensitive items like LPG, sales, market trends etc. The problems of current interest and critical issues would be highlighted for brainstorming and setting down of targets and responsibilities for the concerned units. Progress then on each of the heads was closely monitored. Needless to state, the ICM proved to be most valuable for all round coordinated action on the part of the Industry. It may be relevant to mention here that the Petroleum Minister himself would be present at some of the ICM meetings and a number such meetings would be chaired by the Secretary Petroleum.

Supply Plan Meetings

Industry Supply Plan Meetings for each month planning out the inland distribution arrangements and tank wagon loading slates for each tank-wagon base, product-wise and zone-wise on the basis of the expected product availability was the vogue since the mid-sixties. While this meeting under the Chairmanship of Joint Secretary (M) of the MOP continued even after the formation of the OCC, the detailed plans and inputs now came from OCC. It was the responsibility of the OCC to implement the SPM and coordinate with agencies at various levels including the Railways, the Port authorities, the State Governments, the users, etc. In the event of any changes, the concerned oil companies were expected to initiate prompt action for the approval and implementation of such changes, failing which they were expected to approach the OCC or the Ministry as deemed fit.

For many years, the railways have been the backbone of the inland distribution of petroleum products in our country. The pricing scheme itself had fixed petroleum product prices at upcountry locations with reference to the applicable rail freight from the primary pricing points. After its formation the OCC took over the responsibility of issuing of the monthly tank-wagon loading programme or slate from each tank-wagon loading base, product-wise and consumption zone-wise, after the Supply Plan Meeting in which railway officials (including the Director POL movements, Railway Board and Chairman Railway Inland Petroleum Movement Committee) were fully associated. The OCC also authorised reimbursements from the pool accounts for out of zone movements and road bridging necessitated by non-availability of rail wagons.

Shipping Meetings

For shipping arrangements, the OCC's Shipping wing in Mumbai would organise regular Crude Slate Meetings, Crude Review Meetings and Coastal Plan Meetings.

Immediately after its formation, the OCC took up the responsibilities of preparing the Oil Economy Budget (OEB) for the whole year. The main thrust of the OEB was to identify the import requirements of crude oil and products with the total estimated financial implication in foreign exchange.

The allocation of imported crude by categories to the different refineries in line with their processing configuration and requirements of indigenous crude according to availability would be worked out. Product patterns refinery-wise would then be arrived at based on the allocated crude mix and demand and supply parameters. Product import requirements for the entire year would also be assessed. After the Ministry approved the OEB action would then be coordinated by the OCC.

For crude and product imports IndianOil was made the canalising agency for the entire industry. Import/Export decisions would then be made by an Empowered Standing Committee (ESC) headed by the Chairman, IndianOil for placing of orders against global tenders. The Executive Director of OCC was a permanent invitee to the ESC meetings.

Refineries' Production Pattern and Retention Prices

The retention prices for the refineries were centered on the concept of standard production pattern fixed for each refinery, with adjustments for variations in the actual production arising from crude mix, crude thruput level and Government directives being carried out through the pool accounts. These standards and the manner of their application were to have great impact on the financial health of the refineries. The OCC played a very significant role in laying down the standards, albeit with Government approval and thereafter in monitoring its actual implementation.

Administering the Pool Accounts

In its final report (November 1976) OPC stated: "...as the surcharges are elements of prices to cover the variations in certain element of prices to cover the variations in certain elements of costs, we are of the view that the Pool Accounts should be maintained as Oil Industry's account. There is no need to keep each account in isolation and increase the product prices to cover the deficit in a particular Pool Account. The Oil Coordination Committee should judiciously deploy surplus funds either in short term bank deposits or as advances to the oil companies as authorised by the Government" (Para 13.9 page 104). This became another crucial role and function of the OCC.

Broadly, the following Pool Accounts of the industry were maintained: Crude Oil Price Equalisation Account (COPE), Freight Surcharge Pool Account (FSP), Cost & Freight Surcharge Account (C & F Account), Product Price Adjustment Account (PPA), Sales Tax and other related Under Recoveries and Bombay Octroi.

Coordinating Transportation Arrangements

Among the different modes of transport, sea transport dominates oil movement because of the wide separation of areas of production and utilisation and the ease with which liquid can be transported in bulk at low cost. Seaborne transportation of oil has grown tremendously over the years. The POL traffic handled at major ports rose as follows: 19.02 MMT in 1969-70, 28.78 MMT in 1979-80, 91.07 MMT in 1995-96, 116.71 MMT in 1999-00, 103.26 MMT 2001-02 and109.58

MMT in 2002-03.

Crude oil imports by ocean tankers have gone up from 27 million metric tonnes in 1995-96 to a staggering 78 million million metric tonnes in 2001-02, the final year of the IX Plan. The increase (as can be seen from the preceding para) was phenomenal during the early three decades. Offshore crude, with the development of Bombay High had added a new shipping dimension, which is now in the region of 12 million metric tonnes per annum.

OCC was conceived as — and in fact has been — an active player and agency in POL shipping. It has a critical role to play on behalf of the Ministry and the oil industry as regards planning, coordination and optimising of utilisation, besides decision making, detailed operations and monitoring on a day-to-day basis.

Other Important Functions of the OCC

- Coordinating and developing integrated long range planning.
- Optimisation of oil industry operations including strategy for processing of various types of indigenous and imported crude with reference to processibility and economic evaluation.
- Over-seeing the smooth functioning of the RLC/SLC scheme.
- Coordinating of supply and distribution, including regular monitoring of inventory position, off-take trends and replenishments.
- Review/revision of costs/margins for the oil companies as per pricing norms and Government guidelines.
- Review of pricing parameters and policies and recommending changes.
- Assisting Government in matters relating to inter-products cross subsidies and measures to counter oil pool deficits.
- Coordinating Marketing Activities.
- Coordinating implementation of Ministry's guidelines and management measures.
- Coordinating quality enforcement measures.
- Reviewing of individual sensitive products like LPG, LSHS, Bitumen.
- Implementing Sales Plan concepts and inter-companies Sales Plan Entitlements.
- Operating Petroleum Intelligence Vigilance Cell.
- Parallel Marketing.
- Assistance to the Ministry and the Industry in the management of crisis situations and special situations.

As oil industry officials on deputation ran the OCC, the main responsibility of the Committee was to create a unified oil industry approach, thereby helping optimise the oil industries resources by actively assisting the Ministry of Petroleum on evolving realistic strategies and policies. It was the OCC's responsibilty to apprise the Ministry of Petroleum and bring to its notice key industry problems and find quick solutions. The OCC had also to monitor on behalf of the Ministry performance versus targets at the Quarterly Performance Review Meetings (QPR) chaired by the Secretary (Petroleum) and facilitate integrated industry response during national emergencies, natural calamities and other unforeseen events. Last but not the least, the OCC played the prime mover's role in helping harness the oil industries resources to effectively and efficiently meet the petroleum energy needs of the country.

Industry Cooperation/ Coordination Through Regional/State Level Coordinators

In spite of sounding clichéd, there is no denying that hydrocarbons and their derivatives have become the vital life-stream of countries the world over. No nation can survive without this precious fluid that virtually regulates the heartbeats and pumps the sinews of almost all important sectors of the country's economy. Oil as an indicator of economic health activates and regulates the pulse-beat of countries around the globe. Any impediment or even slight hiccups preventing its smooth flow through the nation's arteries can bring about a cardiac arrest.

In a vast country like India the logistics of supply and distribution of oil is a mind-boggling activity. This complicated exercise calls for an extremely high degree of coordination and cooperation between the oil companies on one hand and the various agencies connected with the oil industry and the public on the other. This is not to speak of the heterogeneous units in the industrial, agriculture and tertiary sectors that also demand attention, including various Governments - not just at the Centre, but also at the State level and Union Territories level. All this adds up to a one big convoluted list and without a well orchestrated coordination and vigilance among one and all could lead to a serious disruption in supplies, crippling the economy and smooth functioning of the nation.

Hence it was extremely important in the overall interest of the country that all problems related to the oil industry were well anticipated and dealt with effectively before they got out of hand. To prevent such eventualities, the Ministry of Petroleum, on an industry basis set up various Oil Industry Coordinator-ships.

Soon after the Government of India had acquired all the three multinational oil companies, a new era of planned development began in the oil sector very much in consonance with national priorities under the Government's overall direction. From the state of belligerent marketing, the national oil companies had to quickly adapt themselves to the changed scenario of cooperation and coordination. Although competition still existed among the marketing companies, it was now in the field of higher productivity, better customer service, and greater internal resource generation etc. The assets of all oil companies in terms of infrastructure or facilities had now become national assets, and therefore, they needed to be utilised optimally in the country's interest.

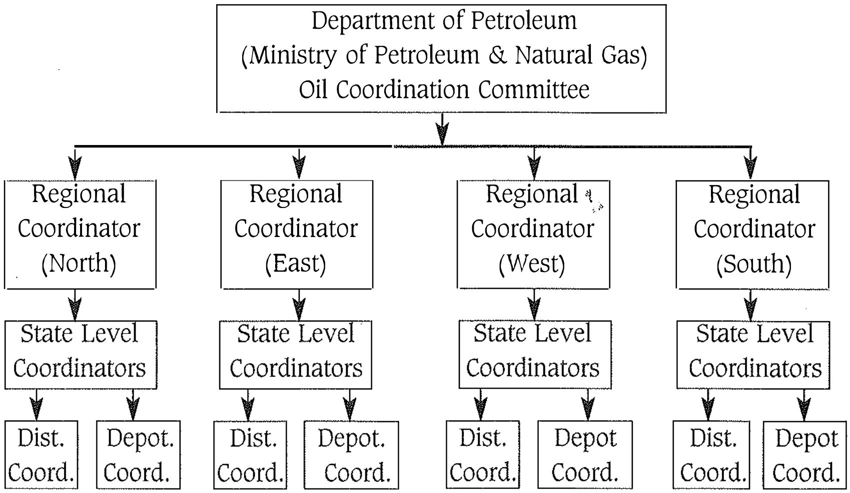
The Ministry of Petroleum appointed four Regional Coordinators — one for each Region viz. North, South East and West. Each Region consisted of a number of States, for example, the Southern Region consisted of the four Southern States of Andhra Pradesh, Karnataka, Kerala and Tamilnadu and the Union Territories of Pondicherry and Lakshadweep. Similarly, other Regions consisted of various States geographically grouped together for convenience. The Regional Coordinators were the Regional heads of Indian Oil Corporation for the respective Regions.

The State Level Coordinators (SLCs) were appointed by the Ministry of Petroleum for every State. They were generally Divisional Managers from the oil company which was having the most prominent presence in a particular State. In the Southern Region, for example, in Andhra Pradesh the SLC was the Chief Regional Manager of HPC because of Hindustan Petroleum's refinery at Visakhapatnam, while the SLC for Gujarat was IndianOil's Chief Divisional Manager because of IndianOil's refinery at Vadodara.

The State Level Coordinator was the key figure in the Oil Industry Coordinators' hierarchy. He was the spokesman for the Oil Industry for the State he represented. He reported to the concerned Department of the State Government the difficulties faced by the oil companies, if any in order to get the same addressed on one hand, and at the same time received complaints, requirements of the State from the Government officials on the other.

Each SLC was assisted by several District Coordinators who were expected to fulfill the same role on behalf of the oil industry in their district as the SLC was for the State. Similarly, depot Coordinators were nominated who were expected to coordinate logistics and product availability on the behalf of the oil industry in their respective location. About 50% of the District and Depot Coordinators were from IndianOil, while the balance posts were equally shared generally between BPC and HPC. Each Regional Coordinator, in close association with the State Level Coordinators falling in his Region, would coordinate and liaise with the respective State Governments and Government agencies coming under their respective jurisdiction.

The above system was structured as noted in the chart shown below:



Functions of the RLC/SLC :

a) Product Distribution

- Demand forecasting for various petroleum products, particularly SKO.
- Allocate/reallocate in consultation with State/District authorities the supply of SKO, etc.
- To monitor SKO releases by oil companies and actual availability in the market.
- Review on a daily basis, stocks of SKO/HSD/LPG at all stock points in the State.
- Arrange stock replenishments quickly, in consultation with Regional Coordinators and the Supply & Distribution Departments of oil companies whenever there was a crisis.
- Liaise with Railways/Port Trusts, etc for movement of POL products.
- To coordinate with Home/Labour Departments of the State Government for maintenance of Law and Order, settlement of disputes, etc. if supply was disrupted at any location.
- To hold periodic industry meetings to exchange information to take remedial action on distribution bottlenecks, to forecast events likely to affect marketing of POL products.
- Liaise with District Coordinators/Depot Coordinator, other oil companies/ State Civil Supplies/Dept/District Authorities and draw up contingency plans to optimise demand/supply of POL products, during periods of industrial relation problems, national calamities, civil disturbances, special occasions, strikes etc.

b) Developmental Activities

▪ Conduct and collect feasibility reports from District Coordinators for the need to establish new retail outlets, SKO-LDO dealerships and LPG distributorship to be consolidated at Regional Coordinator level.

▪ To review progress in obtaining various licenses and in case of a serious problem assist particular oil companies in obtaining such licenses through their good offices.

▪ Allocation of consumer pumps amongst Industry members in consultation with Industry.

▪ Training of the State Government officials on detection of product adulteration.

▪ Coordinate with State Government for allotment of Government land to oil companies for putting up reseller facilities and plants. Similarly, coordinate between State Government and the Industry to implement LPG distribution schemes for weaker sections of society.

▪ Review with the Commerce and Industrial Departments of the State Government, future growth of the industry in the State, to assess future demand of POL products and plan on development of distribution system/network facilities.

▪ Hold consumer advisory committee meetings at suitable intervals and implement suggestions benefiting consumers.

▪ Analyse public grievances and take timely remedial action.

▪ Keep a watch on dealer/distributors activities/trade/labour association activities particularly on product quality — inform Regional Coordinator and the State Government and seek their help wherever necessary.

▪ To hold periodical meetings with District/Depot Coordinators and implement changes if any.

▪ To Coordinate with the State Governments, and ensure safety of the oil installations and provide necessary security, whenever threats to safety came up.

▪ Act as a liaison between the OCC/MoP and the State Governments.

c) Detection and Control of Malpractices in the Trade of Petroleum Products - Dealers/Transporters.

▪ Ensure regular and meaningful inspections as per Marketing Discipline Guidelines.

▪ Encourage exemplary punitive action for gross malpractices/irregularities by ensuring Industry support and support from the Government.

▪ Involve Consumer Advisory Committee/Consumer Protection Associations and solicit their support.

- Discuss openly with other resellers and take them into confidence to weed out the black sheep.
- Encourage/ensure the service of mobile labs on regular basis to the industry network.
- Solicit the help of the State Government to protect honest dealers/resellers from harassment. Check thoroughly at supply locations.
- Advise/encourage oil companies taking exemplary action against known delinquents.
- Inculcate courage among dealers/customers to hand over the tanktrucks to the police where fraud is detected.
- Encourage Officers of oil companies to conduct prompt investigations on consumer complaints.
- To provide information to Police/Enforcement Authorities and seek their help in tracking down transport contractors and men who indulge in malpractices.

d) Malpractices by Unauthorised Processors/Illegal Sellers

- Provide information to Enforcement Authorities or the Police and Civil Supplies Departments.
- Keep communication channels with Secretary (Home) and Chief Secretary open so that prompt Police help can be secured in times of need as well as State Vigilance Department.
- Follow-up on such cases during coordination meetings with the State Government.

e) Other Functions

- Monitoring of tank trucks from supply points to destination through Police escort in case of emergencies.
- Provide to the Civil Supplies Department periodical return of SKO supplies made, dealer-wise, with quantities uplifted for cross-check by DGO/Enforcement Authorities.
- Solicit Police/Enforcement Authorities cooperation in organising raids on wherever and whenever required.
- Create greater consumer awareness through interactions.
- The State Level Coordinators' responsibility to knit together the oil companies in the State in a truly representative capacity, rather than representing only the interests of the oil company employing him.

The functions of the State Level Coordinator, whether it be in the spheres of Distribution, Development or Detection and Control of Malpractices were all inter related and cannot be viewed in isolation from each other.

With the Regional Level and State Level Coordinators (RLC/SLC) set up, the MOP,OCC and the Oil Industry worked in tandem to optimise the Oil Industries' service to every State and Region. Petroleum products being an essential input to the Indian society, this model was successful in performing a very valuable service to the State and the country as a whole and was one of the most effective innovations of the Ministry of Petroleum after the oil companies came into the national fold.

SAVING THAT DROP OF OIL THROUGH CONSERVATION & PCRA

As already stated the unfortunate Yom-Kippur War fought between Israel and a coalition of Egyptian and Syrian forces in the month of October 1973 finally put an end to the era of low-cost crude oil. Today, as always, Oil is very intimately related to national strategies, international politics and global power play. Presently, for any country in the world, a barrel of oil is as important as the computer chip, the only difference being that oil is a finite resource and is already showing signs of depletion. What took the earth aeons to form is likely to be exhausted by humans in a little less than 100 years from now.

How can one waste such a precious commodity such as 'black gold' especially in the face of depleting availability and rising prices? The only sensible course of action is to put the scarce resource to optimum use and save every drop by adopting effective methods of conservation. Petroleum products as feedstock for Petrochemicals and other high-value products could be used more judiciously rather than merely consuming them for energy generation. The last three drops of oil would necessarily be utilised in this order. The first drop for cooking (LPG/SKO). The second drop for transport (MS, HSD, ATF) and the third drop for Petrochemicals.

The problems of depleting oil reserves will soon apply to all non-renewable resources, such as coal, iron ore, copper and so on. The exponential growth in population in the developing countries and conspicuous consumption of petroleum products in developed countries, led to the consumption of these resources at an alarming rate. The question, therefore, no longer is whether, but when would oil run out? Run out it will. It is just a matter of time.

A barrel of crude oil, which cost a little over just one US dollar in 1972, now costs more than $60. India presently imports nearly 95.8 million metric tonnes of crude oil and about 8.8 million metric tonnes of petroleum products (2004-05). Consequently, the oil import bill for the country, which was a little over Rs.200 crore in 1972-73, jumped to over Rs.1100 crore in 1974-75, (Reference Indian Petroleum and Petrochemicals Statistics 1979-80 Ministry of Petroleum, Chemicals and Fertilizers) and now touches a staggering figure of Rs.131756 crore for the financial year 2004-05, (Reference Indian Petroleum and Natural Gas Statistics 2004-05 Ministry of Petroleum and Natural Gas) constituting

10.7%, 25%, 27.4%, respectively of India's entire import bill and likely to be 40% for (2005-06). Looking at the above figures, the dire need for conserving of this fast dwindling precious resource is self-evident.

In 1978-79, the Iranian Revolution under Ayatollah Khomeini and the subsequent Iraq-Iran war triggered off the Second Oil Crisis. Within a decade came the Third Oil Crisis in the form of the Gulf War of 1990-91. For India, the Gulf War led to the near doubling of India's foreign exchange outgo on the import of crude and petroleum products from an estimated Rs.6,400 crore to over Rs.12,000 crore. This in turn caused a severe pre-liberalisation economic crisis and India was compelled to pledge its Gold Reserves. Failing to do so would have made India a defaulter country on repayment of loans due to various international agencies —a situation the country never had the occasion to face before.

The price of crude oil today even momentarily touched $70 per barrel before rallying around $60 per barrel and above. Some oil economists say that prices could shoot up to and go beyond $120 per barrel. Such a situation would be most damaging to India's economic growth. If past trends are any indication, drastic jumps in crude prices did hurt the Indian economy. Just look at these figures: in 1973, the India's Gross Domestic Product (GDP) fell by 0.3% while inflation touched 20%. In 1979 India's GDP fell by 5.2% while its inflation hovered around 17.1% and in 1990 while the GDP grew only by 1.3%, the inflation notched a figure of 14%.

The need for conserving Energy appears to rise in direct proportion to escalating prices of crude and petroleum products and India's increasing rate of consumption would more or less be constant in the foreseeable future. It is obvious but true that one metric tonne of crude oil saved is like four metric tonnes of crude oil discovered and one metric tonne of petroleum product saved is like an equivalent quantity refined.

Much before the first oil shock, coupled with India's own meagre domestic reserves of oil and the ever-growing demand, the Government of India had already set up a 'Fuel Policy Committee' in 1970 under the chairmanship of the noted economist Prof. Sukhamoy Chakraborty, Member of the Planning Commission who in the course of two years prepared an action plan.

The said Committee submitted the First Part of the Report in 1972 and due to changed circumstances after the First Oil Crisis; a comprehensive final report was submitted in 1974. A brilliant document in itself, the Report contained all important steps the Government would have to take for the projected period up to the years 1991-92. The extreme volatility of the oil prices in the international market was taken duly into account and the recommendations were made mostly in keeping price fluctuations in view.

The substitution of oil was promoted wherever techno-economic feasibility existed. In case of electricity higher efficiency in generation and transmission and attention to hydroelectric power developments was emphasised. The promotion of indigenous R&D in energy technologies involving academic institutions was also recommended. The Committee stated that energy availability was a necessity but not a sufficient condition, for economic growth. Therefore the formulation of a coherent energy policy was imperative for national development. The Report also provided an outline for the same.

The Report also suggested certain organisational arrangements like the setting up of an Energy Board to ensure the integration of the energy plan with the national plan not only at the drafting stage but also at every stage of implementation. The Government accepted this important suggestion in principle, but the same is yet to be implemented.

After the Oil Shock of 1973, the resultant energy crisis and the dire need to conserve petroleum products became an endemic necessity for the country. Various policy decisions were taken, including the policy to replace oil with coal wherever possible, at the same time the Government directed the ONGC to intensify its efforts to increase indigenous crude oil production. As luck would have it, this led to the discovery of Bombay High reserves in 1974.

Under the leadership of IndianOil's Chairman, C R Dasgupta, and S B Budhiraja, its Managing Director (Marketing), IndianOil in 1973-74 took the initiative to adopt and propagate oil conservation as a part of its Corporate policy and went further to demonstrate to the users that oil could indeed be conserved through simple in-house measures and by proper combustion without in any way reducing its calorific value or any reduction in efficiency and effectiveness. The utilisation of Energy in all its forms in the most efficient manner was the natural objective of the proposed Conservation activities.

The genesis of this effort was a chance discussion in 1973-74 between C R Dasgupta, Chairman, IndianOil who was then holidaying at the hill station of Coonoor and P. Raghavendran, Assistant Manager, Technical Services, IndianOil (presently President, Reliance Petroleum) and A M Nanjundan, Technical Services Engineer, IndianOil (who retired as Executive Director).

Dasgupta posed this question to the above duo: "Is there any way we can conserve oil and reduce consumption by avoiding wastage without affecting economic activity?"

Raghavendran, had then recently undertaken a fuel utilisation survey in the Government's Cordite Factory at Aravangadu near Coonoor in Tamilnadu. The factory consumpted 700 kilo of furnace Oil per month. He had shown the factory authorities ways and means to avoid wastage not only by lagging the steam lines, but also by means of proper fuel combustion etc. This led to a saving in Furnace Oil of 300 kilo litres per month. He accordingly unfolded his nascent plans of carrying out a preliminary assessment study for other industries as well in line with what he had done in the case of the Cordite factory. Dasgupta was highly impressed.

Immediately following this discussion with Dasgupta, the Marketing Division of IndianOil under the leadership of S B Budhiraja took immediate steps to conduct its first pilot study in Coimbatore since it had a heavy concentration of industries such as textile mills, engineering, cement plants, sugar mills, chemical units and paper mills. It was felt that the IndianOil could play "a very useful role as a catalyst in implementing conservation techniques already demonstrated to other units within the same industry, as well as to other varied industries."

A team comprising four officers from IndianOil and two from the National Productivity Council was set up to survey nearly 130 units in the Coimbatore industrial belt. The results were very encouraging because they indicated that in the short term about 10% saving in fuel oil was possible with minimal investment and very simple changes in the operating procedure. A much higher medium and long term potential savings were identified with additional investments. An industrial seminar was thereafter held in Coimbatore and was welcomed wholeheartedly by the Industry.

The exercise in fuel conservation by IndianOil on an all-India basis began in 1974-75 with the training of IndianOil engineers from its Marketing Division with the National Productivity Council along with the Energy Conservation Division of DGTD. Thereafter, IndianOil conducted a number of studies in 1974-75. The first one covering 309 industrial establishments, consuming furnace oil, indicated an estimated savings of 2,00,000 tonnes costing Rs.18 crore. The second exercise related to consumption of HSD, of which 70 percent was in the road transport sector. A survey by IndianOil in Madras, in collaboration with the Pallavan Transport Corporation, indicated a possible savings of 10 per cent in HSD consumption. Together with surveys elsewhere, a saving of Rs.6 crore a year was envisaged.

Efforts were further intensified and during the year 1975-76 because of which industries actually saved Rs.1.4 crore worth of Furnace Oil. This free customer service was further extended to the State Transport Corporations mainly for conservation of HSD. Thus, IndianOil became the first oil company in India and possibly in the world to launch such a unique free service to its customers, whereby advice was given to customers on how to cut down the consumption of fuel without sacrificing performance and save petroleum products and money through better storage, handling, combustion techniques etc.

In 1975, the Government of India appointed a Committee under the aegis of the Oil Industry Development Board (OIDB) for setting up a separate Cell for promoting Petroleum Conservation in various sectors of India's industrial units. Accordingly, a charter was drawn out to define activities that were to be undertaken by the organisation. The Committee recommended the setting up of a separate organisation under Ministry of Petroleum, as a scientific research body duly approved by Department of Science and Technology and the Ministry of Finance.

In line with the above policy, on January 6, 1976, the Petroleum Conservation Action Group (PCAG) was set up. Two years later, on August 10, 1978, the PCAG became a fully registered society and came to be known as Petroleum Conservation Research Association (PCRA). The oil companies in the public sector duly provided the manpower for PCRA as also members of the National Productivity Council came on deputation as approved by the Ministry. Conservation activities of the PCRA were to be funded by OIDB.

The PCRA objectives were spelled out as follows:

- To formulate strategies and promote measures for accelerating conservation of petroleum products.
- To create awareness among masses about the importance, benefits and methods of conserving petroleum products and clean environment by enhancing information and capacity building.
- To promote research, development and deployment efforts aimed at petroleum conservation and environment protection, support and facilitate efforts aimed at petroleum conservation and environment protection, support and facilitate efforts for adoption and dissemination of fuel efficient technologies and substitution of petroleum products with alternate fuels and renewables.
- To establish synergistic institutional linkages at the national and international levels in the areas of petroleum conservation and environment protection.
- To provide training and technical advisory services designed to achieve economy and efficiency in use of petroleum products for a cleaner environment.
- To function as a "think tank" for the Government of India for proposing policies and strategies on petroleum conservation and environment protection aimed at reducing excessive dependence on oil.

In its annual report for the year 1977-78 IndianOil reported the following:

"In conjunction with Petroleum Conservation Action Group, 158 fuel oil consumers (total annual consumption - 1.13 million Kls) were offered guidance on achieving greater economy in fuel utilisation and the possible savings to them would amount to Rs.5.25 crore per year. Besides, 210,000 kls of fuel oil per year has been replaced by coal and alternative indigenous fuel like LSHS. Action on "Operation Diesel Conservation" studies conducted at 16 State Transport units in different parts of the country is being followed up with the units. Sales of the high thermal efficiency Nutan stove are progressively being extended. Similar significant savings were achieved by BPC/HPC in their respective efforts to conserve

Petroleum Products."

Initially, the PCRA focused its activities on Conservation in fuels mainly for the transport sector (Railways and State Transport Undertakings), and the agricultural sector (lift irrigation) cooking fuel and in creating public awareness on the need for conservation. It also conducted several training programmes to promote conservation in key sectors. It provided financial incentives such as:

- Soft loan scheme for replacement of inefficient oil fired (Lancaster) boilers.

- Accelerated depreciation on investments in energy conservation technologies for tax exemption on such investments.

- Duty exemption for fuel-efficient devices such as pressure cookers, all intended to promote conservation.

Under the leadership of its first and second heads, R V Ganpati (1972-83) and P.K. Goel (1983-91) respectively); the PCRA within less than 10 years made a significant all round contribution against a very modest expenditure of Rs. 5 crore. During the VII Plan (1985-90), however a higher allocation of Rs.12 crore was made. Apart from training programmes, workshops, seminars, and clinics, media and educational campaigns, the PCRA then initiated conducting of model depot projects and driver-training programmes in organised transport sector viz., State Transport Undertakings.

This was a five-phase project aimed at developing on fuel efficiency in depots in every State Transport Undertaking in India. It was an integrated conservation effort comprising improvements in house-keeping, operation and maintenance, skills of operation staff, instituting of management control and incentives to achieve diesel conservation as a continuous process in the Undertaking. In eight State Transport Undertakings where the project was completed a diesel saving of 10 to 15% was achieved.

Over 1700 diesel lift irrigation pump sets, surveyed by PCRA in 1977 were found to be highly inefficient due to the following reasons: mismatching of pump and engine, undersized suction and delivery lines and unnecessary bends, high friction foot valves and poor maintenance.

It was observed that by rectifying the above defects, 25% to 30% diesel could be saved. This was amply proved through rectification of 57 pump sets in 1979. In 1984-85, 140 pump sets were rectified, at a cost of Rs.1.5 lakh, in the pilot project initiated by PCRA, saving, the farmers around 80 kl of diesel worth about Rs.3 lakh per year. Funding schemes instituted by NABARD were made available to the farmers for rectification of pump sets.

There have been a number of additives in the market, which claim to be fuel-efficient. PCRA has been evaluating these additives and devices. By 1984-85, fourteen additives were evaluated under PCRA's sponsorship at IndianOil's R&D Centre and IIP, Dehradun to verify the claim made by parties.

In addition, studies conducted by the PCRA revealed that if the 4,500 old and inefficient Lancashire Boilers then installed in most textile mills and other plants all over the country could be replaced by modern boilers, a minimum saving of Rs.44 crore per year could be easily achieved. Assuming the then average cost of Rs.2 lakh per boiler, this investment could pay out in nearly two years' time. This scheme had to be terminated in 1999, as there were no more Lancashire Boilers in service.

In due course, the PCRA expanded its setup by placing a Coordinator in each Region in order to expand its activities Region-wise; this enabled a greater in-depth penetration all over India. PCRA's arms were further extended to the States where State Level Coordinators were also appointed. Furthermore, State-wise Action Groups were formed to provide a linkage with consumers, the State Government and the Oil Industry. Both these were particularly very effective platforms to enable vigorous and effective Conservation measures.

Since charity begins at home, it was imperative that the refineries in India took adequate measures to conserve energy in their operations and reduce fuel consumption and loss position on a continuous basis. Towards this end a three-pronged approach was adopted as indicated below:

- Implementing short-term measures including optimisation of day-to-day operations.
- Identifying and implementing major long-term energy conservation projects.
- Introduction of effective internal systems of monitoring and control.

Whereas short-term measures impinged upon the day-to-day operational improvement, long-term measures required substantial investments. Illustratively the following long term measures were adopted by IndianOil:

- Furnaces of old design at Guwahati, Barauni and Gujarat Refineries, which had low thermal efficiency of 68% to 70%, could be replaced by furnaces of modern design with high thermal efficiency of about 88% to 99%.
- Heat exchanger trains in Crude Units, particularly the older ones in Gujarat, Barauni and Guwahati could be revamped by putting additional surface area and further rearrangement of the exchangers to improve efficient Heat Transference.
- It was identified that waste heat from outgoing flue gases in the coke calcinations unit of Barauni refinery could be recovered by installing a waste heat boiler which could produce medium pressure steam for use in the refinery.
- The above schemes had a potential fuel saving of 78,000 metric tonnes per year. All other refineries took similar action as well.

In addition to the above, Energy and Technical Audits were introduced in refineries and in 1984-85 the "NRG Factor" was introduced refinery-wise primarily to measure how refineries compared with each other and more importantly with themselves on their efficiency of energy utilisation. This was monitored every quarter, and every effort was made to bring about a reducing trend as indicated below:

Unit	Industry
2000-01	127
2000-02	121
2000-03	118
2000-04	116

An Advisory Board on energy attached to the Planning Commission was set up in 1980. The Board proposed a perspective Energy Demand up to 2004-05. In August 1981, a Ministerial Working Group on Energy Conservation was set up under the Chairmanship of D V Kapur the then Secretary, Department of Heavy Industries. The Group submitted its report in 1983 proposing the setting up of an Integrated Energy Conservation Apex Body to initiate, coordinate and monitor the implementation of various Energy Conservation Measures. The Energy Management Centre was formed in 1989 under the Ministry of Power, which also became the nodal Ministry in India to promote and coordinate all Energy Conservation Activities with other Ministries.

The energy intensity per unit of GDP of India was higher compared not only to countries from the developed world (USA, EU, Japan etc) but also higher than some of her neighbours like Thailand and Philippines. According to BEE (Bureau of Energy Efficiency) it was 1.47 times higher than the overall average in Asia.

Finally, the Energy Conservation Act, 2001 was approved by the President on September 29, 2001 and the Bureau of Energy Efficiency was formed in March 2002 taking over the functions of the earlier Energy Management Centre. The mission of the Bureau of Energy Efficiency (BEE) was to develop policy and strategies with a thrust on self-regulation and market principles, within the overall framework of the Energy Conservation Act, 2001 with the primary objective of reducing energy intensity of the Indian economy. This could only be achieved with active participation of all stakeholders, resulting in accelerated and sustained adoption of energy efficiency in all sectors.

The Bureau was expected to coordinate with energy users and in this endeavor utilise resources and infrastructure by networking with other agencies in performance of duties assigned to the Bureau. The power of the Bureau, include power to specify norms for process and energy consumption standards for any equipment or appliance; advise the Central Government for notifying designated consumers in industries and establishments identified in the Schedule; labeling of appliances; prescribe guidelines for energy conservation building codes; prescribe qualification for certification of energy managers, accreditation of energy auditors, other functions involving energy efficiency and stipulate remunerations for the services provided.

In 1997-98, PCRA spelt out its vision and mission as reproduced below:

VISION

To become a centre of excellence for conservation of hydrocarbons and environment protection for sustainable development on our inherent strength.

PCRA MISSION

Efficient, energy utilisation and environment protection leading to improvement in quality of life.

"Environment Protection" goes beyond mere conservation of hydrocarbons. With this the PCRA, besides continuing its conservation activities, enhanced its Energy Audit Activities and embarked upon a campaign to encourage and promote the formation of ESCO'S — although it occasionally worked as an ESCO itself. This activity was complemented by the contents of the Energy Conservation Act, which stipulated mandatory Energy Audits for certain designated consumers. These consumers would be required by law (the Energy Conservation Act of 2001) to carry out Energy Audit of their facility through an accredited ESCO and feedback on compliance to the recommendations made. The selected consumers were also required to appoint Energy Managers who were expected to report Energy consumed to the designated official agency. Thus in a way PCRA was instrumental in promoting a nation-wide Conservation Movement at the National level including private sector organisations such as TERI.

One of the objectives of the PCRA is to promote R&D efforts aimed at Petroleum Conservation and Environmental Protection. In addition to the Energy Efficient Nutan Kerosene and LPG Stoves, the PCRA has been promoting and sponsoring R&D in several other areas through IndianOil's R&D, IIP, Dehradun and the Bombay Textile Research Association, the Ministry of Information Technology, RDCIS SAIL, Ranchi; Automotive Research Association of India, Pune; University Department of Chemical Technology, Mumbai; Central Scientific Instruments Organisations, Chandigarh; Central Institute Road Transport, Pune; Indian Institute of Technology, Delhi and the Jadavpur University.

For effective promotion of R&D efforts in 1987-88 the Ministry of Petroleum established a Screening Committee with Executive Director, PCRA as its Chairperson. This Committee included members from IndianOil R&D Centre, IIP, Dehradun, Advisor (R) from the Ministry, ARAI, CHT, Lubrizol India Ltd., and EIL R&D Centre, Gurgaon.

This Screening Committee was expected to sponsor appropriate Research

Projects, complete technical scrutiny of R&D proposals, evaluate and certify energy saving additives and devices, assist project developers in obtaining statutory approvals, and facilitate transfer and commercialisation of technology to interested entrepreneurs.

As per the PCRA Annual Report for 2002-03, PCRA R&D was instrumental in facilitating the completion of Kerosene vapour recovery Plant for recovering, recycling of Kerosene vapour from Textile Mills in Bombay. In addition:-

- Design and Development of Low Excess Air Industrial Film Burner (by Indian Institute of Petroleum, Dehradun).

- Design and Development of fuel efficient *Nutan Jyoti* hurricane lantern (by IndianOil, R&D, Centre, Faridabad and IIP, Dehradun.

- Design and Development of Kerosene Vapour Recovery plant for recovery and recycling of Kerosene vapour from textile pigment printing drawing machine by Bombay Textile Research Association, Mumbai.

- Substitution of Kerosene with synthetic thickeners for pigment printing in textile industry by Bombay Textile Research Association, Mumbai and Ahmedabad Textile Industry Research Association, Ahmedabad.

- Feasibility study and development of 2T oil for use in two-stroke engines with one per cent oil/fuel ratio by IndianOil, R&D, Centre, Faridabad.

- Design/Development of fuel efficient *Nutan Deep* wick lamp Model-I (*Diya*) (by IOC (R & D) Centre, Faridabad.

- Design/Development of fuel efficient *Nutan Deep* Kerosene Study Lamp Model-II (by Indianoil R&D), Faridabad.

- Development of Alternate Fuel from an initiative by PCRA, Delhi College of Engineering (DCE), developed a low-cost prototype of Esterification Plant for making Bio-diesel from vegetable oil. PCRA has imparted training to self-help group members through DCE on Bio-diesel manufacturing.

As a result of these efforts the following cumulative sales up to March 31, 2001 have been achieved:

Nutan Wick Stove	-	162.41 lakh
Nutan LPG Stove	-	5.35 lakh
Hurricane Lamps	-	3.65 lakh
Nutan Deep Wick Lamps	-	38,000
Nutan Deep Study Lamps (II)	-	8500

(Source: page13, PCRA booklet on R&D)

During the 10-year period (1992-93 through to 2001-02), the PCRA claims to have been instrumental in securing the following savings of various petroleum products.

	TMT	Rs. (crore)
Additional Savings	1862	1532
Recurring Savings	16484	10115

(Page 36, PCRA Journal, Energy Conservation Future Directions)

Although petroleum conservation has been discussed, in the larger context energy *per se* is indivisible and therefore the pursuit of conservation inevitably percolates into every facet of human activity and becomes an attitude, which when pursued to its logical conclusion becomes a way of life. Cultural levels have been traditionally defined as per capita energy extracted from the environment by a given society, i.e. a form of per capita income. Perhaps the time has come to no longer measure cultural levels by the per capita energy extracted from the environment, but by what is done with the energy extracted and the income generated.

How best to prepare for tomorrow is the question of vital importance and can only be answered by a serious and effective research and development action today. This effort needs to be made independently and jointly by a wide cross-section of agencies and industries connected with the energy sector. Efforts of Research and Development should primarily focus attention on Technology not necessarily based on fossil fuels. One can even think in terms of mandatory regulations and other financial incentives including tax rebates by the Government to encourage this effort.

India, with abundance of sunshine needs to take lead in Research & Development effort to effectively harness solar energy. As of now, the natural process of photosynthesis (vegetation) is the only effective converter of solar energy into matter. It produces nearly as much energy to us in India (30%) as compared to petroleum products (26%). While searching for new ways of utilising solar energy, relentless effort needs to be put towards reforestation and tree plantation on a massive scale.

There is a never-ending scope for excellence in the field of conservation. The magnitude of the problem is so immense and the potential for economy and savings are so great that even a marginally serious effort at what may appear to be a minor innovation can produce very encouraging results. India has been and is a conservationist society and is best equipped to take lead in the field of conservation, not only to find solutions to her own problems but those of other developing countries as well. In this era of globalisation India could even help consumerist and materialistic societies to see the light of day to promote meaningful consumer conservation activities on a global scale.

K.D. MALAVIYA - FATHER OF INDIA'S OIL INDUSTRY

If anyone has the right to be called the 'father of the oil industry in India' it is Keshav Dev Malaviya. Malaviya had a vision to help free India from foreign dependency by making India self-reliant in the field of petroleum. To transform his dream into reality, he struggled extremely hard and finally prepared the basic groundwork that led to the formation of Oil & Natural Gas Commission (ONGC) in 1956, the Indian Refineries Ltd. (IRL) in 1958 and Indian Oil Company Ltd (IOC) in 1959. Malaviya thus managed to set up a wholly homegrown oil industry under the public sector in India.

Malaviya was born in Allahabad in the month of June 1904. He did his Post Graduation from Allahabad University and completed a short course in oil Technology at the Harcourt Butler Technical Institute, Kanpur. At the age of 17, he joined the Congress and the Freedom Movement and went to jail several times. Malaviya became Dy. Minister of Natural Resources & Scientific Research from August 12, 1952 to December 7, 1954 and a Minister of State of the same ministry from then on known as the Ministry of Steel, Mines & Fuels from December 7, 1954 to June 26, 1963.

He quit the Union Cabinet in 1963 but continued to be a member of the Lok Sabha till 1967. Malaviya was the Chairman of Heavy Engineering Corporation during 1968-69. He returned to Parliament from Domariaganj constituency in U.P after the 1971 polls. He then took over the Ministry of Steel & Mines in 1974, and shortly thereafter became the Minister for Petroleum & Chemicals. On bifurcation of the Ministry, Malaviya was given charge of the Petroleum Ministry, a charge he held till the1977 general elections.

It was Malaviya's untiring efforts that helped found the ONGC in 1956, later converted into a statutory body by an Act of Parliament in 1959. In his dual capacity as the Minister of Oil Exploration and Chairman of ONGC in its formative years (1956-1963), Malaviya threw his entire weight in providing administrative support with political back-up to enable ONGC to stand on its own feet. It was due to his singular effort and his powers of persuasion with Prime Minister Nehru and the Planning Commission that Malaviya could obtain a budget of Rs.30 crore, then a princely sum, to launch the oil exploration programme of the ONGC.

It was Malaviya again who was instrumental in gaining Soviet assistance in exploration and discovering crude oil resources in Khambat (Cambay), Ankleshwar and Kalol. The confidence he reposed in his oilmen was vindicated when ONGC struck oil in the first well at Lunej near Khạmbat (Cambay) in September 1958. Subsequently, a significant discovery was made in the village of Hazat, about 19 kilometers from Ankleshwar in Gujarat on May 14, 1960. Malaviya announced this heart-warming news of "the best discovery of oil in Public Sector so far" to the people of India at a press conference in Lucknow. Later during his visit to Gujarat, Pt. Nehru christened the first well in the Ankleshwar oilfield as ***Vasundhara*** (the stream of prosperity).

Malaviya was also responsible for getting Rumanian assistance in setting up of the Guwahati Refinery and Soviet assistance for setting up of the Barauni and Gujarat Refineries. Despite his belief in the Public Sector Oil Industry, Malaviya was a pragmatist guided only by the nation's overall interest. It was during his tenure as the Minister of State that Oil India Pvt. Ltd. was formed in 1958 with Burmah Oil Company (BOC) holding two-third equity and the Government holding the rest to exploit the oil resources at Nahorkatiya and Moran oilfields.

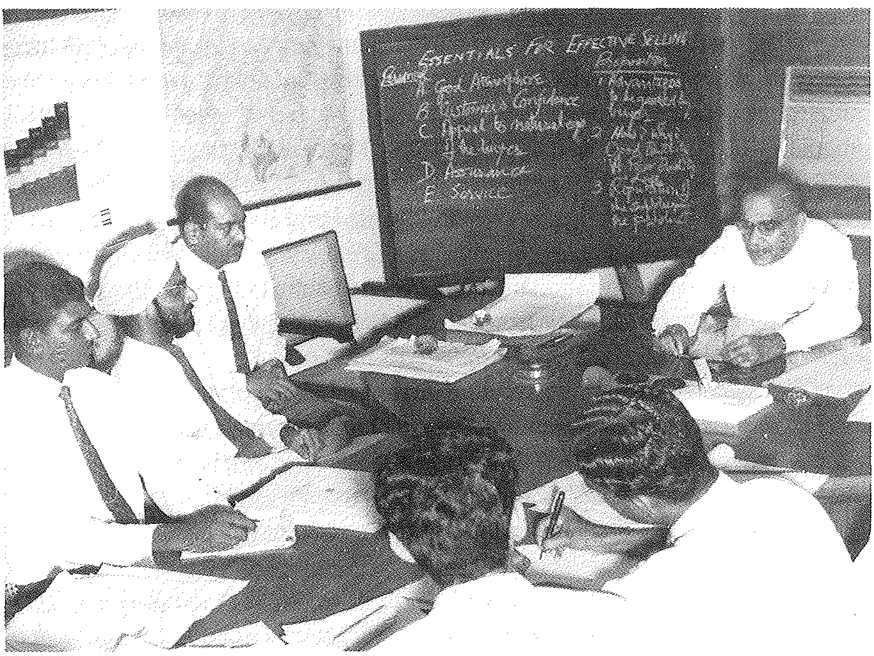
On July 27, 1961, through a new agreement BOC and the Government became equal partners in Oil India Ltd., although with only 50% equity OIL remained technically a private sector company. Around that time Malaviya stated, "There is no question of any aggressive policy or ideology of exclusion behind the Government's decision. It is a plain and simple desire to produce our own oil with our own efforts and try making it as cheap as possible for the Nation.... The Government does not wish to ban foreign or Indian oil companies from coming in to help us in discovering our own oil...... There is no rigidity in the programme of exploration. It has also been considered appropriate to let foreign or Indian private companies do their work if their scheme of work is considered consistent with the National interest as envisaged by our Government."

K D. Malaviya was as keen in developing human capabilities, such as leadership and technological skills, as he was in developing infrastructural facilities. In 1957, he selected a group of five chemical engineers to visit the French Institute of Petroleum in Paris and Rumania thereafter so that they could familiarise themselves with work in connection with the proposed oil refinery at Guwahati. Prior to their departure he spoke to them saying, "Within the period at your disposal, get the maximum experience, and come back fully prepared to serve your country in the field of Refining Technology."

Returning to India in 1960, the entire group joined Guwahati Refinery. To an earlier group of 30 young engineers that was sent to Rumania in 1959, Malaviya told them on the eve of their departure, "You are our ambassadors. On return, you will be serving the Public Sector in Oil Refining. A great responsibility rests on your shoulders to develop this vital field of Oil Refining in our country so as to make India self-sufficient in this field. While in Rumania, you should conduct yourselves well, so that relations between the two countries remain cordial and become strong in the days to come".

By temperament, Malaviya was a scientist and he left no stone unturned in espousing the cause of scientific search for Oil. He laid a firm base and the infrastructure for the development of the Oil Industry in India. The ONGC and allied petroleum industries in the public sector have since grown from strength to strength. It was during Malaviya's time that the Research & Training Institute, a forerunner of the Institute of Petroleum Exploration was set up at Dehra Dun in 1963 with the assistance of UNDP. On December 19, 1981, Prime Minister Indira Gandhi named the Institute of Petroleum Exploration after Malaviya. It is now known as Keshava Deva Malaviya Institute of Petroleum Exploration (KDMIPE).

Malaviya would often visit the office of IndianOil and address young Sales Officers directly and once in a while even participate in their training programmes. This had a strong impact on the minds of the young officers with whom he interacted. It is interesting to note that during Malaviya's first tenure as the head of the Ministry of Petroleum, he was responsible in creating the first Public Sector oil companies (ONGC, IRL and IndianOil). During his second stint (1973 to March 1977), he was to preside over the process of converting the entire oil industry except BOC/AOC into the public sector. For Malaviya this must have been a source



K.D. Malaviya addressing Indian Oil sales officers of deep satisfaction. He was dubbed by many as the "Enrico Mattei" of India. Perhaps his role in India was even greater than Italy's Mattei.

Malaviya's prophetic vision is encapsulated in a letter he wrote on October 15, 1956 to Prime Minister Nehru, contents of which are quoted below:

"*In Saudi Arabia, Iran, Iraq and Kuwait lies 80% world's crude oil reserves. These are to a large extent owned by the Americans and the British. The entire desert belt could be transformed into areas much more prosperous than Texas and Venezuela in 10 years time because oil here can be produced at one-fifteenth of the price in America. We can play our modest part in this big dream and win permanent relations with the Islamic World*".

Fifteen years later on August 20, 1971, in a letter to Prime Minister Indira Gandhi in which while commenting on Iraq he wrote, "*Iraq is perhaps the most hopeful country after USSR which should have been cultivated for friendly and cooperative efforts. Their reserves are incalculably immense and they want only a fraction of oil for their own purpose. They are tired of the IPC foreign cartel, but they dare not quarrel with them. So far as my information goes, we are able to cultivate friendly relations with them. Many years ago, when I initiated a proposal for prospecting oil abroad in the Persian Gulf I suggested we learn their languages and other customs and mix freely with the Arab people for the sake of winning their friendship.*"

Eight months later as hinted by Malaviya in his letter dated June 1, 1972, under their law No. 69, Iraq nationalised its oil industry and by 1973-74 an Indo-Iraq protocol was signed under which a permanent Joint Commission for economic and technical cooperation was established leading to a sizable contingent of ONGC engineers being posted in Iraq to help Iraq National Oil Company (INOC) for drilling, well-logging etc. In addition, specialists from ONGC, IndianOil and IIP were also sent on deputation to INOC in Baghdad and Basra.

Had Malaviya remained in the Ministry of Petroleum a little longer after 1963 perhaps Indo-Arab cooperation may have been of a much higher order. In another note dated October 9, 1963 to Jawaharlal Nehru, Malviya suggested, "*When I met you last I suggested that the time had come to merge (a) exploration, i.e. the Oil & Natural Gas Commission, b) Refining, i.e. the Indian Refineries Ltd., and c) the Distribution, i.e. the Indian Oil Company, into one integrated complex. This integration of all phases of oil industry into one is the natural sequence, which we should follow.*

"*As I said, this is on the lines of the Italian pattern where such rationalisation has resulted in huge savings for the oil industry. This is the one way to make public sector oil into a self-sufficient organisation in due course of time. The three activities of crude oil production, refining and distribution could all be headed at the top by one authority, sub-divided below into three inter-locked* *organisations, which should take care for the separate functions under Vice Chairman responsible for exploration and production, refining and distribution. This is known as the vertical integration in oil industry. All over the world, in the last 30 years, big oil companies have followed this pattern.*"

In spite of a lapse of over forty years this debate is still raging, although ONGC by its acquisition of MRPL in 2003 has become India's first vertically integrated oil company in the public sector.

Again in his letter to Indira Gandhi on August 28, 1971, Malviya recommended the combining of Oil, Natural Gas, Petrochemicals, Coal and Coal Gas under one Ministry in order to evolve an Integrated National Energy Policy. The relevant extracts from the said letter are reproduced below:

"*It seems necessary that departments of Central Government under various ministries should be regrouped for more rational purposes. Take for instance, the break-up of the Ministry of Mines and Fuel constituted several years ago. Both coal and oil are the raw materials for generation of energy and hence they were put together. The section of Petrochemicals was to be incorporated in the Ministry of Mines and Fuel mainly because the raw material for petrochemical industries is substantially derived from oil and coal. You will thus see that the previous notion of including mining, processing of oil and coal and the Petrochemical industries into one ministry was a sound idea. Incidentally, such a grouping of coal and oil into one will also enable the Government to formulate a national energy policy and also that of creating a national price system for other various fuels that are used either as fuel or for generating power. Atomic energy was purposefully separated because of its sophisticated and more or less independent technology*".

He went on to add: "In its totality, therefore, we have a strong case of bracketing coal with oil and taking up coal production to great heights and generate power at pits to save transportation. Natural gas, coal gas, coal and oil should also be placed together for an integrated working and policy-making.

"Further, the question of formulating a national policy on energy and of pricing of energy is called for immediately. Some exercise was done in the past. Not much time therefore need be taken once we agree on the importance of it. If we do not put the whole thing together into one sweep of thinking and action, the power generation programme will not move up, coal will continue to be a very costly commodity for people."

This subject too has been under debate for decades. Recently, the Synergy for Energy Committee under the chairmanship of V. Krishnamurty has recommended among other things the setting up of a Cabinet Committee on Energy Coordination headed by the Prime Minister. Such a committee under the chairmanship of the Prime Minister consisting of Finance, Petroleum, Power, and Coal Ministers, Deputy Chairman of the Planning Commission, Chairman of the PM's Economic Advisory Council and Security Advisor has now been formed. This committee would expectedly shape the country's Energy Policy in a holistic and integrated manner. Thus another sound original suggestion made by the visionary Malaviya 34 years ago is taking shape in India now—although the combining of Petroleum and Natural Gas Ministry—with Petrochemicals coal and coal gas has yet to take place.

The oil industry in India owes a deep debt of gratitude to Keshav Dev Malaviya. When he passed away in May 1981, India not only lost a great visionary and stalwart of the Nehru Era, but also India's oil industry lost a relentless and a fearless crusader without whom the Oil Industry of the country would not have been what it is today.

A historic message from K.D. Malaviya asserting his dedication to the country was carried on the cover of the first issue of IndianOil News, June 1963. The same is reproduced below:

"Unlike other commercial ventures dealing in manufacture and sale conjures up image of romantic adventure in the field of exploration and politics in marketing. Oil has played a leading role in moulding the destiny of nations, economically as well as politically. It was with the awareness of this aspect of the role of oil that the Government of India set up the Indian Oil Company to start marketing of petroleum products. I am sure the journal will endeavour constantly to remind the employees of the Indian Oil Company that the nation has greater stake in their activities and that they are not just another set of employees in any other commercial veture.

