UPSTREAM INDIA

Fifty Golden Years of ONGC

An ONGC Group
Golden Jubilee Publication

The story of upstream Oil Industry in India is synonymous with Oil and Natural Gas Corporation Limited, the flagship E&P Company of India. Starting as a petroleum division within GSI, ONGC became a Commission on August 14, 1956 and a statutory body in 1959. It became a Corporation in 1993. In 2006, its fiftieth year, it is a Fortune 500 company and the Most Valuable Corporate in India with footprints across the globe.

This book is a narrative history of ONGC. In its pages are the aspirations, struggles, achievements and continuing dreams of the unique band of oil explorers in India. The book is divided into ten parts. Each part encapsulates an eventful era. The firm belief of Malaviya that India could produce her own oil, the daring foray into Cambay, the early initiatives in securing equity oil and the tremendous knowledge building have

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Oil and Natural Gas Corporation Ltd.

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Dedicated to the martyrs
who have laid down their lives in the line of duty
for ONGC and for India

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FOREWORD

The level of organic energy propelling a committed group of people is what distinguishes a great organisation from a good organisation. A spirit of indomitable courage and conviction to make the newly independent India into an economically emancipated developing nation drove the pioneers to create ONGC fifty years ago. The same spirit still propels the most valuable corporate of India to fuel the country's transformation from 'a developing nation' to 'a developed nation' in the new millennium.

The amazing clarity of Jawaharlal Nehru's vision, the infectious enthusiasm and steadfast determination of Keshava Deva Malaviya could not but influence the basic character of the organisation. There have been astounding highs and of course, some lows along the way, but the organization emerged enriched and vibrant from both experiences alike.

Now, looking back down the road we traversed in the past half century - from a small Petroleum Division within Geological Survey of India to Asia's best Oil and Gas company, from zero reserves to six billion tonnes, from a small hired laboratory at Naaz building in Dehra Dun to the most valuable Indian corporate, from an abandoned Rumanian rig to the most advanced Dynamically Positioned (DP) class-3 drillship, from shallow vertical wells to ERD wells and multilaterals, from drilling in 3 metres of water depth at Aliabet to 3000+ metres in deep sea (second operator in the world to do so, after Chevron Texaco), from a couple of calculating machines to the largest ERP business system in Asia, from the skepticism of many in allocating meagre resources for its operations to having its public offer of USD 2+ billion (largest ever in India so far) over subscribed within minutes in the global financial markets, from a handful of young aspirants to one of the world's largest group of oil experts - it is a gratifying feeling.

Most significant asset gained in these years is the enthusiasm and determination, be it the strategic goal of doubling the reserves, enhancing recovery from 28 % to 40 % or being a USD 50 billion global giant ONGC group. That confirms, the ambitious vision of the pioneers is alive and burning bright down to this date.

The life at an oil field is hard, risky and full of uncertainties. We have martyrs who laid down their lives in the line of duty without batting an eyelid. As the story unfolds, one can see the messianic faith with which they worked and battled with the forces of nature.

It is a tribute to every ONGCian, past and present, for making a difference through the courage to explore, knowledge to exceed and technology to excel.

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

PREFACE

On August 14, 2005, ONGC day, we took the lift and landed on the ninth floor conference room at Tel Bhavan, Dehra Dun. The conference room was full. The C&MD and Board of Directors were seated along with former chairmen, directors and senior officers. Subir Raha, the then C&MD, had envisioned the History Project to record and preserve the institutional memory as an inspiration for the present and future generation.

Soon, we came to know that M Rajagopala Rao, General Manager (Geophysics) and Head, ONGC Museum Project, has been asked to coordinate the History Project as well. He gave a brief presentation outlining the objectives, approach and schedules.

The agenda was to set a course for the project. After hours of intense discussion, a theme for the project emerged. It was the resilient spirit of the organization to repeatedly overcome what appeared as insurmountable obstacles at different points in its chequered history. In between the discussions, three of us in the Editorial team were looking up at the portraits of all former chairmen in the conference hall. They seemed to come to life as the journey over fifty years was being discussed.

It emerged during deliberations that an approach based on chronology, basin evolution, technology development or milestone events etc. alone may not be adequate. It was decided to follow a judicious combination of them. More meetings followed with more veterans in Delhi, Mumbai, Chennai, Kolkata and other cities. The story of ONGC, it was decided, would cover the journey through successes as well as failures, people and their spirit, obstacles crossed and promises kept.

One day, Raha made a thought provoking suggestion: "Imagine yourself in the position of Malaviya in 1956 amid the challenges before him - vested interests terming India as "hydrocarbon barren", no trained manpower, paucity of funds, 3.14 million square kilometres of sedimentary basin and not knowing where to start. Malaviya had a few tools - vision, conviction and courage. ONGC was born out of these three factors, and they have permeated through the veins of the company as it has grown." Such provocations and guidelines from Raha helped us put things in perspective.

Raj was busy contacting old acquaintances and collecting memoirs. Aniruddha went back to his job on the rig operating in the east coast of India and Shobha to her geology work in Mumbai only to get back to Dehradun and discuss, argue, fight, encourage, get angry and in the end laugh together at our own naiveties. Three of us hit all available journals, periodicals and books. Rajagopala Rao, in the meantime, had prepared the grounds for one of the most comprehensive knowledge management exercises ever undertaken in the company's history through Basin Research Team, Document Research Team, Archival Photo Research Team, series of interviews with hundreds of former ONGCians, feedback forms from thousands of others by post. Dr. A.K. Balyan became the one-stop solution for all impediments, which were plenty - natural in an intellectual exercise of this magnitude. He was available, over phone and in person, anytime we wanted. With his ever smiling face, he was encouragement unlimited.

We took some time to grasp the essence of the organization. Ours was a strange combination. One of us was seventy five, the other two in their mid-thirties, one flamboyant extrovert and the other a lady of discerning sensibilities. It was maddening in the initial stages. Slowly, we found a method in the intellectual