I wish the IndianOil News a success."

CHAPTER V

Fifth Era: 1978-1991

The eradication of poverty became a powerful nationwide sentiment during this period and it became the foremost objective of the 6th Five-Year Plan (1980-85). Modernisation, growth, self-reliance and social justice became the basic objectives of the 7th Five-Year Plan (1985-90)

It was during this Era that the Assam Oil Company (AOC) was bought over by the Government of India. AOC was the only oil company that had so far remained outside the public sector fold. With this last act by the Government the entire Oil Industry came into the Public Sector fold and the historic Digboi Refinery owned by AOC became a part of IndianOil's Assam Oil Division (AOD).

Giant strides were also being made in refining and process technology by the international oil industry. To keep India abreast of the latest technological processes, a Centre of High Technology was founded during this period. Simultaneously, the Indian Oil Industry's R & D activities forged ahead and gathered momentum in its never-ending quest for modernisation and technological upgradation.

This was an Era which also saw refinery expansions and the commissioning of new refineries at Mathura and

Bongaigaon. The Industry also went on a learning curve through major fire accidents that broke out during this period. The accidents led to the founding of the Oil Industry Safety Directorate. This period also saw the birth of GAIL which was formed to market LNG — the potential fuel of the future.

The latter half of this Era did not augur well for the Oil Industry. Two catastrophic wars broke out in quick succession — the Iraq-Iran War (September 1980 to August 1988) and the First Gulf War of January 1991 which became a precursor to the Second Gulf War that broke out on 20 March 2003. These events, needless to state, had much to do with oil and International power politics.

ASSAM OIL MERGES WITH INDIANOIL

After the takeover of Burmah Shell, Esso and Caltex by the Government of India the purchase of Burmah Oil Company (IT) and Assam Oil Company was just a matter of time. The only difference was that Burmah Oil and Assam Oil had in no way alienated the Government, or the community around them. People in the North East had become very familiar and were quite attached to Assam Oil's popular 'Rhinoceros' logo. They had grown so fond of this emblem that they had even developed an emotional attachment and a vague sense of ownership over it.

The Digboi Refinery, the world's oldest operating refinery with a capacity of only 0.5 MMTPA was processing indigenous crude and had provided employment to no less than 3,429 people in Digboi. There were no immediate pressures to force a buy over. On the contrary it was probably Burmah Oil who was very keen to get out of the country for reasons best known to them.

Consequently, the erstwhile Assam Oil Company Limited was taken over by the Government of India vide the Burmah Oil Company (acquisition of shares of Oil India Limited and of the Indian Undertakings of Assam Oil Company Limited and the Burmah Oil Company (India Trading Limited) Act, 1981. The assent of the Government was received on September 28, 1981 and the matter was notified in the Extraordinary Gazette of India, dated September 29, 1981.

As per the provisions of the said Act, the right, title and interest and liabilities of Assam Oil Company Limited and its undertakings in India were vested in Oil India Limited (in respect of the business of exploration of crude oil and gas) and in IndianOil (as regards the business of production, marketing and distribution of petroleum products) with effect from October 14, 1981 which was notified in the Extraordinary Gazette of India, dated October 13, 1981.

The Government's decision to takeover the erstwhile Assam Oil was conveyed to IndianOil by the Ministry of Petroleum, vide letter of October 14, 1981 which *inter alia* advised as under: "*Although the units will become part of IndianOil it will be desirable to keep the identity of the Refinery and its Marketing activities somewhat distinct even within the Indian Oil Corporation. It should, therefore, function as an autonomous Division of the Corporation. The products should also continue to be marketed under the present emblem*".

The assets and liabilities of the Refining and the Marketing functions of the

Assam Oil Company Ltd. were taken over by the Indian Oil Corporation effective October 14, 1981 and a separate division, named: 'Assam Oil Division' was formed. The officers and workmen of the erstwhile Assam Oil who were on the pay roll as on October 13, 1981 were allowed to continue after the takeover, and their service conditions including pay, pay scales and job classifications, were rationalized later. For officers it was 1983 and for workmen in 1985.

Initially, K.L. Goel, Finance Director, IndianOil, became Director-In-Charge of the Assam Oil Division (AOD) but after he left IndianOil, the Director R&P and later Director (R) became the ex-officio head of the newly acquired Division of IndianOil. The first head of AOD was R. Gurumurty. It was during his short tenure of 19 months that Gurumurty initiated various investment proposals which would ultimately culminate in a Rs.1,400 crore modernisation and expansion programme for Assam Oil .

After Gurumurty, the local head was always an Assamese officer. The first Assamese to take over as General Manager was Biren Dutta, and later on it was Ranjit Dutta as its first Executive Director. Ranjit was to become the CMD of Oil India Limited later. The Digboi Refinery with its associated marketing activities that had stagnated for at least three decades now got a new lease of life, whereby its refining capacity was enhanced by 30% (0.5 MMTPA to 0.65 MMTPA) and it was given the freedom to market as much as it could produce.

New Refineries

Bongaigaon Refinery & Petrochemicals Ltd

The Bongaigaon Refinery & Petrochemicals Limited (BRPL) located around 200 kms west of Guwahati in Assam has the unique privilege of being India's first Petrochemical integrated refinery. It was in early 1972 that Prime Minister Indira Gandhi laid the foundation stone for the third refinery in Assam and the country's eleventh. Registered in February 1974 with its corporate office at Dhaligaon in Assam, BRPL was formed with a total paid-up capital of Rs.200 crore with the Government holding 100% equity of Rs.199.8 crore. The Refinery was commissioned in 1979.

Bongaigaon presently is a separate District in Assam, which it was not until it was carved out of some areas of Goalpara and Kokrajhar Districts with its headquarters at Bongaigaon in 1989. Today Bongaigaon is surrounded by the four districts of Barpeta, Goalpara, Kokrajhar and Dhubri.

Coming back to BRPL, the various plants of the petrochemical complex were progressively put into operation between February 1979 and 1988. Originally, the capacity of the refinery was 1.00 MMPTA, later de-bottlenecked and expanded to 1.35 MMPTA in 1987. The main secondary units of this refinery are the Delayed Coker of 0.85 MMPTA and a 52,000 MTPA Coke Calcination Plant, which were commissioned in September 1981, and December 1981, respectively. Apart from other conventional refinery units, BRPL has a Xylene Plant of 35,000 metric tonnes and yet another one of 45,000 metric tonnes per year was commissioned in July 1985. A plant for production of 30,000 metric tonnes of polyester staple was finally put into operation in stages between April-August 1988.

The capacity of the refinery was expanded to 2.35 MMPTA in May 1995 at a cost of Rs. 223 crore but was operated at much lower capacity due to inadequate availability of Assam crude. With the commissioning of the Haldia-Barauni crude pipeline it became possible to augment the crude supply to BRPL by reverse pumping through the Barauni-Nahorkatiya Pipeline.

Thus 1.5 million tonne Ravva crude to BRPL was provided to make up for the shortfall of crude supplies from the North East. A quantity of 1.5 million tonne of Ravva crude was allotted to BRPL for 2003-04 and 2004-05. This resulted in a quantum jump of 45% over the previous year in BRPL's crude run from 1.46

MMPTA to 2.13 MMPTA with a capacity utilisation of 90.5%. During 2004-05 the refinery processed 2.31 million tonnes of crude oil, including 0.5 million tonnes of Assam crude, making capacity utilisation of 98.36%. The refinery is expected to reach 100% utilisation i.e. processing of 2.35 MMPTA crude in 2005-06.

During the years 1991-92 to 1993-94, the Government diluted its equity by disinvesting 25.54% of its 100% share holding in BRPL to the Unit Trust of India (UTI) and other financial institutions as also to the employees of the company.

Dismantling of APM with effect from April 2002, and concurrently the petroleum Industry witnessed volatility in the prices of crude and petroleum products for the past three years, it was therefore viewed that neither a "Stand alone refinery nor a marketing company could survive with steep competition". Therefore, the Government decided to divest its shares on March 29, 2001, simultaneously IndianOil purchased the entire lot of 14,87,93,826 shares of the Government amounting to 74.46% at Rs.10 each, adding to a total investment by IndianOil of Rs.148.79 crore thereby making BRPL a subsidiary of IndianOil with effect from the same date.

BRPL was a profit-making Public Sector oil company right from its very inception. However, it did incur losses during the years 2000-01 and 2001-02 primarily on account of the impact of high crude oil prices without commensurate increase in product prices and one-time freight charges and sales tax recovered for the past period by IndianOil for decontrolled petroleum products in the absence of absorption by the Oil Pool Account.

The situation improved considerably from 2002-03 and the company consolidated its position in 2003-04. During the financial year 2003-04, BRPL had a turnover of Rs. 2849 crore. It made a net profit of Rs. 308 crore. During 2004-05, it achieved highest ever net profit of Rs.435 crore. However, 99% of the turnover and profit came from refinery operations and not petrochemicals. This is likely to go up in 2005-06 mainly because of higher capacity utilisation, and an increase in refinery margins.

The immediate challenge for BRPL is to step up its petrochemical production and marketing activities and achieve quality upgradation of MS and HSD to meet new product specifications applicable from the year 2010. Two projects, i.e. MS quality upgradation to meet Bharat Stage-III specifications and Diesel quality upgradation to meet Bharat Stage-III specifications, are being pursued for implementation. MS and HSD quality upgradation are major products requiring an investment of Rs.800 crore.

Petrochemical markets are situated in far-flung locations in Northern and Western India and there is a paucity of demand in the North East or the Eastern regions due to inadequate industrial investments and industrialisation. "With a view to revive the operations of its Polyester Staple Fibre Plant, BRPL has entered into a three-year agreement with Reliance Petroleum on November 6, 2004. Reliance will provide assistance in operating the plant, sourcing the raw materials at a competitive price and also market polyester staple fibre". From October 2001, the DMT and polyester plants had to be kept idle due to economic reasons and were restarted in December 2003 after an alliance with Reliance Industries Ltd. BRPL achieved highest ever Polyster Staple Fibre production of 23251 MT in 2004-05.

The Reformer Unit of the Xylene plant is being operated on MS mode due to high value addition. Paraxylene required for operating the DMT plant is being outsourced. The DMT and PSF plants were restarted on December 18, 2003 and December 26, 2003, respectively.

To improve operational efficiency, the refinery must improve product quality to reduce costs. It has been discovered the production of only a single variety of polyester staple fibre, i.e.1.4 denier, would be most optimal. It is heartening to note that presently the plant is operating at almost its full capacity.

MATHURA REFINERY

Mathura, situated on the west bank of river Yamuna, 145 kms from Delhi, is famous as a pilgrim town of hallowed sanctity since time immemorial. Not very far from this sacrosanct land stands IndianOil's 8.5 million metric tonne per annum Mathura Refinery.

Even as IndianOil's Haldia Refinery project was midway through 1972, it was realised that the demand and growth for petroleum products was mainly centred in the North and the North West regions. The question then arose, what could make more economic sense, to build a refinery close to the source of crude oil or near the demand centre? Hitherto all IndianOil's "inland" refineries were located at sites close to the source of crude oil. But it was not so in the case of Mathura Refinery. After several rounds of debates and discussion and breaking away from the earlier rationale, it was finally decided to build a refinery close to the demand centre. In 1973, the Government advised IndianOil to carry out a feasibility study based on the above premise.

The feasibility study clearly indicated that the growing pattern of demand was concentrated in the North and North West regions of India and therefore to build a refinery near the demand centre made sense. If a refinery was set up at Mathura, crude could be brought through pipelines, and petroleum products could easily be made available to meet the huge demand of the region.

Finally, Mathura was selected as the site for the refinery. By now IndianOil and Engineers India Ltd. (EIL) had gained sufficient knowledge and experience on refining technology and construction, consequently EIL was rightly roped in for this project. During this period, there was an acute shortage of Middle Distillates and so it was decided to adopt a technology that would yield a maximum quantity of Kerosene and Diesel.

Initially, it was planned to have the refinery commissioned by 1976-77, but the process of selecting the right site took more time than expected. Finally, a stretch of land, 15 kms away from the town of Mathura, was earmarked for the refinery. The foundation stone was laid on October 2, 1973 by Prime Minister Indira Gandhi. Now that the site was selected, and the capacity of the refinery established a series of problems had to be tackled and solved.

The biggest of them all faced by IndianOil was the danger posed by the refinery to the celebrated world heritage monument, the Taj Mahal. Steps had to be taken at all costs to protect this precious monument from the noxious refinery emissions, likely to damage the pure white Makrana marble of the monument. Guardians of ecology and environment were up in arms and vehemently descried the selection of Mathura as the site for a petroleum refinery. While making the choice, IndianOil had already envisaged this problem and being a responsible corporate citizen had duly chalked out suitable plans for protecting the Taj Mahal from refinery emissions.

There was yet another serious problem to tackle: an acute shortage of power. The State Government had already cut off power to all industries, including power for construction of the refinery. All electrical power had been diverted by the Government for the benefit of the agriculture sector. Hence, Bharat Heavy Electricals Ltd. (BHEL) was awarded the contract for building a captive power plant. The problems already faced were further compounded when it was discovered that there was a serious foreign exchange crisis too. All these complications raised a serious doubt whether the project would ever see the light of day.

Meanwhile, infrastructure required for obtaining Bombay High crude including unloading and storage facilities were getting ready at Vadinar and Viramgam in Gujarat as well as the laying of a cross-country pipeline from Salaya to both Koyali and Mathura was under progress. It was therefore essential to have the Government expedite clearance of the project at the earliest. Simultaneously, Dr. S Vardarajan, CMD of Indian Petrochemicals Ltd., was asked by the Government to head an expert committee to review and recommend various measures to be taken in order to control refinery emissions and pollution from other existing industries in the Mathura, Agra-Bharatpur belt, and the Taj trapezium.

The Vardarajan Committee spelt out the steps, and the suitable scientific means by which the Taj Mahal could be fully protected from the noxious fumes of the refinery, and submitted its report in December 1977. Based on compliance, assurance and other commitments made by IndianOil, the Mathura Refinery project was finally cleared by the Government in 1977.

IndianOil's Mathura Refinery with a capacity of 6.0 MMPTA at the time of its commissioning on January 19, 1982, was India's largest grass-root refinery. It was primarily a fuel oil refinery with FCCU as a Secondary Processing Unit aimed at maximising a yield of Middle Distillates using 50:50 Bombay High and Imported Light crude along with a Sulphur Recovery Unit in order to limit sulphur dioxide emissions at very low levels.

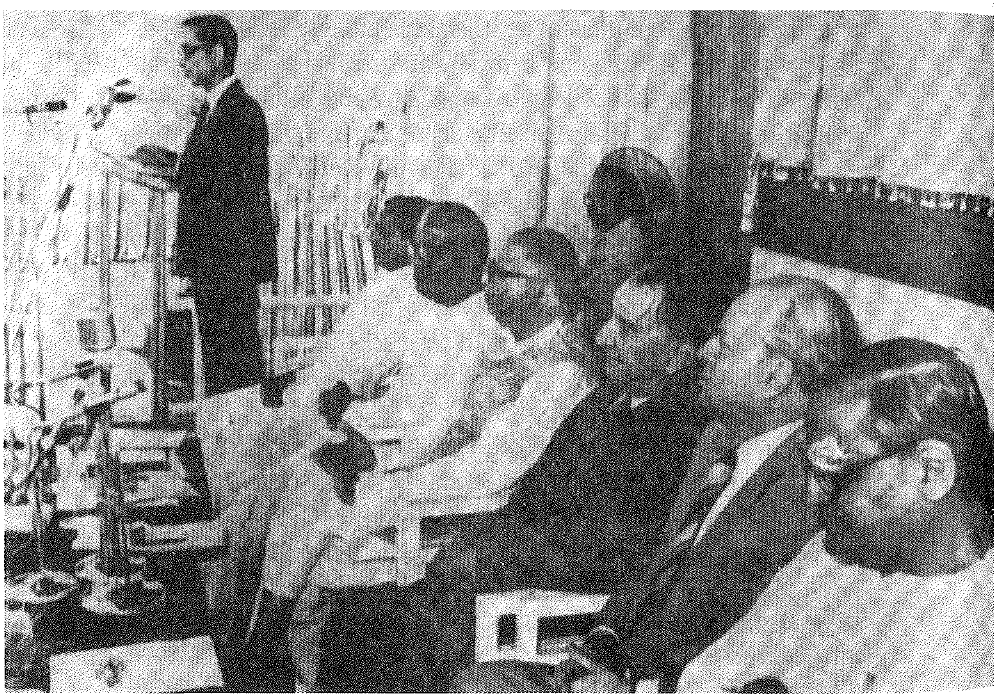
As for the steps taken to protect the environment, Mathura is the only refinery in the country to set up four continuous Ambient Air Monitoring Stations far beyond the work area for protecting community and archeological sites from atmospheric pollution. Out of these, three were set up at Farah, Keetham and Sikandra along National Highway No.2 towards Agra in the downwind direction.

Bharatpur being a sensitive receptor, one Ambient Air Monitoring Station was commissioned even before the refinery went on stream in 1981. All these stations have been in continuous service thereafter. The data collected from these stations indicate that there was and is absolutely no adverse impact of refinery operations whatsoever on ambient air quality of the region. The concentrations of sulphur dioxide (SO2) at all four stations have invariably been found much below the limit of 15 micrograms/m3 of air (on annual average basis) prescribed for sensitive areas.

IndianOil's Mathura Refinery also took extraordinary steps to provide a green cover buffer zone to archeological heritage sites especially the Taj Mahal by planting one lakh trees in the Taj trapezium (35,000 in the Runakta Reserve Forest and 65,000 in the Taj Reserve Forest). Strengthening of green cover was done by planting an additional 15,000 trees in the Taj Reserve Forest. The protection of the Taj Mahal against air pollution by a green belt was an example of plantation as per receptor-oriented approach.

Mathura was IndianOil's sixth refinery and the country's twelfth. The six mil-

A.J.A. Tauro, Chairman of IndianOil, speaking at the formal inauguration of Mathura Refinery, Seated from left: Vir Bahadur Singh, U.P. Minister for Industries; P. Shiv Shanker, Union Minister for Energy; Shripati Mishra, Chief Minister of U.P. ; Arkhipov, first Dy. Chairman of the Council of Ministers of the USSR; and Gargi shankar Mishra (extreme right) Union Minister of State for (Petroleum).



lion tonne refinery was commissioned with an AVU, Visbreaker and Bitumen Blowing Unit and a 37.5 megawatt Captive Power Plant in February 1982. Subsequently, the Fluidized Catalytic Cracking Unit (FCCU) from UOP technology was put on stream in January 1983. The refinery was formally inaugurated by I.V. Arkhipov, Vice-President, Council of Ministers, USSR and Shiv Shanker, Minister for Petroleum, in the presence of Uttar Pradesh Chief Minister Sripati Mishra on May 14, 1983.

With the commissioning of the Mathura Refinery, like rest of the refineries it automatically became a pricing point. This was a big boon for the people and for the economy of North and North-west India because prices of major petroleum products came down drastically, in fact, by an amount equivalent to the notional rail freight from Koyali to Mathura.

This refinery had always been making an all-out effort to be technologically up-to-date by continuously upgrading various facilities from time to time, always keeping in mind its responsibility towards environment protection. The refinery added a 24,000 metric tonne Propylene Recovery Unit using EIL technology in January 1996. The refinery was originally getting gasoline from the FCCU. In order to meet the stringent requirement of lead-free gasoline, a Continuous Catalytic Reformer was installed in May 1998, using IFP technology.

Subsequently, an Hydro De-sulphurisation Unit with IFP technology was put on stream in 1999 along with the Hydrogen Unit. A Once-through-Hydrocracker Unit of Chevron technology was installed in July 2000. To meet the additional power requirement, two gas turbines of 20.2 megawatts were also added in September 1999.

The capacity of the refinery was further enhanced to 7.5 MMPTA in 1988 by de-bottlenecking and revamping. Based on the approval obtained in 1985 for revamping, the limit stipulated for sulphur dioxide emission, which was 1000 kg/hr during summer months and 700 kg/hr during winter (October to February). Subsequently, a major revamping of the Vacuum Unit was carried out to enable the refinery to increase its capacity to 8.0 MMPTA in 1994.

The refinery maintained sulphur dioxide emission levels around 550 kg/hr all through the years up to 1995 with measures like use of low sulphur fuel oil in boilers and heaters, feed management in FCCU and implementation of various energy conservation schemes such as installation of high efficiency furnaces, soaker technology in Visbreaker etc.

In the meantime, M.C. Mehta, a Supreme Court Advocate, filed a Public Interest Litigation (PIL) in 1984 alleging that the pollution in Agra and the Taj area was proving detrimental to the health of monuments as well as the general public. The polluting sources as per the petition were the foundries in Agra, thermal power stations in Agra and IndianOil's refinery at Mathura.

The Apex Court took immediate action and instructed NEERI, the National Environment Engineering Research Institute, Nagpur, to conduct an inspection of Mathura Refinery and submit a report. The Institute duly conducted a study in October 1993 as directed and submitted its report to the Court in the same month. Among the various measures, NEERI suggested the use of Natural Gas to reduce emission of sulphur dioxide.

Thereafter, as directed by the Court an Expert Committee was formed once again under the Chairmanship of Dr. S. Vardarajan in May 1994 as directed by the Ministry of Environment & Forests (MoE&F) to look into various aspects of pollution control in the Taj trapezium. The Committee submitted its report in May 1995 wherein it was indicated that emission of sulphur dioxide would have to be brought down to 340-380 kg/hr from January 1997. However, MoE&F filed an affidavit in August 1995 proposing that the level of 340-380 kg/hr of sulphur dioxide emission, targets set for the future, was linked with the supply of Natural Gas to the refinery and use of the same in furnaces and boilers.

After the above proposal was approved in December 1996, the emission was brought down to the level of around 380 kg/hr. Subsequently, while according clearance for the expansion of Mathura Refinery from 7.5 MMPTA to 8.0 MMPTA and Matching Secondary Processing facilities in 1995, the (MoE&F) revised the limit to an all-season sulphur dioxide emission limit to 450 kg/hr. Presently, the stipulated normal and maximum limits for the refinery are 380 kg/hr and 450 kg/hr, respectively as per the Air Consent granted by the Uttar Pradesh Pollution Control Board (UPPCB).

Despite the increase in refining capacity from original 6.0 MMPTA to 8.0 MMPTA in stages and stage-wise implementation of various projects like CRU, DHDS, HGU and Hydrocracker for quality improvement of products, the refinery is currently operating on a sustained basis at emission levels of around 330 kg/hr with stringent control of operations and measures like installation of improved Sulphur Recovery Units of 99% efficiency against 94% earlier and better control on FCCU feed quality resulting from commissioning of the Hydrocracker.

With its FCCU and OHC the refinery mainly produces middle distillates and supplies them to Northern India through a product pipeline up to Jalandhar, Punjab via Delhi. The present capacity of the refinery is 8.5 MMPTA. In order to meet future fuel requirements, facilities for improvement in the quality of MS and HSD, DHDT and MSQ, projects were completed by September 2005.

The Mathura-Jalandhar pipeline commissioned on April 27, 1982 has been the mainstay for uninterruptedly maintaining crucial supplies of transport fuel, MS and HSD in the State of Punjab in particular, (specially during the peak of terrorist activities), and adjoining States of Haryana and Himachal Pradesh. The pipeline is 596 km long and runs from Mathura Refinery in Uttar Pradesh to the

Jalandhar Terminal in Punjab with a line capacity of 3.7 MMPTA. There are intermediate pumping and delivery stations at Bijwasan and Ambala. The commissioning of this pipeline was crucial to the smooth and optimal operation of Mathura Refinery.

During 1997, a diversion of 11 kms was made to connect this pipeline to Panipat Refinery. Panipat is connected to the KBPL pipeline commissioned on February 1, 1990. Thus Panipat Refinery formed a grid for white oils and accorded further flexibility to the Kandla-Bhatinda pipeline product into MJPL.

In 2000, a 70 km-long, 10.75 inches diameter branch line was laid and commissioned from Sonipat to Meerut. Subsequently during 2003, another branch line 167 km-long, 10.75 diameter line, from Kurukshetra to Najibabad, U.P., having an intermediate delivery station at Roorkee was added to the MJPL network.

In spite of all the court cases, public interest litigations and the media agitation on toxic emissions from Mathura Refinery proving a danger to the Taj Mahal, one can hardly believe that today it has the singular honour of being the first refinery in the world to be accredited with ISO 1801 certification, which it received in 1998. In addition, Mathura Refinery is also having accreditations of ISO 9002 and ISO 14001.

CONCLUSION

Haldia was IndianOil's first Lube integrated refinery and the first one to run on imported crude. Mathura was India's largest grass-root refinery and IndianOil's first inland refinery which ran both on imported crude over and above whatever quantity of Bombay High crude oil was allocated to it. BRPL was the first Petrochemical integrated refinery in India. Thus, all the three refineries had firsts to their credit in their respective categories, a telling feature, which was to prove a harbinger of times to come.

Mathura Refinery was commissioned in February 1982 under the chairmanship of C R Dasgupta who subsequently retired on March 31, 1982. He became IndianOil's first internal chairman in May 1974 having risen from the position Deputy General Manager of Koyali Refinery. He became General Manager of the Refinery in September 1967 and Managing Director of IndianOil's Refineries & Pipelines Division in July 1970.

It was under Dasgupta's leadership that the capacity of Koyali Refinery was expanded from 4.3 MMTPA to 7.5 MMTPA. It was also under his stewardship that both Haldia and Mathura Refineries were commissioned with the state-of-the-art technology. He played a key role maximising LPG production of all indigenous refineries and also contributed greatly in creating a national awareness on the subject of conservation. The evolution of the Petroleum Conservation Research Association (PCRA) was a result of his vision, which provided a buffer to Indian consumers from successive Oil Shocks. For all his outstanding achievements, Dasgupta was posthumously awarded a Lifetime Achievement Award by Petrotech in January 2005.

GAIL (INDIA) LIMITED

Like in most countries, including India, there was a time when Natural Gas was a solution in search of a problem. Today this gaseous commodity has come a long way from being an unwanted byproduct that was flared because of unavailability of infrastructure and utility, to become the fastest growing, economical and environment-friendly source of energy. While the 19th Century was termed as the century of coal, the 20th Century as the century of oil, the 21st Century could well be termed as the Century of Natural Gas.

Way back in the 1960's, the pioneer in the field of Natural Gas was Oil India Ltd. (OIL) in India when it started supplying Natural Gas to local tea producers and the State Electricity Board in Assam. Not long thereafter a number of gas-fields were struck by ONGC and it started feeding end-users like the Dhuvaran Thermal Plant in Gujarat from their Cambay oilfields, Uttran Thermal Plant from Ankleshwar, Bhabha Atomic Research Centre and Gujarat Industrial Development Corporation from Navagam, and so on.

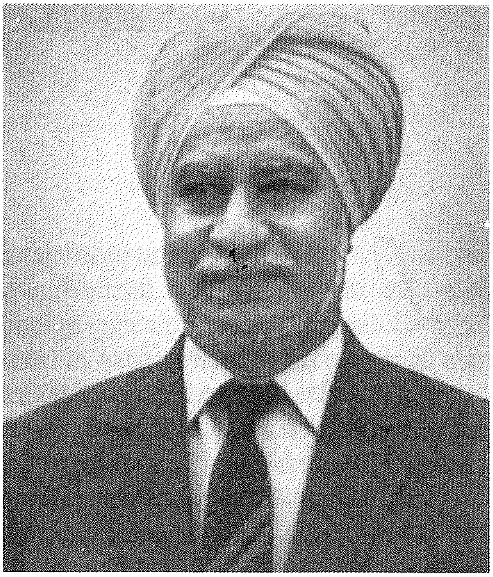
The year 1974 saw the discovery of the giant Bombay High oil and gas-fields by ONGC and commercial production began in 1976. It was only by 1978 that a gas pipeline was laid to the shores of Mumbai for supplying Natural Gas to fertilizer units and thermal power plants like the Tata Electric Company Ltd. etc.

In view of the high prospects and availability of gas, especially after the discovery of the Bassein gas-field by ONGC, the Gas Authority of India Limited (GAIL) was formed by the Government of India on August 16, 1984 and was entrusted with the job of transporting and marketing Natural Gas. GAIL set about its task by laying the Hazira-Vijaipur-Jagdishpur (HVJ) gas pipeline.

For fifteen years after its birth, GAIL focussed on creating and developing an adequate infrastructure and cultivating a market for Natural Gas in India. But during the last ten years, GAIL has been engaged in the creation, operation and management of its business interests not only in Natural Gas but also in LPG, liquid hydrocarbons, petrochemicals, LPG transmission and telecom. In keeping with the expanding product portfolio of the company as well as in the spirit of deregulation, the company changed its name to GAIL (India) Limited in November 2002.

It took GAIL nine years from its inception to achieve an annual turnover of Rs. 2800 crore, rising to Rs. 4400 crore within the next three years. With the sales graph on a steady upswing, the financial year 2004-05 saw the company registering an impressive turnover of Rs.12,412 crore.

The authorised capital and the paid-up capital of the company was Rs. 1,000 crore and Rs. 845.65 crore, respectively. After the recent disinvestment, the Government's current equity holding in GAIL stands at 57.35%. Presently the other equity holders are as follows: GDR holders—6.92%, ONGC-4.83%, IndianOil-4.83% and FIs-26.07%.



H.S. Cheema, first Chairman of GAIL

GAIL owns and operates a network of over 5340 kms of Natural Gas high pressure trunk pipelines with a combined capacity to carry 118 million cubic metres per day (MMSCMD) of Natural Gas across the country. It supplies nearly 63 million cubic meters of Natural Gas per day (21 BCM per annum) as fuel to power plants for generation of about 4,500 megawatts of power, as feedstock for gas based fertilizer plants to produce about 10 million metric tonnes per annum (MMPTA) of urea and to over 500 other small, medium and large industrial units to meet their energy and process requirements.

The LPG transmission business of GAIL includes the Jamnagar-Loni pipeline covering 1298 kms starting from Jamnagar in Gujarat and passing through Rajasthan, Haryana and Delhi, terminating at Loni in U.P. This pipeline with an initial capacity of 1.7 MMPTA in Phase-I commissioned in 2001, was upgraded to 2.5 MMPTA in Phase-II when the 68.5 km-long Kandla to Samakhiali LPG pipeline with a capacity of 0.8 MMPTA was added to it in September 2003. The Visakhapatnam-Secunderabad 580 km-long LPG pipeline was commissioned in July 2004 with a capacity of 1.16 MMPTA. GAIL's share of gas transmission business today is 88% and the company has a market share of 81% in gas marketing in India.

GAIL is the largest organisation in India handling post-exploration activities related to transmission, processing, distribution and marketing of Natural Gas and its fractions and byproducts. It also owns and operates one of the longest pipelines in this part of the world - the 2300 km long Hazira-Vijaipur-Jagdishpur

(HVJ) pipeline system which was completed in two stages: the 1700 km stretch with 18.2 MMSCMD capacities was completed in 1987-88; subsequently it was expanded to 33.4 MMSCMD by laying an additional 505 km pipeline in March 1994. The system currently carries 33.4 MMSCMD of Natural Gas from the West coast at Hazira to Central India at Vijaipur and the Northern region at Jagdishpur.

Following the completion of the Hazira-Vijaipur-Jagdishpur (HVJ) pipeline and its successful commissioning, GAIL gradually expanded its gas business especially in Mumbai, Gujarat, Rajasthan, Andhra Pradesh, Tamil Nadu, Pondicherry, Assam and Tripura. GAIL also supplies Natural Gas to its joint venture companies and to households and commercial customers. For example, the Mahangar Gas Limited (MGL) — a joint venture with British Gas and the Government of Maharashtra was formed in May 1995 to supply Natural Gas to domestic, commercial and small industrial consumers in Mumbai and Compressed Natural Gas (CNG) to the transport sector.

As of January 1, 2005, MGL is supplying piped gas to over 2,10,000 domestic consumers, 637 commercial consumers and 45 industrial consumers and it is supplying CNG to over 1,40,000 vehicles in Mumbai through 96 CNG outlets spread across the city. MGL is shortly going to extend its services from Mumbai to the suburbs of Thane, Belapur and Mira Road.

The Indraprastha Gas Limited (IGL), yet another joint venture company with BPCL and the Government of NCT of Delhi, IGL was incorporated in 1998 for the distribution of Natural Gas to domestic, commercial and the transport sector in NCT of Delhi. As of 1st January 2005, IGL is supplying piped gas to more than 20,000 domestic households, 145 commercial consumers and is providing CNG to over 92,000 vehicles, including DTC buses through 128 CNG outlets spread over the city. Presently, IGL is busy extending its wings to cover Faridabad, Noida and Gurgaon.

Thirdly, the Bhagyanagar Gas Ltd., (BGL), a joint venture by GAIL and HPCL for distribution and marketing of environmental friendly fuels (green fuels) i.e. CNG and Auto LPG for use in transportation, domestic, commercial and industrial sectors in the State of Andhra Pradesh. BGL was formed on August 22, 2003. HPCL and GAIL are holding 22.5% each of the equity while 5% is being held by the Government of Andhra Pradesh and 50% by strategic financial investors.

The BGL has also set up one Auto LPG outlet in the temple town of Tirupati and two Auto LPG outlets in Hyderabad in 2004-05. As regards CNG marketing, to begin with, it has identified Vijayawada in Andhra and has taken up activities of setting up of infrastructure and distribution network. The CNG Mother station has already been commissioned and commercial marketing of CNG for automobiles in Vijayawada has begun in the month of August 2005. Two more daughter stations and six to eight dispensing outlets are coming up shortly. The total investment outlay for Vijayawada city is envisaged at Rs.57 crore over the next three years. BGL has also drawn plans for commencement of CNG in Hyderabad with an investment of about Rs.200 crore in the next three years.

The GAIL today has seven LPG Plants two at Vijaipur and one at Vaghodia, and one each at Lakwa, Assam; Usar in Maharashtra; Auraiya in U.P. and Gandhar in Gujarat, producing over one million tonnes per annum of LPG and other liquid hydrocarbons. LPG is mainly sold in bulk to LPG retailing companies and other liquid hydrocarbon products are supplied to industries.

The field of Petrochemicals is a major area of core competence of GAIL's business activities today. With an investment of Rs. 2500 crore, GAIL has set up a world-class Gas Cracker plant at Pata in Uttar Pradesh, the only gas-based integrated petrochemical plant in North India. The plant has a design capacity to produce 300,000 MTPA of ethylene and plans to expand its capacity to 440,000 MTPA. The Pata plant was commissioned in March 1999. Downstream units include an HDPE production unit of 100,000 TPA capacity and an LLDPE and HDPE swing plant of 20,000 TPA capacity.

The petrochemical complex at Pata is the first one outside Western India and operates on Mitsui's Japanese technology for production of HDPE in India. Specialty grades from this technology are a replacement to the earlier grades. In addition to this technology which is based on slurry process, GAIL's other downstream plant (swing plant of HDPE and LLDPE) is based on solution process using Sclairtech technology of Nova Chemicals, Canada. With the availability of both the processes, GAIL now produces a very wide range of HDPE. A steady price and availability of input raw material (Natural Gas) and some tariff exemptions are major advantages to GAIL in this highly competitive industry.

GAIL has taken up an equity stake in three companies in Egypt as well: Shell CNG Egypt, Fayum Gas and Natgas. The first dividend from Fayum Gas for an amount of US 0.56 million dollars has already been received by GAIL. Last year, the consortium of GAIL, Daewoo and Kogas successfully found gas in Myanmar A-1 block. The Ministry of Energy, Government of Myanmar has issued a Letter of Intent (LOI) confirming GAIL as the preferred buyer for the gas from the A-1 Block.

GAIL is riding very high as is evident from the Global Platts Survey 2002-03 which has ranked GAIL as the No.1 company among global gas utilities in terms of return on investment. Adding one more feather to its cap was the prestigious SCOPE Award won by GAIL for Excellence and Outstanding Contribution to Public Sector Management for the year 2002-03 from the Prime Minister of India.

OIL INDUSTRY SAFETY DIRECTORATE (OISD)

To lend utmost importance to the aspect of Safety in the oil and gas industry, the Ministry of Petroleum & Natural Gas set up the Oil Industry Safety Directorate (OISD). This body was founded mainly for formulating, coordinating and implementing self-regulatory measures to ensure the safety of workers, plant and equipment in the Indian petroleum industry. Initially two core groups, i.e. engineering and process groups were established with a view to develop standards by pooling expertise of PSU oil companies. Later other groups were added. The first to head OISD was IndianOil's K K Malhotra, Director (R&P) Rtd.

In the foregone chapters it has already been revealed how the birth of India's oil industry took place about a hundred years ago in Assam. The small refinery that was set up in 1901 by the Burmah Oil Company saw a lot of modifications and additions till the 1940s. On the other hand, Burmah Shell, Stanvac and Caltex kept themselves busy during the next eighty years building and expanding their coastal and inland terminals and depots.

From mid-fifties onwards, eleven more refineries (as on April 1986) with a variety of secondary processing facilities were built in association with the multinationals, such as Stanvac, Burmah Shell, Caltex, Phillips Petroleum, Amoco and the Russian, Rumanian and the French Governments with an equal support from EIL. While some of them were State-owned from their very inception, others were bought over by the Government in the 1970s.

The facilities at almost all the refineries were of different vintages, both Indian and foreign, and were built on philosophies and practices adopted by an assortment of collaborators at that point of time who incorporated their own philosophy in process design, layouts, fire fighting techniques and equipment. This variety demanded standardisation of methods of inspection and maintenance schedules and other safety procedures.

Some of the major accidents which highlighted the urgent need for an Industry Safety Organisation are noted below :

- The LPG accident at the Mori Gate in Ram Bazaar, Delhi on September 3, 1982 in which twelve persons needlessly lost their lives. This accelerated the process in replacing of 'F' type valves on the LPG cylinders with 'Click-on-Valves' (pin type)—a process which had already been launched.

- The fire in IndianOil's Shakurbasti LPG Bottling Plant on May 15, 1983 resulting in destruction of the plant's entire bottling facilities, although the main LPG bulk storage Hortonspheres were saved. Apart from the severe damage to the plant, four persons outside the plant were killed when the exploding cylinders smashed into them. This serious accident led to a complete change in the design philosophy of LPG bottling plants when new safety standards were subsequently specified by the OISD.
- The Cochin Refinery fire on March 8, 1984, which crippled the refinery. It had to suspend operations for seven months causing heavy financial loss.
- A series of fires in refineries, petrochemical plants the world over, including the BAPCO fire in Bahrain, the Elixborough fire in the month of June 1974 in UK, were some other major disasters.
- The PEMEX disaster in San Juanico, Mexico in the month of November 1984 in which as many as 410 people lost their lives, and more than 60,000 people living around the plant had to be evacuated.
- The tragic Bhopal gas disaster of December 1984 in Union Carbide's Methyl Isocynate plant in which over 2,500 people lost their lives and literally thousands were maimed for life. This tragedy has the sad distinction of being the worst accident in the industrial history of the world.

The Petroleum Ministry took a decision in 1985-86 notwithstanding the statutory laws, the oil industry which was then wholly owned by the Government, with its vast experience, access to codes, philosophies, practices related to various functions and engineering disciplines prevailing in India and abroad, should itself standardise these codes for all future facilities of the Indian oil industry as an exercise in self-regulation. Having established this philosophy, the existing installations could be reviewed against the newly established standards and upgraded as far as possible on a risk analysis and cost-effective basis.

Accordingly, the OISD was formed in 1985-86. Subsequently, the Ministry of Petroleum & Natural Gas on January 10, 1986 constituted an apex level Safety Council headed by Secretary, Petroleum as its chairman and included Additional Secretary, Joint Secretaries, Advisers in the Ministry of MoP&NG, the Chief Executives of all Public Sector Undertakings of the oil industry, statutory bodies such as the Chief Controller of Explosives; Director General of Mines Safety; Adviser (Fire) to the Government of India; Secretary, Central Electricity Board and Director General of Factory Advice and Labour Institutes as members.

Functioning of the OISD

A small group of technical experts on deputation from the industry formed a core group of the OISD. Presently, it is headed by an Executive Director, (although its first head was K K. Malhotra of IndianOil), and got its direction and guidance from the Safety Council, which was the apex body.

The Safety Council and the Safety Directorate did not supplant or in any way take away the ongoing responsibilities of various statutory agencies like DGMS, CCOE, Inspectorate of Boilers, Factory Inspectors etc. It also did not dilute the responsibilities of the Chief Executives of the oil industry who were ultimately responsible for all safety measures in their organisations.

Jurisdiction of OISD

Presently, the following activities of the Oil & Gas Industry attached to the MoP&NG are under the jurisdiction of OISD:

- Upstream Oil/Gas activities.
- Refinery operations.
- Pipeline operations regarding storage, transportation and distribution of crude oil and petroleum products.
- Marketing of petroleum products.

Functions and Responsibility

- To keep abreast of the latest design and operating practices in the area of safety and fire-fighting in the hydrocarbon processing industry in developed countries, so as to evolve standards and codes that would be suitable for conditions in India.
- Carry out periodic safety audits, review, suggest procedures for improvements and report on the implementation of the suggestions to the Safety Council.
- Collect relevant information and exchange it with members of the Oil Industry, including information regarding near accidents, accidents and disasters occurring in the oil industry and organising inter-country meetings for exchange of experience.
- Carry out enquiries into accidents, whenever required and provide support to Enquiry Committees set up by the Government.
- Ensure implementation of all approved codes of practices for industrial hygiene.
- Review practices in the storage and handling of dangerous chemicals and ensure compliance with latest standards.
- Review disaster control procedures and company preparedness.
- Review inplant training programs with regard to safety.
- Specify critical drawing and layouts that need to be vetted by Safety Specialists at the design stage and carry out spot checks of design standards based on site audit findings to serve as feed-back for establishing new standards at the design stage.
- Review zoning regulations around installations and advise industry accordingly.

The OISD collects information on any major accident or fire occurring in the oil industry and apprises the MoP&NG of the same immediately. In case of a major accident or fire, the OISD issues an Advisory Note, highlighting key issues involved to all the oil industry members so that necessary steps are taken in all other industries to prevent the recurrence of similar mishaps. It also collects information on all the accidents taking place in the oil industry on quarterly basis and maintains a database.

Data on accidents and fires are subsequently analysed to find out trends, time of incidents, various causes, damage and loss to the plant and facilities, injuries and loss of human life etc. The purpose of collecting this information was to enable industry members to review their safety performance so that they would be able to determine the efficacy of their management systems and highlight any deficiency so that corrective action is taken to operate the industry on almost zero-accident risk despite the hazards intrinsic to its operations.

The OISD recently brought out a booklet incorporating major industrial accidents that occurred in the oil industry during 1991-96. In this booklet all incidents have been analysed in-depth, including human errors like non-compliance of safety regulations, procedures, inadequate training, non-usage of safety devices and equipment, source of ignition and source of fuel to the fire. This effort of the OISD was appreciated by the Oil Industry as it helped them learn and take corrective steps wherever necessary.

As is well known, any amount of one time in-built measures can-not prevent accidents in future and no one can guarantee total prevention of accidents, unless the laid down procedures are strictly adhered to and carried out as stipulated. Thus, in the potentially hazardous petroleum industry it was essential to effectively manage the 'total system' including the hardware, the personnel, procedures and practices.

Safety awareness of the personnel needed to be strengthened at all levels in order to achieve the objective mentioned above. The OISD, time and again gives due emphasis to this aspect and periodically conducts Safety Workshops all over the country for the benefit of personnel engaged in crude oil exploration, production, refining, transportation and distribution.

FUNCTIONS OF VARIOUS GROUPS

Engineering Group

The activities of the Engineering Group includes among other things, Safety Audit of the refineries. It covers operations, maintenance and project activities of the refineries in particular.

The Engineering group also helps in pre-commissioning audits of the refineries and marketing locations. The above Group also organises Safety Workshops and conducts Accident Analysis, and also engages itself in development of Standards.

Process Group

- Conducts external safety audits of refineries once in two years along with Industry members, and also conducts surprise inspection of refineries annually.
- Is responsible for development of standards, fire-accident investigation and performance evaluation for refineries and marketing locations for the purpose of safety awards.
- The activities include accident investigations, development of standards, pre-commissioning audits, maintenance of database on safety recommendation and compliance, and conducting safety workshops and classrooms.

Pipeline Group

The activities are: accident investigations, safety audits, surprise safety inspections safety workshops, monitoring of implementation of safety recommendations.

Exploration and Production Group

The activities are: accident investigation, external safety audits, and monitoring progress of safety recommendations and Development of Standards.

Gas Processing Group

This Group looks after the plants and facilities and related LPG Recovery, Gas Processing and Purification, LNG handling, storage, gasification and transmission etc. and all cross-country pipelines for crude oil, petroleum products and gas.

Environment Group

Guides on air and water pollution Acts and Rules and Emission Control.

Standards

Development of Standards is one of the most important activities of the Safety Directorate. This is required to be done to keep abreast of the latest design and operating practices in the areas of safety and fire fighting in the hydrocarbon processing industry. The areas where standards; recommended practices and guidelines need to be developed are identified as proposed by the industry to the OISD.

Work on these topics commences after the same are approved by the Steering Committee. The standardisation work is then taken up by the functional committees nominated by the Steering Committee. As a continuous exercise, every year new areas of Standardisation are identified. Over one hundred standards till date have been issued by the OISD, including specifications in respect of storage, handling, transportation of LPG and three in the same category for bulk products.

Review of OISD Standards

Standards once printed and published are reviewed every four years. At the end of four years the standards are revised to incorporate the latest technological changes and experience gained during the intervening years. This exercise is an on-going process.

Safety Awards

Oil Industry Safety Awards were instituted in order to inculcate a friendly competition among oil companies in order to improve their safety standards and performance. Safety performance of the competing organisations and installations are evaluated with the help of a new criteria developed by OISD which takes into consideration, the total loss concept, that is fatalities, fires, lost time, direct and indirect losses etc., and also potential hazards.

However, currently there are no regulations governing Offshore Oil and Gas Industries. The Norwegian Petroleum Directorate (NPD) offered assistance to the OISD (through the Government of India) to formulate such regulations. After studying the Norwegian concept for which NPD is the enforcing authority, discussions were held with the several concerned agencies and Government departments. Considering the various aspects involved and the existence of different agencies for each of these aspects, Onshore and some Offshore, such as the Directorate of Mines Safety, Factory Inspectorates, Labour Commissioners, Controller of Explosives, Electricity authorities (Central and States) Coast Guard, Department of Ocean Development etc., it was considered desirable not to enact any new legislation and was left to the Directorate General of Hydrocarbons (DGH) to stipulate the required conditions in the License Agreement.

To conclude, the formation of OISD was one of the most progressive initiatives taken by the Ministry of Petroleum. The great strength of the OISD lies in the fact that it is a self-regulatory body in which the industry feeds-back to itself its own experience with the aim of elevating standards of safety for men and material in an industry which is potentially the most hazardous and yet can be operated in an extremely safe manner if due care is taken at all times. The best help is self-help. The best audit is self-audit. OISD which is nothing but the industry itself has made India's oil industry among the safest in the world.

EXPORT OF INDIAN EXPERTISE THROUGH PETROLEUM INDIA INTERNATIONAL

During the seventies, under various country-to-country agreements and protocols, experts from ONGC, IndianOil, MRL, CRL and other oil companies in India were seconded (sent) to various friendly countries like Algeria, Iraq, Libya, Malaysia, Sri Lanka, Nepal and the Maldives. This was a cooperative effort and a throwback to the 1960s when the erstwhile Stanvac, (later Esso), Shell and Caltex had carried out a similar exercise when they had seconded Indian engineers and professionals from their refineries and marketing companies on assignments abroad not only to their refineries, but also to their far-flung subsidiary companies located overseas.

When it was discovered that skills of Indian professionals were in considerable demand abroad, enterprises in India's oil industry decided to take advantage of this market demand by coming together on a common platform to form a consortium in order to pool their resources and export Indian skills and expertise to countries where such demand existed. On 1st March 1986, the CEOs of several oil PSUs got together and signed an MoU establishing Petroleum India International, (PII) a unique business venture.

Member signatories of the PII were: Indian Oil Corporation Ltd., Hindustan Petroleum Corporation Ltd., Bharat Petroleum Corporation Ltd., Madras Refineries Ltd. (now Chennai Petroleum Corporation Ltd), Cochin Refineries Ltd. (now Kochi Refineries Ltd), Engineers India Ltd., IBP Company Ltd., Bongaigaon Refinery and Petrochemicals Ltd., and Indian Petrochemicals Corporation Ltd. Initially ONGC was not a member, but it too joined the consortium on April 1, 1994.

The Constitution of PII incorporated the following business agenda: a) Secondment of human resource for assignments abroad. b) Providing training expertise in India and any other business approved by the Management Committee. c) Any other business approved by the Management Committee.

The initial expenditure of the Consortium was to be met out of a corpus fund created by a contribution of Rs. 5 lakh each from member companies. Accordingly, a capital of Rs. 50 lakh was raised to meet the expenses of PII. In the initial years, PII's realm of activity shifted willy-nilly to loaning Indian manpower for utilising their various professional and vocational skills. But this was only a partial fulfillment of the purpose for which PII was set up. From the mid-nineties onwards, PII attempted to enlarge its scope of activities to training, consultancy, both technical and management as well as in the field of information technology.

Technical Consultancy

As far as Technical Consultancy was concerned it included the taking over of sick refineries, stripping and assembling them at another location. For example, the 19,000 barrels per day (bpd), Al-Khafji Refinery in Saudi Arabia was successfully dismantled and rebuilt and re-commissioned at Ras Işa in Yemen with an upgraded capacity of 45,000 bpd. Recently, the Riyadh Refinery in Saudi Arabia invited PII to take over and upgrade their refinery and make it economically viable.

Likewise an adequate technical back-up was provided to Newport Harcourt Refinery by undertaking their O&M contracts from the year 1989 to 1996. During this assignment, PII also provided technical support to 100 specialists and simultaneously took up the task of imparting hands-on training to locals. For the Newport Harcourt Refinery, the PII later successfully planned and executed first of the two Turn-Around-Managements (Tams) along with NNPC engineers.

In yet another assignment handled by PII, the President and Minister of Energy of Mauritania expressed their keen interest in PII taking up and reviving their sick Somir Refinery by managing it for a period of three years on the basis of commitments and guarantees on efficiency and by upgrading the performance parameters of the refinery. PII has also bagged an Engineering Consultancy Contract for Bapco, Bahrain and Qatar Petroleum, Qatar.

PII added one more feather to its cap when it successfully executed a Turn-Around-Management (Tam) in 1994 for the Warri Refinery & Petrochemicals (WRPC), Nigeria. This prestigious assignment was completed much within the given timeframe to the entire satisfaction of the client.

Management Consultancy

As far as management consultancy is concerned PII has been successful in taking over the management of the marketing & distribution company, Nolchem, in Nigeria. PII also took over the management of Madagascar's only oil refinery (Solima) after it was privatised and taken over by strategic investors, Iqbal Rahim Azad Hirdzee and Guinness, and renamed it as Galana SA Refinery. Interestingly, this refinery had been declared as economically unviable by the World Bank but to everyone's surprise PII managed to turn it around at one-third of its originally estimated refurbishing cost of 35 million American dollars.

The PII has made its presence felt in Ethiopia too. The Ethiopian Management Institute (EMI) was entrusted with a total study of the Ethiopian Petroleum Enterprise (EPI). The latter retained Petroleum India International to carry out the study relating to commercial activities of the enterprise especially in the areas of Procurement and Operations.

PII's most recent achievement was when it won a turnkey contract for building a 100,000 bpd grass-root refinery at Lagos in Nigeria.

As a result of the above activities, PII has deputed about 1,500 personnel from the Indian Petroleum and Petrochemicals sectors to 29 countries. The initial contribution of Rs.5 lakh has yielded dividends of over Rs.250 lakh to each member of the consortium. From a negligible turnover for the year ending March 31, 1987, the turnover presently has touched a figure of nearly Rs.5200 lakh for the year ending March 31, 2005. The net profit has gone up from Rs.117.28 lakh during 1990-91 to approx. Rs.1200 lakh for the year 2004-2005.

PII's work was duly recognised by the Federation of Indian Export Organization (FIEO). The consortium bagged the *Niryat Shree* award for the year 2000-01 and the *Niryat Bandhu* award for the year 2001-02 for being the best Indian Export House in the international market. The most recent was FIEO's Gold Trophy for 2002-2003 for being the best consultants in the sub-continent.

By pooling in-house talent of India's petroleum and engineering sectors, and exporting the same, PII has shown what Indian professionals in the field of engineering and technology and IT skills are capable of. There is no doubt that Indian professionals in their respective technical fields are second to none in the world. The future holds even greater opportunities and provides a wider scope as the world rapidly marches towards a global knowledge society.

INDUSTRY R&D

R&D - BHARAT PETROLEUM CORPORATION

Bharat Petroleum Corporation Ltd.; started investing in research and development activities in Mumbai in a small way in 1983. Bharat Petroleum's R&D was launched with clearly defined objectives and mission, which was: "*To create a centre of technical excellence for products and application development through the pursuit of knowledge and by fostering creativity and innovation and to be a trendsetter in the petroleum industry*".

During the last ten years, BPCL R&D Centre's track record has been commendable. It developed more than 300 product formulations, 101 new products and around 60 alternate formulations. It commercialised 49 products and obtained around 125 approvals from equipment manufacturers, resulting in total savings of about Rs.70 crore.

Their R&D Centre's efforts have resulted in making Bharat Petroleum trendsetters in heavy duty petrol, 2T and 4T engine oils in the industry. It also succeeded in developing long life hydraulic, turbine and screw compressor oils and also customer-specific metal working fluids and lubricants. Apart from lubricants, the Centre has also developed the very first branded gasoline named ***Speed*** introduced in 2002 — the first of its kind by any oil company in India. ***Speed*** today commands a market share of over 60 per cent, thereby beginning a new trend in branded fuels, a field that hitherto lay untouched by any other oil company in India. Not content with just ***Speed***, Bharat Petroleum has now added and launched several other brands to their product mix such as ***Speed 93, Speed 97*** and High Speed Diesel under branded fuels, which has made the oil company an enviable market leader in automotive fuels.

Bharat Petroleum's R&D personnel also visit their various customers and industries, where they promptly redress customer complaints, provide guidance on field issues and technical developments. BPCL's R&D Centre has carried out a number of field trials on their products with the Railways, State Transport Undertakings, Defence, Hero Honda, Maruti Udyog Ltd., Ashok Leyland, Bhilai Steel Plant, Mahindra & Mahindra, Tata Motors, Atlas Copco, LG Electronics, ZF Steering Gear Pvt. Ltd., and Waukesha.

The Corporation committed an investment of Rs.300 crore in a phased manner in 2001. This resulted in the development of an additional R&D Centre at Noida near Delhi as well. Today this Centre built on a sixty-acre plot of land with a floor-space of 25,000 square meters stands as a testimony of the Corporation's commitment to research and development activities. The Noida R&D Centre has state-or-the-art facilities including pilot plants to carry out research on projects particularly related to refining, like catalysts, crude evaluation, bitumen emulsions, separation processes, corrosion and fouling, modeling, simulation, which undergo trials in their pilot plants.

The Ministry of Science & Technology has duly recognised both the Mumbai and Noida Centres. About 55 qualified scientists man the R&D activities at both places. These centres would certainly meet the Corporate objectives of setting up an international standard of R&D facilities by offering technical advice to customers on all petroleum products, and preparing for future frontier technologies like environmental friendly, synthetic, renewable and bio-degradable products to translate visions into concepts and set an overall development plan by executing strategic directives and convert concepts into tangible products and services.

R&D - BALMER LAWRIE

To Balmer Lawrie & Company Ltd goes the credit for pioneering the production of lubricating greases in India, and they did it more than six decades ago. The company has in its product basket today three hundred grades of greases and lubricants with an additional vast range of specialty products developed solely through in-house research and specifically tailor-made for critical applications.

The Corporate R&D Centre of the company named, Applications Research Laboratory, formally came into existence in 1981 with the primary objective of carrying out applications-oriented development work in the field of greases and specialty lubricants.

The objectives of the R&D Centre may be broadly summarised as follows:

- Development of new products and processes.
- Quality upgradation and cost reduction of existing products.
- Upgradation of technologies.
- Research on alternative raw materials.
- Import substitution.
- Problem solving in lubrication and support services to customer.
- Technology acquisition and adaptation.
- Value engineering.
- Horizon scanning.

Balmer Lawrie's R&D work encompasses development of new products and processes in the field of lubricants; performance evaluation, scale-up and commercialisation of high performance greases, oils and specialty lubricants for Railways, Steel Plants, Defence, Mining, Jute, Textile, Cement, Oil Exploration and various Heavy Engineering industries as well as for the automotive sector; analytical support services and technical service during field trials to demonstrate the performance of newly developed products to the satisfaction of customers.

The company spends almost two percent of its related business turnover on R&D. The major milestones in the R&D effort of Balmer Lawrie in recent times have been the development of extreme pressure highly water resistant grease for hot strip mill and cold rolling mill applications in integrated steel plants and secondary steel sector. High performance grease for concast application in the steel industry, long-life greases for Railway applications, synthetic greases able to withstand extremes of operating temperatures, greases based on novel thickener system for cement and sponge iron industry, sprayable grease for girth gear applications, synthetic greases for the electronic industry, an entire range of greases for the Defence sector, specialty thread compounds for the oil exploration industry, high temperature synthetic chain and gear oils, an entire gamut of semi-synthetic and fully synthetic cold rolling oils for different configurations of cold rolling mills in the integrated as well as the secondary steel sectors, rolling oils for the non-ferrous sectors, rust preventives and other speciality oils for ferrous as well as non-ferrous industries.

Thus the Applications Research Laboratory of Balmer Lawrie spearheads the company's consistent efforts to offer better product performance and value to customers with Balmerol lubricants and services. In addition, the company has a satellite R&D Centre, referred to as Product Development Centre at Manali in Chennai to meet product and process development requirements in leather chemicals.

R&D - HINDUSTAN PETROLEUM CORPORATION

Hindustan Petroleum Corporation Ltd., (HPCL) set up a new laboratory for R&D in 1983-84. This was a part of an overall strategy for development of process technology for which a pilot plant was set up for studies in de-aromatisation of kerosene and Naptha from Bombay High. In addition, a Product Development Centre was set up in which HPCL experimented and produced new blending formulations for their lubricants.

R&D - CHENNAI PETROLEUM CORPORATION LIMITED

What was Madras Refinery Limited (MRL) became the Chennai Petroleum Corporation Limited (CPCL) soon after the city of Madras was renamed as Chennai. .

As a stand alone refinery, it had the rare distinction of being the most modern in India at the time of its commissioning. For its lube complex, MRL obtained its lube extraction technology from the Texaco Development Corporation of USA. The design was, however, restricted to specific types of crude and solvents for obtaining a product range of certain specifications. The refinery felt it necessary to maintain its technological edge particularly when plans were afoot to double the refinery's capacity to 5.6 MMPTA. This task was achieved in March 1985.

The CPCL established its R&D Centre around July 1984, a little before the completion of a major refinery expansion. Initially its R&D activities focussed on the indigenous development and improvement of lube extraction technology, such as evaluation of various feed stocks lube potential, study for new solvents for extraction of lube fractions, establish optimum operating conditions for revised specifications, study the effect of different operating variables in lube extraction with a view to optimise the lube refining operation, carry out studies on the solvent recovery circuit to minimise utilities consumption and study different types of extraction columns for lube extraction service and to develop capabilities for carrying out the process design of various extraction columns. In due course of time the R&D Centre enlarged its activities into several other areas of refining technology as well — as envisaged in its mission stated below:

- To provide technological inputs to meet the corporate objective of technical excellence in all aspects of refinery operations.
- To promote indigenous technologies for refinery processes in association with national laboratories.
- To develop new products and upgrade the quality of existing petroleum products.
- To conduct environmental impact assessment studies and water minimisation.

In 1992, the lube extraction pilot plant was set up at a cost of Rs. 5.0 crore. This could run on both furfural and N Methyl 2 Pyrodoline (NMP) and was intended to develop indigenous capability for lube extraction. These efforts resulted in successful absorption of the NMP extraction technology (superior to furfural extraction) for the lube expansion unit. This innovation was recognised by the Department of Science and Industrial Research (DSIR) for a national award for R&D efforts in Industry for Technology Absorption for the year 1995.

In the year 1996-97, data obtained from the lube extraction pilot plant was the basis for EIL to design the process package of NMP extraction unit at Haldia. This was the result of a collaborative research effort of IIP, Dehra Dun and EIL. The latter developed the commercial package for lube extraction. For this work CPCL R&D was awarded the CSIR's 'Technology Shield' in the field of Process Technology.

In 1987 FCC, distillation pilot plants and micro-activity test units for FCC catalyst evolutions were established. In the 1996, CPCL set up a Vinci High Pressure Reactor System and a Xytel Hydrotreating pilot plant to evaluate catalysts for hydro-processing applications. The R&D centre also generated data for revamping of the Crude Unit-I Vacuum Tower and provided continuous support for optimising the distillate quality of the revamped unit.

The R&D of CPCL has been a major contributor towards the commercialisation of indigenous technologies such as the development of Bimetallic Reformer Catalyst for Plant-3 with IIP-IPCL 1989-91 and the IIP-EIL process for Food Grade Hexane.

In addition, work is in progress in the following areas: Evaluation of FCC catalysts for the commercial FCC unit, evaluation of Commercial Ultra Low Sulphur Diesel catalysts, Hydrotreating Pilot Plant, Forozon Crude Assay and Analysis of samples for Process Engineering

In conclusion, it can be said that now that CPCL is a part of the IndianOil group, its R&D activities could potentially escalate and provide that extra synergy working in tandem with IndianOil's R&D Centre at Faridabad.

LPG EQUIPMENT RESEARCH CENTRE (LERC)

While talking about LPG Safety, with a capital 'S' is the most dominant factor that overrides everything else concerning this highly inflammable gas. As the number of LPG consumers in India went on to grow dramatically over the years, the task of oil companies to provide safer fittings to LPG cylinders became a grim responsibility.

With this end in view, in 1981-82 it was finally decided to phase out the old 'F' type valves installed on LPG cylinders and replace them with a far superior and a safer valve of a better design called 'Click On' valves. These valves had a spring loaded pin type mechanism which would open only when connected to a pressure regulator through which LPG gas flowed through the hose pipe to the hot plate.

One major advantage of the Click-On-Valve over the old 'F' type valve was that once the pressure regulator was removed the spring would automatically shut the click-on-valve, minimising accidents in the kitchen due to leakage. The best locally manufactured click-on-valves rapidly began to replace the 'F' type. However, there were a series of failures of the new locally manufactured click-on-valves as well, possibly due to a basic flaw in its design.

Around 1983-84, it was decided in the interest of safety to import the best pin type click-on-valves and matching regulators available in the world and install them on domestic cylinders. A year later it was decided by the oil industry with due concurrence from the Ministry to bring in technology from Kosan in Denmark and Siraga in Italy and make it mandatory for all manufacturers of valves and regulators in India to manufacture these fittings by strictly adhering to the new technology that was passed on to them free of cost. This attempt enabled India to manufacture world-class valves and regulators.

Over the years, especially when the number of domestic consumers exceeded a crore, it was felt that an indigenous LPG Equipment Research Facility ought to be created on an industry basis, to invent, develop and evolve the best world class designs for all LPG equipment, including valves, regulators leak detectors etc., within the country.

Furthermore, there was an urgent need to have an indigenous R&D facility to maintain the quality of valves, carry out tests on new inventions etc. Accordingly, in April 1990 IndianOil took the initiative of setting up the LPG

Equipment Research Centre (LERC) on an industry basis, with BPC and HPC cooperating and contributing resources. The LERC was originally set up on a temporary basis opposite IndianOil's bottling plant at Bangalore. In January 1996, it moved to its current permanent complex at Doolvani Nagar in Bangalore in Karnataka.

In the month of January 1993, LERC was registered as an independent society under the Karnataka Societies Registration Act, 1960. Activities were governed and monitored by the General Body which comprised IndianOil, Bharat Petroleum and Hindustan Petroleum. The Governing Body comprised: Director (Marketing), Bharat Petroleum (Chairman); Director (Marketing), Indian Oil Corporation (Member); Director (Marketing), Hindustan Petroleum (Member); Director (R&D), IndianOil (Member); Executive Director (LPG) (Member); Director, Indian Institute of Petroleum, Dehradun (Co-opted Member); Executive Director, Petroleum Conservation Research Association (Co-opted Member); General Manager (Retail), GAIL (Co-opted Member) and Scientist (G), DSIR (Co-opted Member).

The Executive Committee of the LERC consisted of: Executive Director (LPG), IndianOil (Chairman); Executive Director (LPG), HPCL (Member); Executive Director (LPG), BPCL (Member); Chief Controller of Explosives, Nagpur (Member); General Manager (S&EP), Refineries Division, IndianOil-Member; Deputy General Manager (Eng.Tes. & Lab), Bureau of Indian Standards (BIS)-Member; Deputy Director General (Lab), BIS (Member); Deputy General Manager, (Fin), IndianOil, HO,(Member); Sr. LEM, BPCL (Member); Chief Executive Officer, LERC, (Member); DGM (LPG-Ops), HPCL, (Associate Member) and Sr. Manager (LPG-TAT), HPCL (Associate Member). Over and above this Executive Committee, there was the Oil Industry Technical Committee (OITC) whose task was to monitor the day-to-day activities of the LERC.

The LPG Equipment Research Centre now plays an important role in promoting technical up-gradation of safety standards and quality of LPG Equipment in the country. The Centre has the following main objectives:

- Development evaluation of equipment/safety devices in all aspects of the usage of LPG from the Bottling Plants to the consumers, including storage distribution, transportation, handling and application — consistent with Safety, Productivity and Quality.

- To study the design and specification of the equipment and suggest modifications and undertake research to improve overall efficiency, safety and economy.

- Development of know-how for various equipment appliances, devices etc., based on generated know-how and know-how available abroad. Development of new and indigenous technologies for various equipment, appliances, devices etc., to cope with growing technologies abroad for import substitution.

- To improve existing standards and develop new standards wherever necessary.
- To study the process controls adopted by various equipment manufacturers and suggest better methods and procedures with the aim to produce fail-safe zero defect equipment.
- Provide basic facilities for testing and evaluating raw-materials used in the production of cylinders, valves, regulators and other equipment, including components. This will include analysis for the use of various alternate raw-materials (metallic and non-metallic) which can give better working results.
- To carry out periodical testing of samples of cylinders, valves, regulators and other equipment drawn at random from the manufacturers, field and bottling plants for their performance, quality and workmanship etc.
- To undertake detailed analysis of equipment involved in failure/accident cases and to suggest corrective and preventive measures.
- To carry out chemical analysis on LPG to find out the influence of various ingredients on other materials coming in contact with LPG.
- To undertake, promote and assist in research and development of appropriate and alternate uses for LPG.
- To improve the efficiency of existing methods in the field of distribution and utilisation of LPG.
- To help in achieving optimum utility of LPG by training or developing personnel in fuel efficiency techniques and practices.
- To provide technical advisory, services, designed to achieve greater economy, efficiency etc., in all spheres and activities involving LPG.
- To assist in establishment or development of special institutions, research and development organisation, in pursuit of specific activities dealing with problems affecting conservation, application of LPG and its related equipment.
- To assist BIS in developing standards for products and materials used in the LPG Industry.

Over the years, LERC has developed and improved a number of LPG Equipment and a few of those implemented by the oil industry are as follows:-

- LPG rubber hose, *Suraksha* (installed capacity — (approx. 6.0 lakh metres/month/eight vendors)
- Tamper Evident Sealing System — Implemented by IOC/BPC/HPC in almost all plants from 1998 onwards.
- Modification to cylinder design: footring, vapour pressure ring assembly— implemented by IOC/BPC/HPC
- Valve Retrieval System — implemented by IOC/BPC/HPC (approx. 100 units manufactured by LERC and supplied to oil companies).

- Density Meter — implemented by IOC/BPC/HPC (approx. 175 units manufactured and supplied by LERC).
- Rubber Compounds used for valves and DPRs - implemented across the board.
- Cylinder Unloading Device — sparingly implemented.

The LERC has been recognised by the Department of Scientific and Industrial Research (DSIR), Government of India, and its Polymer Laboratory is recognised by the Bureau of Indian Standards (BIS). The Centre is a part of various committees of the Bureau of Indian Standards relating to LPG equipment and rubber products for evolving and upgrading standards safety and quality. With the burgeoning list of LPG consumers in India, the role and responsibility of LERC has become increasingly important.

CONCLUSION - (R&D)

The international hydrocarbon industry made rapid progress during the Second World War and the post-war decade. This growth became a dominant factor in the economies of both the countries engaged in the post-war reconstruction as also in countries that had newly gained independence.

The latter nations at that point of time had neither the access to technologies in this field nor was experienced or trained manpower available to obtain technologies and progress further. India too found itself in a situation which was no different. Barring a few people who had worked at the Digboi or overseas refineries, all that was available was a small pool of raw talent, with little hands-on experience in the hydrocarbon sector.

With the emergence of the public sector oil industry, ONGC, IRL and IndianOil, one of the first tasks before the planners was to establish R&D institutions which could address the knowledge needs of the Indian hydrocarbon industry. The massive implosion of knowledge as a result of the boom in information technology has drastically transformed human beings and societal structures all over the world. Only thirty years ago (in the seventies) it was said that the overall knowledge bank of 'Human Kind' was doubling every ten years. In today's world this doubling is now taking place every five years.

In this rapidly changing international environment, effective and dynamic R&D activities have become as crucial to a country as energy security. Beginning with IIP in 1959 followed by EIL's R&D in 1970 and IndianOil in 1972 and others, the oil industry in India as a whole has taken care to promote R&D activities in various segments of the Industry as the information provided in the preceding pages has revealed. However, the quality, quantity, and value to society of the relevant work done very much depends on the degree of leadership, commitment, motivation, determination and the calibre of people manning the various R&D institutions. It is fondly hoped that the R&D activities in the oil industry in India will grow to become second to none in world.

CENTRE FOR HIGH TECHNOLOGY (CHT)

With the Oil Industry having totally come into the fold of public sector, the Government of India found it absolutely necessary to develop indigenous capabilities in order to attain technological competence and self-reliance in the field of hydrocarbons. With this end in view, a dedicated technology cell named, 'Centre for High Technology' (CHT) was formed by the Ministry of Petroleum & Natural Gas, through a Resolution dated May 27, 1987 and the Cell started functioning in right earnest from August 24, 1987. The first head of the Centre of High Technology was Dr. Jayarama Rao.

The CHT directly functions under the aegis of the Ministry of Petroleum. The Governing Council is headed by Secretary, Ministry of Petroleum & Natural Gas which includes the Additional Secretary, Joint Secretary, Adviser (Refineries), and Chief Executives of oil companies, CMD, EIL, Director, IIP and Secretary, OIDB. The latter also provides the funding for research and development in the field of refining technology, while the former acts as a focal point where information and experience are periodically exchanged in assessing technology requirements to explore the possibilities of developing them indigenously.

Ever since the CHT was set up, it has lived up to its name by updating technological information and by providing support to the downstream hydrocarbon sector through the support of the Ministry of Petroleum. Broadly, following are the areas where the CHT is providing necessary assistance to the industry:

Selection of Technologies: Includes assessment of futuristic technology requirements for acquiring, developing and adopting such modern methods in the refining process as also their application in the operational aspects of storage, handling and transportation of crude oil, refined products and gas. The CHT has invariably been involved in the selection of technologies for Reformers, Sulphur Recovery Units, Hydrocracker and Hydrogen plants, Diesel Hydrodesulphurisation Units (DHDS), Fluid Catalytic Cracking Units, Refinery configurations etc, for various public sector undertakings, joint ventures and private refineries.

ENERGY CONSERVATION & PERFORMANCE BENCHMARKING

The CHT has consistently been taking measures to help refineries achieve international standards in the field of energy conservation by regularly carrying out inspection exercises in energy benchmarking, targeting exercises and energy audits. Executive Committee meetings are also conducted on fuel and hydrocarbon loss minimisation and energy optimisation, steam leaks, furnace efficiency and conducts insulation surveys in refineries every year as also organises seminars and workshops, sponsoring Encon-based R&D projects every year.

The CHT also develops and maintains an up-to-date refinery-wise comparative data for energy consumption on a common denomination and also recommends awards for the best performing refinery. Presently, the energy performance of refineries is reviewed quarterly and annually by analysing the parameters on specific energy consumption, fuel and hydrocarbon loss etc. New energy factors have been developed by CHT in association with EIL are now being used for a more realistic assessment of energy consumption replacing the Thomson Energy Factors, which were earlier used to calculate Specific Energy Consumption in the refineries. As a measure of providing support services, the CHT also undertakes a Joint walk-through energy audits of refineries at regular intervals by teams drawn from the refineries, EIL and CHT.

Centralised Assistance from Abroad

The CHT has also entered into technical services agreement (TSA) with British Petroleum, UK, and Caltex, USA on behalf of the industry. The industry greatly benefited by way of receiving advice and consultation on all aspects of refining, measures for specific operational problems, surveys and audit of critical areas, engineering standards and bulletins.

The latest TSA was signed on December 1, 2004 between the Governing Council of CHT and UOP Services Limited, UK; on behalf of public sector refineries, Gas Authority of India Ltd., and Engineers India Ltd., to provide services in various areas of refining and downstream hydrocarbon sector.

Apart from providing assistance in the development of indigenous technology on a continuous basis, the CHT also sponsors specific Research & Development projects and provides the funding whenever the need arises. It thereafter monitors the progress of R & D projects in coordination with the activities of the Scientific Advisory Committee (SAC) and other Government bodies and agencies. It also organises technical events such as refinery technology meet, question and answer sessions, workshops and seminars.

Further, the CHT has developed a Centralised Pool of information on the operational, maintenance and technical experiences of the refineries for use by the oil industry. It attempts to pool and develop expertise in maintenance and inspection, energy conservation, instrumentation and control, pipeline operations, power generation, for the benefit of refineries in India. This also includes publication of CHT in house technical journals like *Hydrocarbon Technology, Technology Scan* and the *CHT Bulletin*.

The CHT also advises and assists the Ministry of Petroleum on scientific and technological programmes. In short, it is the Government's executive wing for coordination, import, acquisition and up-gradation of refinery technology and its utilisation. It helps in the selection and review of technologies for various public sector undertakings, joint venture and private refineries, in association with relevant experts committee constituted by the Ministry to identify technology gaps if any in all our refineries. In cooperation and in coordination with the Scientific Advisory Committee on Hydrocarbons, the CHT undertakes activities related to product and fuel quality issues, formulation of short term and long-term goals and strategies for improving quality of petroleum products in line with international standards.

Some of the recent initiatives and achievements in the field of energy management and optimisations are as follows:

- Joint Energy Audit of 13 PSU refineries in 2002-2003 through teams comprising engineers from refineries, EIL and CHT highlighting potential areas for energy savings.
- Establishing new energy factors for various process units and introduction of the same from 2004-05 for energy performance evaluation of refineries.
- Detailed study and pinch analysis of hydrogen network of Kochi Refinery carried out jointly by CHT and EIL in 2004 to recommend optimum hydrogen generation and consumption.
- Recently, Shell Global has been engaged as a consultant for benchmarking.

POL BASIC ECONOMIC INPUT TO INDIAN ECONOMY

In today's age of science and technology, one cannot imagine a world without hydrocarbons. There is no aspect of life where hydrocarbons do not touch people some way or the other, day in and day out. The presence of hydrocarbons can be seen and palpably felt all around us. No wonder hydrocarbons today and its various products apart from being a prime source of energy, visibly or invisibly plays some role in day-to-day life.

There is no industry like the Oil Industry. It is an industry that heats and lights up and keeps wheels of the nation on the move — be it essential cooking fuel (LPG/SKO) for urban India, illuminating fuel for rural India, feedstock for the fertilizer or the petrochemical industry, fuel for power plants, inputs to Heavy Industry, aviation fuel for commercial aircraft and the Indian Air Force, bitumen for road building, transport fuel (MS/HSD) for automobiles and the Railways coupled with lubricants to reduce friction in all mechanical equipment, be it the axles of a bullock cart or the moving parts of rockets and satellites and other equipment utilised in India's space programme or meeting the POL needs of our valiant armed forces. The oil industry touches every imaginable aspect of life.

Apart from playing a crucial role in the economic and industrial life of India, the oil Industry has been a provider of a significant number of new jobs directly and indirectly. There are around 1.40 lakh people directly employed by the Oil Industry as a whole. It also provides an additional secondary employment of around 6.00 lakh through LPG, SKO, MS and HSD dealerships and around 1.6 lakh people operating private tank trucks. Thus the downstream oil industry is providing direct or indirect employment to nearly to 9 lakh people. Tertiary and related employment opportunities provided by the industry are in addition to the above numbers. The Industry became instrumental in creating a reasonably large pool of trained manpower, including managerial, technical and vocational skills which have contributed significantly in adding to and increasing societal skills.

From the very beginning, the Oil Industry has been intimately linked with the Indian society and it has been amongst the most if not the most socially conscious and committed industry in India particularly from 1969-70 onwards when it became fully aware of its social responsibilities as corporate citizens. For example, the Marketing Plan concept was introduced by the Ministry of Petroleum & Natural Gas with an objective not only to minimise infructuous expenditure on retail infrastructure on an industry basis, but also to achieve socio-cultural objectives of the Government of India in uplifting socially and economically under privileged segments of the Indian society and other special groups (viz. Defence personnel, physically handicapped, war widows etc.) The Industry has left no stone unturned in rising to the occasion during every national crisis be it war or terrorism that India has faced or even major national calamities such as earthquakes, floods, cyclones etc., which have struck the country from time to time.

The Oil Industry was indigenously built brick by brick particularly from the fifties onwards. This produced a tremendous sense of pride and a strong sense of ownership emerged in the industry which was further strengthened and fortified with the formation of the IndianOil Corporation in 1964 and HPC and BPC a decade-and-a-half later. Cutting across Public and Private Sector lines and parochial company loyalties, this sense of pride was further enhanced when Reliance Petroleum commissioned one of the worlds largest refineries in July 1999 built almost entirely with indigenous skills.

The Oil industry, despite inter-oil company rivalries always took a unified Industry consensus on all major issues such as market demand by meeting the needs of its consumers. This approach was further cemented with the formation of the OCC in 1975 followed in 1978-79 by the Regional level Coordinators (RLC) and State Level Coordinators, (SLC) system: the two-company depot concept and mutual oil company hospitality arrangements.

The Oil Industry has always had the need of its customers upermost in its mind. Hence in areas where it was difficult to reach supplies like in the inhospitable snow-clad Himalayan regions, additional storage capacities and facilities have been provided by the Industry. These steps ensured continuity of supplies at all times. On a few occasions when petroleum products could not be reached (on account of heavy snowfall etc.) by surface transport, supplies were even air lifted to the Kashmir Valley.

Because of the nature of material (hydrocarbons) it handles, the activities of the Oil Industry are inherently dangerous, and there is an ever present risk of fire. Yet the Oil Industry's safety record especially after the formation of OISD in 1985-86 has been of a high order. This (need for safety in Design and Operation) dictated a requirement for a very high degree of work ethics professional and managerial skills, team work and reliability. Additionally, progressive merit-oriented recruitment policies ensured high quality of personnel at the input level in the oil companies, who over years of experience produced world class engineers and managers whose services were in high demand in allied industries in India and abroad.

Even today, the Oil Industry in India is overwhelmingly dominated by the Public Sector. Fortunately, almost from its inception, the Oil Industry has been earning profits and declaring dividends year after year. For the period 1999-2000 through to 2004-2005 alone the amount of dividend paid by the Oil Industry to the Government of India has totalled Rs.32,702.62 crore. For the year ending March 31, 2005 the dividend paid by the entire oil Industry has totalled Rs.10,242.62 crore with a rate of return of 37.48%.

Apart from the above, the Oil Industry has been the largest revenue contributor to the national exchequer through Excise and Customs Duty for the Centre and Sales Tax for the State Governments amounting to approx. 22.5% plus of the total revenue collected by the Central and the State governments. This is illustrated by the following table:-

SHARE OF OIL REVENUE IN TOTAL REVENUE IN 2002-05

Year	Accrued to	Oil Revenue (Rs.crs)	Total Revenue (Rs.crs.)*	Share of Oil Revenue in Total Revenue (%)
2002-03	Centre	64595	236936	27.3
	States	32156	178001	18.1
	Total	96751	414937	23.3
2003-04	Centre	69195	263027	26.3
	States	35180	203746	17.3
	Total	104375	466773	22.4
2004-05	Centre	77692	300904	25.8
	States	43254	235283	18.4
	Total	120946	536187	22.6

* Centre's revenue is taken as net of transfers to States. States' revenue is the total receipts of own tax and non-tax revenue.
Source: Report of the Standing Committee on Petroleum & Natural Gas in Parliament, Government of India; State Finances, A Study of Budgets of 2004-05, RBI, Government of India; Budget Documents, Government of India.

It is quite clear from the above facts how the profitable running of the oil Industry is the real revenue sustainer for the country.

In a fast-developing country like India with a per capita GNP of only Rs. 20,071 per year and a per capita energy consumption of only 0.3 tonnes of oil equivalent (TOE) versus a world average of 1.5 tonnes of oil equivalent (TOE) and where around 30% of total energy consumed (approx 134 million metric tonnes of oil equivalent or more than the consumption of petroleum products of 111.56 million metric tonnes for the year ending March 31, 2005) comes from non-commercial sources such as biomass, wood, cow dung etc. it is quite apparent that the consumption of petroleum products as cooking fuel in our homes, for food production, transportation and national security are all essential for the smooth running of the country's economy. They form basic inputs to Indian society as a whole, whose timely availability has a direct impact on the GDP of the country. This is demonstrated by the paragraphs that follow.

Oil in the Home

Before Kerosene made its appearance, firewood, biomass and charcoal were the main sources of fuel used for domestic cooking in India. Soon after kerosene became available, its use went from beyond being merely a source of illumination to become an important medium for cooking. It took some years for Kerosene stoves to enter the kitchen but in the course of time kerosene became the ladies' choice of cooking fuel for at least the urban housewives in India.

Compared to firewood and coal, kerosene was a far better and more convenient cooking fuel as it saved the housewife from the discomfort of eye-smarting smoke and drudgery in the kitchen. By the mid-twentieth century, kerosene became the main source of illumination in rural India and the primary cooking medium in urban India. In both cases, kerosene became an essential commodity for the masses and it was soon covered under the Government's Essential Commodities Act.

Liquefied Petroleum Gas (LPG)

After the commissioning of Burmah Shell, Esso and Caltex refineries, yet another hydrocarbon fuel, liquefied petroleum gas (LPG) made its appearance in India and it brought about dramatic changes in the kitchens across the country. Later on with the emergence of IndianOil, a major thrust in promoting the use of LPG was undertaken initially — only because it displaced imported kerosene. Over the years, cooking with LPG demonstrated its many advantages, of flexibility, convenience, thermal efficiency and almost no indoor pollution. It has now become the preferred cooking medium not only in urban India but also in those rural households who can afford LPG. With over eight crore consumers, LPG has not only transformed urban kitchens but has brought about several important changes in the social mores of LPG consumers, especially among enterprising housewives.

OIL IN TRANSPORT

RAILWAYS

Indian Railways (IR) is one of the major modes of transport in the country. There is no denying that for the last over 150 years Indian Railways has played a vital role in the overall growth of India's economy. While the two main objectives in the construction of the railways in India in the initial stages were to open up the country to trade and also to the explicit gain of British colonizers, it provided speedy strategic links to important defence locations.

With a modest beginning in 1853 of just 34 kms of railway track, the Railways presently have a vast country-wide network of approximately 63,200 route kms with a running track of approximately 83,800 kms, nearly 73% of which is covered by diesel-powered locomotives. The Indian Railways move on an average 1.5 million tons of freight, 40% of which are run on diesel and 14 million passengers per day are carried on trains of which nearly 53% are hauled by diesel locomotives.

Indian Railways is Asia's biggest and the world's second largest railroad system. The railways in turn helped in a big way towards the expansion of oil business. It provided tank wagons and box wagons for long distance haulage of petroleum products in bulk and packages across the country's vast distances and helped the oil industry feed millions of India's far-flung towns and villages located hundreds of kilometers away from the main oil producing centres — the refineries. While a very high percentage of railway locomotives today run on HSD, the percentage of petroleum products it actually transports across the country amounts to only 30% approximately. Thus, this makes the Railways one of the biggest consumers of HSD in India uplifting approximately 20 lakh kls per year.

ROAD TRANSPORT

The invention of the internal combustion engine in 1876 ushered in the motor car revolution, which gathered momentum slowly but steadily over the next two-and-a-half decades. Henry Ford mass produced his 'Model T' Ford and revolutionised the life-style of people in the USA. In due course the automobile changed the life-style of ordinary people the world over. The car owner began to enjoy the freedom to move from one place to another at any time and at his or her convenience. Over a period of years the automobile drastically cut down time and distance between nations and people and provided the impetus for the construction of autobahns in Germany, turnpikes and super express highways elsewhere.

India has one of the longest road networks in the world. The road length of over 2.4 million kms of which over 1.4 million kms i.e. 59% is surfaced with Bitumen (a petroleum product) traverses across the entire length and breadth of the country from Kashmir in the North to Kanyakumari in the South and from Kutch in the West to Nagaland and Manipur in the East. Over 67 million vehicles that ply on the roads, constituting nearly 90% of passenger vehicles and 10% of goods trucks are fuelled by either by Petrol or Diesel.

In the first three decades after India's Independence, MS or petrol was considered a luxury product for use by the elite only. Today in India the scenario has entirely changed. Presently, the country is the largest manufacturer of two-wheelers in the world at approximately five million units per year and has a total two and three-wheeler population of over 47 million. In this scenario, more than 50% of all incremental MS consumption comes from two and three-wheelers and therefore for all practical purposes MS ceases to be a luxury product. Today the road transport sector runs entirely on petroleum products i.e. MS, HSD, and lubricants. Put together, approximately over 40% of all POL is consumed by this sector.

Air Age Comes to India

The Wright brothers, Wilbur and Orville created history when they flew in a small biplane made of wood and fabric on December 17, 1903 making the world's first powered-flight on a wind-swept beach near the village of Kitty Hawk in the USA. India was not far behind world developments in the field of aviation. The world's first air-mail flight took place on February 18, 1911 when the French Henri Piquet, flew a Humber biplane from Allahabad to the Naini junction across the river Yamuna over a distance of six miles, carrying mail delivered to him by the local postal authorities.

History was, in fact, made in India on October 15, 1932, when a lean, young man of 28 saw his dream of starting a scheduled airline in the country came true. On that fateful day, as dawn broke over the old Drigh Road Airport, Karachi, "a light single-engine plane spluttered to life.... quickly swung into the light wind, took off and headed towards Ahmedabad," en-route to its destination, a 1,300-mile flight across the country to Madras via Bombay and Bellary. The intrepid pilot was none other than the Father of the Indian Civil Aviation — J.R.D.Tata.

During the first full year of Tata Airlines' operation in 1933, it flew 160,000 miles, carried 155 passengers and 10.71 tons of mail. The latter included overseas mail brought to Karachi by the Imperial Airways for destinations in India. From this humble beginning, today 40 million passengers fly and about 1000 million metric tons of freight is carried by air every year in India. Aviation Turbine Fuel (ATF) as the name suggests fuels an overwhelming majority of these aircraft.

Before 1947 and for several years thereafter, the entire Aviation Industry (civil and the Royal Indian Air Force) in India consumed various grades of Aviation Gasoline meant for piston-engine aircraft. In the fifties the turboprop aircraft first made its appearance in India quickly followed by turbojets, both of which consumed Aviation Turbine fuel. Over a period of time the consumption of Av-Gas became negligible and was limited to aircraft owned by flying clubs in India. Today 2.8 MMTPA of ATF is consumed every year to fuel both the Indian Air Force and commerical aircraft.

OIL IN AGRICULTURE

The evil spectre of the Bengal famine in 1943 still loomed on the eastern horizon when India got her Independence four years later. By 1949-50, with food grain production still as low as 55 million tons to support a population of 360 million. India was not out of the woods. She continued to be on a hand-to-mouth existence for many more years. By 1960-61, the food grains production had risen to 82 million tons to feed nearly 440 million.

In 1970-71, it was the miracle of the so-called *Green Revolution* that boosted India's food grain production to touch 108 million tons and further to 170 million tons by 1988-89 and today to over 210 million tons. This revolution was fed by two oil-based technologies: mechanical and biochemical. Both played their respective roles. As a result, India today possesses a sufficient tonnage of food gains as operative margin, a small tonnage for exports and a large tonnage for stocks. The earlier era of famines has fortunately ended. The *Green Revolution* has helped India not only to achieve self-sufficiency in food grains but today we also have a well stocked surplus.

Modern agricultural technology is based on diesel-run tractors and the diesel operated water pump sets. Any shortfall in the availability of HSD during the sowing and harvesting season of either Kharif or the Rabbi crop could seriously affect the availability of food grains. While tractors helped in replacing the traditional plough it also helped in the reclamation of new land and the pump sets provided easy and adequate supply of water to farmlands.

A vital role played almost simultaneously during the *Green Revolution* was the role of biochemical technology: i.e. the manufacture of petroleum-based fertilisers produced with the help of Naphtha, Furnace Oil and LSHS. These fertilisers not only helped achieve higher agricultural yields but oil-based pesticides, fungicides and weed-killers also helped a great deal in saving crops, plants and horticulture from destruction by pests and pestilence.

OIL IN DEFENCE

India's Defence Service is one of the largest consumers of petroleum products in India. The Army, Air Force and the Navy combined would perhaps be consuming as much oil as is being refined by one of India's smaller refineries. Apart from transport fuel and fuel for cooking and heating, the effectiveness of the Defence forces depends on certain special products and lubricants supplied by the Oil Industry, for example: JP-5 fuel for Naval aircraft and 96 Octane for the Unmanned Aerial Vehicle (UAV) of the Army are just two of these special products among many being made available to the defence services.

The role of oil during military operations is extremely vital. This India realised during the Pakistan-supported tribal aggression in Jammu and Kashmir in 1947 and later on during the Chinese aggression in October-November 1962. The Indian military machine at that time totally depended on multinational oil companies for the supply of petroleum products. Having no bulk storage depots in forward areas the Indian army was terribly handicapped during the above two military operations. This situation had to be remedied at the earliest. Action was taken soon thereafter by the Defence Ministry, which entered into a 20-year agreement with the fledgling national enterprise, Indian Oil Company, then barely two years old operationally, for not just the supply of products but also for setting up bulk petroleum storage installations and depots in the forward areas.

Soon Bulk Petroleum Installations (BPI's) for the Air Force were set up by IndianOil in Northern and Western India at Pathankot, Chandigarh, Adampur, Palam, Halwara, Gorakhpur, Agra, Bareilly and Hindon, besides those at Jodhpur Nal, Uttarlai, Jaisalmer in Rajasthan; Jamnagar and Bhuj, Nalia in Kachchh and also in the forward areas of Assam and Arunachal Pradesh in North-East India.

In addition to building of petroleum installations and facilities for the armed forces, a minimum POL inventory was and is being maintained for them at strategic locations. In this regard special mention needs to be made of Pathankot depot and the Okha port installation — the two extreme points, one in the north facing Pakistan bordering J&K while the other on the west coast in Saurashtra facing Karachi. The former maintains uninterrupted supplies for army operations in the State of Jammu & Kashmir, the latter serves as a fuelling point for the Indian Navy.

Bulk installations along with kerb-side pumps and refueling facilities have also been set up by oil companies to provide total logistical support to the three services, i.e. Army, Air Force and the Navy at all their militarily strategic and peace time locations. Defence service units spread all along the border, across inhospitable terrains and far-flung remote areas also require fuel for cooking and heating as many of the army border posts particularly those in the Himalayan ranges experience severe wintry conditions. In the early 80s, yet another hydrocarbon fuel, LPG was made available by oil companies for defence cookhouses replacing fire wood, in the overall interests of preserving our forests and ecology.

Border Roads Organisation

Oil forms one of the most basic needs of the Border Roads Organization (BRO) without which it would almost be impossible for it to function. BRO is the nation's most reputed, multifaceted, transnational, modern construction organisation having a strong, skilled and a committed work-force dedicated to fulfill the strategic needs of the armed forces. This organisation has played a frontline role in the development of infrastructure in forward areas, through 12 projects spread along India borders especially along the mighty Himalayas and on the forested fringes of the North East India making roads through some of the most inhospitable terrains in the world.

The Border Roads Organisation needs sizeable quantities of MS, HSD and lubricants for their vehicles and heavy earth-moving equipment located in far-flung areas and their fuel requirements must be met by the oil industry at all times, most often under severe weather conditions and across most difficult terrains. In addition to transport fuel and lubricants, the BRO also needs kerosene both as a fuel for cooking and for heating at locations often having sub-zero temperatures and no electrical power.

Power Generation

The fuels that energise most power plants are FO, LSHS and HHS and therefore any shortfall in the availability of these fuels could seriously hamper power generation on one hand, and increase wasteful usage of HSD through captive power generation by private diesel generating sets on the other. Most industries especially in the small-scale sector install diesel generators as an insurance against power shortages. This is an important area of avoidable and wasteful consumption.

Way back in 1953, petroleum products produced only 9% of the commercial energy produced in India. In 2005, that is after a lapse of over fifty years, this figure stands at a little over 30%.

Overview

Presented below is an overview of the latest consumption pattern of petroleum products in India:

Consumption of Petroleum Products - 2004-05 (mmt)				
		mmta	% of overall consumption	Usage
1. Light Ends	LPG	10.2	9.1%	Mainly for domestic cooking
	MS	8.3	7.3%	For compression ignition engines mostly automobiles

				and 2/3 wheelers
	Naptha and NGL	13.9	12.5%	Used mostly as feed-stock to fertiliser plants and/or petrochemical units (IPCL etc.)
	Others	2.9	2.6%	
	Total	**35.4**	**31.7%**	
2. Middle Distillates	ATF	2.8	2.5%	Aircraft
	SKO	9.4	8.4%	Cooking and lighting
	HSD	39.6	35.5%	Transport (Railway & road tractors, pumps sets for lift irrigation, power generation (DG sets)
	LDO	1.4	1.3%	For Low RPM engines
	Others	0.6	0.5%	
	Total	**53.9**	**48.3%**	
3. Heavy Ends	Bitumen	3.3	2.9%	Road construction
	Lubricants	1.3	1.1%	Lubrication
	Fuel Oil	8.9	8.0%	Fertilisers/Fuels: Fertiliser plants, power generation, boilers
	LSHS/ HHS	4.6	4.1%	Power Generation, Fertiliser plants, power generation, boilers
	Others	4.0	3.6%	
	Total	**22.3**	**20%**	
	Grand Total	111.6	**100%**	

The energy intensity (KgOE/1000$) in India of 609 is amongst the highest in the world not only when compared with the some of the developed countries but also when compared with other developing countries as is shown below:

Developed Countries	Energy Intensity (KgOE/1000$)
Japan	90
Germany	122
USA	248

The information presented in the preceding pages reveals that other than the ever present need for Conservation of Energy, unlike in consumer societies there is almost 'NIL' Luxury consumption of POL in India. POL thus serves as a basic input to the Indian Economy.

Growth & Expansion Of Oil Industry —SPE And Master Plan For Marketing

After the refusal of the multinationals to market product imported from the USSR in June 1965, their (the multinationals) product availability in India remained restricted to their approved refining capacity which was lower than their market participation. They were therefore obliged to shed business to IndianOil particularly where the Government was a major customer. The multinationals were then also constrained to resort to disinvestment and selective marketing so that they could optimise their returns.

Finally, when the multinationals came into the Government fold, they understandably sought to grow at an accelerated pace and enhance their market share. The Government of India also desired an enhanced all-round growth of the new PSUs. This situation brought about a drastic change in the oil scenario in India.

The accelerated growth of Hindustan Petroleum and Bharat Petroleum began with the Ministry promulgating that the entire product availability within the country as well as product imported would be treated as common industry pool. The Ministry then fixed company-wise sales quotas which permitted market participation of the above two oil companies, along with other oil companies besides IndianOil to grow from 34.6% in 1975-76 (reference Table 13 Chapter ix of Report of Oil Prices Committee November,1976) to 38.9% in 1976-77 (reference Table 15 Chapter ix of Report of Oil Prices Committee November,1976).

The exercise of fixing company-wise sales quotas was followed by the introduction of the Sales Plan Entitlement (SPE) concept in 1977-1978 as per the recommendations of the Oil Prices Committee (OPC). The OPC in its report in November 1976, had visualised that while the Indian Oil Corporation Ltd., should play a leading role in the Oil Sector, its massive market share of 63.6% had to be gradually reduced to 55% in about five years, while the market share of the new PSUs, BPC and HPC should be permitted to grow from 36.4% to 45%. Thereafter, all the oil companies were directed by the Ministry to maintain a uniform growth rate.

The Sales Plan Entitlements, oil company-wise, product-wise was worked out on the basis of 1976-77 sales, giving 50% in incremental volumes to IndianOil and the balance 50% was to be shared by the new PSUs. Within this overall volume allocation the oil companies were required to decide company-wise product mix amongst themselves which was then approved by the Government. As a result of these decisions the market participation of PSUs except IndianOil went up from 34.6% in 1975-76 to 41.7% in the year 1987-88. Thus by getting 50% incremental volumes, BPC and HPC achieved an accelerated growth rate, as shown below:

Period	Years	Growth %		
		IOC (M)	OMCs	Industry
Pre-SPE/ Nationalisation	1975-76 over 1972-73	4.3	(3.9)	1.1
Post-SPE	1979-80 over 1975-76	5.7	10.3	7.4
	1982-83 over 1975-76	5.3	8.3	6.4
	1987-88 over 1975-76	5.1	8.1	6.2

The above arrangement continued till April 1, 1988, when the Ministry decided on a new formula, which stated that henceforth all oil companies would be given incremental volumes on the basis of uniform growth rates. This meant that if for the year 1988-89 the demand was estimated to grow at 7.5% each oil company would be allocated incremental volumes on the basis of 7.5% growth over the year 1987-88.

Until the commissioning of the Bombay-Pune product pipeline all Tap-off-Points (TOPs) belonged to IndianOil and all the expansion of tankages was also being undertaken by IndianOil. With effect from 1985-86, the Ministry decided that each oil company could put up their own tankages at the TOPs to cater to their demand growth pattern. With this decision BPC, HPC and Petronet were able to expand along the product pipeline all over the country as under:

Pipeline	Owner	Length in kms	Diameter in inchs	Year of Commissioning
Mumbai - Pune	HPCL	161	14	1984
Vizag-Vijayawada-Secunderabad	HPCL	576	18	1998 / 2002
Mumbai - Manmad-Indore	BPCL	610	18	1998 / 2003
Vadinar - Kandla	Petronet VK Ltd.	113	24	2000
Kochi - Karur	Petronet CCK Ltd.	292	18/14	2002
Mangalore-Bangalore	Petronet MHB Ltd.	364	20/24/20	2003

With regard to new investments for facilities, tankages, installations and depots etc., the retention price concept guaranteeing a return of 12% on capital employed by marketing companies (Ministry of Petroleum and Chemicals Resolution No. PPD/OPC/OR/75 dated 14 July 1975, para, 3.3) enabled an assured rate of return on investment and encouraged major expansion of facilities. This helped the oil companies to expand up-country depot tankages and obtain 15 days cover for major products.

After coming into the public sector-fold the erstwhile Burmah Shell, Esso and Caltex managed substantial expansion to their existing refineries. Thus refinery-wise crude runs were expanded from 1975-76 to 1984-85 on as follows:

Sl. No.	Refinery	1975-76*	1984-85**
1	BPCL, Mumbai	3.6 MMT	6.00
2.	HPCL, Mumbai	2.8 MMT	3.50
3.	HPCL, Vizag	1.28 MMT	4.50
4.	Total	7.68 MMT	14.00

* From Krishnaswami OPC report, table 10, p55
** Ministry of Petroleum year wise data as of 1.5.85

The Oil Price Committee recommendations clearly enabled the new PSUs to expand their infrastructure and capaciy as also enabled them to increase their market participation significantly.

Amongst the most significant developments in the Public Sector oil industry was the fulfillment of the social objectives of the Government by reservation of dealership and distributionship of oil companies for the weaker sections of society while awarding dealerships/distributorships under the master plan on industry basis.

The process was first started by Indian Oil Corporation in 1969 when it launched a scheme of awarding dealerships and distributorships to young unemployed engineers and graduates whose family income did not exceed Rs. 10,000 per annum. The emphasis shifted after the Bangladesh War of December 1971 mainly to help war-widows and physically disabled members of the Defence Services or their dependents if any. The nominations of candidates for dealer and distributorships were received through the Director General of Resettlement.

In 1977, when the multinational oil companies were also brought into the ambit of the Government, uniform guidelines were issued for reservation of 25% dealerships and distributorships for candidates from Scheduled Castes (SC) and

Scheduled Tribes (ST). Later 2% was also reserved for the physically handicapped. Within three years the social objectives category reservations for dealerships were raised to 70% i.e. 25% for SC and ST, 25% for unemployed graduates with parents' income not exceeding Rs.15000 per annum, 10% for the physically handicapped and 10% for Defence Personnel disabled in war. Only 30% of dealerships could be appointed in the open (general) category. Over the years the open category was increased to 50% and the balance was reserved for the social category.

On June 5, 1980, MoP&NG introduced marketing plan concept development / expansion of Retail Outlets, Kerosene/LDO dealerships and LPG distributorships to be put up by the oil companies with an objective to minimise infructuous expenditure on retail infrastructure on industry basis, to achieve social objectives of the Government of India with respect to reservations for socially and economically weaker segments and those belonging to other special groups (Defence personnel, physically handicapped, etc.) in order to develop retail outlets, kerosene and LDO dealerships and LPG distributorship in a planned manner.

For retail outlets, strict volume distance norms were established so that the oil companies did not waste money on economically unviable locations having poor sales potential. For example, no new retail outlet could be put up within a 3 km radius in cities with a population of 10 lakh and above or within a 5 km radius in cities with a population of 2-10 lakh and within a 15 km radius in cities with a population of 1ess than 2 lakh and so on.

Late Sunil Dutt, MP, hands over IndianOil's donation of Rs.10 lakhs to Smt. Mithu Alur of the Spastics Society of India. Also seen in picture: Chairman, S.L. Khosla, and B.K. Bakhshi, Director (Marketing) of IndianOil Corporation Limited.

In the case of SKO, dealerships were planned in unrepresented Taluka and Block Headquarters. For LPG dealerships, the locations and the numbers per location were based on new customers in the waiting lists and existing dealers who had reached 70% of their ceiling in the fourth year of their operation. Through this method, coordinated industry plans for new MS, HSD, SKO and LPG dealerships were made for the fiscal year avoiding unnecessary duplication.

After conducting feasibility studies, District Level Coordinators of oil companies were required to put up the final list of dealerships in their area to the respective State Level Coordinators, who in turn would put it up to the Industry Working Group (IWG). Based on the market share of the oil companies, Industry Working Group would finalise the number of outlets for each oil company, prepare the draft Marketing Plan with 100-point roster to take care of the reservations and send it to the Ministry for approval.

The 100-point roster contained percentage reservation for various categories totalling to 100, ie. SC and ST: 25%, Physically Handicapped: 5%, Paramilitary/Police/Government personnel: 8%, Defence personnel: 8%, Freedom Fighters: 2%, Outstanding sports persons: 2% and Open: 50%. In the North East tribal areas (Arunachal Pradesh, Meghalaya, Nagaland and Mizoram), there were only two categories viz. Scheduled Tribe (70-90%) and Open (10-30%). 33% in each category were reserved for women belonging to that category.

The Marketing Plan duly approved by the Ministry would then be given to the respective companies through the State Level Coordinators for implementation. Individual companies would invite applications for dealerships and distributorships for the approved locations. Allotments of dealerships and Distributorships were made by the erstwhile Dealer Selection Boards as per guidelines issued by the Ministry.

On the subject of retail outlets, the expansion was to be based on an over all industry marketing plan in which new outlets were allocated company-wise based on their existing percentage share-out. Over the years, important imbalances in the allocation of new outlets developed in which IndianOil continued to get lesser percentage of new retail outlets in the marketing plan as compared to its overall market participation. Again with effect from April 1, 1988, an attempt was made by the Ministry to rectify this lacuna by allocating retail outlets market-wise in an inverse ratio of existing ones. Thus the company having a lower percentage of retail outlets in a particular market would get higher percentage of new outlets in that market.

Review of Cost & Prices — Iyer Committee

After the Krishnaswamy Committee it was the turn of the Iyer Committee, which was set up to review costs and prices. The review of costs and prices at regular intervals had become necessary ever since the introduction of the Administered Pricing Mechanism (APM) as recommended by the Damle Committee Report of 19 th July, 1961.

The Iyer Committee better known as the Oil Cost Review Committee (OCRC) was the fifth committee formed by the Government of India in July 1983, which was entrusted with the task of reviewing the retention price concept as recommended by the Krishnaswamy Report. It (Iyer Committee) was also asked to explore the possibility of including more petroleum products under price control as also to review dealer and distributor commissions. Furthermore, the Committee was instructed to make provisions for incentives to the oil industry in order to induce greater operational efficiency. The Government also wanted the Committee to work out a separate compensation package for independent storage and bottling of LPG.

A detailed and comprehensive review was made by the OCRC and its final report was submitted to the Ministry of Petroleum in July 1984. Basically the Iyer Committee recommended the continuation of the broad principles (retention price concept) as enunciated in the Krishnaswamy Report, (OPC) by appropriately updating the elements of cost and other factors.

However, the most important modification recommended by the OCRC was the replacement of the OPC formula of a 15% gross return on "Capital Employed" with retention margins on the basis of an 11% post-tax return on "Net Worth". The OCRC also recommended dispensing with the Block Control Mechanism for lubes, greases and introduced a Free Trade Product (FTP) concept although more than 98% of petroleum products still remained under the ambit of the APM.

The other key recommendations:

➢ The Committee after taking into account the existing price of indigenous crude (Rs.1382 per metric tonne) and the official selling price of Marker crude of $29 per barrel (Rs.11 was the prevailing exchange rate for one US dollar) worked out the pooled FOB price of crude oil at Rs.1735 per metric tonne. (20.16)

➢ Costs for filling LPG in the bottling plants of the Marketing Divisions differred considerably as compared to costs in the refineries because the Marketing Divisions of oil companies had incurred an additional expenditure to acquire separate space and to build additional infrastructural facilities such as railway sidings, gantries, pipelines, pumps etc. Generally these were already existing facilities in all the refineries. Hence no extra cost was involved. Thus the OCRC recommended an LPG filling rate of Rs.175 per metric tonne in the refineries and Rs.850 per metric tonne for the Marketing Division's filling plants.(Para 20.70 and 20.71 of the report)

➢ The OCRC developed a retention price for lube base stock category-wise for each Lube refinery on the basis of standard thruputs, operating costs, production patterns and return on net worth as also interest on borrowings.(20.77)

➢ The OCRC recommended the dismantling of the Block Control Mechanism for lubes and greases. Products would be grouped under two categories only, that is, price controlled lubricating oils and free trade lubricating oils and greases. As such the existing automotive, railroad, secondary non-additive lubricating oils would continue to remain under the price control category while all other grades would be treated as free trade lubricating oils and greases. (20.82)

➢ The Free Trade Products included products like Benzene, Toluene, CPC, Hexane and other small volume products consumed only by a few large industrial houses. Thus, while LSHS and Paraffin Wax which had hitherto been under the non-formula category were brought under the APM, other low volume products like MTO, JBO, SBPS, Hexane which were till then under the formula category were brought under the FTP category. In spite of all these measures, 98% of the total volume of petroleum products would still be under the ambit of APM. (20.85/20.86)

➢ The need to introduce adequate incentives to promote operational efficiency was stipulated in Item VII of the terms of reference of OCRC. Accordingly, a number of recommendations were made as stated below:

a) If a refinery improved its product pattern or reduced its fuel and loss as a result of managerial efficiency the same could be retained by refineries. (20.110).

b) If a refinery achieved a thruput more than the fixed standard pattern, then on the extra production the refinery would be entitled to get as an incentive the same margin as applicable for standard thruput. Similarly in case of pipeline, if a pipeline was able to achieve better capacity utilisation, it would be entitled to charge the same rate of transportation for the extra thruput as is applicable for standard thruput (20.111).

c) Any saving as a result of reduction in the stock loss should accrue to the oil marketing companies as at present. (20.113).

The Ministry of Petroleum ordered the acceptance and implementation of most of the recommendations made by the OCRC effective October 1, 1986.

Transportation Of Petroleum

Road

The history of petroleum transportation in India started when small quantities of petroleum products were imported from overseas and unloaded initially at Bombay (Mumbai) and later at other ports. The mode of transporting to inland locations and local distribution was mainly by animal-drawn carts, hand carts and head loads. With the advent of mechanised transportation, tank trucks made their appearance in India in the 1920s. In the early stages tanks were mounted on stake trucks for carrying bulk loads. With the outbreak of the Second World War the demand for oil grew significantly.

The framing of Petroleum Rules in 1934 brought the system of bulk road transportation under Government regulations and tank trucks were required to conform to specified safety standards. With the expansion of India's road network and galloping demand, the transportation of petroleum in tank-trucks became an established and flourishing business. Before the birth of IndianOil, the oil industry's practice was to maintain its own fleet of a few tank-trucks but the majority of trucks were owned and supplied by large private transporters on a contract basis.

After IndianOil came on the scene, it initially perceived the need to urgently develop its own fleet of tank-trucks, mainly to maintain reliable and dependable supplies to such important customers as Defence Services, State and Municipal Transport Undertakings, Police and other essential services. This made it necessary for IndianOil to develop and standardise its own tank-truck design and get them approved by the Chief Inspector of Explosives.

Over a period of time, IndianOil developed the following standard designs: 8 kl tank-trucks on Bedford chassis, 9 kl tank-trucks on Tata Mercedes Benz chassis and 12 kl tank-truck on Leyland chassis. This helped in standardising tank-truck designs amongst transporters as well. After IndianOil grew to become the largest oil refining and marketing company in India, it too decided to rely mostly on private transport contractors although the company did encourage its dealers also to have their own Tank trucks.

Traditionally bulk of the movements from the refineries or main terminals to up-country depots would take place by rail. Coastal Terminals would receive product by sea from coastal refineries or through imports. Transportation of petroleum products to upcountry bulk depots for locations in Jammu & Kashmir, North East and other areas which had no rail links had necessarily to go by road only.

In addition, whenever there was a disruption in movement by rail or pipelines due to shutdowns, natural calamities and sometimes due to inadequate availability of tank-wagons, road transportation was the only method of *Bridging* the gap. Thus in many ways transportation of petroleum products by road became a 'balancing' mode of transport to bridge the gap between the need and the industry's inability to meet the same through other means.

For decades, huge quantities of petroleum products had to be fed by road to the high demand areas in the North West mainly from Kandla and subsequently from Koyali as well. A change in this situation came about after the commissioning of the Mathura Refinery and the Mathura-Jalandhar-Pipeline in 1982-83. However, over the years the demand for petroleum products in the North West grew so rapidly that heavy road bridging had to be resorted to once again from Kandla. The final solution, however, came only with the commissioning of the Kandla-Bhatinda-Pipeline in 1996. With the increase in production and availability of LPG, apart from the white and black oils huge quantities of imported LPG also began to be moved by road from Kandla to Hazira, Vijaipur and Jagdishpur for the North West region.

Whereas movement of product by road had inherent advantages such as the availability of roads for use round-the-clock at the 'User's' option, it also had many inherent disadvantages and problems. Firstly, in general road transport has always been far more expensive than rail, pipeline and sea transport. One way of lowering road transport costs was to increase the lot size.

Consequently, the oil industry encouraged the increase in tank-truck capacities from 12 kl to 18 kl and even 30 kl. Higher capacities could be achieved by adding full trailers to a straight chassis tractor. However, this was severely limited on account of poor upcountry road conditions and inadequate road-turning radius.

Secondly, a major disadvantage of road movement was its easy amenability to pilferage and adulteration especially when transporters tended to quote rock bottom rates and then attempt to enhance their profits through malpractices. In addition, a number of serious accidents occurred mainly due to appalling road conditions, bad driving habits and bad vehicle design and tanks.

Thanks largely to the initiatives taken by oil companies as well as Central and State Governments — issues like pilferage and adulteration were tackled very strictly, consequently bringing the situation under control. Oil companies then adequately tightened and introduced stringent norms for the induction of transporters and introduced severe penal clauses against pilferage and adulteration.

There also was a system of constant monitoring of truck movements and quality checks at various stages and automation (trip-track) on a big-scale. Trucks are presently filled by meters in preset quantities of correct product and released only after proper QC checks and pilfer-proof sealing of vents and valves. Monitoring of truck movement by Global Positioning System (GPS) has been undertaken on a trial basis. State Governments too have tightened the procedure for calibration and other periodical checks.

On the safety front, vast changes have been made in vehicle and tank designs with new codes being evolved by oil companies with the help of the Chief Controller of Explosives. The trucks are now protected by various safety fittings such as truck-overturn-protection, fusable-links in valve controls and fuse-plugs on tanks to prevent excessive pressure build-up in case of fire.

The entire design and fabrication of vehicles and tanks were modified to prevent fires and to minimise collateral damage in case of fires and accidents. All the oil companies adopted a strict and regular procedure for checking trucks from the safety angle. The drivers now undergo rigorous training on both road safety and emergency procedures in the unlikely event of accidents and are allowed to drive only after being duly certified.

From a small beginning in the size of tanks from less than nine kilolitres, on a straight chassis, tank-truck capacities have now increased over the last few years and presently the most popular size are capacities of 20 and 25 kl. Efforts are on the anvil to increase the size even further and oil companies are contemplating to use 35 kl capacity tractor and full trailer tank-trucks which will also bring in considerable fuel efficiency. With current emphasis on world-class network of roads starting with links to metros and later into interiors, it may not be far off when much larger and more fuel-efficient tank-trucks will be plying on Indian roads.

Ideally, all road transportation to the main terminals and bulk depots should be replaced by rail, coastal or pipeline transportation. Today around 30% of petroleum products are moved by road. With the increase in pipeline capacities, this figure hopefully will be reduced to probably less than 5% in the near future. Road transport would then be limited only to product flowing from upcountry bulk depots to dealers, agents and customers; a tribe which will continue to grow.

RAILWAYS

With the steady growth in the consumption of petroleum products in the country, cross-country movement of products from refineries and port locations (where imported POL products were received) increased over the years. The major mode of transportation then was by rail tank-wagons. In order to ensure that rail movements were done in an effective and economical manner, the need and importance of a very close coordination between the oil industry and the Railways became absolutely necessary.

From the very beginning there was a great deal of inter-oil company cooperation in the field of logistics and movement of petroleum products. It actually began when the Railways itself encouraged inter-oil company product exchange agreements, so that the Railways could minimise needless and expensive cross-movement of tank-wagons.

The suggestion was very sensible as oil companies would not only be saving a lot of money by way of railway freight, but simultaneously would also be helping the Railways enhance the availability of tank-wagons. For example, the petroleum product requirement of Burmah Shell and Stanvac in Visakhapatnam were met by Caltex from their refinery at Visakhapatnam, and in exchange Caltex was compensated with an equivalent quantity of product in Bombay where the latter had no source of their own, whereas Burmah Shell and Stanvac had their own refinery.

Initially, an Oil Industry Committee (OIC) was formed with its headquarters in Mumbai. In addition, three regional sub-committees known as the OISC located in Kolkata, Mumbai and Delhi were formed to support the OIC. Each Committee was headed by one of the oil company's representative on a rotational basis. The Chairman of the OIC in Mumbai for example would coordinate with the Tank Wagon Controller (TWC) of the Central Railway, who in turn on the basis of the recommendations made by the OIC allocate tank-wagons company-wise to Burmah Shell, Esso and Caltex all over India.. The sub-committee (OISC) would thereafter coordinate with the Tank wagon Controller (TWC) for compliance.

The above system got formalised in 1957 when the Government of India constituted a Railway Inland Petroleum Movement Committee (RIPMC) with its headquarters in Mumbai. It was composed of representatives from each of the four oil companies. The four sub-committees (called RIPMSC) were simultaneously established at Mumbai, Kolkata, Delhi and Chennai to oversee the economic distribution of POL products in their respective areas.

The main function of RIPMC and RIPMSCs was to deal with all issues relating to the inland movement of petroleum products by rail and other modes of transport on a co-ordinated basis and to provide liaison between oil companies, railways and other Government authorities. Over and above, RIPMC could approve and arrange supplies from alternate sources especially during the time of strikes, other operational difficulties and national emergencies.

When Indian Oil Company came into being in 1959, its marketing operations began expanding rapidly and soon thereafter it became the fourth member of the RIPMC and RIPMSCs along with the existing member multinational oil companies. The year 1962 saw a major change when Indian Refineries' Guwahati Refinery was commissioned and the company-wise allocation of wagons became essential for the smooth operation of the refinery because its products had to be moved out by meter gauge tank-wagons outside Assam and transshipped into broad gauge tank-wagons at IndianOil's Terminal at New Jalpaiguri and the multinational oil companies' joint depot at Gharhara.

In addition, a special post was created by Railways in the senior scale of a Dy.COPS (Goods) at Maligaon, North Frontier Railway to look after the movement of petroleum products from Digboi and Guwahati Refineries outside Assam to West Bengal, Bihar and U.P. etc. Apart from the TWC at the Central Railway headquarters in Mumbai, in-charge of tank-wagon requirements of the Western and Northern sectors, an additional TWC was appointed at the Eastern Railway headquarters in Kolkata, so that he could take care of the tank-wagon demands of the entire Southern region in addition to that of the Eastern region.

In 1964, Indian Oil Company, barely five-years old then, took over the Chairmanship of RIPMC and its four sub-committees headquartered in Delhi, Mumbai, Chennai and Kolkata. It was but natural that the move was resisted by Burmah Shell, Esso and Caltex for handing over the Chairmanship to a public sector undertaking, which was then merely a fledgling with hardly any experience. This resistance was soon overcome as IndianOil began to play an effective role as Chairman of the RIPMC and RIPMSC for a period of the following six months.

Then during the 1965 Indo-Pak War, the Petroleum Industry became the main focus for logististical support to the Army and Air Force in the North and the North Western fronts and even the Navy in the Western (Kachchh) sector. IndianOil was asked to play a frontline role on behalf of the oil industry. After the culmination of the 1965 hostilities, the Petroleum Ministry in coordination with the Ministry of Railways and the Railway Board issued a directive to the multinational oil companies that the Chairmanship of RIPMC and RIPMSC which was presently with IndianOil would continue to be with them till further orders as the

Ministry was looking into a reorganisation of the entire tank-wagon movement allotment infrastructure.

After the 1965 Indo-Pak War, the Ministry of Petroleum decided to assume direct control of the oil industry's production planning and logistics of movement. For better coordination, the Ministry began the practice of holding Supply Plan Meetings. The meetings were conducted by S D Bhambri, the then Deputy Secretary, Ministry of Petroleum. All the oil companies were represented in the Supply Plan Meeting where they were given a full opportunity to articulate their needs and problems. A.P. Verma, the then Joint Director Traffic, Railway Board, represented the Railways. He subsequently became the Chairman of IBP.

IndianOil continued with the chairmanship of the RIPMC and RIPMSC for the next two years. In 1968, a policy decision was taken that a Railway official would head the RIPMC and a Railway official would also head sub-committees with headquarters at Delhi, Mumbai, Kolkata and Chennai. A special post was created for him in the Central Railway headquarters and the incumbent was called the Chief Tank Wagon Superintendent (CTWS) ex-officio Chairman of the RIPMC, supported by Tank Wagon Superintendent, Eastern Sector, and ex-officio chairman of the RIPMSC to head the Eastern Sector. Similarly, the Tank Wagon Superintendent Western Sector was ex-officio Chairman of the RIPMSC, Western Sector. Deputy COPS (Goods) Southern Railway for Southern Sector and Deputy COPS (Goods) Northern Railway for Northern Sector to head the sub-committee, respectively.

Subsequently, as movements by rail increased rapidly, a special POL Cell was set up in 1969 by the Railway Board. This was followed by setting Tank-wagon Cells under nodal Railway officers in Mumbai and Kolkata with ex-officio Chairmen of the respective RIPMSCs to oversee all logistic issues. Joint Director (POL) headed the Cell in the Railway Board and the first incumbent was C K Swaminathan.

Indian Oil Corporation, the organisation that oversaw the overall Supply & Distribution arrangements on behalf of the Ministry of Petroleum created a nodal post of Transport Advisor in its Corporate Office which was headed by S. Ketharaman, an outstanding Indian Railway Service (IRS) official who subsequently became the Managing Director (Marketing) of IndianOil. J S Oberoi, another outstanding Railway official, succeeded Ketharaman when the latter went as the first head of the Oil Coordination Committee (OCC). Through this innovation, the oil industry "internalised" coordination and cooperation with the Railways and the Railway in the national interest became a benevolent 'Trojan' horse within the Oil Industry. In 1975 the Government of India constituted the OCC with S. Ketharaman as its first head. This was in a way a benign 'coup' by the Railways and it further strengthened the bonds between the Oil Industry and the Railways.

The seventies posed an enormous challenge as the national economy picked up steam in the wake of the "Green Revolution" which led to an unprecedented growth in the demand for POL products (particularly Diesel and Kerosene) of over 7% annually year after year. In the absence of any significant network of pipelines the brunt of the excessive load was faced by the Indian Railways and partly by the road transport infrastructure.

The Joint Director, POL, Ministry of Railways; Transport Advisor, IndianOil and Director (Operations) OCC formed the *Three Musketeers* who jointly reviewed the entire supply and distribution infrastructure in the country through field visits and on-the-spot action plans evolved with the active involvement of the above mentioned Ministries. The Director Marketing of IndianOil provided proactive support to these coordinated action plans.

Then came a landmark policy decision jointly taken by the Indian Railways and the Oil Industry, which revolutionised movement of petroleum products. This was the introduction of tank-wagon movement by special rake-loads with a train of 70 wagons between the Refineries, Port Terminals and the inland POL Depots. This path-breaking innovation, although it did not happen overnight, eliminated avoidable detention of tank wagons in marshalling yards and needless shunting at intermediate railway stations and junctions. Needless to say, the time saved was immense. This policy meant that provision had to be made for accommodating full railway set-rakes of 70 tank-wagons at all oil industry up-country depot locations and facilities were to be provided to unload each rake within four hours.

The impact of this policy, after the infrastructure was in place, was immediate and produced dramatic results as far as the turn-around of wagons was concerned. This was a key strategy adopted to avoid "dry-outs" at critical locations, especially during the peak season. The process of implementation of this strategy was somewhat painful and expensive for the Oil Industry, which had to gear up for loading, and unloading of full rake-loads of 70 tank-wagons within the stipulated "free-time" allowed by the Railways. This also necessitated an exercise in major renovations and modifications to existing POL Terminals and Depots which obviously also meant heavy expenditure in developing additional storage tanks, pipeline network, pumps and allied infrastructure.

To be fair to the Oil Industry, the new operational strategy of the Railway was heavily loaded against the Oil Industry but it sportingly took it in its stride in the overall interest of the country. The oil industry's acceptance of this concept would not have been possible without the support of S Ketharaman heading the Marketing Division of IndianOil and J S Oberoi the then General Manager, Transport & Coordination.

However, one major area of conflict of interest between the Oil Industry and the Railways was the issue of development of the pipeline network planned for high thruput segments in which the Railways perceived a major threat to their own market share and revenue in respect of POL movements. Naturally, if a pipeline came up between two strategic locations, who would use rail tank-wagons? There were endless discussions and consequential delays in sanctioning of pipeline projects but the ultimate economic logic was loaded heavily in favour of pipelines, which could not be wished away and the Railways eventually cooperated, to cite an example, in the laying of the strategic Kandla-Bhatinda Pipeline.

The quantum reduction in rail movement and consequential idling of rail tank-wagons at the time of commissioning of the Kandla-Bhatinda Pipeline was another issue of friction which was tackled to the satisfaction of the Railways through an innovative scheme titled, "Own Your Wagon Scheme" launched by the Railways in coordination with the Oil Industry by which the latter provided rail tank-wagons even at the risk of some inevitable idling of wagons and thereby insulated the Railways from the impact of commissioning of the above pipeline.

Crude and product pipelines are spreading all over the country but the Railway still remains a centre-stage player in the logistical chain as it has to because of the rigidity of pipelines in case of emergencies can be mitigated by the inherent flexibility in rail and road transport. The synergy of the various modes of transport has been fully exploited by the Oil sector as the preceding events have shown and they bear clear testimony to an administrative structure that emerged to solve logistical problems when the Oil Industry was finding the going very tough.

PIPELINE

Since the beginning of the Oil Age in 1859, inland transportation of petroleum products in India has seen through two major revolutions. The first was around the beginning of the last century through rail and road, the second was through pipelines. The first revolution, i.e. transportation by rail and road was ushered in primarily by Marcus Samuel — the man who founded the Shell Transport & Trading Company in 1897. In his attempt to capture as large a chunk of the vast kerosene market in India as fast as possible, Samuel penetrated deep through the country's sprawling hinterland. Bombay (Mumbai) and Calcutta (Kolkata) were at that time among the six major Kerosene markets of the East, the other four being Java, Hong Kong, Shanghai and Japan.

The laying of pipelines was the second revolution. One important factor in maximising oil company economics and viability is the minimising of transport costs. The transport of crude oil and petroleum products through pipelines was a step in that direction because it is by far the most economical land mode of inland transportation. Although laying pipelines is capital intensive initially in the long run, however, pipelines are the most cost-effective over land means of oil transportation. The other most important advantage of pipeline transportation is that it is safe, environment-friendly and affords immense operational flexibility with almost negligible operating losses.

Pipelines today have become a symbol of India's life-stream. Pipes are the sinews of steel and form the nation's arteries through which throbbing pumps like a massive heart pulsate to maintain a steady flow of synergy of a country on the march towards economic progress. By the end of 1950s excluding the USSR and China, there were 10,40,000 kms of Natural Gas pipelines; 3,04,000 kms of crude pipelines and 1,12,000 kms of product pipelines in the world. These arteries of oil were primarily overland pipelines, but in the decade that followed, i.e. the 1960s pipelines began to be laid under the sea (submarine) as well.

Although the history of pipelines in India is more than a hundred years old (1901), when the country's first crude oil pipeline was laid to pump the crude oil discovered in the Digboi oil fields to the Digboi Refinery in Assam, two important developments in the early 60's marked the beginning of the pipeline revolution in India. The first was the laying of the crude oil 1,158 kms crude pipeline from Nahorkatiya-Moran Oil fields to the public sector refineries at Guwahati in March

1962, and extending of the same to Barauni in July 1964.

The second was the commissioning of the 435 kms Guwahati-Siliguri product pipeline in October 1964, by IRL and IOC. Whereas the multinational BOC pioneered the laying of the cross-country crude oil pipelines in India, it was the public sector IndianOil who pioneered the laying of the trunk product pipelines in the country. India's plans to construct cross-country pipelines were very much in keeping with the worldwide trend in this field.

Crude Oil Pipelines

India has in all ten coastal refineries and eight inland refineries. Currently the supply of indigenous crude to these refineries is only up to the extent of about 30%, while the balance 70% has to be met by imports. The supply of crude to the coastal refineries is being done by oil tankers discharged through oil jetties and from Single Buoy Mooring (SBM) system.

Nahorkatiya-Barauni Crude Pipeline

The first major cross-country crude oil pipeline stretching from the Nahorkatiya and Moran oil fields in Assam to the refineries at Guwahati and Barauni in Bihar was commissioned by Oil India Limited in 1962.

This 1,156 km-long pipeline transports the entire crude oil produced in the North East (both by OIL and ONGC) to the four IndianOil refineries at Digboi, Guwahati, Bongaigaon (all in Assam), and initially to Barauni refinery in Bihar and BPCL's Numaligarh Refinery in Assam. Imported crude is now being pumped to Barauni through the Haldia-Barauni crude pipeline and reverse-pumped to Bongaigaon from Barauni using the same line. The pipeline is a fully-automated telemetric pipeline with 212 kms of looping with a total capacity to transport over 5.5 million metric tonnes per annum. This pipeline was commissioned in 1962.

Salaya-Mathura Crude Pipeline

The next crude oil pipeline system was IndianOil's 1,870 km-long pipeline transporting imported oil as well as Mumbai High crude from Salaya on the coast of Kachchh to feed three inland refineries, i.e. Koyali Refinery in Gujarat, Mathura Refinery in Uttar Pradesh and Panipat Refinery in Haryana. This line was commissioned in 1978, enabling the Koyali Refinery to expand by three million metric tonnes per annum. The pipeline had an initial capacity of 12.0 MMTPA, which was subsequently expanded in 1997 to 21.0 MMTPA. This pipeline has three large crude oil storage tank farms at Vadinar (1,105 thousand kls), Viramgam (515 thousand kls.) and at Chaksu (360 thousand kls.).

BOMBAY HIGH SUBMARINE PIPELINE

The Bombay High-Uran submarine crude oil pipeline owned by ONGC transports Bombay High crude from Mumbai Offshore to ONGC's shore Terminal at Uran. This 30-inch diameter pipeline with a total length of 203 kms was commissioned in 1978 with a design thruput capacity of 20.0 MMT of crude oil per annum pumped from different feeding platforms. Since this stretch of pipeline has completed its designed life-span of 25 years, ONGC has now commissioned to replace this ageing pipeline.

HEERA-URAN CRUDE TRUNK PIPELINE (OFF-SHORE)

Heera-Uran-Trunk (HUT) oil pipeline is used to transport crude oil produced in Neelam and Heera fields of ONGC's Mumbai Offshore to its shore terminal at Uran. This is a 24-inch diameter 81 kms submarine pipeline commissioned in 1989-90 and has a designed thruput capacity of 11.5 MMT per annum.

HALDIA-BARAUNI CRUDE PIPELINE

This 498-kilometer long pipeline of IndianOil was commissioned in February 1999. The pipeline is designed to supply crude oil to Barauni refinery in Bihar from the port of Haldia in West Bengal. The pipeline originates at Haldia and terminates at Barauni. The initial capacity of the pipeline was 4.2 MMT which was further enhanced to 7.5 MMPTA.

Currently, India has an intricate pipeline network of 5,252 kilometers for transportation of crude oil. IndianOil is in the forefront, owning around 70 per cent of the total length while the balance belongs to OIL and ONGC.

PRODUCTS/PIPELINE NETWORK

INTRODUCTION

It was during the Second World War that Burmah Shell first introduced product pipelines into India. A small four-inch diameter pipeline from Bombay to the Army POL Depot at Bhusawal and another four-inch diameter pipeline from Burmah Shell's Infinity Terminal at Budge Budge to Dimapur were laid by them. Both these pipelines were purely short-term measures taken during the Second World War and the pipelines became defunct after the war and abandoned by Burmah Shell.

GUWAHATI-SILIGURI

India's first cross-country product pipeline was commissioned on October 24, 1964 by IndianOil carrying 0.818 MMTPA of product through a 435 kms pipeline connecting Guwahati Refinery in Assam with Siliguri in West Bengal. This project was conceived when the Guwahati Refinery was under construction, because it was clear that most of the production from the refinery would have to be moved outside of Assam. In view of lack of indigenous knowhow the erstwhile Indian Refineries Ltd. asked BOC (Pipelines) U.K. for a preliminary study for a pipeline from Guwahati Refinery to Siliguri. As per their preliminary assessment the pipeline was to be 400 kms long having a size of 8-5/8" diameter capable of carrying Motor Spirit, High Speed Diesel and Kerosene.

Later, in order to get a clearer idea of the scheme, a detailed project report was obtained from Bechtel Corporation of USA, who were at that time one of the most prominent Pipeline Engineering and Consultancy firms of repute in the world. After obtaining the detailed project report, Bechtel were also entrusted the work of detailed engineering, construction supervision, procurement and complete project management of Guwahati Siliguri Pipeline.

The Guwahati-Siliguri pipeline was constructed by Snam-Saipem, subsidiary companies of ENI of Italy under Government of India-ENI Credit agreement of August, 1961 covering three pipeline projects including Haldia-Barauni-Kanpur and Koyali-Sabarmati pipeline in addition to the Guwahati-Siliguri Pipeline. Running alongside OIL's crude pipeline from the Nahorkatiya-Moran oilfields to Barauni, the product pipeline was a pioneering link between Guwahati Refinery and the Siliguri Marketing Terminal, forming the vital connection between the far-flung oilfields of Assam to India's heartland where the products were most needed.

The above pipeline traverses a varied terrain, at times treacherous but mostly across a picture postcard landscape of paddy-fields, tea gardens, rolling green hills and thick jungles abounding with rich wild life. Going across hills and dales, the pipeline has to go through no less than seventy river crossings, including the one across the mighty River Brahmaputra whose anger and fury the pipeline has to withstand during the peak months of the monsoon.

Koyali-Sabarmati Product Pipeline

IndianOil's second product pipeline of 116 kms, 8-inch diameter, one MMPTA capacity Sabarmati-Koyali product pipeline was commissioned on April 1, 1966. Whereas this pipeline was designed by Snam Progetti, it was entirely managed by IndianOil. Ahmedabad is a busy industrial city with several textile mills, and was once known as the "Manchester of India". The pipeline's strategic significance, and economic importance is comparable to the Haldia-Barauni-Kanpur Pipeline. Like the latter, the pipeline feeds the enormous and ever-growing need of industries in and around Ahmedabad. The pipeline also meets the requirements of an affluent agricultural community and a large population of fast growing financially rich people. The pipeline has an impeccable record for safety and efficiency. For such a commendable performance, the pipeline has through the years deservedly won many international awards.

Barauni-Kanpur Pipeline

The Barauni-Kanpur pipeline was the third in the series of IndianOil's product pipelines. By 1965, IndianOil had fully acquired the technical know-how and expertise in pipeline construction and management. As a matter of fact, when the Bechtel agreement came to an end in 1965, the remaining construction of this as well as the Haldia-Barauni Pipeline was entirely taken over by the engineers of IndianOil. While the Guwahati-Siliguri and the Koyali-Sabarmati product pipelines transported petroleum products straight from the refinery to the respective Marketing Terminals, the 668-kms Barauni-Kanpur product pipeline, commissioned by IndianOil in September 1966, introduced the concept of Tap-Off-Points (TOPS) for the first time. The Barauni-Kanpur pipeline connected Barauni to IndianOil's Marketing Terminals at Patna, Mughalserai, Allahabad — en-route to its final destination, Kanpur. The initial capacity of the pipeline was 0.512 MMTPA which was subsequently augmented to 1.8 MMTPA. Presently, the line capacity is 3.5 MMTPA and has been extended by another 69 kms to feed Lucknow in Uttar Pradesh.

The Barauni-Kanpur Pipeline is very strategically linked. It literally passes through the heart of India's thickly populated areas, industrially throbbing cities and towns where petroleum consumption is considerable. The Barauni-Kanpur section in particular proved to be a boon to reach petroleum products to the far-flung areas in India's north-west Punjab, Himachal and the Jammu & Kashmir State, very important not only from the defence point of view, but also from the point of view of the emerging 'Green Revolution'.

Haldia-Barauni Pipeline (HBPL)

The Haldia-Barauni Product Pipeline (HBPL) was commissioned by IndianOil in 1967. The 12.75-inch diameter 525-km long pipeline with a present capacity of 1.25 MMPTA connects Haldia to Barauni. While this pipeline was designed by Snam Progetti its construction and management was done entirely by IndianOil from 1965 onwards. The pipeline enables imported products to pass from Haldia to Barauni and from there via the Barauni-Kanpur product pipeline to Kanpur. Although this was a product pipeline originally, the Haldia-Barauni section can be operated either way. It can carry petroleum products or crude oil from Haldia to Barauni and vice versa. This flexibility was planned to meet emergencies arising out of non-supply of crude for whatever reason from the oilfields of Assam. This was a precautionary measure taken in view of what had occurred in October 1962 —the Chinese Aggression.

In fact, the pipeline was temporarily converted and mobilised for crude service during 1972-73, before reconverting it to product service. Later on, Barauni Refinery began pumping products in the reverse direction. After commissioning of the Haldia Refinery, pumping was once again resumed from Haldia to Barauni and till today the pipeline carries crude or imported products from Haldia to Barauni and from thereon to Kanpur. This was not only a fulfillment of the long cherished dream of K D Malaviya and P R Nayak, the then Managing Director of Indian Refineries Ltd., but it was also a real breakthrough for the country, because now petroleum products could be made available from either Haldia or Barauni even in the far-flung and remote corner markets of North West India.

It is significant to note here that from the very beginning the IRL Management at that time headed by its Managing Director P R Nayak under the visionary leadership of K D Malaviya were following a carefully worked out plan for the earliest absorption of pipeline technology by Indian engineers. The methodology adopted was that during the initial phase when first two pipelines, required in a tight time frame, were entrusted to foreign companies Bechtel and ENI Indian engineers and managers and staff would be seconded to Bechtel. During this phase, Indian engineers absorbed not only the engineering skills, but also the best practices of project management. Thus, by 1965-66 IndianOil had fully acquired the knowledge of pipeline technology in all its aspects and all the pipelines thereafter were designed, built, supervised and wholly managed indigenously.

On account of IndianOil's expertise and experience gained through the years by handling its own pipeline projects, the Corporation was invited to be consultants for project management, construction and supervision of the Mumbai-Pune Pipeline for HPCL and for preparation of feasibility reports of the Mumbai-Manmad Pipeline for BPCL.

Haldia-Mourigram-Rajbandh Pipeline (HMRPL)

The Haldia-Mourigram-Rajbandh product pipeline is 12.75-inch diameter and 277 km- long pipeline built by IndianOil in early 1972 for transportation of petroleum products from IndianOil's Haldia Refinery to its Mourigram Marketing Terminal and beyond to Rajbandh near Durgapur. While the Haldia-Mourigram section of the pipeline was commissioned in 1972 the Mourigram-Rajbandh extension was commissioned in 1974. This pipeline has a capacity of the 1.350 MMPTA. It was entirely designed and constructed by IndianOil engineers.

In 1999 a 10-inch diameter, eight kilometer branch pipeline was extended from this line through a "tee" at Raghudevpur in the Haldia-Mourigram section across the Hooghly River to IndianOil's Marketing Terminal at Budge Budge. This too is a white oil pipeline. The Haldia-Barauni pipeline today is the "life-line" of West Bengal, as it supplies products from Haldia Refinery, supplemented through imports at Haldia. In order to lay the Raghudevpur-Chitragunj section under the River Hooghly, Horizontal Directional Drilling technology was used in India for the first time. This pipeline also serves as "a balancing line" for supplies to Kanpur.

MATHURA-JALANDHAR PIPELINE AND TAP-OFF-POINTS

The Mathura-Jalandhar pipeline commissioned on April 27; 1982 has been the mainstay for maintaining an uninterrupted flow of crucial supplies of transport fuel, namely MS and HSD for the State of Punjab (in particular during the peak of terrorist activities in this State) as also the States of Haryana and Himachal Pradesh. The 596 km-long pipeline runs from Mathura Refinery in Uttar Pradesh to the Jalandhar Terminal in Punjab with a line capacity of 3.7 MMTPA, interspersed with pumping and delivery stations at Bijwasan and Ambala.

During 1997, an eleven-kilometer diversion was made to connect this pipeline to Panipat Refinery. The Refinery at Panipat is now connected to the KBPL pipeline commissioned on February 21, 1996. Thus Panipat Refinery formed a grid for white oils thereby affording further flexibility to the Kandla-Bhatinda Pipeline product into MJPL.

In the year 2000, a 70 km stretch of 10.75 inch diameter branch line was laid and commissioned from Sonipat to Meerut. Subsequently during 2003, another branch line 167 km long, 10.75 inch diameter from Kurukshetra to Najibabad (in Uttaranchal) having intermediate delivery station at Roorkee was added to the MJPL network.

KANDLA-BHATINDA PIPELINE (KBPL)

With a length of 1,443 kilometers, the Kandla-Bhatinda pipeline has the privilege of being IndianOil's and India's longest product pipeline. The stretch up to Sanganer in Rajasathan was commissioned on February 21, 1996 and on 17 June 1996 the line extending up to Bhatinda in Punbjab started functioning. With a diameter of 22-inches at its starting point, the diameter reduces at various stages to 14 inches and even 10 inches for operational needs. This white oil (MS, SKO, ATF, and HSD) pipeline was designed to carry 6.0 mmtpa of petroleum products. The pipelines capacity has since been further enhanced to 8.8 MMTPA. As the Panipat Refinery is planned for expansion up to 12.0 MMTPA, the 1,113 km Kandla-Panipat section is now being converted to crude oil service in order to feed additional crude to Panipat Refinery on its expansion.

KOYALI-VIRAMGAM-SIDHPUR PIPELINE

The 18" diameter Koyali-Viramgam-Sidhpur product pipeline built by IndianOil originates from Koyali Refinery and has a 10-inch branch pipeline from Bareja to Navagam for delivery of products. The system has facilities to inject products pumped ex-Koyali into KBPL at Sidhpur for deliveries to all tap-off points of KBPL by utilising the boosting facilities of KBPL pump stations.

Mathura-Tundla Pipeline

Mathura-Tundla pipeline built by IndianOil originates from Mathura Refinery and traversing a distance of 56 km has a diameter of 16 inches and a capacity of 1.2 MMTPA was commissioned in December 2002. Petroleum products are pumped through this pipeline for delivery to IndianOil's Tundla Terminal.

Koyali-Navagam Pipeline

The 78 km long, 14-inch diameter Koyali-Navagam pipeline, which was being used by ONGC to pump crude to Koyali Refinery, has been taken on lease by IndianOil from ONGC from December 31, 1999 onwards. The pipeline was converted into a product pipeline by IndianOil and commissioned in March 2003 for pumping products from Koyali Refinery to IndianOil's Navagam Terminal.

Digboi-Tinuskia Pipeline

Bulk refined products (white oils) of the Digboi Refinery are transported to the Tinsukia Marketing Terminal 35 kms away by IndianOil's Digboi-Tinsukia pipeline. This 4-inch diameter pipeline was originally commissioned in 1962. In 1970-73 the pipeline was replaced with two 6-inch and one 4-inch line. At present there are two lines — the first being a 6-inch diameter, 36-km stretch of a dedicated black oil pipeline and an 8-inch diameter 39 km-long for white oils.

Mumbai-Pune Pipeline (HPC)

HPC's 14-inch diameter 161 kms, Mumbai-Pune product pipeline with a capacity of 3.67 MMTPA is used for pumping MS, SKO, HSD and LDO via Vashi in Navi Mumbai to Pune. The pipeline was commissioned in 1985.

Visakhapatnam-Vijayawada-Secunderabad Pipeline (HPC)

HPC's Visakhapatnam-Vijaywada-Secunderabad product pipeline in Andhra carries white oil's from HPCL's Visakhapatnam Refinery, via Tops at Vijayawada and ending in Secunderabad. The 576 km-long 18-inch diameter pipeline has a capcity of 4.1 MMTPA was commissioned in two phases. The Visakhapatnam-Vijayawada section was commissioned in 1998 while the Vijayawada-Secunderabad phase became operational in 2002.

Mumbai-Manmad-Indore Pipeline (BPC)

The extension of the Mumbai-Manmad pipeline up to Indore by BPCL was completed on September 12, 2003. The extension is part of the Mumbai-Manmad pipeline to transport petroleum products to Madhya Pradesh for distribution within the State as well as for onward dispatch by rail to the Northern region.

Petroleum products from this pipeline are distributed in the cities of Ujjain, Ratlam, Bhopal, Jabalpur, Gwalior and Itarsi.

VADINAR-KANDLA PIPELINE (PETRONET)

This pipeline is meant for pumping of petroleum products from the Reliance's Refinery at Jamnagar and Essar Oil Refinery (yet to be commissioned) at Vadinar. At present, a pipeline has been laid from Reliance Petroleum at Jamnagar to IndianOils' Installation at Kandla where it is hooked to IndianOil's existing Kandla-Bhatinda pipeline for carrying products from Reliance's Jamnagar Refinery. The100-km section of the pipeline from Sikka to Kandla was commissioned in May 2000. The Vadinar-Sikka segment is currently on hold and will be programmed to synchronise with the commissioning of Essar Refinery under construction at Vadinar.

The Essar pipeline originates from their refinery at Vadinar near Jamnagar in Gujarat and traverses a distance of 17 kms to reach Reliance's Marine Tank Farm at Sikka. After passing the Marine Tank Farm, this pipeline that rests on concrete pedestals for a stretch of 12 kms, runs off-shore for 44 kms to enter the Gulf of Kach.

KOCHI-KARUR PIPELINE (PETRONET)

This pipeline will transport petroleum products from Kochi Refineries Ltd. (KRL) at Kochi in Kerala to BPC's Marketing Terminal at Karur in Tamil Nadu. The pipeline, which was commissioned in March 2002, has an intermediate tap-off-point at Coimbatore in Tamil Nadu. The pipeline originates from BPC's Oil Installation at Kochi and traverses a distance of 149 kms through Ernakulam, Thrissur and Palaghat districts in Kerala. It then passes through Coimbatore, Kangayam and Karur districts. The pipeline's final destination is BPCL, Karur.

MANGALORE-HASSAN-BANGALORE PIPELINE (HPCL-PETRONET)

HPCL and Petronet India Ltd., in July 1998 jointly promoted the MHB pipeline and laid a cross-country petroleum product line from Mangalore to Bangalore via Hassan in Karnataka. The 364 km pipeline stretch laid from Mangalore to Devanagonthi (near Bangalore), with an intermediate pumping-station-cum-tap-off-point at Hassan, was commissioned in 2003. The pipeline is designed for a thruput of 5.6 MMTPA in Phase I, expandable to 8.5 MMTPA in Phase II. The pipeline carries petroleum products from the MRPL's Refinery on the West Coast to the consumption centres across Karnataka.

LPG Pipelines

Jamnagar-Loni Pipeline (GAIL)

Gail completed the worlds longest and India's first cross-country LPG pipeline in 2001 thereby heralding pipeline transportation of LPG in the country. The 1,298 km Jamnagar-Loni pipeline passes through Gujarat, Rajasthan, Haryana, Delhi and Uttar Pradesh. To begin with, in Phase I the pipeline had a capacity of 1.7 MMTPA. In Phase II, the 68.5 km long Kandla to Samakhiali pipeline having a maximum thruput capacity of 0.8 MMTPA was commissioned in the month of September 2003, taking the overall pipeline capacity to 2.5 MMTPA.

The LPG for this pipeline is sourced from Reliance's Refinery at Jamnagar and also from IndianOil's Import Terminal at Kandla and is evacuated at Ajmer and Jaipur in Rajasthan, Piyala in Haryana, Madanpur Khadar in Delhi and Loni in Uttar Pradesh.

Visakhapatnam-Secunderabad LPG Pipeline (VSPL)

The 580-km long Visakhapatnam-Secunderabad LPG pipeline was mechanically completed in 2003 but its commissioning was delayed due to the non-availability of an adequate supply of LPG. The pipeline was finally commissioned in July 2004 and is designed for a maximum thruput of 1.16 MMTPA from Visakhapatnam to Secunderabad via Vijayawada.

Natural Gas Pipelines in India

Initially, almost all the associated gas that was being discovered in India was flared. The 1960s saw some developments in the Natural Gas market with OIL supplying gas to local tea producers and State Electricity Boards in Assam. Then the ONGC started supplying associated gas from its Ankleshwar fields discovered in 1960 to Alembic Glass and Sarabhai Industries at Vadodara through a gas pipeline that was laid by the then Gujarat Pipelines Project of ONGC.

Supply of free-gas from Khambhat to Dhuvaran Thermal Power Station started in 1964. The 24-km Nahorakatiya-Pamrup pipeline was commissioned in 1965 to supply feedstock to FCI and fuel to the Assam State Electricity Board. In December 1970, another gas pipeline was laid to market Natural Gas from Navagam in Gujarat to the Calico Mills. The 150-km long Ankleshwar-Koyali gas pipeline was commissioned in September 1971 at a cost of Rs. 3.6 crore. The year 1974 saw the discovery of the giant Bombay High oil and gas fields by ONGC. Commercial production of this gas started in 1976 and it was only by 1978 that gas pipelines were laid to the shores of Mumbai for supplying gas to power generation and fertilizer manufacturing units.

On August 16, 1984, the Government of India set up the Gas Authority of India (GAIL) in the public sector for transportation, and marketing of Natural Gas and LPG. In 1987-88 the country's first cross-country, 1,700 km long, 18.2 MMSCMD capacity Hazira-Vijaipur-Jagdishpur (HVJ) pipeline was commissioned. In March 1994, GAIL further expanded the capacity of the HVJ system to 33.4 MMSCMD by laying an additional 505-km pipeline. Not long thereafter other enterprises also entered the Natural Gas transportation business. They are:

- Gujarat State Petronet Limited (GSPL), a subsidiary floated by Gujarat State Petroleum Corporation Limited (GSPCL) to set up a Rs.3200 crore, 2,500 km pipeline network for transportation of gas within the State of Gujarat.
- Assam Gas Company has a 600-km pipeline network in Assam including the 250-km pipeline from Sibsagar to Margharita in Assam.
- Gujarat Gas Company Limited (GGCL), a private player, has a pipeline network spanning more than 1,800 kms in Gujarat. It's pipeline network caters to Surat, Bharuch, and Ankleshwar. GGCL has also extended its network to Jhagadia.

MAJOR ADVANTAGES OF PIPELINE TRANSPORTATION:

- Energy saving in pipeline transportation.
- Optimal (least cost) for large volumes as compared to land mode of transportation.
- Pipeline transportation is highly environment-friendly.
- Generally being subterranean in nature, safety is an intrinsic feature of pipeline transportation of gas.
- Pipelines are free to a large extent from the vagaries of nature like floods, breaches etc. which usually disrupt surface transport systems.
- No wasteful use of energy and infrastructure for transportation of empty carrier.
- Petroleum products handling losses of products in the case of rail and road are as high as 0.3 to 0.5% of the volumes transported. In comparison, transportation loss in pipeline is less than 0.1%.
- Land and manpower requirements in pipelines are significantly low as compared to railway transportation.
- Capacity augmentation for peak demands can be met with pipeline technology with less time loss, disturbance and cost.
- Other modes, particularly road, cause wear and tear to the infrastructure i.e. roads, leading to high maintenance cost for the economy. This is not the case with pipelines.
- Pipelines do not alter the land use pattern. Moreover, pipelines can traverse through most difficult terrain where laying railway lines would be difficult and costly.

The quantity of product transported through pipelines can be increased by nearly 10% of the rated capacity without any mechanical modifications by simply dosing the pipeline with a special chemical called drag-reducers. This additive is normally doped in very small quantities in the range of 10-20 ppm. It reduces intermolecular friction in the turbulent pipeline flow. This leads to enhanced flow in the pipeline. This flexibility of pipeline operation can be used for meeting peak demands of any product by simply dosing the drag reducer into the pipeline.

However, pipelines being capital intensive are economically viable only for transporting high volumes over long distances. Taking into account the several advantages of pipelines over other modes of transportation in India, pipeline transportation has a vast scope and potential which hopefully will be fully exploited in the near future.

Detection of Leak and Pilferage in Petroleum Pipelines

Despite traditional methods of leak, theft or pilferage detection there has been a significant increase in attempts at theft and pilferage from petroleum cross-country pipelines. This is a matter of serious concern for all the oil companies in the country. Following are some of the existing methods used for detections of leaks, thefts and pilferage.

Line patrolling along the pipeline

Known as LPM (Line Patrol Man), this existing method of leak or pilferage detection is one of the oldest systems of surveillance of cross-country pipelines adopted by pipeline operators. The Line Patrol Men physically walk in relays along the entire length of the pipeline route much like it was done by runners in the postal system of days gone by.

Helicopter patrolling

In addition to physical line patrolling as per requirements of the region and the needs of the company, surveillance of pipeline's ROW (Right-of-Way) is also carried out through helicopters at pre-determined frequencies, especially to cover inaccessible areas and for conducting surprise checks of the ROW. However, helicopter patrolling cannot be done on a daily basis. The frequency may vary from once in fifteen days or more. OIL has been doing helicopter patrolling on its crude pipeline to Barauni since its very inception.

Monitoring of operating parameters with the help of Supervisory control and Data Acquisition System (SCADA) with pipeline application software for leak detection.

This system is also defined as Computational Pipeline Monitoring (CPM) which uses algorithmic monitoring tools to enhance the abilities of a pipeline operator to recognise anomalies which may be indicative of a commodity release.

The application software generates real time dynamic models. These dynamic models are used for detecting leaks and its corresponding location for pressure drop estimation, pipeline performance analysis and parameter tuning.

Close Circuit Video Transmission (CCVT) at pumping stations and terminals

This system provides surveillance of pipeline pumping stations and terminals primarily for any unauthorised entry into the plant. The system is basically recommended as perimeter control system.

ACOUSTIC BASED LEAK DETECTION SYSTEM

Recently new technologies have been introduced by pipelines for the detection of leaks. The acoustic leak detection system is designed to detect occurrence and location of leaks in petroleum pipelines and uses the principle of acoustic/negative pressure wave technique during breach of pipeline and commodity release.

FIBER OPTIC LEAK DETECTION SYSTEM

Intrusion attempts will be detected by an advanced fiber-optic sensor cable attached directly to the pipeline and connected to a coherent laser light source. Any physical interaction with the pipe, even a faint disturbance alters the 'speckle patter' of the multimode sensing fiber. The resulting change in light signal characteristics is detected at the end of the fiber-optic cable and converted to an electrical signal similar to the voltage generated by a microphone in contact with something that is moving or vibrating.

ENTERPRISE BUILDING INTEGRATOR

This is the new security system which can monitor pilferage attempts along the pipeline route. This technology has been effectively employed for the Caspian crude oil pipeline. This is the first project where this technology is being tested and is just a year old.

ATMOS PIPE TECHNOLOGY

ATMOS is a statistical pipeline leak detection system incorporating advanced pattern recognition functions. This technology has been developed at Shell and uses advanced statistical technique of flows and pressure measurements of pipeline. Variations generated by operational changes are registered and leak alarm is generated only when unique patterns of changes in flow and pressure exist.

PIPE-GUARD - PIPELINE SECURITY SYSTEM

This system provides a solution for securing buried assets, gas and oil pipelines and communication lines such as fiber optic cables. Pipe-Guard system has the ability to detect potential attack and an alert is sounded before damage occurs.

Fiber Optic Technology

A real-time technology for early detection of leak and pilferage attempts on cross-country petroleum pipeline is fiber optic based security system.

Virtual Pipeline Manager

Virtual Pipeline Manager (VPM) is another system for real time online monitoring, control and optimisation of operations of pipelines. This can be applied for multiphase pipeline asset management and control. The system is claimed to be capable of detecting 2% leak within 60 minutes.

Conclusion

Pipeline transportation more than amply justified its investment during two of India's most challenging crises, the first one in 1980-81 during the peak of the Assam Agitation, when Barauni Refinery was forced to shut down temporarily. The needs of petroleum products of the North West were met via additional imports from Haldia and then pumped to Kanpur through the Haldia-Barauni-Kanpur pipeline network.

P R Nayak made a significant contribution to the commissioning of the Guwahati-Siliguri and the Haldia-Barauni pipelines. In fact, Nayak was personally involved from the blueprint stage to the final commissioning of the pipelines and managed to save a considerable amount on costs by arranging the use of various equipment imported earlier by the Burmah Oil Company (BOC) for the Nahorkatiya-Barauni crude pipeline.

The second crisis came during the years of disturbance in the Punjab (decade of the eighties) the POL needs of India's granaries were met uninterruptedly, thanks to the Mathura-Jalandhar pipeline.

The ENI pipeline agreement signed in 1961 was the first milestone in ENI/IRL/IndianOil relationship. This covered three projects i.e. the Guwahati-Siliguri Pipeline, the Haldia-Barauni Kanpur product pipeline and the Koyali-Sabarmati pipeline. In the first project whereas the design and project management was entrusted to the Bechtel Corporation, the actual construction was undertaken by ENI under a construction contract. In the second project while the design and construction was entrusted to Snam Progetti and Snam Saipem respectively (both subsidiaries of ENI) once again the Project Management was entrusted to the Bechtel Corporation. In the third project, IndianOil took over the project Management while once again the design construction was entrusted to Snam Progetti and Snam Saipem. This collaboration of IRL with ENI was as significant as IRL's collaboration with the Rumanians for the building of the Guwahati

Refinery in as much as it heralded the introduction of transport of petroleum products through long distance pipelines in a significant manner for the first time in India. The role of Enrico Mattei the head of ENI vis-a-vis the above three pipeline projects was analogous with the role of the Prime Minister of Rumania vis-a-vis the building of the Guwahati Refinery.

It has, however, to be acknowledged that the contribution of Bechtel was quite noteworthy and worth mentioning. The Bechtel Corporation played a significant role in helping the transfer of pipeline technology to IndianOil, especially with regard to the best design engineering, construction supervision procurement and project cost control practices.

Presently, only around 32 % of the country's petroleum products are transported through the network of pipelines as compared to 74% in the United States. The percentage definitely has to be stepped up as this mode of transportation is a much more economical proposition than any other. Internationally, Druzba — the longest crude oil pipeline in the world transports Siberian crude, right up to the shores of the Baltic Sea (Lithuania). There is a great future potential for the Iranian Natural Gas and Central Asian crude oil bringing in to the sub-continent through a pipelines. As of now, the full potential of pipeline transportation of Gas is yet to be fully exploited in India

TABLE A- CRUDE OIL PIPELINES

	Owner	Length km	Diameter Inch	Capacity MMTPA	Year of commissioning
Salaya-Mathura	IndianOil	1,870	28/24	21	1978 & 1997
Haldia-Barauni*	IndianOil	498	18	7.5	1999 & 2002
Viramgam-Koyali	IndianOil	148	28	N.A.	2003
Nahorkatiya-Barauni	OIL	1,156	16/14	5.5	1962
Ankleshwar-Koyali	ONGC	95	14	2	N.A
Bombay High-Uran	ONGC	203	30	20	1978
Heera-Uran	ONGC	81	24	11.5	1990
Expansion of Viramgam-Chaksu-Mathura section of SMPL	IndianOil	803	24	--	1981
Chaksu-Panipat	IndianOil	398	24	--	1998

* Designed by foreign firms. Rest designed indigenously.

TABLE - B
Existing Product Pipeline Network in India

	Owner	Length (Km)	Diameter (Inch)	Capacity In MMTPA	Year of Commissioning
Guwahati-Siliguri Pipeline *	Indian Oil	435	8	0.818	1964/1991/2002
Koyali-Ahmedabad *	Indian Oil	116	8	1.1	1966/1983
Barauni - Kanpur	Indian Oil	668	20/12	1.8	1966/2002/2003
Haldia-Barauni	Indian Oil	525	12	1.25	1967
Haldia-Mourigram -Rajbandh	Indian Oil	250	12	1.35	1972/1974/1999
Mathura -Jalandhar #	Indian Oil	526	16 /14/ 12/10	3.7	1982/2001/ 2003
Kandla-Bhantinda	Indian	1443	22/14/ 10	8.8	1996 / 1999 / 2002
Koyali-Viramgam - Sidhpur	Indian Oil	249	18 / 10	4.1	2003
Mathura-Tundla	Indian Oil	56	16	1.2	2003
Koyali - Navagam	Indian Oil	78	14	1.8	2003
Digboi-Tinuskia	Indian Oil	75	8/6	1.00	1956/1985
Mumbai -Pune	HPCL	161	14	3.67	1984
Vizag-Vijayawada - Secunderabad	HPCL	576	18	5.38	1998 / 2002
Mumbai-Manmad - Indore	BPCL	610	18	4.3 / 5.73	1998 / 2003

Vadinar - Kandla	Petronet VK Ltd.	113	24	11.5	2000
Kochi - Karur	Petronet CCK Ltd.	292	18/14	3.3	2002
Mangalore -Bangalore	Petronet MHB Ltd.	364	20/24 /20	2.3	2003
Sidhpur - Jaipur	IndianOil	510	16	7.5	2004
Barauni-Patna P/L (In addition to BKPL)	IndianOil	112	20	3.5	2003
Panipat - Rewari	IndianOil	155	12	1.5	2004
Chennai – Trichi-Madurai	IndianOil	683	16	1.8	2006

* Designed by foreign firms.
Rest designed indigenously.
\# Includes Sonepat-Meerut and Kurukshetra - Rourkee - Nazibabad branch pipelines.

Shipping

Two years after the discovery of the first oil-well in Titusville, Pennsylvania, USA (1861), a 224 MT ship "Elizabeth Watts" moved kerosene-filled barrels from Philadelphia to London. This was followed by a sizable export of kerosene to European and British ports from the USA. Exports via the sea received a further boost when the first iron sailing vessel a specially designed bulk carrier "Atlantic" was built in 1863.

In 1879, the first real oil tanker "Zoroaster" began plying between Baku (Caspian Sea) and the Volga. It was, however, not until 1886 that the world saw its first ocean going vessel "Gluck Hoff", which was to become the precursor for future tanker movements across the seas and the oceans.

Marcus Samuel on a visit to Baku in 1890 was deeply impressed to see tankers plying on the Caspian Sea. He immediately ordered a fleet of eight tankers including the 4200 MT "Murex", and by July 1892 he was busy plying his tanker fleet. In the same year in a water-shed achievement Marcus persuaded the Suez Canal authorities to permit movement of tankers through the canal, reducing the travel time between Batum and India to only 30 days versus the traditional four-and-half months that it took to move kerosene from east coast of USA to the Indian coasts.

Before the commissioning of India's first operating refinery all petroleum products (overwhelmingly kerosene) necessarily had to be imported into India. The development of tankers and the evolution of the movement of petroleum products in bulk were to become a crucial factor in the economics of the oil industry everywhere in the world, including India.

Among the different modes of transport, sea transport dominates oil movement because of the wide separation of areas of production and utilisation and the ease with which liquid can be transported in bulk at a low cost. India's sea-borne transportation of oil has grown tremendously over the years. The POL traffic handled at our major ports rose from 19.02 million tonnes in 1969-70 and 28.78 million tonnes in 1979-80 to 91.00 million tonnes in 1995-96 and to 122.00 million tonnes in 2003-04. The increase has been phenomenal e.g. crude oil imports by sea from 37.0 million tonnes in 1997-98 had gone up to approximately 78.0 million tonnes in 2001-02, the final year of the IX Plan and to approx. 90.0 million tonnes in 2003-04 and approximately 96.0 million tonnes in 2004-05.

The size of tankers kept growing continuously to achieve economies of scale. The Second World War saw the coming of the T2 (16,000 tonnes) type tankers then considered a large size tanker. After Independence, Indian Shipping started with a humble beginning of just 0.32 gross million metric tonnes in 1948. Subsequently, with the proactive policies adopted by the Government for promoting national tonnage, India became a significant maritime nation. From sixties to the seventies was the "Golden Period" for growth of Indian tonnage as it reached a level of 6 gross million metric tonnes by the end of 1979 and then crossed 8 gross million metric tonne mark. The growth of crude oil tanker tonnage was most impressive amongst all categories of tonnage as the Government provided both cargo support (by stipulation of FOB imports) and freight support (through cost plus regime) stability to Indian ship owners.

Till 1952, the main ports handling the import of petroleum products in India were Okha, Kandla, Pir Pau (Bombay) Murmagao and Cochin, on the west coast. On the east coast the main ports were Madras, Visakhapatnam and Calcutta (Budge Budge and Paharpur). With the coming of the multinational refineries in Bombay and Visakhapatnam an attempt was made by the respective port authorities to upgrade their handling facilities in order to accommodate new and comparatively large size tankers. The best facility was provided at Butcher Island (in Bombay) by the BPT (Bombay Port Trust) in 1952, with three separate oil jetties and facilities to enable the discharge of a T2 tanker within 48 hours. In Calcutta two riverine ports were developed—one at Budge Budge and the other at Paharpur with river mooring jetties. In Visakhapatnam special oil jetties (OR1 and OR2) were built in order to facilitate the discharge of crude oil and petroleum products.

Indian port facilities have since lagged behind the needs of an explosive growth in oil traffic. This has hit the oil industry hard by the way of hampered movements, inability to ensure optimum utilisation of resources and high cost of ocean transportation. The inadequacy of Indian port infrastructure to meet the demand of POL traffic has been amongst the most serious problems faced by the oil industry in the country.

India has a strategic location on the global maritime map and has an extensive coastline with 160 odd ports. Out of these, only a few actively carry cargo traffic. These include the 12 major ports, which carry three-fourths of cargo, and 40 minor ports, which account for the balance. The major ports are under control of the Government of India (GOI) while the minor ports are controlled by the State governments.

The Major Ports:

West Coast	**East Coast**
Kandla	Calcutta - Haldia
Mumbai	Paradeep
JNPT	Visakhapatnam
Murmagao	Chennai
Cochin	Tuticorin
New Mangalore	Ennore

Major ports handle almost 75 per cent of coastal cargo. Crude, POL and coal account for 90 per cent of traffic handled through these ports. POL, cement, building material and iron-ore account for 90 per cent of the traffic handled at minor ports.

A Working Group on port facilities set up by OCC along with industry experts, in its report of March 1996 has drawn attention *inter alia* to the following deficiencies:

- The ruling draft restrictions are severe (Haldia, Kandla in particular) and have necessitated lighterage operations and substantial dead freighting resulting in high cost of movement.
- Low capacity and old docklines in Mumbai have resulted in poor discharge rates and heavy tanker detentions (At the Jawahar Jetty the hourly loading and discharge rate stands at an incredibly low level of 150 tonnes of MS, 350 tonnes of SKO/HSD and 100 tonnes for black products).
- Lack of night navigation facilities at most ports.
- Inadequate availability of pilots.
- Poor pumping rates both of several ships and facilities onshore.
- Poor discharge rate of crude at Chennai due to smaller diameter of pipeline, loading arms at BDI and BD3-22 are 11 years old, respectively and in a bad shape.

In the early years, all crude oil and product was generally moved in tankers belonging to the multinational oil companies, as there were no Indian flag vessels. The Great Eastern Shipping Company introduced the first Indian flag carrying tanker, the 13,125 MT deadweight (dwt) *Jag Jyoti* in April 1956, chartered to Standard Vacuum Oil Company, (SVOC- later ESSO), marking a modest beginning of tanker trade in India. With the formation of the Shipping Corporation of India (SCI) in 1962 three more tankers - 11,226 metric tonne (dwt) *Desh Deep*. 16,070 metric tonne (dwt) *Desh Sevak* and 17,312 metric tonne (dwt) *Desh Alok*—were added to the fleet of Indian tankers. In 1960, the newly formed Jayanti Shipping introduced a few tankers to the Indian fleet. On January 1, 1973, Jayanti Shipping merged with SCI. The movement of petroleum products through tankers had already become a highly cost-effective means of transportation and coastal movement through tankers became an excellent mode of moving product from one Indian port to another, either through two or three port discharge of imported product or movement up and down the coast from Bombay to the refinery at Visakhapatnam and later on also to and from Haldia Refinery. From the mid-fifties onwards the Government of India had reserved coastal movement for Indian flag tankers. For imported products, Indian flag vessels were to be given first preference.

The 1956-57 Suez crisis—blockage of the Suez Canal, (and because of the far longer haul via the Cape) gave a powerful impetus to tanker owners to build tankers of a much larger size in order to increase the lot size and reduce the ocean freight unit cost. The commissioning of the Cochin Refinery in 1966 and the Madras Refinery in 1969 required larger jetties and drafts at these ports in order to accommodate the coming of large size tankers and also to take advantage of lower freight costs which large tankers charged.

In the case of MRL, its profitability was severely curtailed until the commissioning of the Bharati Docks which could accommodate crude oil super tankers (30,000 dwt). By the sixties and early seventies smaller tankers, including the veteran or T2, became outmoded and it became difficult to find small tankers to haul specialty products like AvGas which was being imported for piston-engined aircraft most of which were used in flying clubs around the country. General Purpose vessels (GP) now ranged from 20,000 dwt to 38,000 dwt. A Medium Range vessel (MR) ranged between 38,000-50,000, dwt and Large Range (LR) tankers were between 50,000 - 80,000 dwt and even Larger Range (LR-II) weighed between 80,000-125000 ton dwt.

In 1973-74, the SCI acquired six-LR-II range crude tankers through a World Bank loan. The World Bank while granting the loan laid down several conditions relating not only to the working of the Shipping Corporation but also to the main user of the services rendered by the SCI i.e. IndianOil, which included the creation of a separate Shipping Department and the positioning of a Special Marine Superintendent as a part of the new department. This was a very timely action on the part of the Shipping Corporation because with the commissioning of Haldia Refinery and the buy over of the multinational oil companies by the Government of India, the entire burden of importing and transporting crude oil and deficit products fell on IndianOil as the sole canalising agency as such new and bigger tankers were badly required by the oil industry.

In the meantime, as mentioned earlier tanker discharge facilities even at the main ports did not get upgraded in line with increasing tanker capacities world wide. This often forced dead freighting of tankers for Haldia Refinery or crude had to be imported on a two port discharge basis for both the East and West coast.

To quickly overcome this problem, the oil industry decided to import crude in larger lots, anchor the vessel midstream and lighten the mother vessel through daughter vessel (usually Time Charter) which shuttled between the mother tanker and the port. This lighterage procedure from the Mother to the Daughter vessel was further extended soon to product tankers as well, and in the process substantial freight saving was achieved.

Another problem looming over the Oil Industry was how to bring crude oil (mostly imported) to meet the needs of the Koyali Refinery expanded from 4.3 MMTPA to 7.5 MMTPA by 1978, and later on the need to position an additional 6.0 MMTPA of crude for the Mathura Refinery. Thus by 1982, more than 9.0 MMTPA of crude had to be positioned on the west coast and because of the quantities involved there were tremendous freight savings if the crude was brought in by supertankers and even extra large supertankers, the VLCC 200,000 metric ton. This problem was overcome by IndianOil by commissioning the Single Buoy Mooring (SBM) facility at Salaya.

The SBM was far out at sea to enable tankers of any size to cast anchor near the SBM, after which the crude could be pumped via submarine pipelines to the shore Terminal in Vadinar only 9 kms away and from there by pipeline to Koyali and Mathura. The crude intake at this point steadily increased from approx. 9.0 MMTPA in 1982-83 to approximately 19.0 MMTPA today (2005).

As per study conducted by IndianOil, 14 SBMs were required to handle the traffic by 2006-07. At present, there are 10 SBMs as listed below:

Oil Cos.	Location	SBMs	Service	Max tanker unloading capacity (TMT)
RIL	Sikka	2	Crude	300
RIL	Hazira	1	Naphtha	54
IOC	Vadinar	2	Crude	280
IOC	Mundra	1	Crude	300
IOC	Paradeep	1 (P)	Crude	300
BPC	Cochin	1 (P)	Crude	300
ES AR	Sikka	1 (P)	Crude	300
CAIRNS	Rawa	1 (P)	Crude	300

Planned/Under Execution

Although the Indian crude oil import which has risen from 6.0 MMT in 1960-61 to 96 MMT in 2004-05 and will increasingly require larger size tankers such as Aframaxes, Suezmaxes and VLCCs, the Indian shipyards do not have the capacity to build these type of ships. The largest ship that can be built at any of the

Indian shipyards is approximately of around 110,000 dwt (at the Cochin Shipyard). However, at least three major shipyards comparable to the best in Asia are making progress:-

i) Adani Group has finalised a ship repair and ship building project at Mundra costing Rs. 800 crore.

ii) Surat-based ABG Shipyard, India's largest shipyard in the private sector is in the process of setting up another new shipyard at Dahej which could potentially become the largest shipyard in Asia.

iii) Pipavav Shipyard, situated on the Gulf of Cambay, is also poised to put India on the global ship building map.

ROLE OF TRANSCHART

Post-Independence India in its desire for rapid industrialisation, had to import significant quantities of capital goods and project material from different parts of the world. To ship these consignments in the most economic manner, in order to obtain volume discounts and also to protect Indian shipping which was in its infancy, the Government set up the Transchart Cell in 1957. This cell was responsible for consolidating items of imports to make a full ship load and in case no Indian ship was available only then was it authorised to charter a foreign ship for the purpose. This service was meant for all cargo bound for India whether hired by private or the public sector. However, the former generally did not avail the services of Transchart Cell whereas it was mandatory for the public sector companies to do so.

With regard to the petroleum industry, the multinationals made their own shipping arrangements. The SCI was formed in 1962 solely to promote Indian shipping industry. After the entire oil industry came into the national fold, crude oil shipments were made through SCI vessels first on long term time charters which later on were changed to Contract of Affreightment (COA). IndianOil, however, always utilised the services of the Transchart Cell for all its requirements for product import and export, over and above what could be provided to it by the Shipping Corporation.

For coastal movement which was reserved for Indian shipping companies only, oil companies and later the OCC was authorised to directly negotiate with the shipping companies. Product imported from the Soviet Union was through tankers flying the Soviet flag and their freight charges were linked to AFRA (Average Freight Rate Assessment).

The transaction of product imported from other sources was often concluded on C&F basis even though the existing policy was to import on FOB and export on a C&F basis. In 1996, the Transchart Cell issued a clear circular reiterating the National Policy that product must be exported only on a C&F/CIF basis and that imports (including crude oil) must only be on a FOB basis.

Transchart had thus become a canalising agency for hiring ships and tankers for the industry. Over a period of time (especially after the liberalisation of economic policies), the oil industry began persuading the Government to allow it to hire ships directly in order to meet their requirements without having to go through Transchart in line with the freedom available to the oil companies in the private sector. Finally, in 2005 the Government of India permitted IndianOil to directly charter ships on its own for one year on an experimental basis. Thereafter, based on its experience, the Government was to extend this freedom to the other PSUs as well. For the time being Transchart continues to play a very important role in the shipping industry.

ROLE OF THE SHIPPING CORPORATION, INDIA (SCI)

The Shipping Corporation's crude oil tankers are primarily deployed to meet the demands of imported crude of Indian refineries along with coastal movement and storage of indigenous crude. They are also deployed on cross-trades world wide. Product tankers are deployed for coastal movement, import requirements and also cross-trades world wide. The fleet of various sizes makes it flexible enough to provide total logistic solution to the needs of the Indian Oil Industry.

One must admit that the Shipping Corporation of India rendered signal service to the country over years, but most particularly during the Iraq-Iran War of the eighties and later on the First Gulf War of 1991.

In spite of the high risks involved and the danger to lives on board SCI vessels when a majority of other shipping companies refused to send their tankers to the Gulf, the SCI rose to the occasion and maintained continuity of supplies by unhesitatingly sending their vessels to loading Terminals like Lavan, Kharg Islands.

Notwithstanding the high insurance premiums, SCI adopted various safety measures to ensure that their vessels sailed through the Gulf region speedily and safely. Suitable guidelines were issued to all SCI vessels entering the battle zones, to boldly stencil "INDIA" in English and Persian on the hull and on the deck and keep cargo oil tanks on board fully insulated. The ships were also instructed to maintain total blackout on board by covering all portholes and keep all lifeboats ready for deployment and also to maintain strict radio silence by keeping communication to bare minimum.

Vessels heading to the embattled zones were directed to be in constant touch with US warships patrolling the entrance to the Persian Gulf. A detailed Passage Plan was also made for SCI vessels, highlighting the areas which had to be transited only during darkness, under total blackout aboard. Even cargo loading operations at various Terminals in the war zone had to be carried out in total darkness in order to avoid being sighted by hostile aircraft.

During the lengthy conflict, a number of SCI vessels were damaged due to rocket attacks from the air. They were: MTs *Kanchenjunga*, *B.R.Ambedkar*, *N.S. Bose*, *MV Archana* etc. Some of the ship's crew were also wounded and had to be evacuated for medical treatment ashore. However, this did not deter the Shipping Corporation fleet from their tour of duty sailing through war-torn troubled waters to help lift critical crude parcels to meet the oil import requirements of the nation.

CHAPTER VI

Sixth Era: 1992-2002

Over the last 55 years, the Indian economy has seen tremendous transformation. India has built a resilient agricultural capabilities and self-sufficiency in food production. A diversified industrial and service structure has emerged with a large pool of skilled manpower which has immense potential for industrial growth and modernisation.

The Oil Industry too made very significant technological strides during this period as has been seen. However, considering the economic growth in neighboring countries in Asia particularly in China, the emergence of the WTO in 1995 accompanied by an impetus for globalisation, the time had come for India to re-examine and reorient its Industrial Policies as well as the role of the Planning Commission.

Consequently, this period witnessed the evolution and development of the liberalisation of economic policies in India, the Era of economic reform, the coming up of refineries and oil companies in the private sector. In addition, several joint ventures between multinational oil companies and oil companies in India were formed. This period also saw the end of the APM as also of the Oil Coordination Committee (OCC) with effect from April 1, 2002. This era also saw a massive expansion in domestic LPG when all waiting lists were wiped out and the total number of LPG household connections went up to 8.4 crore.

Cooking Gas Triggers a Silent Revolution in The Kitchen & Lifestyle

Finding out better ways and means of cooking food has probably been *homo sapiens*' age-old quest ever since they evolved on this planet. For the earliest Stone Age people living in caves, cooked flesh must have tasted better the moment they discovered fire. Cooking never remained the same again and for several thousand years human beings relied on cow dung, wood, dry leaves, coal, charcoal, and so on to cook their meals until a little more than a hundred years ago kerosene came on the scene and changed everything.

For several decades it was kerosene that was the most popular fuel for cooking among the urban class and also among people in rural India who could afford it. Then, yet another hydrocarbon fuel named LPG or Liquefied Petroleum Gas came on the scene and brought about sweeping changes in the kitchens across India. How revolutionary the change was can be gauged from the census figure of 2004 which says that 8.45 crore households in India used LPG as cooking fuel.

LPG or cooking gas is a petroleum product, a mixture of hydrocarbon gases primarily consisting of propane and butane. LPG is produced during the process of refining crude oil. It is also extracted from associated gases which emerge from the ground along with crude oil or from Natural Gas. LPG was first produced in USA in 1912.

Today, LPG has transformed urban kitchens across India and transformed cooking and eating habits of people in almost all cities and towns in the country. Although IndianOil played a leading role in bringing about this transformation, it was the multinational oil companies who in 1955 introduced LPG into India. However, they only targeted the urban elite as their customers and LPG marketing was restricted to just a few posh localities.

The annual consumption was not more than 50 metric tonnes in 1955, but by 1966 the consumption jumped to 40,000 metric tonnes. The price, however, was deliberately marked higher in comparison to an equivalent quantum of kerosene primarily because of its higher calorific value as also the fact that every additional metric tonne of LPG sold in India displaced more than one metric tonne of Kerosene which the multinationals were then importing into the country from their own overseas sources.

The multinationals did not enjoy this advantage for too long, for as soon as the Talukdar and Shantilal Shah Committee reports came out they recommended a substantial cost reduction in the selling price of LPG for domestic use. In fact, both the committees had realised the potential of LPG in displacing and reducing Kerosene imports. IndianOil had realised the importance of LPG from its very inception and very well knew that the promotion of indigenously produced LPG would cut down the equivalent quantum of Kerosene imports and thereby reduce the outgo of India's precious foreign exchange.

It was in the city of Kolkata that IndianOil first launched LPG in the month of September 1965, by which time the product's annual demand had shot up to 40,000 metric tonnes. Like it very often happens while trying out something new, there was some initial resistance to the introduction of LPG in the kitchen on account of fears of many housewives to switch over from what they thought was a safe cooking medium such as Kerosene to LPG — a highly inflammable and 'explosive' gas.

But as soon this unfounded fear was allayed, ladies soon realised that cooking with LPG was not only safe but also had many advantages in comparison to cooking with kerosene. By 1974, urban housewives in India decided that LPG was what they would want to have in their kitchen. Within ten years, i.e. from 1965-66 to 1975-76 the total number of LPG users went up to approximately 26.4 lakh.

Thereafter, the demand for LPG grew exponentially and there was absolutely no looking back either for IndianOil or for any other oil company. The long waiting list that literally totaled to a lakh all over India was something unimaginable. Within a period of five years, from March 31, 1976 to March 31, 1981 the number of consumers had grown to 33 lakh, a jump of 25%, averaging 5% per annum on a weighted average basis.

By 1985-86, the total number of customers had grown to around 106.6 lakh, representing a growth of 303.8% in ten years or a weighted average growth of 30.4% per annum from 1975-76 to 1985-86. Within a matter of another decade, LPG had 263 lakh consumers representing a growth 896.2 % since 1975-76 or a weighted average growth of 44.8% per year from 1975-76 to 1995-96. Today, i.e. the year 2004-05 the number of LPG customers are 845 lakh.

If one were to assume that 80% of the total numbers of cylinders were going to households, the number of households using LPG for cooking would amount to 676 lakh. If one were to assume four members per family this would add up to 27.04 crore people. In other words a very substantial percentage of the entire urban population of India is now dependent on LPG for cooking purposes. The domestic market however will continue to grow because of the rural exodus to urban centres, a phenomenon that cannot be wished away, and is still happening on a continuous basis.

Simultaneously, the proportion of LPG consumed versus the overall consumption of petroleum products began rising steadily from 1.4% in 1975-76 to 2.9% in 1985-86, 5.3% in 1995-96 and 8.9% in 2004-2005 (see Table page 279). Today, every household that can afford to pay for cooking fuel prefers LPG and it has become the cooking medium all over urban India and as also in rural areas for those who can afford it.

When LPG was first introduced in India the multinational oil companies undertook the responsibility of delivering and installing LPG cylinders in the customers' kitchen. This was not only an exercise in sales promotion and customer service but also a very sound safety measure. Delivered supply thereafter became an established norm right till this day. This practice was further reinforced by the Sudha Joshi Parliamentary Committee which stipulated in 1988 that Home Delivery be made mandatory.

As the housewife began to experience the convenience, cleanliness and flexibility of LPG, the demand over the years grew by leaps and bounds. This led to a huge gap of supply not being able to meet demand, so much so that an LPG cylinder those days joined the list of dowry items. Over the years, the housewife became almost totally dependent on LPG. Consequently, the average domestic consumption per customer shot up from 7.2 kg per month to nearly 12 kg per month.

There were constant complaints till the early 90s about inadequate and even poor service, delays, run-outs (of stocks) and backlogs. Around 1984 the oil industry realised that there was no way of satisfying a customer without giving the housewife a second cylinder, because should her only cylinder run out, unless she received a refill before the next meal, the hapless lady was terribly handicapped. The oil companies thereafter began encouraging consumers to have a stand-by second cylinder (double-bottle-connection or DBC).

Today, approximately 60% of all domestic customers have a second, stand-by cylinder. This incidentally further enhanced the per capita consumption. Two very special characteristics of the LPG market became evident over a period of time. Firstly, LPG forged a life long relationship between the consumer and the oil company. (Switching dealerships generally did not take place). Secondly, because of the tens of millions of consumers, dedicated customer service became an important image builder for the oil company.

Sometime in the early 80s, considering that LPG was an item of mass consumption a subsidy was introduced by the Government on the price of LPG for all domestic consumers. However, this not only led to an illegitimate and unscrupulous diversion of large quantities of LPG from the subsidised domestic consumption to unsubsidised commercial and industrial use, but in addition the subsidy undeservedly benefited consumers who were financially and comparatively better off. Luckily for the latter, as per the Gazette Notification of November 21, 1997, issued by the Government of India, the subsidy on domestic LPG and PDS

Kerosene is to continue and is likely to be retained for the next three to five years.

LPG: Social Revolutionary

The Indian housewife has always been used to serving food for the family in the kitchen from her ever-burning *chulah* (oven). The food was always served piping hot, directly from the oven. She usually cooked squatting on the floor and lovingly served her family members individually. As per age-old traditions, the Indian housewife invariably ate last, only after she had served and fed everyone in the family. This tradition also contributed to the legendary sacrificial relationships that the Indian housewife is capable of in respect of her family members: wife-husband, mother-children, daughter-in-law — parents-in-law and the list goes on and on.

Strangely, all this changed with LPG. Earlier the Indian housewife did her cooking while squatting on the kitchen floor, now with the cylinder she was required to stand to cook, something she had never done before. Even if cooking with LPG was faster and cleaner, continuously standing in the kitchen while cooking for many of the older housewives was quite strenuous. To top it, the kitchen had to be modified in order to accommodate the new LPG cooking stove, which necessarily had to be ISI certified to meet safety standards as stipulated by the Government. Cooking gas dealers often pushed these stoves as a part of the deal along with the gas connection. As a result the new gas stove was the costliest cooking appliance that an average Indian housewife had ever bought. This required a new kitchen layout, an additional expense; as also enforced a change in her cooking style.

Yet, the attraction of the new fuel was tremendous. Cooking gas was launched as a modern, clean, energy-efficient, scientifically formulated fuel. It drastically reduced Indoor Air Pollution (IAP). The housewife who could now breathe cleaner air and was now liberated from smarting eyes in the smoky kitchen right from lighting the fire, which could now be done by the flick of the knob. And *voila*! No more blackening of utensils from the soot of the fuel. These were not just simple benefits from LPG but what gave her an added advantage was more leisure hours from the daily grind and drudgery of the time-consuming activity of cooking.

With so many advantages, cooking gas quickly caught the imagination of housewives all over India. Cooking on LPG became a style statement for the modern urban housewife whose sole ambition was to own one gas cylinder and have a gas-based kitchen. By 1985-86, for every new gas connection given in the country more than two families eagerly awaited to join the ranks of LPG users. With demand outstripping supply by an almost unbridgeable gap even as late as 1990-91 when the waiting list grew ten times longer than the lucky 7,00,000 families who managed to get their connections that year.

The story of LPG and Society

The business of a product like cooking gas was bound to involve several operational and sociological issues. When a product touches millions of families every day and in so intimate a manner through their kitchens and the food they ate, its importance multiplies many times over. But the silent revolution that cooking gas triggered off in the Indian society is really the great untold story that is worth telling here.

The impact of cooking gas was deep and significant, it managed to penetrate through several layers of society and sociological behaviour. On the surface, cooking gas brought about the following changes:

Efficiency in utilisation of heat energy: Scientifically, LPG is known to provide best calorific (read "heat") value per unit of fuel consumed as compared to other domestic fuels. This efficiency translates into best value for money spent on cooking fuel for the household.

Better control over heating: With the click of the lighter and turn of the knob to ignite the gas, control over the flame and the corresponding heat was a long way from the tedious process of lighting the earlier coal or firewood based ovens. Once lit, controlling the fire was very difficult process in conventional ovens. Yet another plus-point is that the flame from cooking gas is also more concentrated. Therefore, LPG cooked food in a more concentrated way instead of dispelling heat into the atmosphere.

Fatigue from using conventional fuels: Firewood or coal-based ovens invariably produced a substantial amount of smoke especially at the initial stages of lighting the fire, making it a health hazard. This caused not only the blackening of utensils but also the walls of the kitchen. The sooty kitchen also made the housewife feel unclean. The flames of the traditional ovens could not be controlled or put out instantly. The housewife was therefore exposed to extreme heat for long periods of time. The soot and sweat caused by traditional ovens took their toll on the housewife in the form of fatigue and exhaustion at the end of the day.

Time-saving: It is a well-known fact that due to the vastly unusual features of LPG, cooking gas saves a significant amount of time. With the use of cooking gas now the housewife quickly adjusted her other cooking-related activities to fully utilise the time thus saved on other household pursuits or hobbies. Before the advent of cooking gas, savings in time did not mean much as cooking took a longer time and would generally go on as long as the *chulah* (oven) was glowing. It is estimated that cooking gas saves an average of two hours of time daily from the drudgery in the kitchen for an Indian housewife. Out of the twenty-four hours in a day, the Indian housewife may sleep for about eight hours and out of the remaining sixteen hours, on an average she spent about eight hours of time on cooking and cooking-related activities. Therefore, a saving of one-fourth of this time calculated over the entire population of about 64 million gas-using housewives meant about 128 million of women-hours saved every day or about 4.67 billion women working days saved annually.

Money saving: Using fuel only when required and with the desired intensity made cooking gas least wasteful. Its heating efficiency and price subsidy further made it most financially economical to the housewife. Most of the above advantages were sufficient enough for the widespread acceptance and use of cooking gas in the country. But, its impact did not stop here. The next level of transformation that LPG managed to bring about is even more startling and profound.

Change in cooking technology: In India cooking gas in itself was a comparatively new cooking medium. But, to fully utilise the benefits the housewife soon learnt to change her earlier cooking methods as well. For example, use of the pressure cooker made more sense with cooking gas. With the traditional fuels like firewood and coal, fuel wasted and time saved could not be quantified. With LPG it had become possible.

Restructuring of daily activities: Time is not only a non-renewable resource but if not used profitably is also the most perishable. Unlike most other things, time cannot be stored for later use. Therefore, the two hours saved by housewives every day through the use of gas had to be spent immediately. This resulted in restructuring the day's routine. In the absence of any societal planning for the utilisation of hours thus saved the activity of restructuring happened in a somewhat *laissez faire* manner. The daily routine of the Indian housewife using gas changed irreversibly.

Introduction of new products in the family: It was not just the pressure cooker, which became closely associated with cooking gas that found entry into the gas-using household. With gas the entire meal for the family could be cooked very speedily. The entire family could now eat together. This brought about the entry of the dining table and the paraphernalia that goes with it, adjuncts like chinaware and casseroles to keep the food warm were suddenly found in Indian middle-class households.

The next level of transformation which cooking gas brought about in Indian households is really amazing. However, to a less sensitive observer the phenomenon may even have gone unnoticed. Some of the important changes were:

Changing self-perception of the Indian woman: As mentioned earlier, traditionally before the introduction of LPG on a mass scale, the Indian housewife spent most of her waking hours in cooking food and on performing other household chores. Therefore, she naturally perceived herself as the cook and 'maid' of the family. In fact, the exhaustion brought about by the soot and smoke for the duration of time she spent in the kitchen would possibly have made her think of herself as no more than a 'glorified house maid' of the family. With time and energy saved in a cleaner ambience of the kitchen and eating together (as against the earlier tradition of serving every member of the family and then sitting last to eat) now made the Indian housewife feel like a queen — "first among equals" in the family.

Change in lifestyle: With the time saved in cooking and with the consequent restructuring of domestic activities, the Indian housewife not only evolved a new lifestyle but she actually reinvented herself and improved her quality of life. She was no longer the busy bee she used to be. When she discovered that she had enough time on her hands to restructure her activities, she found an opportunity to develop her latent talents and profitably put them to use. This made the housewife financially more secure and she even managed to acquire new consumer durables for the family, which otherwise she could not afford.

The new lifestyle became self-evident in terms of her activities pertaining to her areas of interest and they varied according to the housewife's social standing. For the outgoing and gregarious lady-of-the-house it meant more time to spend on socialising within her neighborhood as well as outside. She even probably acquired a car to keep up with Joneses. Her drawing room became the centre for her extra-curricular activities such as socialising, spending more money on grooming and *haute couture*. Overall, she found herself having considerably improved her quality of life.

On the other hand, there was also a section of housewives who utilised their time thus saved by taking up part-time jobs. This not only brought in additional income for herself but also improved the standard of living of the family, made her more equal and a more respected member of the family.

There are millions of various examples to demonstrate how cooking gas transformed the life of housewives who were otherwise busy with household drudgery. The common thread running through them was that it brought about irreversible changes for the better in the standard of living and lifestyle. This was the kind of silent revolution never ever intended or anticipated by oil companies when they first launched cooking gas in the country.

Actually no one has given a serious thought to the changes that cooking gas has brought about in the lives of people. The sociological paradigm shift since the advent of cooking gas in the kitchen is most significant. Today gas has reached almost all urban households not only in metropolitan cities but also small towns. In the near future when it reaches every nook and corner of India, a demographic exercise if conducted will surely reveal the amazing transformation that LPG has brought about in the sociological profile of the country. The oil industry today is no longer merely fulfilling consumer needs; it has also become the harbinger of change for India's economic, sociological and cultural progress.

S. No.	Year	No.Of Customers (Lakhs)	LPG 000 MT	Total Pol 000 MT	LPG%
1	1975-76	26	336	23673	1.4
2	1985-86	107	1241	43363	2.9
3	1986-87	124	1497	46274	3.2
4	1987-88	138	1686	48938	3.4
5	1988-89	153	1962	52882	3.7
6	1989-90	162	2268	56779	4.0
7	1990-91	170	2415	57745	4.2
8	1991-92	181	2650	59603	4.4
9	1992-93	192	2866	61655	4.6
10	1993-94	207	3133	63648	4.9
11	1994-95	231	3434	68624	5.0
12	1995-96	263	3849	72518	5.3
13	1996-97	293	4184	79168	5.3
14	1997-98	337	4581	84290	5.4
15	1998-99	344	5041	90562	5.6
16	1999-00	473	6029	97086	6.2
17	2000-01	521	6613	100074	6.6
18	2001-02	635	7310	100432	7.2
19	2002-03	698	8143	104126	7.8
20	2003-04	770	9090	107751	8.4
21	2004-05	845	9967	111561	8.9

Indane in Dakshin Gangotri Antartica

CURTAIN RAISED ON LIBERALISATION & BIRTH OF PRIVATE REFINERS AND MARKETERS

The two oil shocks in the mid-1970s, more than anything else, compelled the Government of India to buy the downstream petroleum sector. While Esso was purchased in 1974, Caltex and Burmah-Shell were bought over in 1976. Earlier IBP had already been purchased by IndianOil in 1970. The oil industry became highly regulated after the Government of India began to own the oil companies.

With no major oil finds after 1986, India's dependence on imported crude and petroleum products increased substantially. It was then felt necessary to attract private and foreign investment to augment India's refining capacity as also explore domestic oil reserves and production. With the onset of economic reforms in the 1990s, steps were taken to attract private sector companies and gates were flung open in 1991 giving them the liberty to set up oil refineries.

In April 1993, the Government de-canalised imports of LPG, Kerosene and LSHS and also allowed the import and marketing of LPG and Kerosene by interested parties under the Parallel Marketing Scheme by amending the relevant control orders in August/September 1993. Similarly the Government also de-controlled direct imports of LSHS by private parties for captive consumption.

The marketing of lubricants was totally deregulated from November 1993. In January 1995, the Ministry of Petroleum & Natural Gas appointed a Strategic Planning Group which was entrusted with the task of making recommendations for restructuring the oil industry. Known as the R-Group, it recommended the gradual phasing out of the Administered Pricing Mechanism (APM) by allowing a free play of market forces to determine prices.

In the refining sector, many private industrial groups in India like Reliance, Essar, Aditya Birla and Nagarjuna were eager to set up refineries in the private sector. Success so far has been achieved only by Reliance Petroleum who have commissioned the world's largest grassroot refinery of 27.0 MMTPA, along with an aromatics complex at Jamnagar in Gujarat. The Aditya Birla Group came up with a 9.6 MMTPA refinery in a joint venture agreement with HPCL at Mangalore in Karnataka. Barring the above two, all other initiatives of setting up refineries in the private sector have not materialised so far although the 10.5 MMTPA Essar Refinery at Vadinar near Jamnagar is likely to come up by the end of 2006.

Similarly, for parallel marketing of LPG many global players like Shell, Caltex, SHV, Elf, Mobil and others eagerly entered the Indian LPG market with great plans. But with the Government's subsidy on LPG still being in place, private parties and multinational players to their discomfiture found the market economically unviable.

Based on the R-Group recommendation, the Government issued a Gazette Notification in November 1997 delineating the path to dismantle the APM in phases starting 1April 1998, with full deregulation to be achieved by March 2002. In June 1996, the Ministry constituted yet another group known as the Expert Technical Group (ETG) to examine the impact of duty structure at all levels on various sectors in the wake of the dismantling of the APM as recommended by the R-Group. The first interim report of the ETG made recommendations on tariffs on capital goods, which were subsequently implemented in a modified manner.

The second report dealt with the phased dismantling of the APM suggesting appropriate duty structures within the constraints of the prevailing pool deficit. In accordance with the recommendations, a phased program of duty rationalisation was implemented from April 1998 onwards. The ETG submitted its third and the final report after examining pipeline tariffs for crude and products, and also the compensation mechanism for marketing operations.

With effect from June 1, 1998, the refining sector was totally de-licensed. From 1st of April 2002, the APM was finally dismantled and oil marketing companies were allowed to fix retail prices for MS and HSD. The subsidy on domestic LPG and kerosene for public distribution, however, would continue to be operative for next three to five years with the incidence of subsidy being borne by the Central Government.

In the wake of the dismantling of the APM, the Oil Pool Account too was dissolved and the Government in its lieu issued Oil Bonds worth Rs.9,000 crore to all the oil companies against their outstandings with the Oil Pool Account. Then on April 18, 2002, the Union Cabinet cleared the bill for setting up the Petroleum Refining and Marketing Regulatory Board. This Board's main task was to monitor the price of petroleum products in the deregulated scenario and ensure that there was no undue profiteering by the Oil Marketing Companies. The Board was also to ensure that petroleum products were easily available throughout the country by imposing retail service obligations for existing and new oil marketing companies. In May 2002, the Government granted marketing rights to Reliance, Numaligarh Refineries, ONGC and Essar Oil.

On May 6, 2002, the Regulatory Board's Bill was introduced in the Parliament after the Parliament's Standing Committee on Petroleum reviewed the Bill and made certain modifications. The cabinet then approved the modified Bill with some further amendments and finally the revised Petroleum Regulatory Authority Bill was approved by the Parliament and received the President's assent on March 31, 2006.

AVI-OIL INDIA PVT.LTD.

India's Air Force is fourth largest in the world. Apart from aircraft manufactured in India at the various Hindustan Aeronautics Ltd (HAL) units, the Indian Air Force (IAF) acquires combat and other fighter aircraft from several NATO countries, although its *coup de frappe* was built and delivered by the erstwhile Soviet Union, i.e. the MiGs and Sukhoi fighters of which some versions are being manufactured and assembled in India.

Almost all the IAF aircraft require special lubricants and the Air Force was importing the lubricants either from the Western countries for aircraft procured from them or from the USSR for MiGs, Sukhois, other Soviet helicopters and transport aircraft. After the break-up of the USSR, India faced a serious problem in getting these special lubricants for aircraft supplied by the former USSR.

It was then felt necessary for India's Oil Industry to develop indigenous expertise in manufacturing specialty lubricants required by the Indian Air Force. With this end in view a search for foreign collaborators was launched which led IndianOil and Balmer Lawrie (then subsidiary of public sector IBP) to zero in on 'Nyco' a small French lube manufacturing company which had approvals to supply lubricants to American, NATO (European) as well as Soviet (Russian) aircraft.

After due diligence and deliberations IndianOil joined hands with Balmer Lawrie and obtained the Cabinet Committee on Economic Affairs' (CCEA's) approval for a Joint Venture with 'Nyco'. The JV when it was eventually formed in November 1993 was named Avi-Oil India Ltd — India's first aviation lubricants company in a joint venture, IndianOil (25%), Balmer Lawrie (25%), and Nyco SA of France (50%).

The JV was established with a paid-up capital of Rs. 12 crore. This tie-up between India's largest commercial enterprise, IndianOil — which as it is had a strong indigenous R&D base having already done pioneering work on the indigenisation of aviation lubricants in the Defence sector and Balmer Lawrie with its core competency in project engineering, along with a premier aviation lubricant specialist, Nyco SA France undertook the challenging task of setting up a project for indigenisation and blending specialty aviation lubricants on Indian soil for the first time. .

The village of Piyala in the district of Faridabad, Haryana, 45 kms from Delhi was selected as the site for the plant. Construction began on October 14, 1996 and the blending plant was finally commissioned in August 1999. After obtaining due approvals from the Military Civil Airworthiness certifiying agendies, the plant began producing synthetic and mineral-based aviation lubes.

In Phase II, Avi-Oil planned to manufacture synthetic base esters. The Phase II plant was commissioned in March 2005 and its product "Turbonycoil 600" was approved by important engine manufacturers such as Rolls Royce, Allison, and General Electric etc. for use in their industrial and marine gas turbines.

Avi-Oil is presently supplying aero-engine oils, hydraulic fluids, greases for use in high temperature applications and preservatives to the Indian Air Force, Indian Navy, Indian Army, Hindustan Aeronautics, Coastguard, flying clubs, private operators, domestic airlines and helicopter operators. In other words, Avi-Oil has received approvals for their products not only for the Air Force but also from civilian aircraft (Civil Aviation) as well.

The JV has been making profits since its inception. The turnover for the year 2003-2004 was Rs. 35 crore, with a net profit of over Rs. 4 crore. Avi-Oil has made a significant contribution in making India proud and self-reliant in specialty lubricants for military and civilian aircraft.

INDIAN ADDITIVES LTD JOINT VENTURE

Dr. J.S. Ahluwalia, the head of IndianOil's R&D Centre at Faridabad, after leaving IndianOil in 1981 immigrated to USA and joined Chevron. In the late '80s, he visited India with the aim of finding a JV partner to manufacture lube additives for Chevron.

Dr Ahluwalia's efforts finally gave birth to a JV between the then MRL (60% equity up to 31 January 2000) and Chevron Oronite (a group company of Chevron Texaco). With effect from February 1, 2000 Chevron Oronite's equity went up to 50%, thereby becoming a JV with both partners having an equal stake. While the Chairman of Indian Additives Ltd was the head of MRL (before it became CPCL) the Managing Director was a Chevron nominee.

Until the formation of Indian Additives Ltd., Lubrizol India Ltd. was the only additive company in India and enjoyed a monopoly position. With the coming of Indian Additives Ltd (IAL), Lubrizol was soon going to face competition. IAL's 15,000 MTA additive plant was fully commissioned on the December 1, 1993 at Manali near Madras Refinery at a cost of Rs. 65 crore. The company reached a turnover of Rs. 104 crore and having begun exporting part of its production, had a good opportunity to grow substantially.

Armed with Chevron's state-of-the-art technology, IAL's manufacturing facilities were on par with any comparable facility in the world. All plant operations including those of the blending units were based on fully-automated computerised bath process control through Honeywell TDC-3000 distributed control system. The latest mass flow meters ensured accurate measurements of additive components and reactants.

IndianOil now is a direct JV partner with Indian Additives Ltd's only competitor, Lubrizol. On the other hand, IndianOil by virtue of owning CPCL became an indirect partner with Chevron and Indian Additives Limited. Presently, there is stiff competition between Lubrizol and Indian Additives Ltd in the lube additives market. IndianOil encourages this competition in the interest of continuous improvement in product quality of additives and service.

Unlike many other JVs that emerged in India after liberalisation of the economy, Indian Additives Ltd has survived a period of 12 years and is showing every sign of prosperity and growth along with the expanding hydrocarbon sector in the country.

BPC-SHELL JOINT VENTURE

One of the first multinationals to make an entry into India following liberalisation in the petroleum sector was the Royal Dutch Shell group. Burmah Shell when nationalised in 1976 as Bharat Petroleum Corporation was found to be a natural ally by Shell for investment in India for a joint venture.

The opening up of downstream marketing opportunities for the sale of LPG in the non-domestic sector and lubricants was restricted to multinationals only up to a shareholding of not more than 51%. Hence, most multinationals keen to enter the Indian market, especially for marketing of lubricants had perforce to take an Indian partner both from the point of view of shareholding norms as well as for leveraging the foreign partners local knowledge of market conditions for successful market penetration and growth.

Bharat-Shell Ltd was formed as 51-49% joint venture between Shell (51%) and Bharat Petroleum (49%). The JV began operations in India in late 1993. Shell lubricants were launched in double pilfer-proof caps at a single all-India maximum retail price (MRP) using containerised secondary transportation for the first time in India. To obtain a cutting edge, lube blending facilities at Bharat Petroleum's plant at Wadi was upgraded to Shell's high operational standards. At the same time, construction of a 45,000 MTPA (single shift) modern lubricant oil blending plant was undertaken at a cost of Rs. 75 crore in Mumbai.

The initial understanding between Bharat Petroleum and Shell was to replace Bharat's brand of lubricants by Shell for both retail and direct sales segment. However, this led to channel and market segment conflict and Bharat Petroleum decided to retain its brand equity and continued marketing its own brand of lubricants.

Subsequently both JV partners developed independent thrust areas using their own channels to market their respective brands. This resulted in a deeper thrust of Shell brand in direct sales and high street (bazaar trade) channel and Bharat Petroleum in direct sales, retail outlets and high street channel. The volumes of Shell lubricants eventually stabilised at 40,000 kl per annum with the shift in focus from volume growth to per unit margin maximisation.

Shell also reduced cross haulage and improved asset utilisation by having a tie-up with IBP for toll blending for the Eastern and Western markets of India.

The takeover of Pennzoil also helped considerably. However, for all practical purposes the tie-up between Bharat Petroleum and Shell in marketing of lubricants ceased subsequently.

LPG marketing in India by any private sector company was bound to head for trouble and failure mainly because of the incidence of subsidy for domestic consumption was not withdrawn by the Government in spite of assurances given to foreign investors based on which commitments were made by them for investing and developing the market. While Bharat-Shell was successful in developing a profitable business in marketing Shell lubricants, capturing about 4% of the market, its foray into LPG marketing was a losing proposition.

Meanwhile, the Government of India allowed marketing of LPG by entities owning 100% equity by foreign investors and Shell bought over the LPG assets from its JV partner to set up independent operations for marketing of LPG. The business is in doldrums with extremely low levels of market share.

IBP-CALTEX JOINT VENTURE

IBP-Caltex was the first joint venture (JV) to make forays into the field of high performance, high premium lubricants. The JV company was formed with the purpose of blending and marketing lubricating oils and greases. It was envisaged that with liberalisation, Indian lube brands in the course of time would be knocked out or marginalised by international brands. It was most probably on this high hope that IBP and Caltex joined hands.

IBP-Caltex Ltd was registered as a public limited company under the Companies Act, 1956. It was incorporated on 4 October 1993 and commenced marketing in 1994.

The initial paid-up capital of the JV was Rs.20 crore, which was subsequently increased to Rs. 40 crore with 49% equity held by IBP and the balance 51% with Caltex. Since Caltex was the major stakeholder, the management of the company rested obviously with the multinational and IBP accordingly became a Caltex subsidiary. The JV, however, was not able to take off successfully and failed to generate projected volumes of sales and revenue, ultimately leading to continuous losses.

As mentioned above, the JV was formed primarily to lure Indian customers towards multinational brand of lubricants. Far from Indian brands being marginalised, the JV itself failed to survive. With prices pegged as per international norms in the face of a highly cost conscious Indian customer, the JV's high hope that Indians would prefer a high end brand of lubricants was a miscalculation.

The IBP was primarily a retailing company and the JV was expected to leverage the company's retail network. Having first thought of dominating the retail market the JV was then planning to venture into direct marketing of lubes in bulk to industrial customers. Both the marketing strategies failed, primarily because of customer resistance to the steep difference in prices between the multi-national brand and lubricants manufactured by Indian oil companies. In the very first three years of its operation IBP-Caltex suffered heavy losses and its survival became economically unviable.

On analysing the causes of failure of the IBP-Caltex JV., it clearly revealed that the cost conscious Indian consumer resisted the steep difference in price. Secondly, Caltex adopted their (Caltex) management style without taking into account and understanding either the Indian market conditions or the Indian consumer. Thirdly, marketing through the IBP network was adversely affected due to lack of empathy and understanding between IBP-Caltex and IBP officials which affected the formulation of its marketing policy and implementation in the day-to-day management of sales.

Taking all these problems into account, IBP called it quits and divested its equity in the JV in 1999 in favour of Caltex Oil Corporation Ltd. The marketing of IBP-Caltex lubricants through IBP's network of retail outlets subsequent to the demise of the JV continued half-heartedly thereafter for a period of about nine to twelve months.

INDIANOIL MOBIL (INDO MOBIL-2) JOINT VENTURE

Soon after economic liberalisation of the country the Government of India's policies underwent a radical change. With the opening up of the market, the import of lubricants too was de-canalised and private sector companies could now freely import and market lube oils. This attracted several multinationals into the country. It was under these circumstances that IndianOil thought it appropriate to seek a Joint Venture with a multinational and market its lubricants in India alongside its own successful Servo brand.

From a list of the best known international lube oil producers and marketers, IndianOil decided to choose Mobil Oil once again not only because it was amongst the world's most renowned brands but also because the brand recall of Mobil among consumers was very high in the Indian sub-continent.

Mobil's response to this new opportunity was equally enthusiastic. Accordingly, a 50:50 joint venture company called Indo-Mobil was formed on March 4, 1994 with the aim of jointly building a state-of-the-art lube oil blending plant at Asaoti near Faridabad, having R&D collaboration between the two as also marketing of Mobil lubricants alongside Servo. This joint venture was an attempt to make the foreign and Indian brand complement each other.

'Pegasus' - the flying red horse thus had a third home-coming to its very special Indian market. The intention of the joint venture was to extend this collaboration in due course to several different areas including marketing LPG (which too by then had been de-canalised). These expectations, however, failed to materialise for various reasons, one of them being the unforeseen international merger of oil major Exxon and Mobil. This unfortunately brought about the annulment of the joint venture on August 28, 2001 by mutual consent at a time when the all-India Indo-Mobil sale of lubricants touched around 20,000 metric tonnes in the all-India lube market of 1,141,000 metric tonnes.

B.K. Bakhshi, Chairman of IndianOil and chairman of the JV Indo-Mobil, adressing a press conferance along with R.C. Parker, Chairman of Mobil Asia Pacific (P) Ltd., Singapore

HPC-Exxon Joint Venture

Exxon was very keen to find a JV partner in India along with whom they could market Exxon lubricants. The existing oil companies were the obvious choice. In 1993-94 they first approached IndianOil, who by then were already negotiating with Mobil.

Exxon then contacted HPC and an agreement was signed between Exxon and HPC in February 1995 both for transfer of technology, lube blending, formulations and marketing of its lubricants in India. While HPC succeeded in upgrading their technology and modernising their own blending facilities, Exxon lubricants blended by HPC could not make any in-roads into the Indian market because of its high cost. Eventually, the technology transfer agreement was allowed to lapse by HPC after three years.

HINDUSTAN COLAS LTD.

Hindustan Colas Ltd (HINCOL) was formed in July 1995 as a Joint Venture between HPCL and Colas SA of France. The latter is a world leader in Bitumen emulsions. HPCL and Colas are holding 50% each of the share capital of HINCOL.

HINCOL is currently operating six Bitumen Emulsion Plants located in Mumbai, Delhi, Chennai, Vadodara, Visakhapatnam and Mangalore. The company in a short span of less than 10 years has emerged as the market leader with over 50% market share for Bitumen Emulsions. In 2004-05 the company sold 65,000 MTs.

The HINCOL has transformed itself from being a Bitumen Emulsion company into a company that deals with a wide range of value added bituminous products such as modified bitumen, cutback bitumen and bitumen emulsions. It has successfully started manufacturing and marketing modified bitumen also.

The company has been earning profits since 1997-98 and has been consistently paying dividends for the past six years.

INDIANOIL TANKING LTD.

During the year 1993-94, Oiltanking GmBH, a German multinational and the world's second largest oil and storage company provider, approached IBP to form a joint venture company to set up an independent dedicated terminal service to cater to India's oil and chemical sectors.

IBP approached IndianOil to become co-partners in the venture. IndianOil agreed to participate, provided the combined equity of IBP and IndianOil was 50%. Oiltanking GmBH, on the other hand, initially wanted 51% and therefore the controlling equity, but finally they came around and settled on a 50:50 basis. The JV was duly incorporated in November 1996 with Oiltanking GmBH owning 50% of the equity and IBP-IndianOil owning 25% each. After the takeover of IBP by IndianOil the latter's equity rose to 50% to be on par with the German collaborators.

Over the past eight years, Indian Oil Tanking (IOT) has been providing a wide variety of professional services to India's leading oil companies and other industrial customers at 14 terminal facilities in India alone. IOT was the first Indian company to take up world class independent terminal operations enabling products from different companies to be handled from a common infrastructure at a given location.

The combined higher volumes undoubtedly ensured tremendous economies of scale, which has benefited all users. With HSE (Health, Safety and Environment) standards and costs as well as land and construction costs escalating day by day across the world, terminals demanded increasingly huge investments. But in the case of Indian Oil Tanking investment was very cost effective, as a single company was providing service to several, thus lowering the individual company's unit cost. This system was far more economical and the best way of circumventing the incidence of heavy investments in building one's own infrastructure and incurring needless costs.

Amongst the various completed projects is Indian Oil Tanking's flagship Terminal at Navghar in Navi Mumbai. This state-of-the-art fully automated terminal was commissioned in October 1998. Fully equipped with integrated, automated operations, a tankage of 2,35,000 kls is supervised and monitored from a single control room. This terminal facility is presently being used by several companies like IndianOil, ONGC, BPC, HPC, Reliance, Essar, MRPL and Phillips Carbon Black.

Indian Oil Tanking has also set up a world class bulk LPG terminal just 4 kms away on a Build-Own-Operate-Transfer (BOOT) basis for the Chennai Petroleum Corporation Ltd., Chennai, and the thruput of the terminal was likely to cross 4,00,000 metric tonnes per annum by the year 2006. Indian Oil Tanking has successfully leveraged its world class core competencies in Engineering and Construction to develop its EP&C (Engineering, Procurement & Construction) Division into a versatile and fast-growing business enterprise to provide customised service of world-class quality combined with Indian cost-effectiveness to sectors as diverse as petroleum, petrochemicals, power and other infrastructure industries.

Indian Oil Tanking is presently in the process of executing six projects at Panipat and Mathura, handling nearly 260 kms of offsite and utility piping, 4,60,000 kl of tankage, a 95 metre-high flare, hydrogen bullets and air compressors. Indian Oil Tanking has also made a very successful bid for a crude oil storage and treatment facility for Oil India at Tengakhat in Assam thereby making a beginning in the upstream sector. Similarly, forays have been made into cross-country pipeline work by winning a competitive bid for a 75 km long product pipeline for Oil India in Assam. Currently the JV is working at 12 major work sites, in addition to supervision of retail outlet constructions all over the country.

Petronet India Ltd (PIL)

In order to conserve India's oil resources and to avoid unnecessary duplication of facilities as well as to take care of commercial and allied interests of all oil companies, the Government of India in May 1997 approved the formation of Petronet India Ltd., a holding company and a consortium consisting of the following PSUs and non-PSU member companies with the following equity holdings: IndianOil-16%, Bharat Petroleum-16%, Hindustan Petroleum-16% and IBP-2%; all totaling to 50%. The non-PSU member equity holdings are: Reliance-10%, Essar-10%, ICICI-10% Infrastructure Leasing & Finanancial Services-10% and State Bank of India-10%; totaling to 50%.

As per the agreement, the holding company, i.e. Petronet India Ltd was free to form subsidiary companies for each specific pipeline project and route. It was also ensured that in the general equity structure of the subsidiary companies, Petronet India Ltd had 26%, the other major interests held 26% equity, while the balance went to public and financial institutions. Petronet VK Ltd (Vadinar-Kandla pipeline) for example has the following equity breakup: Petronet India Ltd-26%, IndianOil-26%, Reliance-13%, Essar-13%, Financial Institutions and others-22%; all totaling to 100%.

The composition of the holding company as well as the subsidiary companies is so structured so as to meet the needs of all group interests as well as to ensure that investments are made in the country's interest.

Major Projects of Petronet India Ltd

1. Vadinar-Kandla Pipeline (VKPL) (under operation)
2. Kochi-Karur Pipeline (CCKPL) (under operation)
3. Mangalore-Bangalore Pipeline (MHBPL) (under implementation)
4. Chennai-Madurai Pipeline (CTMPL) (under implementation)
5. Bina-Kanpur Pipeline (BJKPL) (approved)
6. Paradip-Rourkela Pipeline (PRPL) (approved)
7. Central India Pipeline (CIPL) (Pre-project activities in progress)
8. Bhatinda-Pathankot Pipeline (BRPL) (proposed)

SOUTH ASIA LPG CO. (P) LTD.

Hindustan Petroleum and Total Gas & Power India (a wholly owned subsidiary of Total SA of France, the fifth largest oil major in the world) formed a Joint Venture company in November 1999, i.e. South Asia LPG Company Ltd. for construction and operation of underground LPG Cavern storage of 60,000 MT capacity and associated receipt facilities at Visakhapatnam. This would be the first of its kind in this part of the world and would facilitate imports of LPG in large vessels resulting in savings in freight costs. The project will meet the requirement of a large storage for imported LPG in order to meet the burgeoning demand in Andhra Pradesh and neighbouring states.

Underground Cavern storages are the safest means of storing hydrocarbons and are being used by several developed countries. There are over 80 mined underground caverns in the world for LPG alone.

The Cavern would be at a depth of about 162 metres below sea level. The cost of the project is estimated to be Rs.333 crore and it is being financed through debt-equity of 2.33:1. The financial closure of the project has already been achieved. Both HPCL and TGPI would be having a 50% equity participation in the company.

The Cavern construction job has been awarded to Larsen & Toubro on a competitive bid. The project is fast progressing. The Cavern is expected to be commissioned by December 2006.

CONCLUSION: JOINT VENTURES

In the foregone chapters the most striking feature the reader may have observed is that with the exception of Lubrizol, Indian Additives Ltd., Avi-Oil India Ltd, Indian Oil Tanking; and Hindustan Colas Ltd. most public sector-multinational joint ventures and collaborations did not survive for long. Most of them died an untimely death with a life-span barely exceeding ten years. There were several reasons for these failures. One important reason was that the multinationals demanded and commanded equities of 51%. This equity imbalance had the effect of reducing the Indian collaborator to the status of a subsidiary to the multinational.

Unfortunately, this situation had the tendency to encourage the Indian collaborator to work in the interest of the multinational's principals rather than in the interest of the joint venture company itself and thereby the JV deviated from the win-win mindset on which alone it could survive. Even in the case of Indo-Mobil (the longest surviving JV of seven years) i.e. from March 1994 to August 2001, where despite the fact that both partners shared an equal 50:50 partnership to begin with, the situation changed when the Exxon-Mobil merger took place and consequently the JV began operating as a virtual subsidiary of the new management. There were also attempts made by some multinational's to ride 'Piggy Back' on the shoulders of their Indian partners in order to penetrate the Indian market at a minimum cost to themselves.

The successful and longer lasting JVs, such as Lubrizol, Indian Additives Ltd., Avi-oil India Ltd., Indian Oil Tanking, Hindustan Colas Ltd. were able to sustain their cooperation, because the principles of mutual interest were permanently kept in mind by both partners. In short, they went in for a win-win situation. Be that as it may, there were no institutional or legal bars to prevent the Indian companies from any extent of collaboration in the downstream petroleum sector with multinational enterprises.

NEW REFINERIES AFTER LIBERALISATION

MANGALORE REFINERY & PETROCHEMICALS LTD. (MRPL)

It was mid-1982, when the Ministry of Petroleum & Natural Gas asked IndianOil to develop a feasibility report for two refineries, one planned to be set up at Karnal in Haryana and the second in Mangalore in Karnataka. The feasibility reports for both were accordingly made and submitted to the Ministry in 1983.

Public bids were invited for the above two projects, on the basis of which the Government of India decided that the 3.0 MMTPA refinery at Mangalore would be a JV between Hindustan Petroleum and the Aditya Birla Group (ABG) while the refinery project at Karnal (later on shifted to Panipat) was to be undertaken through a JV between IndianOil and the Tatas. The petroleum industry in India then was still under the Administrative Pricing Mechanism (APM), which assured a 12% post tax return per year on capital invested in refineries.

With Mangalore having such a promising potential for industrial growth, it became a natural choice when the Government of India planned to set up a petroleum refinery in Karnataka. Thus was the seed sown for the birth of the Mangalore Refinery & Petrochemicals Ltd., (MRPL). It was incorporated on March 7, 1988 after signing of an MoU on 26 June 1987 between the Government of India, Hindustan Petroleum and the Indian Rayon & Industries (IRIL)—the Aditya Birla Group.

Lying on the west coast and touching the Arabian Sea, Mangalore was quite the right choice for the setting up of MRPL. Gifted with a modern all-weather port at Panambur, this city once internationally known for its 'Mangalore' tiles was poised for an all-round industrial growth, the advantage being its new port and its easy accessibility by sea. One overriding factor of Mangalore being a choice was that Karnataka had no oil refinery in the entire State. Hence, the MRPL project was not merely a commercial venture but a project planned to fulfill the need for an equitable regional development of the country.

After obtaining a certificate for the commencement of business on August 2, 1988, actual work on the project began in September 1992 on a plot of land measuring about 1,450 acres approximately 11 kilometers away from Managalore harbour. The design philosophy of the refinery was to maximise

Middle Distillates like HSD, SKO and ATF which were perennially in short supply. The refinery was configured accordingly. The first phase of 3.0 MMTPA costing Rs.2792 crore went on stream on 25 March 1996. Although the refinery was intended to produce only 3.0 MMTPA, in the second year itself it produced 4.0 MMTPA — accordingly its nameplate capacity was raised to 3.69 MMTPA.

While building the refinery, state-of-the-art technologies from reputed licensors were incorporated. EIL designed the Crude Distillation Unit (CDU), the Hydro Cracker Unit (HCU) was licensed by UOP, USA, the Vis Breaker Unit (VBU) was licensed by ABB Lummus, Holland and the Continuous Catalytic Reformer (CCR) was licensed by UOP, USA etc.

In order to finance part of the project cost, the company floated a mega public issue consisting of 4,31,60,000 shares of which 16% were Secured Redeemable Partly Convertible Debentures (PCDS) of Rs. 135 each aggregating to Rs. 582.66 crore. The issue for PCDs met with a good public response and was subscribed eleven times over (2,80,00,000, 17.50% secured redeemable non-convertible debentures of Rs. 200 each with detachable equity warrants) aggregating to Rs. 560 crore). The refinery project was structured around a 4:1 debt-equity ratio. As MRPL was not permitted to raise debts from domestic financial institutions the actual debt-equity ratio climbed to 5:1 for Phase I of the project. In a liberalised scenario, refinery projects were being considered with debt-equity-ratios of around 1.5:1. Hence MRPL projects' debt-equity ratio of 4:1 was much too high.

While the implementation of Phase-I was in progress, the Government granted an approval on December 31, 1993 to expand the refinery's capacity to 6.0 MMTPA. The expansion work (Phase-II) began in August 1995 with the appointment of Toya Engineering Corporation as Project Management Consultant (PMC). Phase-II was commissioned on September 16, 1999; again two months ahead of the target date, but commercial production could begin only on April 10, 2001. This long gap of 19 months was on account of the need for major rectifications and modifications on the new units — and inevitably on the lessons learnt from experience at Panipat Refinery.

Phase II of the refinery estimated to cost Rs. 3690 crore was funded, as per the original means of finance approved by ICICI Ltd. (the lead institution) through debt (both in foreign currency and rupee) of Rs. 2293 crore and by way of equity of Rs. 1397 crore including Promoters' contribution of Rs. 726 crore towards their share of the equity. In view of adverse capital market conditions and the prevailing low refining margins in the oil industry, a public issue of Rs. 671 crore could not be floated and this gap was met by raising an additional debt, which led to the distortion of debt-equity ratio to 4:1 (for Phase II) as against the envisaged debt equity ratio of 1.5:1 leading to a steep increase in the company's interest burden.

After Phase-II expansion the refinery had the flexibility to process 38 types of crude oil with API gravity ranging from 24° to 49° with sulphur content as high as 4%. MRPL became the first refinery in India to have two Hydro Cracker Units (HCU's) for the maximisation of production of Middle Distilates. It has two Continuous Catalytic Regeneration type Platforming Units (CCR) capable of producing High Octane Reformate and also to produce "lead free" MS meeting Euro III Standards. MRPL's two Visbreakers enabled it to upgrade residue and increase distillate yield. With this configuration the refinery was quite capable of going up to 10.8 MMTPA, producing green transport fuels meeting Euro III Standards.

While the construction and expansion of this landmark project was going ahead as planned, the project received a serious setback with the tragic and untimely demise of Aditya Vikram Birla (one of the founders) on 1 October 1995. He was succeeded by his son Kumaramangalam. Earlier, P. Rama Krishnan, the previous Chairman of HPC superannuated on February 28, 1995 and was succeeded by H.L. Zutshi. The JV was given a hydra-headed organizational structure by the promoters having two Managing Directors — one of them, MD (Finance & Administration) was nominated by the Birlas and the other MD (Technical) was appointed by HPC. This dual power control led to lack of adequate cohesion and synergy at the Board level particularly in the years to come when MRPL was to face a severe financial crunch.

Based on the recommendations of the Expert Technical Group (ETG), the Government of India initiated the process of deregulation of the petroleum sector. To begin with the retention price mechanism applicable to refineries was abolished with effect from 1st of April 1998, with the assurance of suitable tariff protection to provide adequate returns on investment in refineries. The ex-refinery price for controlled products such as LPG, Motor Spirit, High Speed Diesel, Superior Kerosene Oil and Aviation Turbine Fuel was replaced by adjusted import parity prices. During the formation and commissioning of MRPL, it was assumed that the APM would continue for a period of at least five to seven years and hence the above factors coming into play were unforeseen.

With the withdrawal of the APM from April 1998, MRPL was dangerously exposed to the vagaries of international market forces. This triggered a drop in refinery margins, resulting in mounting losses. As per the MoU of June 26, 1987 signed between the Government, HPCL and ABG, marketing and distribution of all formula petroleum products was to be canalised through the public sector marketing companies, while marketing of non-formula products as well as petrochemical products manufactured by the refinery were to be marketed directly by MRPL.

Keeping in mind that the oil sector was going to be totally decontrolled with effect from the month of April 2002, MRPL appointed Arthur Anderson as consultants to carry out a detailed study so that they (MRPL) could undertake direct marketing of petroleum products produced for the financial year 1999-2000. Based on the report submitted by the consultants, MRPL approached the Government of India to grant them rights to market automotive and transportation fuels in line with the already laid down State policy. So far MRPL had been marketing its finished products only through HPCL.

As a consequence of the abolition of the Retention Price Mechanism, the Government of India de-canalised the import of crude oil. Accordingly, all private and joint sector refineries were permitted to directly import their requirements of crude. In October 1999, MRPL engaged the services of Chevron and Texaco through competitive bidding to help them procure crude oil. They (Chevron and Texaco) were also to train MRPL personnel in procuring the optimum crude mix in order to maximise refinery profitability. This arrangement, however, was terminated immediately after the takeover of the refinery by ONGC.

The need for top level cohesion became even more critical for the economic health of MRPL especially after the Retention Price Mechanism was abolished in the month of April 1998. At a time when there ought to have been clarity with regard to crude purchase and marketing, both MDs attempted to perform these tasks jointly.

As mentioned earlier the dismantling of the APM, coupled with the reduction in refinery margins and on account of the non-availability of tariff protection led to a drastic reduction in operating margins. As the interest burden began to mount fearfully, the refinery started incurring heavy losses. This situation led to a severe cash crunch and in turn severely affected refinery operations reducing its capacity utilisation to around 60% in 2001-02.

At one stage the refinery was literally starved of crude oil (feed stock) as there was no money to pay for it. In addition, the Industry Logistic Plan (ILP) which came into existence after dismantling of the APM for marketing on March 31, 2002, oil companies beat down the refinery's capacity to 6.0 MMTPA,which was only around 60% of its installed capacity. This situation in 1999 was brought about soon after the commissioning of Reliance Refinery at Jamnagar when the availability of domestic products exceeded demand. MRPL, in spite of under-utilising its capacity was forced against its wishes to export its surplus products like Naphtha and Fuel Oil, which further compounded its losses.

The situation became extremely grave and in a last ditch effort, Kumaramangalam Birla decided to consult the Boston Consulting Group (BCG) to advise him on how to deal with the challenge and save MRPL and prop it up if possible. He also had a brain-storming session with his senior managers. At the end of the consultation, Kumaramangalam surprisingly decided to pull out his company's stake from MRPL. ABVG thereafter informed its JV partner about its reluctance to pump in any more money into MRPL to revive it. Left out in the cold, HPCL now had to single handedly save the situation and prevent MRPL from sinking.

It is understood that between the months of February and March 2001 the Birla Group (AVBG) formally conveyed its intention to exit from MRPL to HPCL and the Ministry of Petroleum. As per the tripartite MoU of 1987 if one of the promoters intended to sell their stake, the other promoter had the first refusal option. AVBG accordingly offered the sale its shares in MRPL in February 2001. HPC and AVBG appointed Joint Valuers (SBI Caps and Arthur Anderson) in May 2001 for valuation of AVBG's stake in MRPL. The final valuation report was submitted in September 2001 to the promoters.

The Valuer's pegged MRPL's share price at Rs.16.78 per share, as against the then prevailing market rate quoted on BSE and NSE of around Rs.7 per share. On 30th of September 2001, HPCL offered to buy AVBG's stake at 50% of its book value, i.e. at approximately Rs.1.55 per share in view of the continued losses the refinery had incurred. This offer was turned down by AVBG.

MRPL's poor performance could mainly be attributed to the withdrawal of the APM, low refining margins, and high debt burden. In a desperate attempt to financially restructure the Joint Venture, in April 2001 MRPL appointed Lazard India Ltd. for advice. This appointment was followed by an all-Lenders meet on 15 June 2001 whereby MRPL formed a Monitoring Committee consisting of eight representatives of the Lenders to negotiate restructuring on its behalf. The Lenders were requested to grant a six-month moratorium for payment of interest on Term Loans and Lease Rentals falling due after May 15, 2001 which was fixed as the cut-off date for financial restructuring, payment of interest and the principal with six months' arrears to avoid loans becoming NPA in Lenders' books.

A draft business plan was prepared by Lazard India Ltd for the year 2002 to 2011. The consultant then informed MRPL on February 22, 2002 that a large equity infusion was an immediate must to prevent MRPL from becoming a Non Performing Asset (NPA) in the books of the Lenders and a potentially sick company under the BIFR. Based on the Draft Business Plan, Lazard India Ltd was of the view that MRPL's liabilities needed to be restructured and it called for an immediate equity infusion of Rs.1500 crore in order to enable Financial Institutions to convert loss into equity and part conversion of Long Term Debt by the Lenders into equity by Financial Instituations and the Banks.

However, none of the two partners were willing to pump in any more money to revive this sick national asset now in the ICU and which was on the verge of becoming an NPA. Lazard India Ltd was then instructed to look for a potential investor for raising the required equity of Rs. 1500 crore. As losses kept on mounting and crossed 50% of the Net Worth of the company, MRPL as on March

31, 2002 became a seriously sick company under the Sick Companies (Special Provisions) Act 1985. It is relevant to mention here that despite the Board level tensions between the promoters, senior managers in MRPL (below the Board level) had strong sense of ownership and commitment to the efficient running of the refinery. They evolved an informal, cohesive work culture, which promoted efficiency dedication and team work.

Lazard India Ltd. failed to identify any potential investor in the market who was willing to raise such a huge equity of Rs. 1500 crore required to revive the sick company and it soon became clear that this precious national asset was on the verge of pulling down its shutters. This fortunately was prevented by the Government when it intervened around mid June 2002 and asked ONGC to step in and save the situation.

ONGC gallantly took up the offer and at the very outset proposed a Debt Restructuring Package for the company, which was approved in principle during the Head of Institutions Meeting (HIM) held on July 18, 2002. J P Morgan was appointed by ONGC for the Restructuring of MRPL's loans. ONGC then entered into Share Purchase Agreement with AVBG for the purchase of its entire shareholding in the company subject to approval by the Government of India.

On January 22, 2003 ONGC received PIB's approval for investment in MRPL. On February 19, 2003, the CCEA's approval was granted for cancellation of the earlier Tripartite Agreement between HPCL, AVBG and the Government of India and on 3 March 2003, ONGC acquired 37.38% of the stake of AVBG in MRPL at Rs.2 per share (approx.Rs.59.43 crore). On March 23, 2003, MRPL's shareholders at an Extraordinary General Body Meeting approved the issue of Preferential Equity shares to ONGC and the Lenders as per the Debt Restructuring Package (DRP) and amendment to the Memorandum and Articles enabling ONGC's entry into MRPL.

On March 30, 2003, the Debt Restructuring Package pertaining to the Long Term Rupee loans was implemented, pursuant to which equity was issued to the Lenders as well as to ONGC. The latter infused Rs.600 crore towards subscription of the 60 crore equity shares in MRPL thereby increasing its stake from 37.38% to 51.25%, making MRPL a subsidiary of ONGC and the Lenders converted part of their loans into equity capital of Rs. 358 crore (35.8 crore equity shares were allotted to them at par).

Further, in the month of June-July 2003, ONGC exercised the call option in terms of the DRP for the purchase of the balance equity shares held by Financial Institutions and Banks. In addition, in the June-July 2003, pursuant to the Option Agreement, and ONGC's purchase of 35.8 crore shares held by them at an approximate cost of Rs.381 crore, ONGC increased its stake to 71.62%. Thus, the present share holding (175.29 crore equity shares) pattern is as follows: ONGC-71.62%, HPC-16.95% and Others-11.43%.

The Debt Restructuring Package (DRP) was proposed by ONGC in July 2002 and implemented within four weeks from the day ONGC acquired AVBG's stake in MRPL. The salient features of the DRP were:

- Rupee Long Term Debt was reduced from Rs. 3185 crore to Rs. 2185 crore.
- Rupee Loans of Rs. 600 crore were paid on March 31, 2003 out of the funds pumped in by ONGC towards equity.
- Rupee Term Lenders and Deferred Payment Guarantee (DPG) Lenders converted Rs. 358.20 crore of their loans into equity, Rs. 9.19 crore into 0.01% Non-cumulative Redeemable Preference Shares (Preference Shares) and Rs. 147.83 crore into secured Zero Coupon Debentures (ZCDs). Preference Shares and ZCD were made repayable in two annual installments at the end of ninth and tenth year respectively from July 1, 2002.
- The interest rate on the Rupee Term Borrowings were reduced from an average 13.61% p.a. to 9.15% p.a. payable in a stepped-up manner to match the interest payments with projected cash flows.
- Debt-Equity ratio was brought down from 9.77:1 to 3.45:1 on implementation of DRP, Average Debt Service Coverage Ratio (DSCR) post-DRP was set at 1.57.
- The Term Loans were made repayable in the eighth year with a moratorium of four years from 1 July 2002.
- MRPL was given the option to prepay Rupee Term Loans at any time without any prepayment premium.

The acquisition of equity coupled with the finalisation of DRP by ONGC rescued MRPL from the brink of reference to BIFR as a 'sick company'. By taking over MRPL, ONGC not only converted a private sector refinery, one of the most modern in the country, on the verge of collapse into a public sector company, but also succeeded in turning it around completely in an incredibly short time. In an era of privatisation, this was apparently a reverse case. As a matter of fact, L K Advani, the then Deputy Prime Minister remarked on 15 May 2003 at Mangalore while commemorating the receipt of the first parcel of ONGC's off-shore Equity crude from Sudan that the MRPL's turnaround was an unprecedented example of a public sector enterprise reviving a non-PSU.

After ONGC's takeover, expectedly there was an immediate rise in the morale amongst all segments of MRPL's employees. When the CMD of ONGC paid his first visit to MRPL the workers thanked him profusely for the takeover as they now saw a very bright future. One of the first decisions taken by ONGC after its takeover was to run the Refinery to its full capacity.

The decision by ONGC to takeover MRPL could not have been taken at a better time. Soon after the ONGC's acquisition, the 363 km Mangalore-Hassan-

Bangalore Product Pipeline (MHBPL) was commissioned on August 1, 2003. This was built by Petronet MHB Ltd., a project promoted by HPC and Petronet India Ltd. with an equity investment of 26% each in which ONGC joined as a strategic investor with a 23% stake at a later stage. Potentially the pipeline was a great asset to MRPL for product evacuation.

In order to convert its strategic decision to run the refinery to its full capacity, the positioning of adequate quantities and appropriate quality of feedstock (crude oil), arranging sufficient finances including working capital and ensuring evacuation of the refined products were the inescapable decisions that had to be taken almost simultaneously.

Fortunately, the refinery Process configuration with two Hydrocrackers as secondary processing units enabled it to refine almost any type of crude oil and had in fact already refined 38 different types of crude. ONGC provided it with two types of 'Sweet' crudes (Mumbai High and the Nile Blend from Sudan) and two types of "Sour" crudes (high sulphur content) i.e. Iran Mix and Arab Mix. As far as product evacuation was concerned, the Government of India was requested to advise the other oil companies to revise MRPL's capacity from 6.00 MMTPA to 9.69 MMTPA in the ILP system.

However, this has yet to take place. In view of this, a conscious decision was taken to export surplus products to sustain the capacity utilisation of the refinery to its rated capacity. Agreements have been signed with Essar, OIL, and Shell India Marketing Private Ltd., for sale of HSD and MS effective November 5, 2004. In addition MoU's have been signed with IndianOil, BPCL and HPCL for uplifting products ex-MRPL for three years starting from April 1, 2004 onwards. Surplus products that could not be evacuated in the domestic market continue to be exported although export realisation then was lower than domestic sales.

Whereas MRPL had already commenced direct marketing as early as August 2000, presently it is attempting to significantly enlarge these volumes. In addition MRPL has succeeded in exporting significantly large quantities of its products without any loss in cash flow. Currently product evacuation mix is as follows: Direct Sales by MRPL-3% and sale to other oil companies-58% and Export-39%.

Like any new entrant into the Indian petroleum market already dominated by seasoned players, MRPL has several marketing challenges to face and overcome for it to successfully penetrate the domestic retail market as also to settle down to its full refining capacity 12.0 MMTPA. Some of these challenges facing MRPL are: speedy development of marketing infrastructure, earliest possible commissioning of adequate number of retail outlets and the ability to attract large direct customers.

Retail marketing is not only an essential part of marketing strategy of any oil

MRPL Board Meeting

company but also represents its public image. Today, with surplus refining capacity in the country, every oil company is trying to increase its domestic market share by competing with other oil companies. Present-day customers too have not only become extremely cost conscious, but also highly quality conscious. These are some of the challenges MRPL Marketing will have to face and overcome at the earliest.

After the takeover by ONGC, the first challenge MRPL had to face was the minimisation of interest cost. This was done by reducing the quantum of working capital, followed by a series of other steps. For example, working capital borrowings were kept outside the scope of DRP, which would otherwise have kept MRPL exposed to high interest rates linked with Prime Lending Rates (PLR) stipulated by the Lenders. In order to lower the interest rate on MRPL's working capital, ONGC sanctioned a working capital assistance of Rs.450 crore at SBI PLR (10.75% p.a) without recovering on over-riding service charge of 1% on SBI PLR as earlier charged by HPC. This immediately saved Rs.4.5 crore per annum.

In May 2003, MRPL secured an A-1 rating from ICRA for its short-term borrowings of Rs. 300 crore. This enabled MRPL to secure Rs.150 crore on the basis of commercial papers released by it, at an average interest of 5.41% per annum as against a PLR of 10.75% by consortium Banks. This meant a notional saving of approximately of Rs.8 crore per annum.

After the successful issue of Commercial Paper, MRPL entered the market with issue of Mibor linked Bonds of Rs. 50 crore with a green-shoe option of Rs. 25 crore at interest of overnight Mibor plus 15 basis points. (around 5% p.a) . The issue was oversubscribed 4.2 times. Seeing MRPL's success in raising money through Commercial Papers and Mibor-linked Bonds as against PLR linked rates, SBI — its lead Bank, agreed to give working capital facilities on par with Commercial Paper/Mibor linked benchmark rates of around 5% compared to SBI PLR of 10.75%.

Since MRPL was exporting petroleum products, the company decided to access Export Packing Credit in dollars from Indian Banks and also started shifting its Working Capital borrowings to Buyers Credit Facility linked with Libor, which was even less than half of Mibor. These loans also enabled MRPL to repay its crude supplier in foreign exchange without any Forex Transaction charges to a large extent. The cumulative effect of all these efforts was that interest on the Working Capital requirements of the company came down considerably despite increase in thruput as demonstrated below:

Year	2002-2003	2003-2004	2004-2005
Refinery capacity utilisation	75%	104%	120%
Interest on working capital (Rs. crores)	160	71	39

The other areas offering a very significant scope for savings were a Long Term Loan, which carried interest rates of 9.15% per annum. MRPL explored the possibility of repaying these loans by raising Non-Convertible Debentures/Loans from Markets/Banks at around 5.5% to 6% backed with ONGC's Comfort Letter based on which DRP loans were continuing. ONGC, however, itself gave MRPL an Unsecured Loan of Rs. 2600 crore at the Bank rate of 6% with which the company between December 2003 and January 2004 was able to prepay its entire Long Term Loan of Rs. 2637 crore and thereby save 3.15% per annum on this amount or Rs. 82 crore. This was the largest prepayment of loan so far in Indian Corporate history.

In view of these daring initiatives undertaken by MRPL, interest and finance cost for 2003-04 was Rs.373.42 crore as compared to Rs.567.07 crore for 2002-03, a sharp decline of 34%. Interest and Finance cost for the year ending March 31, 2005 came down further to Rs. 230 crore, reducing it further by 38%.

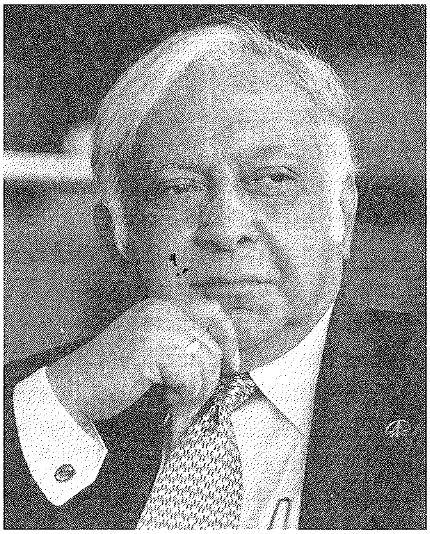
MRPL was also able to save substantially on LC costs on crude imports. In one case, with the Ministry's approval MRPL secured the assignment of IndianOil's and the National Iranian Oil Company's (NIOC) term contract to itself and thereafter succeeded in persuading NIOC and its Bankers (Bank Markazi) to waive 0.1% LC confirmation charges. Even the State Bank of India which had the monopoly for opening NIOC's LCs under the ACU Mechanism was persuaded to gradually reduce its LC opening charges from 0.77% to 0.32%. Similarly MRPL also persuaded Saudi Aramco to supply crude oil without insisting for any LC on the basis of ONGC's parental financial backing.

MRPL virtually created history when it pre-paid a Sales Tax Deferral Loan of Rs. 517 crore due to the Government of Karnataka at NPV calculated at 6.5% on March 31, 2004 amounting to Rs. 261 crore. This single transaction brought down accumulated losses by Rs. 256 crore.

All this only goes to reveal how MRPL was virtually rejuvenated by ONGC. However, this process is best described in the words of Subir Raha, the then Chairman & Managing Director, ONGC in his address to the students of the Indian Institute of Technology, Guwahati in Assam on April 15, 2004.

"After taking over MRPL, what did we do to rejuvenate the Refinery? ONGC provided the working capital. We did not give it free, we charged interest. ONGC had about Rs.8,000 crore Cash Reserves in the bank and the average interest rate we were getting was 5.5%. The bank interest rate today is 6%. We gave a loan to MRPL at 6%. MRPL debt was having an interest burden of 13% before ONGC came into the picture. With Debt Restructuring Package (DRP) the average interest rate came down to 9.15%.

"With working capital made available, we began supplying Mumbai High crude. Mumbai High crude is one of the best crudes in the world. We began sup-



Subir Raha, Former Chairman & Managing Director ONGC and first Chairman of the Public Sector MRPL

plying crude from our Sudan property, which we acquired in March 2003. Sudan crude is also sweet crude. With the supply of crude from Mumbai High and Sudan, the average crude purchase cost by MRPL has come down.

Then, we looked at maintenance of the plant. A lot of maintenance was overdue as most of the maintenance jobs were postponed because of non-availability of working capital. We looked at the catalogue of maintenance and attended to all the issues one by one.

Today, MRPL is the most energy-efficient company among Indian refineries. We have no information about Reliance's Jamnagar refinery as they do not publish any figures. The energy index of MRPL is in two digits, which is 85, whereas the energy index of every other refinery is more than 105.

Coming to capacity utilisation, MRPL never processed more than 7.25 million metric tonnes in a year. This year (2003-04) MRPL achieved 104% of the rated capacity of 9.69 million metric tonnes. In the last six months of year 2005-06, we are running at 128%-plus capacity utilisation. Enhanced capacity utilisation has given more valuable products. We have trebled our exports. We got better realisation on our exports, by combining ONGC's value-added products with MRPL products".

The overall result of all these efforts and actions led to an increase in capacity utilisation of the refinery from 75% (2002-03) to 104% for the year 2003-04 and further to 122% in 2004-2005. MRPL's output of finished products increased by 39.60% from 6.7 MMTPA to 9.3 MMTPA and 13% to 11.05 MMTPA in 2004-2005. The company's turnover increased by 47% from Rs.8581 crore in 2002-03 to Rs.12612 crore in 2003-04 and further by 64% to Rs. 20693 crore in 2004-2005. Income from exports went up by 133.8% from Rs.1913 crore in 2002-03 to Rs.4478 crore in 2003-04 and Rs. 6185 crore in 2004-05.

After being neck-deep in debt and in serious trouble on many fronts, MRPL rose like a phoenix from the ashes to reach the portals of BSE 30 in August 2003. The market capitalisation at the Bombay Stock Exchange (BSE) rose from Rs.643 crore on 30 March 2003 to touch Rs.10,000 crore on 7 January 2004, a gigantic leap of 1,455% in less than a year's time.

On December 31, 2004, MRPL had the rare distinction to become the first refinery in India to produce HSD to match Euro III Standards. All the refineries had been directed the Ministry to produce and supply HSD and MS conforming to Euro-III specifications from April 1, 2005. Projects to further upgrade the quality of MS and HSD to conform to Euro IV Standards at MRPL are underway and will be completed by 2006.

Presently MRPL is not only preparing to increase its capacity to 15.0 MMTPA, but also planning to maximise the value of the barrel of crude refined by converting its excess Naphtha stream to value-added Aromatics in addition to maximising propylene from the heavier fractions through integrating with a Petro FCC.

A financial snapshot of the Refinery is very well captured by the following table.

	Under APM		Post APM					Post ONGC Acquisition	
Year Ended March 31st	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**1HY 2005**
Total Income	1300	1399	2665	3263	2721	5429	8694	12196	8489
Total Expenditure	770	845	2172	3206	2577	5141	8292	10839	7713
PBDIT	530	554	493	57	144	288	402	1357	776
Interest & financial charges	308	393	343	237	238	672	567	373	126
PBDT	222	161	150	(180)	(94)	(384)	(165)	984	650
Depreciation	118	130	134	143	173	394	405	409	205
PBT	104	31	16	(323)	(267)	(778)	(570)	575	445
Provision for Tax	13	3	2	0	0	(286)	(241)	115	165
PAT	91	28	14	(323)	(267)	(492)	(329)	459	280
Extraordinary/ Exceptional Items				(23)	-82	0	83	0	0
Net Profit/(Loss)	91	28	14	(300)	(185)	(492)	(412)	459	280

MRPL has been one of the most valuable assets acquired by ONGC at Rs.1040 crore. It is an asset whose replacement value today would be nothing less than Rs.10,000 crore.

The saga of ONGC-MRPL turnaround is a remarkable tale in India's corporate history having all the ingredients of an amazing case-study of rejuvenating a sinking company faced with a crippling debt burden. By adopting all possible financial strategies, ONGC achieved almost the impossible to everyone's surprise.

Presently, ONGC is steadily treading the path of becoming the first vertically integrated oil company in India after the pre-1981 Oil India and Digboi Refinery. With a sizeable stake in downstream activities of the oil industry, ONGC is well equipped to expand exponentially to become a frontline player in the field of Refining, Marketing and Petrochemicals in addition to upstream production of crude oil.

A view of the Mangalore Refinery & Petrochemicals Ltd. (MRPL)

PANIPAT REFINERY

In October 1998, IndianOil's seventh refinery located at Panipat amidst lush green fields of the historic Panipat District in the State of Haryana went on stream. The refinery is located about 23 kms from the town of Panipat with an installed capacity of 6.0 MMTPA and is referred to as India's most modern refinery with state-of-the-art technologies from IFP, France, Haldor Topsoe, Denmark, Unocal, UOP, Stone & Webster, USA, etc. The refinery has been processing both indigenous and imported crude and has been meeting the petroleum needs of North-Western parts of India since 1998. In order to preserve the ecological balance Panipat refinery is the country's first zero discharge refinery.

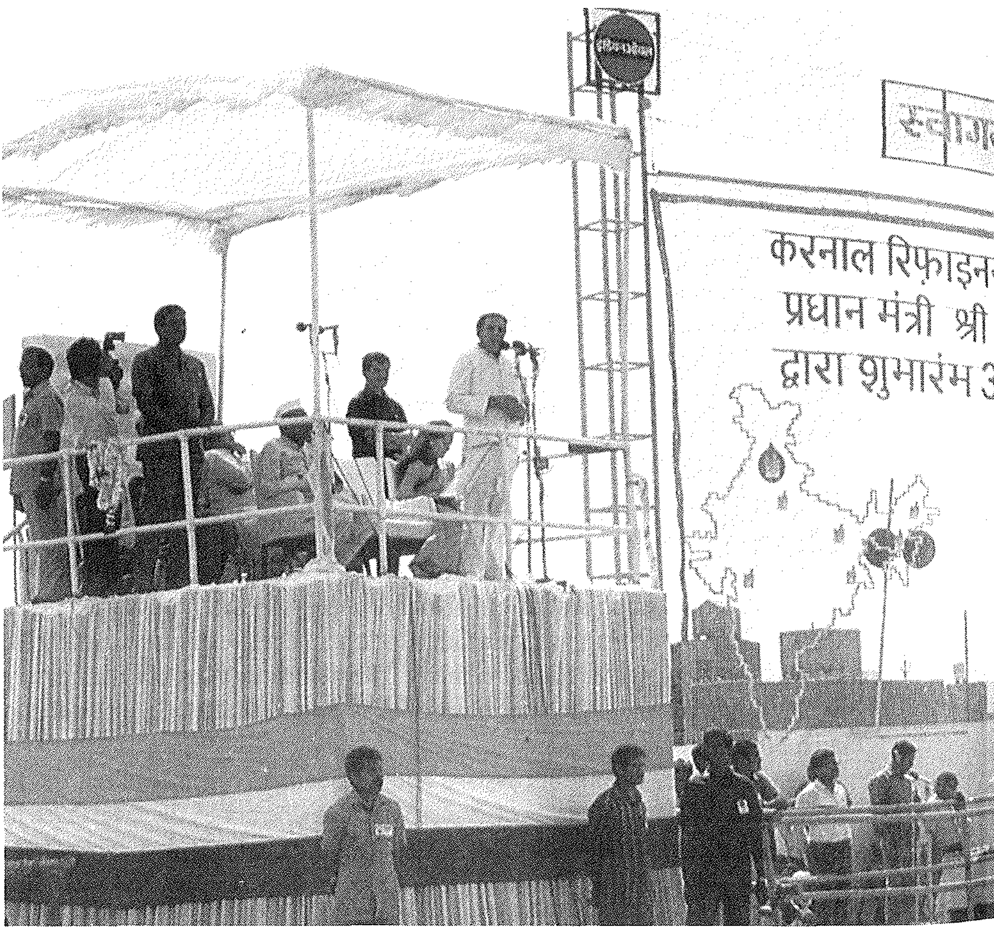
On completion and commissioning of the Mathura Refinery and around the middle of 1982, the Government of India asked IndianOil to develop feasibility report for two JV refineries one at Karnal in Haryana, and second one at Mangalore in Karnataka. Such a feasibility report was completed and submitted to the Government in 1983. Public bids were called for the two projects on the basis of which the Government decided that the six million tonne refinery at Karnal (later renamed Panipat) would be built by IndianOil and the three million tonne Mangalore Refinery project was entrusted to HPCL, as a separate joint venture with the Birla Bros., headed by the late Aditya Vikram Birla.

While IndianOil commenced its Panipat project in 1984, including selection of site and Licensor agreement for different units with their capacities worked out, construction work soon began picking up momentum by 1985. Thereafter Government's policies underwent some revision. The MoP & NG directed IndianOil to form a joint venture for Panipat Refinery with the Tatas. Accordingly, IndianOil along with Tata Chemicals formed a separate joint venture company for the project then known as Karnal Refinery. The foundation stone of the refinery (by now renamed Panipat Refinery) was laid by Prime Minister Rajiv Gandhi on March 30, 1987.

Soon thereafter, serious discussions and negotiations began between the JV partners, but despite continuous dialogues with Tata Chemicals, the talks failed to yield positive results on account of several basic differences that cropped up between the two partners. The project was getting inordinately delayed and since nothing fruitful was forthcoming through the IndianOil-Tata JV, the Government ultimately felt that the project ought to be entrusted entirely to IndianOil. This was in 1991 by which time eight valuable years were lost.

Finally, in October 1992 the Government of India approved the setting up of a 6.0 MMTPA petroleum refinery in Haryana with associated crude supply and product dispatch facilities at an estimated total cost of Rs. 3,868 crore, which also included a foreign exchange component of Rs 506.8 crore. The actual cost of the refinery worked out to Rs. 2793.98 crore, and the rest was for other facilities like marketing (Rs.331.1 crore) and pipelines (Rs.742.9 crore).

An area of 2,065 acres located near the village of Baholi on the north-west of Panipat town, about 100 km from Delhi was selected as the site for the new refinery. An additional piece of land of 161 acres was also acquired about 7 km away from the refinery for building a township for the employees.



The existing SMPL (Salaya-Viramgam-Mathura crude pipeline) was utilised for transporting crude oil from Salaya to Chaksu. The relevant sections of the SMPL were expanded appropriately from Salaya to Chaksu. From Chaksu, a new pipeline of 345.7 km (24" diameter) at the cost of Rs.549 crore was laid right up to the Refinery Pipeline Terminal to receive crude oil for processing in the refinery. The total cost of laying the new pipeline was Rs.743 crore. This included crude oil storage tanks at Chaksu in addition to storage tanks at the refinery. Three crude oil storage tanks of 60,000 kls each were built to take care of crude storage.

Panipat Refinery was originally designed to process 6.0 MMTPA of crude oil, which comprised 3.0 MMTPA of Bombay High Crude Oil (having a gravity of 40 degree API) and 3.0 MMTPA 1:1 mixture of Arab Light and Arab Heavy crude (gravity of 30 degrees API) in a blocked out operation.

Processing schemes of refining with Once-Through Hydrocracker Unit (OHCU) and Fluidised Resid Catalytic Cracking Unit (FCCU) were selected, based on the maximisation of middle distillate production to meet the huge deficit in the region and the need to produce superior quality products. In order to produce unleaded gasoline and to avoid emission of toxic lead compounds, a Catalytic Reformer with Continuous Catalyst Regeneration (CCR) technology was also installed as a measure of environment protection. To meet the power and steam needs of the refinery, its units in the marketing, pipeline and township, a 75 megawatt captive power plant was installed and subsequently a 20 megawatt gas turbine was commissioned in 2001.

A new model village at Sithana which is adjacent to the refinery was built with all basic infrastructure for rehabilitation of the displaced villagers of Baholi. The project provided direct employment to about 750 people for the operation and maintenance of the refinery complex,

Foundation stone of Karnal Refinery (Now Panipat) laid by Prime Minister Rajiv Gandhi on March 30, 1987 besides, a much larger figure of indirect employment. In addition, Panipat Refinery acted as a nucleus for the future growth of auxiliary and ancillary industries in the area.

While adopting latest global technologies for the refinery, utmost importance was given to the protection of environment. Some of the special measures taken were:

- A comprehensive environment assessment done through NEERI and an elaborate management plan as recommended by them was implemented.
- A state-of-the-art waste water treatment plant was installed for treating effluents to achieve parameters better than prescribed by minimal national standards (MINAS).
- Air quality around the refinery even today is being monitored continuously through seven air monitoring stations and a mobile van.
- A sulphur recovery plant for the reduction of sulphur dioxide emissions with recovery efficiency of 96% in the beginning and with ultimate target of 99% efficiency was installed.

The latest global process technologies from USA, France and Denmark were adopted to produce superior quality products. Complete automation of all refinery processes and line blending of various products was done to achieve optimum product quality and to maximise high value of superior quality products. Products produced while meeting all BIS specifications, were in fact more superior to the minimum mandatory requirements..

The product pipeline from the refinery was hooked to MJPL and KBPL product pipelines which passed through Panipat in order to transfer the products to the marketing depots all over the North-West. This had the dual advantage of catering to Delhi and Ambala marketing depots, and further up to Jalandhar during down time of Mathura Refinery.

LPG from the refinery is transferred to the Karnal Bottling Plant, located at a distance of 9 kms from the refinery through an underground pipeline of 10" diameter and pumps having a capacity of 240 m3/hr. and 12.0 kg/cm2 discharge pressure. The line was provided with facilities for pig launching and receiving.

IndianOil's Panipat refinery has since undertaken two very major projects with a combined investment of approximately Rs.10,000 crore. The first was the expansion of the refinery by another six million tonnes adding similar units along with secondary processing including a Hyrocracker and Delayed Coker to minimise black oil generation. This will double the refinery capacity to 12.0 MMTPA at the cost of only Rs.4,000 crore.

In order to meet an additional requirement of 6.0 MMTPA of crude for the refinery, the Kandla-Bhatinda pipeline will be converted to crude oil service up to Panipat. The refinery expansion project will be completed progressively during

2005. The second major project under implementation is the Rs.5104 crore integrated Paraxylene and the PTA Project. This project will utilise 0.5 MMTPA of high aromatic Naphtha from Mathura and Panipat which will ultimately produce a world scale capacity of 553,000 metric tonnes per annum of PTA making it the largest single PTA plant in India with state-of-the-art technology.

PTA so produced has been envisaged to be marketed to fibre manufacturers (PSF and PFY) as well as to the bottle-chip manufacturers (PET). Larsen & Toubro have been awarded with the job of construction of the PTA unit on LSTK basis. For the PX unit, EIL is the LSTK contractor. The project is now expected to be mechanically completed and commissioned by December 2005.

This first refinery-cum-petrochemical mega venture of IndianOil is poised to be front runner for its major entry into the field of Petrochemicals. The above two projects are the largest single investment by IndianOil in Haryana. The location of the refinery has also emerged as the right place for building of a Naptha Cracker Unit which will absorb all the surplus Naptha which is likely to be available from Koyali, Mathura as well as the Panipat Refineries. Accordingly an 800 TMT per year Naptha Cracker project at an investment of Rs.6,300 crore has been approved by the IndianOil Board and the project is targeted for commissioning in February 2007.

This Cracker will yield a significant quantity of downstream petrochemicals including LDPE, HDPE, PP, MEG and even Benzene. Simultaneously, with the Naptha Cracker project the refinery has grand plans to expand to 15.0 MMTPA at a cost of approximately Rs.1,200 crore.

To conclude, IndianOil's Panipat Refinery is going to play a leading role in the progress and economic prosperity of the State of Haryana.

NUMALIGARH REFINERY LTD.

Numaligarh Refinery, popularly known as "Assam Accord Refinery" was set up as a grass-roots refinery at Numaligarh in the District of Golaghat in Assam for fulfilling one of the commitments made by the Government of India in the historic "Assam Accord" signed on August 15, 1985. In the comparatively under-developed State of Assam it was necessary to build this refinery for giving a thrust to the industrial and economic development of Assam.

Numaligarh Refinery Limited (NRL) was incorporated on 22 April 1993 with IBP and the Government of Assam as co-promoters having 51% and 10% equity participation respectively leaving a balance 39% to be raised by floating a public issue. On June 2, 1995 Bharat Petroleum Corporation was brought in as the third promoter, whereby the equity structure stood revised to 32%, 19% and 10% for BPC, IBP and the Assam Government respectively, leaving a balance of 39% to be raised through a public issue.

Subsequently in March 2001, BPC acquired IBP's entire equity of 19% thereby raising BPC's equity to 51% and making NRL its subsidiary. Out of the 39% equity earmarked to be raised from public, 10% each had been placed with OIDB and OIL through private placement. Presently, Bharat Petroleum Corporation Limited holds 62.96% of the company's paid-up capital. The other equity holders are the Government of Assam, Oil Industry Development Board and Oil India Limited with equity participation of 12.35 % each.

The refinery was designed to process 3.0 MMTPA of indigenous crude oil adopting state-of-the-art technologies with the configuration of Crude Distillation Unit (CDU), Vacuum Distillation Unit (VDU), Delayed Coker Unit (DCU), Hydro Cracker Unit (HCU), Hydrogen Unit (H2U), Coke Calcination Unit (CCU), and a Sulphur Recovery Block (SRB). The adopted configuration met the objective of maximising middle distillates like Kerosene and Diesel. The refinery and the Marketing Terminal were operated by fully automated systems and supported by business systems driven by Enterprise Resource Planning (ERP). The crude oil requirement of the refinery was supplied by OIL through pipeline from the oilfields of OIL and ONGC in Assam.

The refinery was designed to produce LPG, MS, Naphtha, Aviation Turbine Fuel, Superior Kerosene, High Speed Diesel, Petroleum Coke and Sulphur. The approved project cost for the Refinery and Marketing Terminal was Rs. 2,489 crore and Rs. 235 crore respectively, totaling Rs. 2,724 crore (based on December 1997 prices). The total amount of Rs. 2,724 crore were met from equity of Rs. 908 crore and the balance Rs.1816 crore from debts involving a debt equity ratio of 2:1. Both projects were completed within the approved cost of Rs. 2724 crore.

In sharp contrast to other parts of the country, implementing any major project in the North East presented a host of difficulties in view of its inhospitable industrial climate, uncongenial social environment and grossly inadequate infrastructural facilities to support industrial ventures of any kind. Though the philosophy of mitigating challenges in different projects is often similar, circumstances in the North East call for extraordinary measures to overcome the very difficult hurdles on various fronts. The Numaligarh Refinery project was able to take all these challenges in its stride and eventually overcame them successfully and rose above the expectations of its shareholders, stake holders and the community at large.

Project work demanded high levels of individual skill and professionalism. NRL received excellent support from BPC in terms of senior level personnel for project implementation. People were also drawn from industries located in the State and from some Government departments on deputation, as recruitment of people from outside the region proved to be difficult task in view of the prevalent law and order situation in Assam. Besides, there was the need to deploy maximum number of local people at the grass root level. Since local technicians lacked the requisite skills and experience they had to be trained extensively to take up a host of highly skilled functions. Welders were trained in batches at the Regional Research Laboratory, Jorhat and a number of local contractors were trained by Engineers India Ltd., NRL's project consultants,

The induction of a large number of personnel for project work called for development of infrastructure and facilities such as proper housing, recreational avenues, a good hospital and school. Considerable efforts were made to rope in Vivekananda Kendra for managing the hospital and the Delhi Public School to run the Primary and Secondary schools. The conceptual design and layout of the township was entrusted to the School of Planning & Architecture, Delhi. Emphasis was always laid on improving quality of life of the residents of the township.

From the very beginning, the refinery was planned to be operated with a lean staff of less than 600, comprising both management and non-management personnel. There was a need to formulate systems and procedures conforming to best business practices while remaining within the ambit of public sector policies. An ERP solution was put in place and the entire range of ERP applications went "live" progressively from October 1998 onwards.

The greatest challenge encountered was the remoteness of the location and the difficult topography. There was virtually no infrastructure to support any industrial venture, not to speak of a project of this magnitude. High transportation cost, strict environmental stipulations and the seismic potential of the region added to the overall cost of the project. Overcoming the negating effects of a remote and underdeveloped location cost the company an estimated amount of Rs 375 crore.

There was no direct rail link to the project site and the nearest airport at Jorhat was 65 kms away. In addition to the general environmental stipulations, stringent conditions were imposed by the Government due to proximity of the refinery to the famous Kaziranga National Park. Additional restrictions included a minimum of five air monitoring stations including one within the above wildlife sanctuary. Besides there was the requirement of a Sulphur Recovery Plant despite the minimal generation of Sulphur-based gases from the refinery and the stipulation for zero effluent discharge to the adjoining river.

In view of environmental guidelines vis-à-vis the Kaziranga National Park, all over-dimensional and over-weight consignments had to be transported through waterways. These consignments from within the country and abroad were first moved to the Kolkata port, from where, the consignments were loaded onto self-propelled, externally powered barges for onward dispatch to Numaligarh. Thus, the barges sailed some 1800 km via Bangladesh, across the Brahmaputra River up to a Ro-Ro Jetty constructed on the banks of Dhansiri River, 11 kms away from the site. All heavy consignments from the barge were loaded into large hydraulic trailers each consisting of as many as 20 axles with each axle having four wheels on either side.

The Ministry of Environment & Forests set guidelines for developing greenbelts with 500 metres width around the refinery and the marketing terminal, which was a stringent condition by any standards. However, after persistent representations, the norms were relaxed to a certain extent. Greenbelts with 100 metres and 25 metre width were developed around the refinery and marketing terminal respectively. The meticulously planned and developed green belt has now grown to a rich foliage. This has provided a perfectly natural barrier to reduce noise and air pollutants.

Transporting massive consignments to the project site posed major challenges, especially the 167 metric tonne CDU column or moving the three Hydrocracker Units which weighed up to 376 metric tonnes each. Yet another important challenge was to synchronise three linked projects with the completion of the refinery. These projects were: the crude pipeline,the Marketing Terminal and the Product Evacuation Arrangement.

The laying of a 14 km crude pipeline of 16 inch diameter was executed by

OIL. Numaligarh Refinery was assigned the responsibility of building the Marketing Terminal at a late stage by the Ministry of Petroleum, which gave rise to the challenge of synchronising its completion along with the refinery. The Railways were entrusted with execution of the third linked project related to rail transportation of products. The project entailed gauge conversion of the main line up to Dibrugarh; the loop line between Furkating and Mariani as well as a new 10 km BG line with a siding from Furkating to the Numaligarh Refinery Marketing Terminal.

Numaligarh Refinery was completed in good time, logistical bottlenecks and difficult environment notwithstanding. Unit-wise commissioning dates of the refinery were as follows:

Units	Commissioning date
CDU/ VDU	April, 1999
DCU	Sept.,1999
H2U	Feb., 2000
SRB	Feb., 2000
HCU	June, 2000

Commissioning process of the Numaligarh Refinery began in April 1999 in a phased manner and completed in month of June 2000. The refinery was dedicated to the nation by Prime Minister, A.B. Vajpayee in July 1999. Synchronising with the commissioning of the refinery, the Marketing Terminal was also commissioned in April 2000 with commencement of product evacuation from the terminal from 3 April 2000 by road. The first rake was flagged off by the then Union Minister of Petroleum & Natural Gas, Ram Naik on April 9, 2000.

The successful construction and the commissioning of the Numaligarh Refinery demonstrated what could be achieved in Assam given the will and determination. Concurrent with the commissioning of the refinery, because of its high depreciation cost, the Government of India on February 9, 2000 approved a special incentive for full excise duty exemption only to Numaligarh Refinery. In other words it could recover the duty from marketing companies and retain the same. Naturally, other refineries operating in the North East demanded a similar concession. After long-drawn arguments, the Government finally decided to reduce the excise duty concession to NRL by 50% and extended a similar facility to all refineries in the North East from March 1, 2002 onwards.

REFINERY PERFORMANCE

The refinery has completed four and a half years of commercial operations, demonstrating very good performance every year as evident from the key performance indicators stated below:

Physical Performance					
Criteria	**2000-01 (Oct'00 -Mar.01)**	**2001-02**	**2002-03**	**2003-04**	**2004-05**
Crude thruput (TMT)	1035	2307	1879	2200	2042
Distillate Yield (% Wt.)	87.22	85.39	84.64	85.43	85.41
Refinery Fuel & Loss (% Wt.)	12.00	11.07	11.06	9.64	9.72
Specific Energy Consumption(MBTU /BBL/NRGF) [Old CHT method]	162.00	133.50	135.00	122.20	116.60
Financial Performance					
Sales Turnover (Rs/crore)	811.74	2261.28	2804.74	3220.26	4298.99
Profit Before Tax (Rs/crore)	23.60	133.32	316.99	377.22	557.13
Profit After Tax (Rs/crore)	21.60	122.98	174.63	214.95	409.15
Dividend Outgo (Rs/crore)	7.30	37.52	59.75	73.03	142.60*
* Proposed					

Environment Management

Numaligarh Refinery was conceptualised as one of the most environment friendly refineries in the country. Right from its inception, conscious efforts were made at every stage to preserve the environment complying with statutory norms prescribed by concerned authorities. Besides normal pollution control measures specific steps have been taken to ensure that there is no adverse impact on the nearby Kaziranga National Park.

In spite of processing low Sulphur Assam Crude, a Sulphur Recovery Unit has been established which is the first among all refineries processing Assam Crude. The Effluent Treatment Plant with tertiary treatment facilities along with provision for re-use of treated effluents is considered to be one of the most modern with latest technology. Installation of non-illuminating ground flare in the refinery is one among the first in the country.

Facilities have been provided for continuous monitoring of furnace stacks. Five continuous air-monitoring stations have also been positioned for monitoring of ambient air quality in the vicinity of the refinery and also at the Kaziranga National Park. A modern sewage treatment facility in the township and an incinerator in the hospital are provided to take care of hygiene in the locality.

SOCIAL WELFARE INITIATIVES

While the primary function of the company is to operate the refinery with optimum efficiency and yield, the socio-economic welfare of the region was naturally imbibed as an integral part of NRL's corporate philosophy and organisational culture. It is against this backdrop that NRL initiated definitive measures for improving the quality of life of people in the neighbouring areas through innovative and people-friendly programmes. Some of the schemes launched by the company include self-employment through skill development, community based activities, development of strong and sustainable rural institutions and providing community facilities in co-ordination with various Government departments.

RELIANCE PETROLEUM

With a design refining capacity of 22.5 million metric tonnes per annum but operating at 33.0 MMTPA, Reliance's Refinery at Jamnagar in Gujarat is the largest grass-root refinery in India and the third largest operating refinery in the world. Prior to the commissioning this refinery on 14 July 1999 there was a deficit of petroleum products in India. The domestic consumption of all products for the period of April 1999 to March 2000 was 95.0 MMTPA, indicating a growth of 6.5% over the previous year.

The demand for HSD, which accounted for 41% of the total consumption, had increased by about 6.4% over the previous year. The total crude processed in all the refineries during the same period was estimated at 83.0 MMTPA, about 20% higher than the previous year. The supply shortfall from domestic refineries was met by import of petroleum products. This presented an excellent project rationale for a refinery at Jamnagar. Originally planned to process only 9.0 MMTPA of crude, the overall capacity of the refinery was expanded in stages (at the design and construction phase) to a final capacity of 22.5 MMTPA to take advantage of economies of scale when the Government of India relaxed capacity related constraints.

Reliance's Refinery has been set up by Bechtel, a global major in turnkey projects. The latter then sourced the technology for the plant from UOP and Foster Wheeler, who are global leaders in refining technology. Subsequently, the refinery was de-bottlenecked to its current capacity of 33.0 MMTPA making the refinery the largest grass-root refinery in India.

Reliance's Refinery one of the most modern and complex refineries in the world and the configuration providing a lot of operational flexibility in terms of crude-mix and determination of product slate. The Nelson Complexity Index of the refinery is 9.93, which indicates a vast range of secondary processing capabilities enabling the production of higher value-added products.

Deviating from the earlier concept of maximising middle distillates the refinery was configured to maximise value-added products like LPG. It also achieved backward integration by providing products for the own needs of the Reliance Group. Bulk of the credit for these changes in configuration goes to K.K. Malhotra who was Group President, Director, Reliance Petroleum and the former Director (R&P) of Indian Oil Corporation Limited.

With the commissioning of this refinery, the total refining capacity in India shot up to 112.0 MMTPA. This increase in capacity resulted in an over-supply of certain petroleum products in India during 2000. However, domestic demand for petroleum products remained strong from the transport (HSD and MS), power (Naphtha and Coke) and the household (SKO and LPG) sectors.

Reliance with its superior product slate, low per tonne capital costs and considerable economies of scale capitalised on the robust domestic demand outlook for refined petroleum products. The refinery forms an integral part of the strategy of the Reliance Group for vertical integration, enabling production of a high value-added product streams. Further, about 25-30% of the refinery products are consumed by the petrochemical complex within Jamnagar itself.

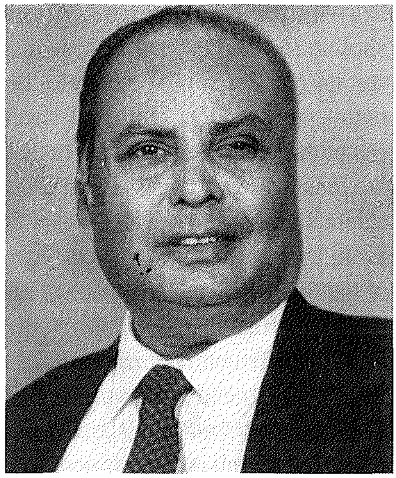
The integrated nature of the refinery and associated facilities at Jamnagar provides Reliance with a significant cost and operational advantage over other refineries in India. The refinery, as already stated, enjoys the benefit of considerable economies of scale and has been set at and up to 30 to 50 percent lower per tonne capital cost as compared to other refineries recently set up in Asia. The economies of scale contribute to lower operating costs, enabling Reliance to achieve significantly higher refining margins as compared to its peer group.

The refinery has access to captive port facilities at Jamnagar which can handle the entire crude requirement of the refinery. The refinery also has access to a fully automated dedicated rail and road loading and product dispatch terminal, a tank farm complex, sea-water desalination facility, power and steam facilities; and petroleum product pipeline originating at the tank farm and connecting the refinery to the consumption zones in North India.

THE MAJOR HIGHLIGHTS OF THE PROJECT INCLUDE:

- The world's largest Fluidised Catalytic Cracker Unit and the world's largest Delayed Coker Unit
- The captive all-weather port facility at Jamnagar has a capacity to handle over 50.0 MMTPA. This is India's largest marine oil terminal.
- The fully automated dedicated rail/road loading and product dispatch terminal has a capacity of around 10.0 MMTPA. This is one of the largest terminals of its kind in India.
- The tank farm complex has capacity of around 4.0 MMTPA representing around 15% of the total tank farm capacity of the India's petroleum industry.
- The sea water desalination facility with a capacity 12 million gallons per day is the first of its kind in India.
- The captive power facilities have a generating capacity of nearly 285 megawatts of electricity.

To conclude, the Reliance Refinery enjoys several logistical advantages by virtue of its location on the west coast such as proximity to the crude producing regions of the Middle East and easy round-the-year access to the all weather port at Jamnagar with adequate draft for receiving all types of vessels, including VLCCs; as also tankers have access to captive storage and multi-modal product quick evacuation facilities. Finally, the refinery complex houses India's largest fully automated product handling terminal incorporating extensive facilities for evacuation of products by road, rail, sea and cross-country pipelines.



Dhirubhai Ambani, founder - Chairman of Reliance Industries Ltd.

TATIPAKA MINI-REFINERY

Most readers may not be aware that the ONGC's Tatipaka mini-refinery is unique and the first of its kind in the country. This scaled-down version of a full-fledged refinery is a skid-mounted retractable unit, conceptualised when there were problems in transporting low sulphur crude from the remote location and marginal oilfield developed by ONGC in the Krishna-Godavari River Basin. Inaugurated on September 3, 2001 the plant has been producing the highest quality of products conforming to all standards followed by the oil industry.

An initial investment of Rs. 26 crore was paid back by the refinery in a record span of 15 months. The Tatipaka Mini-Refinery was awarded the ISO-14001 on 20 March 2002. During the second year of its operations it bagged the ISO-9001 and recently, the unit was bestowed with the prestigious OHSAS-18001.

The refining design capacity is about 100 TMT per year. The refinery's normal operating capacity is 1500 barrels per day (bpd) with a maximum capacity of 2000 bpd. It processes sweet crude from Krishna-Godavari Basin, which at times is spiked with condensate. The refinery has a skid-mounted crude distillation unit. A typical product pattern is as follows:

Product	**%**
F & L	0.7
Naphtha	31.2
SKO	28.8
Diesel	14.6
RCO	24.6
Total	100

The refinery produces Diesel, Naphtha and Kerosene. Naphtha is currently being sourced by HPC for supply to fertilizer plants. Diesel is partly consumed by ONGC's own drilling rigs in Rajahmundry and Karaikal and the balance is sold to HPC, IndianOil and BPC. Kerosene is supplied to HPC and IndianOil for public distribution scheme (PDS) supply. Currently RCO is sold as LSHS.

ONGC has drawn up a plan to increase the operating capacity of this mini-refinery from 0.1 MMTPA to 0.2 MMTPA at a cost of around Rs. 40 crore.

Technology & Quality Upgradation

Technology Upgradation

India's first refinery was set up at Digboi in Assam over one hundred years ago in 1901. It reached the production level of 0.50 MMTPA by the time of India's Independence. Despite its vintage technology, the refinery had some secondary processing facilities such as Dubb's Process Coker Unit (country's first) licensed by UOP in the 1930s along with an old labour-intensive manually operated Wax Extraction Unit and facilities for production of low grade lube base stock.

The Digboi Refinery had several design deficiencies and many valuable products were either flared (LPG) or down-graded to Furnace Oil. From this modest beginning, India went through many vicissitudes in the field of petroleum — a journey of over nine long decades until it saw the commissioning of the 33.0 MMTPA Reliance's Refinery at Jamnagar in Gujarat with the world's largest FCCU and Coker Unit capable of producing nearly 100% distillate yield.

In Independent India, people needed and therefore naturally demanded a better standard of living. This necessarily entailed higher consumption of energy. A few years after Independence, Stanvac and Burmah Shell set up refineries in Trombay (Mumbai) in 1954 and 1955 respectively. The Caltex Refinery at Visakhapatnam was commissioned in 1957. All the three multinationals brought with them a quantum jump in refinery technology, as comparable to the vintage refinery at Digboi.

The above mentioned three refineries set up the first Vacuum Distillation Units to process Reduced Crude Oil (RCO) from the Crude Distillation Unit to maximise distillate yield, even though Vacuum Units at that time were quite different from those of today. This was mainly because of comparatively lower product specifications prevailing at that time. The main concern was to get as much product yield as possible. Today, Vacuum Distillation Units have undergone a sea change in terms of height, diameter, internals and severity of operation. For example, presently the Vacuum Column diameter itself measures around 10 to 12 metres and they operate at zero or less vacuum. Much research has subsequently been done on its ejector system and furnace for maximum recovery of product yield.

As far as the secondary processing units were concerned, the three oil companies (Stanvac, Burmah Shell and Caltex) installed small Fluidised Catalytic

Cracking Units (FCCUs) at their refineries. Although these FCC Units were not as efficient as those of today, they were nevertheless serving their purpose by way of giving higher distillate yields. As the demand for petroleum products went up, FCC Units began playing an increasingly important role. It was the American, Stanvac that commissioned India's first Catalytic Cracker Unit.

While the demand for petroleum products was increasing rapidly on one hand and the availability of Low Sulphur (Sweet) Crudes especially after the Oil Crisis of 1973 was diminishing on the other, the refineries were forced to process Heavier Crudes. In addition there was a steady and increasing market demand for middle distillates like Diesel and Kerosene. Accordingly, new Fluidised Catalytic Cracking Units were set up with advanced technology first at Koyali and then at Mathura in 1982-83 and subsequently such units were added to all other refineries in the countries except refineries in the North East.

The Fluidised Catalytic Cracking also underwent an upgradation in technology and the severity of its operation so that Units which were originally processing Vacuum Gas Oil from Light Crudes were subsequnetly able to process Vacuum Gas Oil from Heavy Crudes. Now-a-days even heavier feeds like Slack Wax, Furfural Extraction Unit extract, and Vacuum Residues can be processed in Fluidised Catalytic Cracking Units yielding valuable distillates like LPG, Motor Spirit and Proplylene. This upgradation process has culminated in the installation of the world's largest Fluidised Cracking Unit at Reliance's Refinery at Jamnagar with a processing capacity 5.5 million metric tonnes per annum.

Although there was an occasional demand from some State Transport undertakings like MSRTC for HSD with higher Cetane Number and lower Sulphur content, a serious thought for upgrading the quality of HSD and MS was given only in the early 80s, especially when Mathura Refinery was under construction. Simultaneously, there was a nationwide concern for the safety of the Taj Mahal in Agra and fear that Mathura Refinery's emission would harm the World Heritage Monument. This triggered off a heated public debate in the country on environmental pollution and noxious vehicular emissions.

The public, government and courts of the land brought in powerful pressures to bear upon oil companies for upgrading the quality of MS and HSD on one hand and reducing sulphur dioxide emission from refineries on the other. This led to the installation of Reformers with advanced technology in all Indian refineries except Guwahati. However, ISO SIV Process (UOP - USA) has been implemented at Guwahati in January 2003 for production of unleaded Gasoline and to raise the Octane rating to 87 to meet Euro III and BS III Standards. Presently, all refineries are producing lead-free Motor Spirit.

Increasing quantities of high sulphur imported crude coupled with imperatives to further increase distillate yield particularly HSD despite the existence of high severity Fluidised Catalytic Cracking Units created the need for Hydrocrackers. Koyali Refinery for example entirely ran initially on indigenous Low Sulphur Sweet Crude. Even after its first expansion to 7.5 MMTPA and thereafter, the quantum of Sour (High Sulphur content) imported crude was only around 1.5 MMTPA. At that stage a Hydrocracker at Koyali was not justified. Only when the refinery was further expanded to 9.5 MMTPA with a much higher percentage of imported crude, a need was felt for the installation of a Hydrocracker at Koyali.

Consequently, IndianOil's first Hydrocracker with a capacity of 1.2 MMTPA was installed at Koyali and commissioned in 1994 with Chevron technology. After successfully commissioning the Hydrocracker at Koyali, eight more Hydrocracker Units were installed in India with advanced technology from Chevron and UOP with one each at Mathura, CPCL Chennai, BPC Mumbai, Numaligarh and two each at Panipat and MRPL, Mangalore..

Hydro Desulphurisation Units

Recent trends in environment protection make it compelling to increase the use of green fuels. Environmentalists are maintaining a hawk-eyed vigilance busy gauging the dangers posed by toxic and poisonous chemicals in HSD and Motor Spirit on human health and environment. Since the cost of a barrel of crude oil has gone up during the last thirty years from $2 to $60 and threatens to hit the roof in the near future, it is inescapable for refineries not only to process Sour and Heavier Crudes but also to optimise refinery profitability and to produce greener fuels at the same time.

This requirement for green fuels demands the extraction of metals and other toxic compounds along with recovery of Sulphur has been increasing. In this endeavour all refineries have installed Kero and Diesel Hydro De-sulphurisation Units combined with high efficiency Sulphur Recovery Units in order to reduce the Sulphur content in HSD for example from 1% by weight down to 0.05% by weight and now to 0.035% in order to meet Euro III Standards.

Lube Oil Processing

After the production of low grade lube base stock at Digboi, CPCL in Chennai was commissioned in month of September 1969 as the first lube integrated refinery in India. Subsequently, Esso's refinery in Mumbai provided the feedstock for Lube India Ltd, a 50:50 partnership between the Government of India and Esso. This lube refinery adjoining the Esso's Refinery in Trombay was commissioned in December 1969.

Thereafter, IndianOil's lube integrated Haldia Refinery was commissioned in 1975-77. Both these refineries used more or less similar technologies with similar product yield patterns. The finest Vacuum Cut was generally the feedstock norm for Lube Units. These cuts were processed through Phenol and Furfural/NMP extraction process for further de-waxing and Hydro-finishing. Now-a-days Phenol Extraction has been discontinued and in its place an advanced extraction technology called N Methyl 2 Pyrodoline process was implemented in all refinery units except Digboi. It is said that necessity is the mother of invention. The demand for a higher quality and the need to reduce import of expensive lube base-stock forced Indian engineers to devise the above mentioned innovative method for upgradation of lube base-stock.

Meanwhile lube processing was going through a period of transition with Hydro Processing and Catalytic De-waxing techniques gathering momentum as against Solvent Extraction and Solvent De-waxing. Sensing the need for upgraded base-stock, the selective Dewaxing Unit severely Hydro-treated or Hydro-cracked feeds were required because this provided improved yields with a high Viscosity Index to meet the growing demand for very high quality lubes.

This process created a class of feedstock which was clean, i.e. without Sulphur, Nitrogen or Coke. The catalyst designed for such an operation was such that the conversion was much superior to the conventional Solvent De-waxing method. In addition to high yields, this process also contributed valuable distillates as by-products. One such unit, Catalytic Iso De-waxing Unit — the first in India, second in Asia and third in the world was set up at Haldia Refinery.

REFINERY AUTOMATION

Initially, refineries were operated with pneumatic controls. Thereafter in the 1970s they were changed and up-graded to Electro-pneumatic Controls System. However, it was from 1990 onwards, all refineries in the country switched over to Digital Control along with Advanced Process Control. Thus all refinery operations can now be controlled and optimised from a centralised Control Room.

UNDERGROUND STORAGE FACILITY (LPG)

HPC and Total France have formed a Joint Venture named, Asia LPG for underground storage of LPG at Visakhapatnam for the first time in India. These huge storage tanks will be buried at a depth of 250 metres. This facility is likely to be commissioned in 2006.

CRUDE STORAGE

The Government of India commissioned a study group for feasibility of underground crude storage tanks at different locations in the interests of the country's Oil Security. In this endeavour, Engineers India Ltd along with Bharat Earth Movers Ltd and a Swedish firm completed the DFR. With logistical data in place, four locations with different storage capacities have been identified.

Conclusion

Technological upgradation of refineries in India became a necessity on account of the need to maximise distillate yield with a special emphasis on middle distillates through Fluidised Catalytic Cracking Units. The need for reducing or eliminating the import of high value, high quality lube base-stock spurred the production of lube base-stock by Lube India Ltd at Trombay, at CPCL in Chennai and IndianOil's Refinery at Haldia.

After the 1973 Oil Crisis followed by the shortage of Sweet Crude, refineries had to gear up to process Heavy Sour crude oils requiring Desulphurisation and Hydrocracker technology. When the APM was removed from the refineries on 1st of April 1998, there was a severe pressure on all refineries to optimize production from every barrel of crude creating the impetus for maximising distillates beyond 85% of the unit's capacity. The country's demand for clean and green fuels conforming to Euro III and IV Standards demanded Reformers (for Non-leaded Motor Spirit) and Desulphurisation Units for Low Sulphur HSD.

With the price of crude touching $ 60 per barrel and still going up, refineries were compelled to go in for high value Petrochemicals and Petrochemical feed-stock. This trend is perhaps a sign of the times to come.

QUALITY UPGRADATION OF AUTOMATIVE FUELS

Since the development of specifications for automotive fuels, there have been several significant improvements. Today, there is an increasing demand for quality upgradation of automotive fuels for engines that are improving at a tremendous pace and they demand fuel of a very high degree of intrinsic quality. The Government quality control regulations against atmospheric pollution in the interests of environment protection have compelled the Bureau of Indian Standards (BIS) to draft a string of stringent specifications.

Vehicular emissions are produced as a result of a combination of several factors such as outdated vehicle engine technology, poor fuel quality, poor vehicle design, poor maintenance coupled with bad driving habits and various other factors. It is the tail pipe emissions and not the fuel itself that affects ambient air. Hence only the right combination of fuel and engine technology, meeting the prescribed vehicular emission norms was acceptable from the environment protection point of view. In addition, the very rapid increase in both spark ignition engines running on MS and compression ignition engines using HSD have made vehicular emission and consequential pollution an increasingly important issue.

The present trend in MS and HSD specifications is to match US and Euro norms and to accelerate improvements in fuel quality standards. As expected, future Indian specifications of Diesel and Motor Spirit have added parameters for further tightening and reducing the content of Sulphur, Benzene and Lead. To cope up with the future Euro equivalent of long term stringent specifications, oil companies are gearing up and have taken the challenge to meet additional fuel quality parameters as per the schedule fixed by the Government of India by adopting advance process technology, stringent quality planning and automated systems of testing.

In keeping with the worldwide trend and in line with the directives issued by the Ministry of Environment and Forests (MOE&F), the Petroleum Sector embarked upon a major quality improvement programme and formulated a time-bound schedule for supply of higher quality of MS throughout the country in a phased manner. As a sequel to this, Bharat Stage-II (BS-II equivalent to Euro II) MS which is now available throughout the country and from April 1, 2005, Euro-III (E-III) has now become available in eleven designated cities, i.e. Delhi, NCR, Mumbai, Kolkata, Chennai, Bangalore, Hyderabad, Ahmedabad, Pune, Surat, Kanpur and Agra.

The historical evolvement of BIS specifications and upgradation for key parameters and road map for introduction of "Green-fuels" in India are as follows:

MS SPECIFICATION/UPGRADATION

- The BIS specification (IS 2796) for MS was first published in 1964, which covered MS of 83 Octane rating only. The first revision of this Standard was made in June 1971 which covered 93 Octane MS. Thereafter, the first major change took place in November 1984 when the Rating of Octane Number (RON) of regular MS was amended from 83 to 87 in order to meet the requirements of the latest high-compression-ratio cars such as Maruti being manufactured in the country.
- The second revision of BIS Standard was made in 1995 when Anti-knock Index (AKI) i.e. RON+MON/2, was additionally incorporated to indicate the Octane Rating. The Sulphur content was reduced from 0.25% to 0.20% mass max. In addition, specifications like existent and potential gum, Vapour Liquid Index (VLI), limits for blending of Oxygenates and Water tolerance limit for alcohol blends were also introduced.
- In the year 1995, the Government of India stipulated that all new cars be equipped with catalytic converters, which helped convert gases that do not burn fully, such as the lethal Carbon Monoxide (Co) to the harmless Carbon Dioxide (CO_2) and the explosive and dangerous Hydrogen (H_2) to steam and water (H_2O).
- The introduction of catalytic converters demanded almost lead-free MS because leaded MS could make the catalytic converters dysfunctional. This led to tremendous pressure to eliminate the addition of poisonous Tetra-ethyl Lead (TEL) to MS and to produce lead-free MS. This was a very welcome step not only from the point of protecting catalytic converters but also in eliminating a major hazardous operation of handling Lead at the refinery end. The new specification required the lowering of Sulphur content of unleaded MS and was accordingly amended from 0.20 to 0.15% mass max in March 1997.

Based on emission considerations, major changes in MS specification were notified by the Ministry of Environment and Forest by their Gazette notification No:. GSR/176 (E) dated April 2, 1996. The notification specified further reduction of Lead in MS from a max.of 0.56 to a max of 0.15 g/l of lead by December 31, 1996, for the entire country. Further it required the marketing of only Lead Free MS in Metros by April 1, 1995, and in the State capital, Union Territories, major cities by 1st of December 1998 and by April 1, 2000 in the entire country. For the first time, Benzene limits in MS of 5 % volume max for the entire country and 3 % volume. max for the four Metros were achieved by the year 2000.

LEAD CONTENT

In order to meet the lead limits, Catalytic Reforming Units have already been set up and commissioned wherever necessary such as at IndianOil's Barauni, Digboi and Mathura refineries. The production and supply of Unleaded MS has been accomplished as given below:

- Supply of low Lead MS with Lead content of 0.15 g/l max. (against the earlier limit of 0.56 g/l) in the four metros i.e. Delhi, Mumbai, Kolkata and Chennai with effect from June 16, 1994 and in the Taj trapezium from 1 September 1995 and throughout the country from December 31, 1996.
- Supply of Unleaded MS at selected outlets only for use in cars fitted with catalytic converters in the four metros and Taj trapezium from 1 April 1995, and for use in all other state capitals and Union Territories and major cities from June 1,1998.
- Exclusive Supply of Unleaded MS in NCR from January 1, 1999, in Mumbai from October 2, 1999 and in the entire country from February 1, 2000

(b) The refineries have already made necessary changes in the MS blending pattern and modified mode of operations to meet the Benzene limit of 3 % vol. max. for the entire country and 1 % volume max for Euro-III petrol.

(c) As regards Sulphur content, the MS produced in the country meets 500 ppm and 150 ppm as per BS-II and E-III specifications, respectively.

(d) New limits with regard to aromatics, olefins content in MS are also incorporated in Euro-III petrol specification.

In addition to the above, various other improvements have been accomplished since 1st of April 2000. Investments of about Rs.3,000 crore have been made for the above petrol quality improvement.

HSD SPECIFICATION/UPGRADATION

The BIS specification (IS 1460) for HSD was first published in 1959 and subsequently revised in 1968 and amended in 1971. The second revision was done in 1974 during which two grades of diesel were identified as HSD and LDO in place of grade A and B respectively. The Cetane number of HSD was reduced from 45 to 42, and the flash point was reduced from 55° C to 38° C to enable the maximisation of middle distillates in the country. Also total sediment content was incorporated as a new specification in order to keep control on the oxidation stability of HSD.

In 1980, the second revision was amended to incorporate the Cold Filter Plugging Point (CFPP) specification. In 1981, the flash point of Naval grade Diesel was amended to 66°C minimum. In 1985, the flash point of HSD was further reduced from 38° C to 32°C again to increase indigenous production of HSD in order to minimise imports.

Dissatisfaction among large HSD consumers like the State Transport undertakings was brewing over the years on the Sulphur content of the HSD being supplied to them. For example, while GSRTC received its Diesel from the Koyali Refinery with practically no Sulphur content, on the other hand MSRTC received HSD either from Mumbai refineries or imported Diesel, both of which had a high Sulphur content. Market pressures were building upon for lowering the Sulphur content and raising the Cetane number.

The third revision of BIS specification of HSD was made in 1995 during which the Cetane number was again raised back from 42 to 45. The specification with regard to total Acidity, Carbon number and Viscosity were also revised upwards and the density specification (820-880) was introduced.

Based on emission norms, major changes in HSD specifications was notified by MOE&F vide Gazette Notification No. GSR/176 (E) dated April 2, 1996. The notification laid down drastic reduction of Sulphur content from 1.0 % mass to 0.25 % mass in phases so that 0.5 % mass to be achieved by 1 April 1996 in the Metros and Taj trapezium; and 0.25 % mass by September 1, 1996 in Taj trapezium and 0.25 % mass was to be achieved by April 1, 1999 for the entire country.

The notification further specified increase in Cetane number from 45 to 48 to be obtained by December 31, 1998 by all refineries (except North East refineries at Digboi, Guwahati and BRPL). The existing distillation recovery specification of 90% volume minimum recovery at 366° C was revised to 85 % volume recovery at 350° C maximum and 95 % volume at 370° C maximum. The density was also revised from 820-880 to 820-860.

In keeping with the worldwide trend and in line with the directives issued by the Ministry of Environment and Forests, the Petroleum Sector embarked upon a major quality improvement programme and formulated a time-bound programme for supply of desired quality of HSD throughout the country in a phased manner.

Low Sulphur HSD

The first step in this regard undertaken by the Petroleum Sector was in respect of lowering the Sulphur content in HSD and production of extra low Sulphur HSD. During the combustion process, Sulphur compounds in the diesel burn to form acidic by-products such as SO2 and SO3 which in solution with moisture produces corrosive sulphurous and Sulphuric Acids respectively and increases the burden of particulate matter in the exhaust. Reduction of Sulphur content in HSD was essential to reduce emission of particulates and the spreading of acid from the exhaust. In order to meet sulphur limits, Diesel Hydro Desulphurisation Units (DHDS) have already been set up and commissioned at nine refineries. Modification of these units are being planned to further bring down the Sulphur content.

The production and supply of low and extra low sulphur HSD has been successfully accomplished as given below:

- Supply of low Sulphur HSD with 0.5 % mass Sulphur (brought down from the earlier level of 1.0 %) in four Metros and Taj trapezium from April 1, 1996.
- Supply of extra low Sulphur HSD with 0.25 % mass Sulphur: in Taj trapezium from 1st of September 1996, inside Delhi from August 15, 1997, entire Delhi, Mumbai, Kolkata and Chennai from 1 April 1998 and the entire country from January 1, 2000.

At present, Bharat Stage-II Diesel is available across the country with 0.05% Sulphur and Euro-III fuel is also available in eleven designated cities such as Delhi,NCR,Mumbai, Kolkata, Chennai, Bangalore, Hyderabad, Ahmedabad, Pune, Surat, Kanpur and Agra with 0.035% Sulphur from 1 April 2005.

CETANE NUMBER

The Cetane number of HSD has been increased from 42 to 45 in 1995 and further raised to 48 in 2000. In this regard, the refineries processing Assam crude and other low Sulphur imported crudes, produces streams with low Cetane rating. The cracked gas oil from Coker, Cycle oil from the FCCU and some of the straight run gas oil require further treatment to increase the Cetane number. Already Hydro-treaters are being installed at IndianOil's refineries at Digboi, Guwahati, and Barauni to meet this requirement. At present, Euro III fuel is being made available in eleven designated cities with a 51 Cetane number from April 1, 2005.

DISTILLATION SPECIFICATION

There are very limited options to meet the distillate recovery specifications without downgrading some of the heavy ends.

CONCLUSION

Oil companies have implemented major programmes for upgradation of petrol and diesel quality in the past few years. A total investment of over Rs.10,000 crore has been made by the oil industry so far for petrol and diesel quality upgradation to meet Standards specified for the year 2000.

Natural Gas and Liquefied Natural Gas—Fuel of the Future

Natural Gas is a gaseous fossil fuel consisting primarily of methane (generally over 80 to 85%), ethane, propane and butane. It is found in natural gasfields and as associated gas in oilfields, as well as in smaller quantities in coal beds. Natural Gas is called as such when the gas is in its natural state. When it is transported through pipelines in a compressed form it is referred to as Compressed Natural Gas (CNG) and is mainly used in the transport sector. The gas is known as Liquefied Natural Gas (LNG), when natural gas is liquefied by cooling it to cryogenic temperatures, i.e. below minus 160 degrees centigrade.

Both compression and liquefaction enables multi-fold reduction in gas volume, i.e. up to1/600th, which can then be transported inexpensively over long distances. The process of Natural Gas liquefaction dates back to 19th century and the world's first LNG plant was built in West Virginia, USA in 1912. For the purpose of this chapter we shall refer to natural gas in all its forms as **Natural Gas**, unless the context demands a different nomenclature.

Natural Gas is a clean and eco-friendly fuel, and can virtually be used in all areas and every conceivable application where liquid fuel is traditionally used, such as power generation, fertilizers plants, industrial units, city gas to domestic households, etc. Natural Gas is also a good substitute for coal in power generation. In many countries of Europe, US, Korea, Japan etc., gas is used for diverse applications, in fact in a big way for heating homes and offices. In times to come, there is no doubt that the power sector in India will be able to provide the anchor-load for Natural Gas projects.

Natural Gas in the United States has come a long way from being an unwanted by-product that was flared because of unavailability of infrastructure, to become the fastest growing primary energy source. In India too, the story was no different. Initially not much use was found for Natural Gas and for several decades most of the associated gas from the oilfields was flared. But it was in the 1960s that Natural Gas made some dent in the market when Oil India Limited (OIL) started supplying Natural Gas to local tea producers and the State Electricity Board in Assam.

Following the footsteps of Oil India, the Oil & Natural Gas Corporation (ONGC) began the supply of Natural Gas from its Ankleshwar oilfields (discovered in 1960) to Alembic Glass and Sarabhai Industries at Vadodara through a gas pipeline that was laid by the then Gujarat Pipelines Project of ONGC. Supply of free gas from Cambay (Khambat) to the Thermal Power Station at Dhuvaran began in 1964. The 24 km Nahorakatiya-Namrup pipeline was commissioned in 1965 to supply feedstock to the Fertilizer Corporation of India (FCI) and fuel to the Assam State Electricity Board.

In December 1970, yet another gas pipeline was laid to supply gas from Navagam to the Calico Textile Mills in Gujarat. The 150 km long Ankleshwar-Koyali gas pipeline was commissioned in September 1971 at a cost of Rs.3.6 crore. In the year 1974, ONGC discovered the giant Bombay High oil and gas fields (now known as Mumbai High fields). But it was only in 1978 that a sub-marine gas pipeline was laid to connect the shores of Mumbai for supplying gas to power generation units and fertilizer plants.

There is no doubt that Natural Gas is going to dominate the world energy scene in the 21st century, not only because most of the gas finds are likely to be in Asia but also because natural gas is a clean eco-friendly fuel. LNG would facilitate the growth of Natural Gas trade because its amenability to cryogenic transportation. The Asian gas market is going to emerge as the prime mover for growth of the world's Natural Gas industry. The nascent markets such as those in India, China and Korea are expected to provide a significant fillip for the expansion of this industry. Much of the Natural Gas that will be available in the developing world is expected to be used as fuel for power generation by these countries.

Greater use of Natural Gas is one of the best medium-term measures to counter the threat posed by climatic changes brought about by global warming and the dwindling availability of fossil fuels. Natural Gas is perhaps the only source of energy which can save the earth by mitigating the effects of global warming by providing energy without harming the environment. But all this will happen only when Natural Gas is easily and inexpensively made available. Then the consumer can easily decide what feedstock to use, the primary considerations being easy availability, price, quality and customer service.

Its eco-friendly quality makes Natural Gas the most preferred fuel and feedstock for core sectors like power, fertilizer, petrochemicals and several other industries. Natural Gas is also the fuel much in demand in the transport sector both because of its eco-friendly nature as well as economy when compared with other fuels. India has a huge potential for the consumption of Natural Gas since many of the core industries are still using the more expensive liquid fuels such as Naphtha, Furnace Oil and Low Sulphur Heavy Stock (LSHS) mainly due to the paucity of gas from domestic sources. If this need is fulfilled, there will be an unprecedented demand from industries such as transport, chemicals, petrochemicals, glass and ceramics and even from petroleum refineries.

India's Hydrocarbon Vision 2025 document envisages an increasing share of Natural Gas in the energy basket, growing from its current level of 8-9% to 20% by the year 2025 as tabulated below:

Expected Share of Natural Gas in the Energy Basket in India (Hydrocarbon Vision 2025)			
Year	2006-07	2011-12	2024-25
Coal	50	53	50
Oil	32	30	25
Gas	15	14	20
Nuclear	1	1	3
Hydel	2	2	2
	100	100	100

Natural Gas demand in India is estimated to be around 391 million metric standard cubic meters per day (MMSCMD) (142.7 billion cubic meters BCM per annum) or 128.4 million tonnes of oil equivalent (MTOE) as of 2024-2025, rising from 151.0 MMSCMD (55 BCM per annum or 49.5 MTOE) in the year 2001-2002. India is therefore, likely to emerge as one of the world's largest consumers of Natural Gas.

Natural Gas Demand				MMSCMD/MTOE
Year	**Power**	**Fertilizer**	**Others**	**Total Demand**
2001-02	67 / 22	54 / 18	30 / 10	151 / 50
2006-07	119/ 39	66 / 22	46 / 15	231 / 76
2011-12	168 / 55	83 / 27	62 / 20	313 / 103
2024-25	208 / 69	105 / 34	78 / 25	391 / 128

With a current availability of only 75 MMSCMD (27.4 BCM per annum) or 24.6 MTOE, the country is facing a major deficit of 76.0 MMSCMD (27.7 BCM per annum) or 24.9 MTOE.

To enhance the availability of Natural Gas in India, the Government has taken strategic decisions of intensifying domestic exploration activities, importing Natural Gas through International pipelines, LNG imports, by acquiring upstream gas blocks in other countries and sources for bringing Natural Gas to India.

Domestic Exploration

Several domestic and foreign companies have been awarded exploration and production blocks in the last five rounds of the New Exploration Licensing Policy (NELP) of the Government of India. About 100 blocks have been awarded for exploration in different Indian Basins.

The Government's move is already bearing fruit with Reliance, ONGC and GSPC, among others, already declaring large discoveries of gas, especially in the Krishna-Godavari Basin. The renewed interest in exploration in deep water Basin Covers in India has given a significant lead for gas discoveries in the country, which will certainly help in creating security of energy supplies.

Import of Natural Gas through International Pipelines

Several projects for gas import through trans-national pipelines are under consideration. These include pipelines from Oman, Iran, Turkmenistan, Russia, Bangladesh and Burma. These proposals have been discussed for last several years but are yet to be finalised on account of several complex political and technical issues that are yet to be resolved. The Table below shows pipeline gas import projects under consideration:

Pipeline	Pipeline Route	Status
A1 Iran - India	Onland/ Offshore	While Feasibility study for offshore pipeline from Iran to India is being carried out, Iran, Pakistan and India are also vigorously pursuing resolution of various issues for an onland pipeline, this being the cheapest mode of receiving Natural Gas from Iran.
A2 Turkmenistan - Pakistan	Onland	New multi-lateral initiatives started. Extension to India possible.
A3 CentralAsia -China- India	Onland	Central Asia - China progressing well.Branch to India being conceptualised
B1 Bangladesh -India	Onland	Implementation of the project is dependent on clearance from Govt. of Bangladesh for gas export to India.
B2 Myanmar-India	Onshore/Offshore	Highly prospective block with gas reserves 10-12 TCF, Indian Companies (OVL,GAIL) have equity gas, which GAIL wants to bring to India. Various options for the pipeline route are being explored, including

		via Bangladesh, through North East India by circumventing Bangladesh, through an offshore pipeline, or as CNG/LNG.
Qatar-Pakistan -India	Offshore	Also referred as Gulf-South Asia or GUSA pipeline. This pipeline is presently being discussed between Qatar and Pakistan. There is a possibility of extending the same to India.

LNG Imports

Despite discussions for the last ten years none of the proposed Natural Gas pipeline projects have seen the light of day mainly because of various geo-political and technical reasons. Import of LNG is a relatively costlier alternative considering the cost involved for gas liquefaction at the exporting terminal and transportation by cryogenic vessels and its storage and re-gasification at the receiving terminal. However, this mode is free of infringement from other countries. Keeping in view the need for increasing the energy security by diversifying energy types and supply sources, the Government of India has permitted the import of LNG under Open General Licence (OGL). Thus any company or party can today import Natural Gas and LNG, re-gasify and sell it to potential consumers.

The most important factor for LNG imports is its cost. LNG is generally sold with its price linked to crude oil prices. In the current scenario of high crude oil prices, the price of LNG has also shot up substantially in the international market. Further, the mismatch in price between subsidised indigenous gas and imported LNG is too wide. This makes customers hesitant in going in for the relatively higher priced imported LNG.

The Government has also made some efforts for arriving at price parity between indigenous gas under the APM and imports. However, this is a politically sensitive issue and it may be a long time before parity can be achieved. Private gas producing companies are, however, already permitted to charge the market price. Considering that the power sector provides anchor-load for gas projects, it is essential to import LNG at a price which can provide an economically viable production of power.

Gas supplies from India's first LNG Terminal at Dahej commenced in March 2004. The Terminal has a capacity for processing 5.0 MMTPA LNG, which is being supplied by RasGas of Qatar. The terminal has been set up by Petronet LNG

Ltd. a JV promoted by Indian PSUs, viz. IndianOil, ONGC, GAIL and BPC. The marketers of gas are IndianOil, GAIL and BPC for the 5.0 MMTPA of LNG being imported at this Terminal from Qatar. The Terminal's capacity is proposed to be expanded to 10.0 MMTPA, for which action has already been initiated by Petronet.

Indian PSUs, i.e. IndianOil, GAIL and BPC, have recently entered into separate LNG Sale Purchase Agreements with Iran for import of a total of 5.0 MMTPA which will be with effect from the last quarter of 2009. Part of this LNG is expected to be received at Petronet's expanded Terminal at Dahej. Petronet is also making efforts for setting up an LNG import Terminal at Kochi, in Kerala. As per media reports, GAIL is likely to receive its share of LNG from Iran at this terminal for supply to NTPC's power plant at Kayamkulam.

Shell has also set up an LNG Import Terminal at Hazira in Gujarat. However, LNG supplies for this project have not been tied-up on a long-term basis. Consequently, the Terminal's capacity is grossly underutilised. Yet another Terminal is in a partly completed stage at Dabhol. The project, which is part of the Enron's promoted Dabhol power plant got involved in controversies and litigation on account the multinational's problems in the United States. The Government of India has now announced its decision to revive this project and both GAIL and NTPC have been entrusted with the task. Also on the cards are IndianOil's and ONGC's plan to develop LNG Terminals at Ennore and Mangalore respectively.

With the string of projects lined up, an estimated 25.0 MMTPA of LNG would be imported into India on a short to medium term basis. India also has one geographical advantage i.e. proximity to both West Asia and the Far East. India also has the advantage of saving on transportation costs by bringing LNG either from the Middle East or from countries in the Asia Pacific region. Considering the demand for Natural Gas, it is expected that during next five to ten years, nearly five to six LNG Terminals may come up at different locations, both on West and East coast of India. LNG imports to India commenced when the first LNG cargo sailed from Ras Laffan in Doha to Petronet's Dahej Terminal on the West coast on January 30, 2004.

Acquiring upstream Gas Blocks overseas

Indian PSUs as well as private companies are aggressively pursuing acquisition of upstream blocks in several countries worldwide, including gas blocks.

Sources for Natural Gas Imports

As already discussed, projects for import of Natural Gas both through pipelines and LNG route are under consideration by the Government. India must not lose this opportunity as enormous gas reserves are available in the adjoining countries of West Asia. The North Pars field in Qatar is the largest Natural Gas field in the world giving the country a massive potential for Natural Gas production. Qatar could become one of the largest suppliers of LNG to India, besides other suppliers from the Middle East.

Iran is also in the process of developing its large gas reserves in the South Pars field (a geological extension of Qatar's North Pars field). After a recently concluded contract between Indian PSUs and Iran, LNG would be supplied by procuring gas from the South Pars field. Other potential sources for gas imports include Myanmar, Bangladesh, Malaysia, Australia, Indonesia, Abu Dhabi, Yemen, as well as countries bordering the Caspian Sea such as Turkmenistan, Azerbaijan etc.

Petronet LNG Ltd.

In view of the crucial importance of Natural Gas and for the future energy security of the country, the Government of India decided to form Petronet LNG Ltd with the sole purpose of importing LNG to fill the growing gap between indigenous availability versus the demand for Natural Gas. For example, as the current availability of only 75.0 MMSCMD which is expected to remain constant in the near future, the demand of Natural Gas is expected to be around 231.0 MMSCMD in 2006-07 and 313.0 MMSCMD in 2011-12.

The equity breakup of the consortium which was incorporated on April 2, 1998 consisted of: ONGC-12.5%, IndianOil-12.5%, BPC-12.5% and GAIL-12.5% (total 50%). The equity breakup of non-PSUs is as follows: GAZ De France International-10%, Asian Development Bank-5.2% and Financial Institutions/ Public-34.8% (total-50%).Making best use of both worlds, the new enterprise enjoys the flexibility of a private sector organization on one hand and with the controlling equity resting in the hands of PSUs, protection of nation's interest is taken on the other.

Conclusion

The Liberalisation of the Natural Gas sector will play a significant role for the enhanced development of a strong and competitive energy industry all over the world. India must also resolve all domestic energy policies in such a way that the development of energy sector in the country gets a real boost. Natural Gas is going to be one of the major sources of energy to fuel the Indian economy in the 21st century. Market reforms in the consumer sector like power; fertilizer and other industries are essential for generating additional resources for the economy to develop.

Coal and hydroelectric generation can only develop if power and other sectors pay the market price so that these sectors can generate additional resources which can be ploughed back for further development. The Indian energy market is poised for a dynamic change and this fact needs to be considered by Natural Gas suppliers and equipment manufacturers for it is to their advantage to exploit the new market and get the best returns.

As India stands on the threshold of exponential growth and development, there is an urgent need to garner all possible resources for securing energy. The incumbent Government has taken several initiatives to source gas and oil from other countries. A concerted effort with renewed vigour from all would surely go to help India to economically develop its energy security.

CHAPTER VII

Seventh Era: April 2002 Onwards

The 7th Era is perhaps the most exciting epoch in the life and history of the Downstream Sector of the Oil Industry. The future holds many challenges and an equal number of opportunities. The first major challenge that the world is already facing is the phenomenal rise of crude oil price in the international market which has touched a whopping $70 per barrel.

The past history of India has shown that drastic price hikes in crude oil price triggered a fall in GDP giving birth to undesirable inflationary trends. If these problems are to be solved, solutions must be found to keep oil companies economically viable and keep the oil industry insulated from the harmful effects from the vagaries of soaring price hikes of crude.

The Oil Industry must once again rise to successfully overcome the challenges posed by the dismantling of the APM.

DISMANTLING OF ADMINISTERED PRICE MECHANISM (APM)

Liberalisation of the Indian economy and the era of economic reforms earnestly began from the year 1990. A series of bold decisions were taken by the then Government of India, thereby opening the floodgates of free enterprise with the hope of giving a boost to the Indian economy in the 21st century. One major policy decision taken by the Government was the dismantling of the almost half a century old, Administered Pricing Mechanism (APM) and permit petroleum prices to be determined by market forces.

In the month April 1993, the Government de-canalized the import of LPG, Kerosene and Low Sulphur Heavy Stock (LSHS). The Ministry then opened the doors for the import and marketing of LPG and Kerosene by private parties under the Parallel Marketing Scheme. This was done by amending the relevant control orders in the months of August-September 1993.

Similarly, the Government allowed direct import of LSHS by private parties for captive consumption and furthermore Raw Petroleum Coke (RPC) was categorised as a free trade product (FTP) in August 1993 followed by declaring Carbon Black Feed Stock (CBFS) and Phenol Extract as FTP in July 1994. Marketing of lubricants was completely deregulated from the month of November 1993.

In January 1995, the Ministry of Petroleum & Natural Gas appointed a strategic planning group (known as the R-Group) and entrusted it with the task of restructuring the oil industry. The Group was told to make recommendations to meet policy objectives and initiatives required for restructuring of the oil industry. After due deliberations the R-Group recommended the gradual phasing out the Administered Pricing Mechanism (APM) so that oil prices became amenable to free market mechanism.

Based on the recommendations of the Strategic Planning Group, the Government of India decided to dismantle the APM by introducing reforms in a phased manner. The R-Group in its report recommended the dismantling and introducing a market determined Pricing Mechanism with rationalisation of Custom and Excise Duty rates in the wake of APM dismantling as it would have its impact on various other sectors of the economy.

Accordingly, the Government of India vide Gazette notification dated 21 November 1997 announced details of the phasing out the APM and the dismantling schedule, plus rationalisation of the duty structure over a four-year-period commencing 1st April 1998. The schedule was as under:

Phased Programme of Reforms	
Particulars	**Model**
Transition Phase	**4 years**
Year 1 (1998-1999)	
i) Removal of cost plus formula and payment to crude producers as percentage of weighted average FOB price of actual imports.	75 per cent.MS.
ii) Products to be controlled during transition period.	MS, HSD, Kerosene, ATF and LPG.
iii) Withdrawal of retention margin concept for the refineries and refinery gate prices for controlled products.	Adjusted import parity prices to existing refineries and tariff adjusted import parity prices to new refineries.
iv) Products to be decontrolled.	Naphtha, FO, LSHS, Bitumen, Paraffin Wax.
v)Exim Policy.	Decanalisation of imports/exports of all petroleum products except crude (slop crude and crude condensate), NGL, ATF, MS AND HSD.
vi)Sourcing of crude.	Sourcing of crude to be liberalised and import to be allowed for joint and private sector refineries under actual user licence.
vii)Customs duties.	Rationalisation to be done in a phased manner.
viii) Increase in prices of: Kerosence (PDS). LPG(Domestic).	30 per cent of existing ex-storage point price. 33 per cent of subsidy to be passed on.
ix) Freight and other under - recoveries.	33 per cent to be passed on, in an equated manner.
x) Shipping of crude oil.	Withdrawal of cost plus formula for shipping of crude oil and move

	towards market related rates.
Year 2 (1999- 2000) i) Payment to crude producers as percentage of weighted average of FOB.	77.5 per cent.
ii) Increase in prices of: Kerosence (PDS). LPG(Domestic).	30 per cent of revised ex-storage point price at the end of first year. A further 33 per cent of subsidy to be passed on.
iii) Freight and other under recoveries.	A further 33 per cent to be passed on, in an equated manner
iv) Rationalisation of duties.	To continue.
Year 3 (2000-01) i)Payment to crude producers as percentage of weighted average FOB price.	80 per cent.
ii) ATF	Deregulation of imports and pricing.
iii) Increase in prices of : Kerosene (PDS). LPG(Domestic).	20 per cent of the revised ex-storage point price at the beginning of the year. Suitable adjustment in prices to reach subsidy level at 15% of import parity.
iv) Freight and other under-recoveries	Balance subsidy to be passed on in an equated manner
Year 4 (2001-2002) i) Payment to crude producers as percentage of weighted average FOB price.	82.5%
ii) Increase in prices of : Kerosene (PDS).	Suitable adjustment in prices to reach subsidy level at 33.33% of the import parity.
2002 onwards	Full Deregulation Transfer of subsidy on SKO (PDS), LPG (Domestic) and freight subsidy on supplies to far flung areas to the fiscal budget to the Government.

On 1 April 1998, the Retention Price Mechanism for the refineries was abolished, and ex-refineries prices could now be fixed on the basis of import parity. Within the next two months, in June 1998 the entire refinery sector was de-licensed.The pricing of all products except MS, HSD, PDS Kerosene, ATF and LPG were decontrolled. On 1st of April 2001 even pricing and import of ATF were deregulated.

A year later, on April 1, 2002, the APM was almost totally dismantled except in the case of PDS Kerosene and LPG which constituted less than 20% of petroleum consumption. The subsidy on domestic LPG and PDS Kerosene was to continue and was likely to be retained for the next three to five years. Now that the APM was dismantled in all other respects, the oil marketing companies could henceforth fix the retail price for MS and HSD. The Government's next step was the dismantling of the Oil Pool Account. In lieu of the money due to the oil companies, the Government issued Oil Bonds worth Rs.9,000 crore to the oil companies against their outstanding with the Oil Pool Account.

With the decision to dismantle the APM effective April 1, 2002, the Government of India issued a Gazette notification dated March 30, 2002 abolishing the Oil Coordination Committee (OCC). To carry out some of the functions hitherto performed by the OCC, the Government under the same notification set up a Petroleum Planning and Analysis Cell (PPAC) from April 1, 2002. Major functions of the PPAC were (a) Administration of the subsidy on SKO (PDS) and LPG (Domestic). (b) Analysing trends in the international oil market and domestic prices. (c) Forecasting and evaluation of petroleum import and export etc.

On the eve of deregulation effective April 1, 2002, the Apex Body of OCC in its meeting chaired by Special Secretary, Ministry of Petroleum advised members to expedite formation of an organisation to represent all petroleum and allied organisations in private, public and joint sector bodies which was also to include petroleum traders in the market. An ad-hoc body named Petrofed was formed immediately and was registered under the Societies Act, 1860 on August 7, 2002.

The Petroleum Federation of India, or in short Petrofed is a registered society of Indian and International companies and associations in the Hydrocarbon industry to promote the interests of members through a self-regulatory environment. Petrofed will act as interface not only between the oil industry and the Government of India but also other regulatory authorities, the public and representative bodies of traders, etc. Petrofed is authorised to represent the oil industry on Government bodies, Committees and task forces.

All Oil Companies today are corporate members of Petrofed, and all registered associations representing industry, trade, commerce and transport are allowed to enroll as associate members and all corporate bodies in the Petroleum Industry with turnover of not less than Rs.50 crore and other individuals and organisations are entitled to become ordinary members.

Petrofed, a non-profit organisation, provides a forum for deliberating issues of common interest to the industry members and keeps a database for upstream as also the downstream sector and among various other activities organises seminars, conferences, and training programmes and so on.

On April 18, 2002, the Union Cabinet cleared the Bill for setting up the Petroleum Refining and Marketing Regulatory Board. The Bill is presently awaiting clearance by the Parliament. The main task of the Board is to monitor petroleum product prices in the deregulated scenario and ensure that there is no undue profiteering by oil marketing companies. The Board has also to ensure that petroleum products are easily available throughout the country. When the Bill is cleared this would be done by imposing retail service obligations and would be imposed for all existing and new oil marketing companies.

Product Pricing Challenges

During the course of years that have passed, the Government of India appointed several committees to regulate prices of petroleum products in the country under the Administrated Pricing Mechanism. While insulating the Indian consumer from the erratic price volatility in the international market this system also provided for reasonable returns to the oil companies.

Having attained maturity in the oil sector and aligning with the general policy of globalisation, the Government of India decided on total deregulation of the oil sector. In order to streamline and iron out the process, deregulation was to be undertaken in a phased manner.

Largely perhaps for economic and to some extent political reasons, some of the measures that ought to have been taken during the intervening period were either not taken at all or not fully decided upon. Around the target date for total dismantling of the APM on March 31, 2002, international price of crude and petroleum products were already on the upsurge. With a view to protect the Indian consumer from the heavy shock of price rise coinciding with dismantling of the APM, the Government of India informally restricted oil companies from jacking up the price of Petrol and Diesel—products of mass consumption in the transport and certain other sectors. The process of reducing subsidy on SKO and LPG for the common man in any case for obvious reasons had been unhurried and very measured.

During the last three years and more, especially during the year that has just gone by (2004-2005), the international price of crude and petroleum products have literally hit the roof. This trend continues. Despite crude prices having touched $70 per barrel, (and there is widespread speculation of the price crossing $100 per barrel) the Government has made brave attempts each time to contain the price shock to every extent possible for the public at large. It is to be seen now whether over a period of time the Indian consumer would continue to be protected by the Government from the pitfalls of steady price rise, or will the consumer have to suffer being serviced by a group of financially enervated oil companies of the country?

Energy Demand Growth Pattern in India

There is no gainsaying that Energy plays a crucial role in the socio-economic development of any nation in the world. India's economy has been on a long-term growth curve during the1980s when it reached an average GDP growth rate of 3.5 per cent a year, and moved up to an average of 6 per cent in the 1990s. Over the last five years, the GDP has steadily grown at an average rate of 5.6 per cent.

Experience everywhere proves that the energy market needs to keep pace with growth in the economy. In fact, the sustained handholding by energy availability is one of the important requirements for economic growth. India, especially over the last five years has prominently shown this trend. The requirement of energy in the form of petroleum products has increased steadily from a meagre consumption of 2.72 million metric tonnes at the time of Independence to reach 111.56 million metric tonnes in the year 2004-05. The trend is reflected in the table below:

1.	3.48 mmt in 1950-51
2.	8.28 mmt in 1960-61
3.	19.13 mmt in 1970-71
4.	32.26 mmt in 1980-81
5.	57.74 mmt in 1990-91
6.	89.98 mmt in 2000-01
7.	100.43 mmt in 2001-02
8.	104.26 mmt in2002-03
9.	107.7 mmt in 2003-04
10.	111.56 mmt in 2004-05

The demand is likely to grow as per the 10th Plan to 175.51 MMT by March 31, 2017. Towards the end of 20th century, a wide gap existed between the demand for crude, Natural Gas as well as refined products and their domestic supply demanding heavy imports. The degree of dependency on imported crude increased from nil in 1950-51 to 95.86 mmtpa for 2004-05 representing 77% of the countries needs.

S.No.	Year	Crude Needed mmt	Crude Imported mmt	Imports (% of crude needed)
1.	1950-51	2.26	Nil	-
2.	1960-61	6.13	5.71	93
3.	1970-71	18.38	11.68	64
4.	1980-81	25.84	16.25	63
5.	1990-91	51.77	20.70	40
6.	2000-01	103.44	74.10	72
7.	2001-02	107.27	78.71	73
8.	2002-03	112.56	81.99	73
9.	2003-04	121.84	90.43	74
10.	2004-05	123.28	95.86	77

Only for refined fuels, the trend changed substantially after a sudden increase in domestic refining capacity just before the dawn of 21st century. In almost all refined products, the dependence on imports is now reduced and as we move towards 2004, India presently has surplus refining capacity.

Commercial energy consumption in India has increased at a Compounded Annual Growth Rate (CAGR) of 4 per cent from 280 million metric tonne oil equivalent in 1999-00 to 327 million metric tonne oil equivalent in 2003-04. This is mainly because the country has seen a strong economic growth. India is highly dependent on non-renewable sources of energy, that is, coal, lignite, oil and gas, which account for 95 per cent of the commercial energy mix. Coal and lignite form 48 per cent whereas oil and gas account for 47 per cent of the total commercial energy mix. Consumption of coal has grown at a Compounded Annual Growth Rate of 4.75 per cent whereas consumption of petroleum products has grown at the Compounded Annual Growth Rate of 3.11 per cent.

Most economists and planners expect India to record a real GDP growth rate of 5% to 8%. In fact, the Government in its **Vision 2020** has targeted an annual GDP growth rate of 8.5% to 9% over the next 20 years. This would result in the quadrupling of India's per capita income in real terms and almost eliminate the percentage of the underprivileged and impoverished Indians living below the poverty line. This confidence in the Indian economy is also shared by many other international agencies.

The planners and policymakers of the Indian economy in recent years have envisaged a faster rate of growth of the economy in the years to come, which will in turn result in a higher growth in the consumption of petroleum products. Currently, the services sector remain the principal driving force of the Indian economy, contributing 51 per cent of the growth of real GDP in 2003-04, up from 47 per cent in 1998-99. The share of agriculture and allied activities; declined from 29 per cent of GDP to 24 per cent in the corresponding period. The industry's share remained broadly unchanged at 24/25%. The shift in the sector share reflects the long-term structural changes that are transforming the Indian economy.

The overall real GDP growth of 8.1% in 2003-04 was the highest since 1991-92 and India turned out to become one of the fastest growing economies in the world. Further, the data available for the first quarter of 2004-05 show that the real GDP increased by 7.4 per cent as against 5.3 per cent in the first quarter of the previous year. Thus, the Indian economy appears to be in a resilient mood in terms of growth, inflation and balance of payments, a combination that offers a large scope of consolidation for growth momentum with continued macro-economic stability. However, India, like the rest of Asia remains vulnerable to external forces, notably volatile oil prices and a downturn in the information technology sector. Besides, large budget deficits and rising levels of public debt are a cause for concern for the long-term growth of India's economy.

The Indian economy, however, has always been badly affected whenever global oil prices have shot up. To illustrate: in 1973, GDP fell by 0.3 per cent and inflation was up at 20.2 per cent; in 1979, GDP fell by 5.2 per cent and inflation went up by 17.1 per cent and in 1990, GDP grew by 1.3 per cent while inflation climbed to 14 per cent.

In the wake of a low growth and high inflation came a dangerous cocktail of social unrest and political turmoil. These are very good reasons for India to worry when global crude oil prices begin to climb. This year (2005) although, oil prices shot up by more than 40 per cent, the economy remained relatively stable. Most economists say that India's economic growth this year will be around 6.5 per cent, inflation will eventually drop to 5 per cent. Although, this situation cannot be expected to continue for long as there have been buffer effects due to Government policies of protecting petroleum prices. As India continues to be heavily dependent on crude oil imports, vulnerability of the Indian economy will naturally increase as it grows in size and power.

The International Energy Agency (IEA) calculates the energy-intensity of an economy as the amount of energy needed to produce one unit of GDP. This ratio shows how well a country uses its oil supplies. In 2002, says the IEA, India was one of the most energy-intensive economies in the world — 2.88 times that of richer countries. Thus India consumed more than three times energy as an average rich country took to produce an equivalent amount of output.

Generally, rich countries use less oil per unit of output than developing countries. This is because of a variety of reasons: better capital stock and modern infrastructure, for example, countries that are less dependent on manufacturing which helps them conserve energy and this is where India's energy-inefficiency stands out. Even China, despite the fact that its economy is powered by manufacturing, is less energy-intensive than India which is almost 24% higher than China's, despite the fact that both countries are around an equivalent developmental stage.

As mentioned earlier, the planners and policy makers of the India's economy in recent years have envisaged a faster growth rate of the economy in the years to come, which might in turn result in a higher growth in consumption of petroleum products expecting India to record a real GDP growth rate anywhere between 5-8 per cent during 2011-12. In fact, the Government in its Vision 2020 has targeted an annual GDP growth rate of 8.5 to 9 per cent over the next 20 years.

The most fundamental reason for this optimism is demographic. As the Economist (India Survey 2004) has noted in its country brief, more than half of all Indians are under 25 years of age. It is the sort of bulge in the number of people in the productive age that can produce high growth. According to the 2001 census, India's population of 1027 million grew at less than two per cent a year in the previous decade. While, this represents a marked decline in growth rates from earlier decades, there still was an addition of 181 million people to the country between 1991 and 2001 i.e. more than the total population of Brazil. The reason why India is poised to outperform Brazil, Russia and possibly China as well as most of the developed world as per the Goldman Sachs forecast is that India is the only country where the population is expected to grow for the next 50 years and where the proportion of working-age people will increase well into the 2020s.

As the per capita energy consumption, in India it is only 0.3 Tonnes of Oil Equivalent (TOE) against the world average of 1.5 of TOE and the average in USA of 8.55 TOE. Even if India reaches the world average this would mean a five-fold growth in the country's energy consumption. This highlights the increasing importance of Energy Conservation. The growth in consumption of petroleum products of almost 5% in India needs to be contained through vigorous conservation activities. Growth rates in the USA and Western Europe for example for the period 1990-2000 have been only 0.4% and 0.5% respectively. As India's per capita consumption reaches the world average its growth percentage needs to be reduced. This appears to be contradictory, but essential to India's long term energy security interests.

The high rate of economic growth is likely to be accompanied by an increasing per capita income and life-style changes. This will also have an upward effect on energy demand. In view of the rising awareness of environmental protection and conservation, the future growth in the energy sector must consider such concerns and all development must be done in an environment-friendly manner.

At the same time it is also essential that the overall energy intensity of the economy is brought down through the adoption of more efficient technologies. The key issues facing India and other developing countries that have energy implications are as follows: rising population, need for economic growth and access to adequate commercial energy supplies. The financial resources required to achieve these objectives are: a rational energy pricing regime, improvement in energy efficiency of both, energy supply as also consumption, technological upgradation, a matching R&D base and environment protection.

The factors that are driving the energy demand upwards are economic growth accompanied by growth in urban and rural population. In addition, there may be the following factors that affect the demand: Price of oil products, environment considerations, and increase in efficiency of use, higher contribution of the service sector in the GDP, impact of information technology, telecommunication and e-commerce.

These factors give room for substitution by other products; that is, Natural Gas, non-conventional and other renewable sources of energy. Because India is heavily import-dependent, oil security is a matter of key concern to policymakers. Global oil prices are especially volatile as they are sensitive to various global, political and economical factors. The impact of such volatility on India is aggravated by its current inability to respond by increasing crude production.

To address these issues, policymakers and key stakeholders require scenarios that enable them to assess the contours of energy demand and supply. However, past experience has amply illustrated that projections are subject to a great deal of uncertainty. The deeper one looks into the future, things become more and more hazy and nebulous. At the same time while developing strategies to position for growth may take several years and would require a significant amount of forward planning for which some expectations about the future have to be modeled and presented in quantifiable terms. Thus projections, based on accurate data and clear assumptions must be viewed as tools meant to provide a framework to analyse, "if and when" scenarios.

As recorded in ***Hydrocarbon Vision 2025***, GDP and energy consumption for the country grew at about 6 per cent during the last 20 years and the trend is expected to continue. It also states that the energy-GDP elasticity has come down from 1.6 in the decade1950-60 to around unity in the 1980s. Further, according to the 10th Five-Year Plan, (2002 to 2007) the consumption elasticity for primary commercial energy for the period 1991-2000 was less than unity. India's commercial energy consumption is indeed growing at a faster rate than the world's commercial energy consumption. Growth of the economy has been principal driver of energy consumption.

The world's primary energy mix is dominated by oil and gas. According, to the BP Survey 2004, the share of oil and gas in the world energy consumption in 2003 was almost 61 per cent. In India despite the abundant availability of low cost coal, relative to the other energy sources, coal (including lignite) accounts for only 48 per cent of the commercial energy mix whereas oil and gas account for another 47%.

Consequently, India's imports during 2003-2004 of 90.43 million metric tonnes constitute about 74 % of the crude oil requirement. The total oil import bill in the financial year 2003-04 was about US$ 17.6 billion (Economic Survey 2003-04), accounting for about 28.6 per cent of the country's total import bill. After having become more or less self-sufficient in petroleum products owing to substantial increase in the country's domestic refining capacity, in recent years India has been importing only crude oil.

It is important to note that non-commercial energy (biogas, cow dung, wood etc) constitutes approximately 30% of the total energy consumed in India (commercial and non-commercial) which would approximately be 134 Tonnes of Oil Equivalent (TOE) which is even more than the petroleum products consumption of 104.1 million metric tonnes for the year 2002-2003. Non-commercial energy is almost entirely used for cooking purpose in the rural sector and is a heavy pollutant. Cooking fuels (SKO and LPG) would be increasingly required in the future to replace these non-commercial services, leading to an even greater increase in demand of petroleum products. This highlights the increasing importance of the need to develop alternative (renewable) sources of energy if the demand of petroleum products is to be contained.

VISION

Energy security for a nation of over one billion citizens (likely to go up to 1.4 billion in 2030) is as essential as food security. Any failure and or breakdown in this area would result in a national calamity with international dimensions. This is the great challenge to which the Oil Industry in India must rise. The dimension of this challenge can be judged when one considers that the actual demand for petroleum products of 111.5 MMT for the year 2004-2005 is likely to multiply more than three times to 368 MMT in the year 2024-2025 as per the ***Hydrocarbon Vision 2025*** document. On the basis of the same document, the estimated refinery capacity would then be 358 MTPA requiring 364 MTPA of crude oil versus the current production of around 33 MTPA.

As per the 10th Plan document India is world's sixth largest consumer of energy accounting for 3.5% of world commercial energy demand in 2001. If the country maintains a sustained GDP growth of 6-7%, India's energy consumption will increase at the rate of around 5% per annum and by 2025 India is likely to become 3rd or 4th largest energy consumer in the world.

Most of the households in the rural sector still cannot afford to pay for cooking fuel and are obliged to use traditional sources of energy such as fuel wood, crop residue, dung etc. These form the bulk of the source for non-commercial energy produced in the country. In 1950 Non-commercial sources of energy contributed to approx 72% of the total energy generated in India. By the nineties this figure went down to 35%. By then approximately 65% of the energy produced in India came from the commercial sector. (*Hydrocarbon Vision*-Report Para 3.4)

As per estimate by the Planning Commission in its 10th Plan document, even in 2006-07, 26.9% of total energy consumed in India would come from the non-commercial sources equivalent to 151.30 MTOE as against a demand for petroleum products (other than Natural Gas) of 144.5 MMT. By 2011-2012 while the contribution of non-commercial energy is likely to go down to 23.5% the equivalent in MTOE would go up to 170 MMTPA. Hopefully sooner rather than later the per capita GNP in India is going to rise to a point where everyone would be able to afford to pay for cooking fuel and negligible amount of energy would be produced in the non-commercial sector. At that point in time, another 170 MMTPA of oil equivalent would be added to the commercial energy basket.

India's per capita energy consumption is only 0.3 TOE against a world average of 1.5 TOE in 1997 (*Hydrocarbon Vision 2025*). Any future plan must perceive and prepare for at least a five-fold growth in per capita energy consumption in order to reach at least the world average.

Hydrocarbon Vision 2025 estimates that by 2024-2025, 95% of the commercial energy produced in India would be produced from Coal, Crude oil and Natural Gas; all non-renewable Hydrocarbon resources, only 2% from renewable Hydel and 3% from Nuclear energy. In other words, less than 5% of the commercial energy produced in India twenty years hence would be from renewable resources, even though the estimated coal reserves in India of 220.98 billion MT as of 2001 could last for two to three hundred years depending upon consumption.

On the other hand, India's current degree of dependence on imported crude oil of approximately 70% is likely to grow up to 90% in the next 10-15 years unless India discovers significant quantities of crude reserves within the country and within the economic zone of exploitation under the sea. This inevitably boils down to a massive national effort and mission to continuously augment if not replace non-renewable sources of energy with renewable sources of energy and prepare for a Non-Fossil Fuel Economy. As a matter of fact, the President of India in his Independence Eve address on August 14, 2005 called upon the Nation to move forward from a condition of Energy Security to 'Energy Independence' by 2030, i.e. within the next 25 years. The relevant portion of his speech is quoted below:

"Energy Security, which means ensuring that our country can supply lifeline energy to all its citizens, at affordable costs at all times, is thus a very important and significant need and is an essential step forward. But it must be considered as a transition strategy, to enable us to achieve our real goal that is—Energy Independence or an economy which will function well with total freedom from oil, gas or coal imports. Is it possible?

Hence, ***Energy Independence*** *has to be our nation's first and highest priority. We must be determine to achieve this within the next 25 years i.e by the year 2030. This one major, 25-year national mission must be formulated, funds guaranteed, and the leadership entrusted without delay as public-private partnerships to our younger generation, now in their 30's, as their lifetime mission in a renewed drive for nation-building."*

India's journey towards industrialisation commenced with a vision of a mixed economy during the cold war era when most of the world was divided in two ideological camps. Despite the collapse of the USSR followed by an international wave towards western style capitalism, India has continued to be a mixed economy. This did not mean that India was insular. It did, however, mean that whereas earlier greater emphasis and resource allocation was made in the Public Sector, with the advent of liberalisation policies initiated in 1991 by the Narasimha Rao Government, a converse shift towards the Private Sector began to take place.

If there is any energy model from which India could learn or benefit — it is the Chinese model a copy of such a model as reproduced in the 10th Plan document is attached.

The words of famous Chinese leader and the father of Chinese reforms, Deng Ziao Ping once said, "What do we care whether the cat is black or white as long as it catches mice." This gives one potent message that is Pragmatism. Any dichotomy between the Public and the Private Sectors in India must end. India should take any feasible step be it in the Private Sector or Public Sector or both; whichever best serves the country's national interests that goes to eliminate India's heart-breaking poverty. This is "unity in diversity" very much in line with the pluralistic character of India.

The future of the industry depends on: Energy Security, maximisation and optimum use of indigenous coal, promotion of renewable sources of energy, which can eventually replace non-renewable sources, conservation of energy, convergence of energy policy and pricing and other related issues.

An attempt will be made to briefly deal with each issue from the above mentioned statement starting with Energy Security.

ENERGY SECURITY

Two out of the five points made in the ***Hydrocarbon Vision 2025*** are on the subject of security and are reproduced below:

- To assure energy security by achieving self-reliance through increased indigenous production and investment in equity oil abroad.
- To ensure oil security for the country keeping in view strategic and defence considerations.

As far as Downstream Oil Security is concerned it is generally accepted that dependence on imports should not exceed 10% of domestic consumption. According to the *Hydrocarbon Vision 2025* which states that against a demand of 368.0 MMTPA in 2025, it is estimated that India's refining capacity will touch 358.0 MMTPA. This *prima facie* appears very satisfactory although care needs to be taken that deficits if any specially for lube base stock and Aviation Turbine Fuel are kept at safe manageable levels and that there is a constant continuous upgradation in Refining Technology at all times.

As far as Natural Gas is concerned for which huge quantities will need to be imported in future in order to meet the 2025 demand of approximately 128.0 MMTPA. The current attempts being made to import Natural Gas by pipeline from Iran, Central Asia, former Soviet Republics and India's neighbours will need to fructify in the near future, although it would be prudent in India's security interests to have adequate if not matching import facilities at various port locations as back up.

Maximisation/Optimum Use Of Indigenous Coal/Lignite

India must rely on and maximise her inherent natural strengths and resources. This inevitably brings up the question of exploitation of India's abundant coal resources including lignite. However, a very sizable quantity of Indian coal reserves are lying too deep under the bowels of the earth, in fact as deep as one kilometer below the earth's surface and is too difficult if not impossible to mine.

The 10th Plan document most comprehensively covers the subject of coal. Accordingly, whereas coal constitutes around 50% of all commercial energy produced in India; 70% of the power generated in India is coal based, while the world average is 38%, 80% in the case of China and only 56% in the case of USA.

On the other hand, China is the world's largest producer of coal at 1171 MTA per year followed by USA at 899 MTA per year while India produced only 310 MT in the year 2000-01 out of which 96% came from the public sector, 325.65 MT in 2001-02 and likely to go up to 405 MT in 2006-07. Indigenous coal is likely to remain the most stable and least cost option for bulk of India's energy needs in the foreseeable future according to the 10th Plan document on Energy, Para 7.3.96.

The Oil Industry also has a common interest in the potential for coal based energy generation in extracting Coal Bed Methane and underground coal gasification. As far as Coal Bed Methane is concerned, ONGC has been working on this since 1994. They have been given a block in the North Raniganj area on a nomination basis. Similarly, OIL and Great Eastern Energy Corporation also have been awarded blocks. Ten years ago this environment friendly source of energy has been harnessed very successfully in the USA. India needs to have a serious look into it and pursue the possibility of exploiting Coal Bed Methane very vigorously. ONGC has already drilled its first CBM (R&D) well in Parbatpur area of the Jharia coalfields in 1997. In the second well a stabilised flow rate of 6000 cubic meters per day was established by 2000.

According to *Hydrocarbon Vision 2025*: around 137 billion metric tons of India's coal reserves are inaccessible as they are found at depths below 600 meters. Underground Coal Gasification (UCG) thus becomes a priority option because it potentially holds the opportunity of converting coal to fuels and feed stocks without the need to change existing engine and equipment design.

ONGC has already initiated action to exploit UCG and downstream technologies in association with the Department of Coal, Council of Scientific & Industrial Research (CSIR) and Gujarat State Petroleum Corporation, Neyvelly Lignite

Corporation and other coal producing companies. In addition it is seeking expertise from SKO Chinsky Institute of Mining — a leading Russian Institute in the field of UCG. Other oil companies too could also take prompt initiatives in this area.

Promotion Of Renewable Sources Of Energy

On a world wide basis proven reserves of Oil, Natural Gas and Coal are likely to last approximately for another 40, 60 and 230 years respectively. While the increase in population will lead to a higher demand, new discoveries can enhance the reserves at the same time. However, fossil fuels are intrinsically 'Finite" therefore 'Non Renewable' and the world must prepare for transition to a non-fossil fuel based economy at the earliest. The President of India, however, has laid down the national target of 25 years to achieve this target. Interestingly, even a country like Iceland, for example, generates 72% of all its energy from renewable resources.

India is endowed with abundant sources of renewable energy. Their potential and quantum exploited has been tabulated in the 10th Plan document and is reproduced below.

(Table 7.3.3/7.3.16 10th plan document)
Renewable Energy Sources Potential

Source/ Technology	Units	Potential/Availability	Potential Exploited	
			Units	Percentage
Biogas Plants.	Million	12	3.2	26.8
Biomass-based power.	MW	19,500	384	1.9
Efficient wood stoves.	Million	120	33.9	28.2
Solar Energy.	MW/Sq.Km	20	1.7	8.7
Small Hydro.	MW	15,000	1,398	9.3
Wind Energy.	MW	45,000	1,367	3.0
Energy Recovery from Wastes.	MW	1,700	16.2	0.9
Hydel.	MW	148,700	16,083	10.8

The above table reveals the very low levels of exploitation of existing renewable resources in the country and the tremendous future challenge in utilising them fully, particularly Hydel Power. The argument often put forward for the non-exploitation of Hydro-Electric power is that most of it is available in the Himalayan regions (Uttaranchal, Jammu & Kashmir and North East), areas with inadequate demand, development and infrastructure. However, the question may be asked what comes first? In addition, what are the repercussions of lack of development and how much does it cost the economy. Obviously, the country has to find a solution, attract investments, create demand and find other innovations to usefully exploit these perennial sources of energy.

Solar Energy has a maximum potential. In a largely tropical and sunny country like India solar energy is the most neglected field. In order to promote its use legislation may be required. In Tel Aviv, Israel, for example, solar geysers in homes are required by law. However, there is also the potential for tapping of solar energy in space and beaming it back to earth. This requires a high altitude platform in space and suborbital solar collectors and communication systems. Experimental work is already being done in the USA by various groups including Lockheed Martin.

Hydrogen is the fuel for the future. It is odourless, colourless, and 14 times lighter than air, but most importantly its main product of combustion i.e. water, is pollution free and environment friendly. Hydrogen cells potentially could transform the Transport Industry and leave behind a much cleaner world. The *Hydrocarbon Vision 2025* also refers to the Hydrogen cell and it's potential. The Ministry of Petroleum and Natural Gas has constituted a committee headed by the Additional Secretary, MOP&NG to draw up an Action Plan to use Hydrogen.

A National Hydrogen Energy Board (NHEB) has been set up under the Ministry of Non-Conventional Energy Sources with the Minister of Non-Conventional Energy Sources as its Chairman. NHEB in its first meeting on February 23, 2004 decided to set up a Steering Group under Ratan Tata, Chairman, Tatas to prepare a National Hydrogen Energy Road Map.

The Steering Group set up five expert groups (on Hydrogen production, its storage, its application in transport, power generation and Hydrogen system integration) to prepare the National Hydrogen Energy Road Map. Such a Road Map based on the reports of the Expert Groups has now been prepared. It highlights the need for adequate ability for the production of Hydrogen as the key action before other things could fall into place. The Road Map recommends that in addition to existing methods of production of Hydrogen its availability as a by-product from the chloral-alkali industry, fertiliser plants and refineries should also be tapped.

In addition the Road Map has identified two major initiatives as listed below:

a) **Green Initiatives for Future Transport:** The Green Initiatives for Future Transport (GIFT) aims to develop Hydrogen powered I.C. engines and fuel cell based vehicles through different phases of development. It is envisaged that by 2020 one million vehicles will be on road run by Hydrogen fuel.

b) **Green Initiatives for Power Generation:** The Green Initiatives for Power Generation (GIP) involves not only developing Hydrogen powered I.C. engines and turbines it also envisages fuel cell based decentralised power generating systems ranging from few kilowatts to megawatts size systems in different phases. If this programme as proposed is implemented it is expected to generate 1000 megawatts by the year 2020. A sum of Rs. 25000 crore is estimated to be required to implement towards what has been proposed in the Road Map.

IndianOil R&D is actively associated with the group constituted for the use of Hydrogen in the Transport Sector. It has been entrusted with the responsibility for providing Hydrogen to 1000 Hydrogen fueled vehicles within three years. While this is commendable, Hydrogen fueled prototypes are already plying on the roads in the USA-West including Barth in Germany, Zevco in London, Reykjavik in Iceland and countries as far apart as China and Australia. Indian prototypes should be on the road earlier than the planned target year of 2008. Facilities to manufacture, package and market Hydrogen would need to be planned simultaneously.

Bio-diesel is an eco-friendly renewable alternative to Diesel for compression ignition. It is extracted from edible or non-edible vegetable oil. In the USA-West it is mainly derived from soyabean, rape seed and sunflower oil. However, since India is an importer of edible oils, Bio-diesel could as well be easily produced from *jatropha*, *karanjia* and *mahuva* and a large variety of other plants that are available in India which yield non-edible oils. Bio-diesel contains no petroleum and thus needs to be blended with HSD usually in proportions up to 20%.

The Bureau of Indian Standards (BIS) has appropriately amended the specifications to permit this blending. *Jatropha* is amongst the most suitable plants for cultivation in India because it can grow in arid wastelands. In addition Bio-diesel offers similar if not better characteristics as HSD such as Cetane Number, engine performance, wear and tear, mileage, reduction in exhaust smoke and better lubricating characteristics thereby enhancing engine life. For India this alternative has three-fold advantage, in as much as it is renewable, grows in arid wastelands, and provides additional rural employment. By 2030, it is expected to replace between 6.0 to 18.0 MMTPA of HSD requiring 3.91 million to 11.33 million hectares of arid land.

IndianOil R&D Centre has taken several initiatives in the promotion of Bio-diesel. As per an MoU with the Indian Railways, the R&D Centre has been given 500 hectares of land by the Railways to grow *jatropha*. Trial runs on *Shatabdi* and *Jan Shatabdi* express trains have been conducted and in the near future five more trains will run on Bio-diesel blends.

Similarly, MoUs have been signed with Escort Tractors, Faridabad, Tata Motor Vehicles, Pune, Gujarat State Road Transport Corporation and Haryana State Road Transport Corporation for experiments on the use of Bio-diesel. Similarly HPCL also is conducting an experimental project with 25 BEST buses in Mumbai. In addition Daimler Chrysler and Mahindras are setting up pilot projects with Bio-diesel. This eco-friendly renewable fuel holds excellent potential and promising future as an alternative to HSD. The various projects will need to be converted to full scale commercial operations soon after solving the teething problems including the incidence of price.

Ethanol is an excellent renewable fuel alternative to Motor Spirit (Gasoline) for spark ignition engines. It has a much higher octane rating compared to typical Motor Spirit, allowing the use of higher compression ratio Engines thereby increasing their thermal efficiency. In addition emissions, from Ethanol are far more environment friendly.

While a brief report on work being done in India on the use of Ethanol -Motor spirit mixtures (Gasohol) for spark ignition engines has been given on pages 110 (Indianoil R&D), in Brazil all spark ignition vehicles operate on Gasahol with 20-25% blend of Ethanol. Very appropriately ONGC has recently offered equity in green field Refineries to Petrobras the Brazilian National Oil Company in return for securing technology for producing GASAHOL.

For transport fuel the future holds great promise for Bio-diesel for compression Ignition Engines and Gasohol for Spark Ignition Engines.

Development and commercialisation of alternative sources of Energy need vigorous and effective Research. The oil industry already has significant R&D facilities. In addition ONGC is proposing to commission the "ONGC Energy Centre" as a National activity for commercially viable research work by the end of the 10th Plan period (2006 - 2007) — in the area of alternate and renewable sources of energy.

CONSERVATION

Saving one metric tonne of crude oil is like discovering four metric tonnes of new crude resource. With the degree of dependence on imported crude likely to go up from the current 70% to 90% in the next decade, conservation of crude and petroleum products become important elements of enhancing India's energy security.

In addition, India's energy intensity as measured by the ratio KGOE/$1000 of 609 is amongst the highest in the world. It is even higher than many of its neighbours in the developing world (Thailand 374) not counting developed countries like the USA and Japan etc. (USA-248, Japan-90).

According to the Bureau of Energy Efficiency (BEE), it is 1.47 higher than the overall average for Asia. The need for Energy Conservation stands self justified. With the formation of PCRA in 1978, the passage of Energy Conservation Act of 2001 and the consequential formation of BEE, the country has the full institutional support to effectively promote Energy Conservation measures in a vigorous and effective manner. However, the question arises whether all that can be done is being done? And whether technologies, engines manufacturers, operations in industries, especially process industries are securing for the country the energy saving that they potentially could.

HSD with annual consumption of nearly 40.0 MMTPA for the year ending March 31, 2005 is the obvious potential area for petroleum conservation. This includes the production of fuel efficient car and truck engines, efficiency of railway locomotive operation, specially over long distances, conservation in the State Road Transport Corporations, the need for Mass Transport services in Metros and other big cities etc.

In addition around 25,000 to 30,000 megawatts of energy is generated by HSD fueled standby power (captive Generating sets). This is a precaution taken by the Industry to keep their plants running against power shortages from the respective State Electricity Boards. This colossal wastage is worth plugging. Equipment and engine manufacturers need to be given specific quantifiable norms on Energy Efficiency to comply with. For example, there is no reason why thermal efficiency of LPG stoves and hot plates should not be raised from the current 64% to the easily achievable figure of 70%. This could save 6% of all LPG used for cooking in the country and could be anywhere between 500,000 to 700,000 metric tonnes of LPG per year. A similar concept could apply to boilers, furnaces and steam utilisation services.

Emergence of a significant Number of ESCOs need to be encouraged, so that they could go into areas of large potential savings such as agricultural pump sets. An oil industry conservation fund could be created and administered by PCRA or BEE to finance petroleum conservation equipment and technologies. Such a scheme although on a much smaller scale was floated in the 70s when the PCRA was financing industries to replace their old inefficient, Lancashire boilers with newer more fuel efficient ones.

Convergence of Energy Policy & Pricing

Energy is indivisible and can be converted from one form to another. This spells out the need to integrate all forms of energy into one network, as also energy and energy pricing policy. As early as in 1974 in his letter to the Prime Minister Indira Gandhi in December 1974, K.D. Malaviya wrote as follows: "*I think we must have an integrated approach to energy problems in which oil, coal and power, and research in all these sectors go into one basket. Perhaps this could be done through a Cabinet Committee to begin with. At the same time, I may also suggest that the suggestion of the Malaviya Committee Report regarding the constitution of an Energy Policy Commission should also be considered without delay*".

The way the Government was structured over the last 30 years — this integration could not take place. As mentioned earlier, ultimately in accordance to the recommendation of the V Krishnamurthy Committee on "Synergy for Energy" a Coordination Committee under the Chairmanship of the Prime Minister was formed in July 2005.

Miscellaneous Issues

The *Hydrocarbon Vision 2025* envisages an internal restructuring of the PSUs within three years, and phased disinvestments of PSUs to 26% other than ONGC, IndianOil and GAIL. On a long-term basis it recommended the privatisation of oil PSU's other than IndianOil, ONGC and GAIL whose government holding are to be determined specifically.

This pattern of disinvestments does not appear feasible for now. However, as early as in 1963, K.D. Malaviya had recommended the vertical integration of ONGC, IRL and IndianOil in a note dated October 9, 1963 to the then Prime Minister Jawaharlal Nehru. Today, after the acquisition of MRPL, ONGC is the only vertically integrated oil company in the Indian Public Sector. However, in an era of globalisation, oil companies must become large enough in order to secure maximum economies of scale, to be in a position to operate and hold their own globally with the state-of-the-art cutting edge technology and therefore must integrate vertically. This requires a new image and a new work culture, socially committed and technologically advanced. In view of the varying sources of energy in the future, oil companies must look upon themselves as Integrated Energy Companies and secure for India the energy that it needs.

In order to move in this direction, it is necessary to build an oil company work environment in which there is a continuous search for knowledge, relevant and effective R&D activities, with a culture which relentlessly pursues advancement in technology and energy efficiency. It also requires powerful social engineering and human development.

Consequently, the HRD function will become increasingly crucial in years to come as managers will need to cope with rapidly changing and often unfamiliar developments in unfamiliar environments. Because of information explosion and rapidly changing technologies, systems and methods will need to be built which provide greater opportunity and entrusts greater responsibilities on younger managers.

There is an ever-present danger for Vision and Plans to remain on paper only. In order to eliminate *Vision* falling into this trap, it is essential for the oil companies to evolve a transformation mechanism which regularly converts elements of the *Vision* to long-term Plans, elements of the Long Term Plans to Five Year Plans and elements of the Five Year Plans into an Annual Plan.

CONCLUSION

Apart from securing Crude and Natural Gas for the country, the future challenges will centre around an ever greater reliance on renewable sources of Energy, Conservation, meaningful R&D, restructuring of the oil companies to move towards vertical integration and major Human Resource Engineering which enables competent younger managers to man higher positions of responsibility.

However, nothing could be more appropriate than to quote a concluding remark from the President's Independence Eve Address to the Nation on 14th August, 2005. "By 2020 the nation should achieve comprehensive energy security through enhancement of our oil and gas exploration and production worldwide. By the year 2030, India should achieve energy independence through solar power and other forms of renewable energy; maximise the utilisation of hydro and nuclear power and enhance the bio-fuel production through large scale energy plantations like *jatropha*".

INTERNATIONAL EXPERIENCES

Energy Policy Focus and Current Energy Policy Framework and Objectives for China.

ENERGY POLICY FOCUS ON CHINA

1980s

- Rapid increase in coal production to address severe shortage of energy supply driven by reforms led economic growth.
- Large number of township and village-run coalmines were set up.

1990s

- Coal liberalisation initiated:
  - Reduction in Government subsidies
  - Price liberalisation/deregulation
- Electricity sector reforms led to capacity addition
  - Entry of non-state sector via build-operate-transfer
  - Electricity supply met demand in most regions, with surplus in some areas

CHINA'S CURRENT ENERGY POLICY FRAMEWORK AND OBJECTIVES

Highlights of energy policy in tenth five-year plan (2001-05) in China

Key features/policies

- Increase share of clean energy including Natural Gas and clean coal
- Set up 40-50 nuclear power plants, to account for 5% of total primary energy in 10-15 years

- Promote renewable energy (solar, wind, hydro) sources.
- Reduce/close number of small sub-scale loss making energy (power generation, coal mining, oil refining)units.
- Strictly enforce energy consumption standards and technologies for new industrial capacities.
- Build more efficient national power grid (as opposed to transporting coal from North to South/East).
- More market oriented reforms in the power sector.
  - Separate power gencos from grid companies.
  - Free competition in power generation.
- Continue to pursue policy of self-reliance in energy supply, based primarily on domestic coal production, without sacrificing economic efficiency.
- Increase the number of suppliers in oil to meet increased import requirements.

EPILOGUE

Having reached the end of the chronicle of the history of the Downstream Oil Industry in India, it will be seen that the country has over the decades developed and acquired the requisite skills needed to design, build, operate and expand facilities and activities to efficiently run India's Downstream Oil Industry.

For well over 53 years, i.e. from 1901, no new refinery was built in the country. The first refinery that was commissioned after Independence was in 1954 belonging to SVOC (ESSO). During the next 50 years, 16 new refineries were built with a total capacity of 127.4 MMTPA including the 33.0 MMTPA Reliance Refinery at Jamnagar being amongst the worlds largest. Today, while 74% of India's refining capacity comes from the public sector, the scenario is likely to change when the Essar Refinery, currently under construction at Jamnagar is commissioned, and also when the Reliance Refinery expands its present capacity from 33.0 to 60.0 MMTPA. This entails that approximately half of India's refining capacity could then come from the private sector.

Thus, the refining capacity in India which was 100% in the private sector up to 1962 became 100 % in the public sector from September 1981 onwards till 1999. The country, however, will need nearly three times the current capacity, going up to 358.0 MMTPA in the next 20 years (up to 2024-2025). The required additional refining capacity of 230.6 MMTPA will be shared by the public and the private sector — hopefully a larger percentage going to the most cost effective and efficient of the oil companies. Thus in today's India and its policy of mixed economy, what matters most is cost effectiveness, efficiency, subservience to national interests, irrespective of whether the Downstream Oil Industry growth is in the private or the public sector.

Currently the worldwide refinery capacity utilisation has gone up to over 84% for the year 2005 and according to some projections may reach just short of 90% by 2010. Such high global refinery capacity utilisation makes availability of products highly vulnerable to accidents and natural calamities befalling any refinery or region. In the USA no new refinery has been built since 1976, instead a sizable number of refineries have been closed down over the years especially the smaller ones because of environmental regulations or economic considerations.

The incremental petroleum product demand is likely to be 30-35% higher than the incremental refining capacity over the next five years leading to an unmet global demand of over 115.0 MMTPA out of which 65.0 MMTPA is in the Asia-Pacific region. India is advantageously placed to meet this demand gap both in the West as well as in the East.

This scenario presents a very attractive opportunity. India could seize by rapidly expanding or preponing expansions in its coastal refineries and accelerating the commissioning of new refineries such as IndianOil's Refinery at Paradeep as well as ONGC Groups' Refineries at Kakinada and Mangalore; thereby enhancing its product export capability. This could give India the cutting edge and flexibility to meet internationals as well as domestic demand simultaneously, depending on the country's demand supply balance at the relevant point in time.

Low refining costs are essential to stay competitive in the international market for which economies of scale refinery-wise would become inescapable. Producing products to international specifications has the added benefit of making high quality products available in the domestic market as well. Future product quality specifications will require sizable investments and ability to refine a wide variety of crude oils requiring high refinery complexity. As a result, several smaller refineries particularly in the developed world are likely to be closed down in the near future, depleting further the refinery capacity worldwide. In the light of above, it is hoped that India's Downstream Oil Industry will enter the international export market in an even bigger way and reap benefits for the industry and the country.

Low transport cost plays an important role in oil company viability on a long term basis. It has been established that pipeline transportation is the cheapest overland mode of transport. In addition, it is speedier, safer, environment friendly and robust against natural calamities and other disruptions. Yet presently only 32% of India's petroleum products are transported through pipelines as compared to 74% in the USA. With the expected refining capacity in India going up to nearly 360.0 MMTPA by 2024-2025 — the Oil Industry will need to drastically expand its pipeline network and make massive investments.

At the end of the fifties when there were only four refineries in the country a few refiners and other oil company executives quit the MNC's to join the Indian Refineries Ltd.(IRL)/Indian Oil Company(IOC) and later on Cochin Refineries Ltd.(CRL)/Madras Refineries Ltd., Bongaigaon Refinery & Petrochemicals Ltd. (BRPL) to build and operate the thirteen public sector refineries and the public sector oil marketing companies. When Reliance, Essar and Shell emerged, an even larger number of experienced, serving as well as superannuated executives with refining and marketing experience from the public sector oil companies joined the new private sector oil companies. It is this transmigration and cross fertilisation of knowledge and experience which builds the overall 'Industry' professionalism and skills within the country. Henceforth this transmigration of skills could also be internationalised. As a matter of fact PII has already made a significant headway in this direction although the future holds even larger opportunities.

In a globalised world there is no reason why companies in India's Downstream Oil Industry should not go in for multi-nationalisation by venturing into countries not only in the immediate neighbourhood (SAARC) but also go in for trading partners (joint ventures) in countries in the East, South East and Central Asia and elsewhere. The current entry of IndianOil into Sri Lanka and Mauritius is only a small but important beginning and a precursor of things to come.

Vertical integration and mergers — in order to achieve economic stability, economies of scale may become essential in the future if oil companies from India are to make their mark on a global scale. As India moves into the first quarter of the 21st century (2025) there is every indication that the Downstream Oil Industry will be able to provide to the country at large, world class products and services.

ABBREVIATIONS

COMPANIES / ORGANISATIONS

AOC . . . . .Assam Oil Company
AOD . . . . .Assam Oil Division
ARTC . . . . .Assam Railway and Trading Company
BHEL . . . . .Bharat Heavy Electricals Ltd.
BIS . . . . .Bureau of Indian Standards
BOC . . . . .Burmah Oil Company
BP . . . . .British Petroleum
BPCL . . . . .Bharat Petroleum Corporation Limited
BSR . . . . .Burmah Shell Refineries Ltd.
CASTROL . . . . . . .Castrol Lubricants & Specialties Limited
CDO . . . . .Central Design Office
CHT . . . . .Centre of High Technology
CMERI . . . . .Central Mechanical Engineering Research Institute
CORIL . . . . .Caltex Oil Refining (India) Limited
CPCL . . . . .Chennai Petroleum Corporation Limited
CSIR . . . . .Council of Scientific and Industrial Research
DGH . . . . .Directorate General of Hydrocarbons
DOF . . . . .Department of Fertilisers
DSIR . . . . .Department of Science and Industrial Research
EIL . . . . .Engineers India Limited
CALTEX / CIL . . . .Caltex (India) Ltd.
ESSO . . . . .Esso Standard Eastern Inc.
ESRC . . . . .Esso Standard Refining Company of India Ltd.
ESCO . . . . .Energy Service Company
ETG . . . . .Expert Technical Group
FIEO . . . . .Federation of India Export Organisation
GAIL . . . . .Gas Authority of India Ltd.
GGCL . . . . .Gujarat Gas Company Limited
GLC . . . . .Gas Linkage Committee
GSI . . . . .Geological Survey of India
GSPCL . . . . .Gujarat State Petroleum Corporation
GSRTC . . . . .Gujarat State Road Transport Corporation
HIL . . . . .Hydrocarbons India Limited
HPCL . . . . .Hindustan Petroleum Corporation Limited

IBP . . . . .Indo Burma Petroleum Company
ICMA . . . . .Indian Chemical Manufacturers Association
IEA . . . . .International Energy Agency
IFP . . . . .Institute French Petroleum
IGL . . . . .Indraprastha Gas Limited
IIP . . . . .Indian Institute of Petroleum
IOBL . . . . .Indian Oil Blending Limited
ICPEEB . . . . .Indian Council for Promotion of Energy Efficiency Business
IOC . . . . .Indian Oil Corporation Limited
IPCL . . . . .Indian Petrochemicals Corporation Ltd
IPE . . . . .Institute of Petroleum Exploration
IREDA . . . . .Indian Renewable Energy Development Agency
IRL . . . . .Indian Refineries Ltd.
KDMIPE . . . . .Keshav Dev Malaviya Institute of Petroleum Exploration
KRL . . . . .Kochi Refineries Limited
LIL . . . . .Lube India Ltd
LUBRIZOL . . . . . .Lubrizol India Limited
MFL . . . . .Madras Fertiliser Ltd
MGL . . . . .Mahanagar Gas Limited
MNES . . . . .Ministry of Non-Conventional Energy Sources
MSRTC . . . . .Maharashtra State Road Transport Corporation
MOE&F . . . . .Ministry of Environment and Forests
MOPNG . . . . .Ministry of Petroleum and Natural Gas
MRL . . . . .Madras Refineries Ltd
MRPL . . . . .Mangalore Refinery and Petrochemicals Limited
NABARD . . . . . . .National Bank for Agriculture and Rural Development
NCL . . . . .National Chemical Laboratory
NHAI . . . . .National Highway Authority of India
NIOC . . . . .National Iranian Oil Company
NOC . . . . .National Oil Companies
NRDC . . . . .National Research Development Corporation
NRL . . . . .Numaligarh Refinery Limited
NRSR . . . . .National Resources and Scientific Research
NTPC . . . . .National Thermal Power Corporation
OCC . . . . .Oil Coordination Committee
OECD . . . . .Organisation for Economic Cooperation and Development
OIDB . . . . .Oil India Development Board
OIL . . . . .Oil India Limited
OISD . . . . .Oil Industry Safety Directorate
ONGC . . . . .Oil and Natural Gas Corporation Limited

OVL ....ONGC Videsh Limited
OPC ....Oil Price Committee
OPEC ....Organisation of Petroleum Exporting Countries
OAPEC ....Organisation of Arab Petroleum Exporting Countries
PCRA ....Petroleum Conservation Research Association
PETROFED ......Petroleum Federation of India
PII ....Petroleum India International
PIL ....Petronet India Limited
PLL ....Petronet LNG Limited
POCL ....Petrosil Oil Company Limited
PPAC ....Petroleum Planning and Analysis Cell
RIL ....Reliance Industries Ltd
RIAF ....Royal Indian Air Force
RLC ....Regional Level Co-ordinator
RRL ....Regional Research Laboratory
SLC ....State Level Co-ordinator
SPIC ....Southern Petrochemicals Industries Corporation Ltd.
SPC ....Special Project Cell
STANVAC ......Standard Vacuum
UPPCB ....Uttar Pradesh Pollution Control Board
VMU ....Vizag Marketing Unit
WRPC ....Warri Refinery and Petrochemicals

Other Abbreviations

AFRA ....Average Freight Rate Assessment
ALDS ....Auto LPG Dispensing Stations
APM ....Administered Pricing Mechanism
BAU ....Business as Usual
BEE ....Bureau of Energy Efficiency
BOOT ....Build Own Operate Transfer
BPI ....Bulk Petroleum Installation
C&F A/C ....Cost and Freight Surcharge Account
CBM ....Coal Bed Methane
CCR ....Continuous Catalytic Regeneration
CCU ....Catalytic Cracking Unit
CCVT ....Close Circuit Video Transmission
CDU ....Crude Distillation Unit

CFC . . . . .Continuous Film Contactor
CMU . . . . .Crude Modification Unit
CNG . . . . .Compressed Natural Gas
CPT . . . . .Calcutta Port Trust
CTWS . . . . .Chief Tank Wagon Superintendent
DBC . . . . .Double Bottle Connection
DHDS . . . . .Diesel Hydro De-Sulphurisation
DRP . . . . .Debt Restructuring Package
DCU . . . . .Delayed Coking Unit
DWT . . . . .Dead Weight Tonnage
DHDT . . . . .Diesel Hydro Treatment Project
E&P . . . . .Exploration and Production
ETP . . . . .Effluent Treatment Plant
FCC . . . . .Fluid Catalytic Cracking
FPU . . . . .Feed Preparation Unit
FRE . . . . .Fuel Refinery Expansion
FSP . . . . .Freight Surcharge Pool
FTP . . . . .Free Trade Product
GDP . . . . .Gross Domestic Product
GPS . . . . .Global Positioning System
HCU . . . . .Heavy Crude Processing Unit
HGU . . . . .Hydrogen Generation Unit
HDS . . . . .Hydro Desulphurisation
HOG . . . . .High Output Growth
IAP . . . . .Indoor Air Pollution
ILP . . . . .Industry Logistic Plan
ISFL . . . . .International Seminar on Fuels and Lubricants
KTU . . . . .Kerosene Treating Unit
LOI . . . . .Letter of Intent
MI . . . . .Main Installation
MJPL . . . . .Mathura-Jalandhar Pipeline
MMSCMD . . . . . . .Million Metric Standard Cubic Metres per Day
MOC . . . . .Memorandum of Collaboration
MOU . . . . .Memorandum of Understanding
MTPA . . . . .Million Tonnes per Annum
MV . . . . .Medium Viscosity
MVI . . . . .Medium Viscosity Index
MINAS . . . . .Minimal National Standards
NMP . . . . .Normal Methyl Pyrolidene
NELP . . . . .New Exploration Licensing Policy
NGDC . . . . .National Geophysical Data Centre

NGHP . . . . .National Gas Hydrate Programme
NPMP . . . . .National Petroleum Management Programme
OGL . . . . .Open General Licence
ODS . . . . .Ozone Depleting Substances
OHCU . . . . .Once Through Hydro Cracker Unit
OMC . . . . .Oil Marketing Companies
OPC . . . . .Oil Prices Committee
OCRC . . . . .Oil Cost Review Committee
PDU . . . . .Propane De-Asphalting Unit
PIL . . . . .Public Interest Litigation
PRU . . . . .Propylene Recovery Unit
PMS . . . . .Parallel Marketing Scheme
POL . . . . .Petroleum Oil and Lubricants
PPA . . . . .Product Price Adjustment
R&D . . . . .Research & Development
RFCCU . . . . .Resid Fluidized Catalytic Cracking Unit
RIPMC . . . . .Railway Inland Petroleum Movement Committee
RSP . . . . .Retail Selling Price
SBM . . . . .Single Buoy Mooring
SC . . . . .Scheduled Castes
SCR . . . . .Selective Catalytic Reduction
SPE . . . . .Sales Plan Entitlement
SPM . . . . .Supply Plan Meeting
SRU . . . . .Sulphur Recovery Unit
SSP . . . . .Single Super Phosphate
ST . . . . .Scheduled Tribes
TAM . . . . .Turnaround Management
TEL . . . . .Tetra Ethyl Lead
TOE . . . . .Tonnes of Oil Equivalent
TOPS . . . . .Tap Off Points
TWC . . . . .Tank Wagon Controller
UAV . . . . .Unmanned Aerial Vehicle
UCG . . . . .Underground Coal Gasification
ULCC . . . . .Ultra Large Crude Carrier
VDU . . . . .Vacuum Distillation Unit
VLCC . . . . .Very Large Crude Carrier
VSAA . . . . .Valued Stock Adjustment Agreement
VREP PROJECT . . .Vizag Refinery Expansion Project

PETROLEUM PRODUCTS

ATF . . . . .Aviation Turbine Fuel
AVGAS . . . . .Aviation Gasoline/Spirit
CBFS . . . . .Carbon Black Feed Stock
CNG . . . . .Compressed Natural Gas
FO . . . . .Furnance Oil
HHS . . . . .Hot Heavy Stock
HSD . . . . .High Speed Diesel
JBO . . . . .Jute Batching Oil
LABFS . . . . .Linear Alkyl Benzene Feed Stock
LDO . . . . .Light Diesel Oil
LOBS . . . . .Lube Oil Base Stock
LPG . . . . .Liquiefied Petroleum Gas
LSHS . . . . .Low Sulphur Heavy Stock
MS . . . . .Motor Spirit
MTO . . . . .Mineral Turpentine Oil
NGL . . . . .Natural Gas Liquid
PET-COKE . . . . . . .Petroleum Coke
SBP-SPIRIT . . . . . .Special Boiling Point Spirit
SKO . . . . .Superior Kerosene Oil
TDO . . . . .Tea Drier Oil

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CPCL . . . . .Chennai Petroleum Corporation Limited
GAIL . . . . .Gas Authority of India Limited
HPCL . . . . .Hindustan Petroleum Corporation Limited
IOC . . . . .Indian Oil Corporation Limited
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PPAC . . . . .Petroleum Planning and Analysis Cell
PETROFED . . . . . .Petroleum Federation of India

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The oil crisis of 1973 shook the entire oil world. In India, this was followed by the purchase of Burmah Shell, Esso and Caltex by the Govt. of India and the birth of the public sector HPC and BPC. Over the next 25 years, the Industry was totally dominated by the very profitable public sector oil companies who also developed and acquired the technical and professional skills needed to run a world class downstream Oil Industry in India.

After liberalisation the Oil Industry was also thrown open to the private sector and Indian entrepreneurs emerged with Reliance building amongst the world's largest refineries at Jamnagar. During the last 50 years, 127 MMTPA of refining capacity has been added in India through 16 refineries with plans on hand to enhance this to 358 MMTPA in order to meet India's projected demand upto 2024-2025. The unprecedented spiralling of crude oil prices has thrown a fresh challenge to the Industry which it will need to overcome.

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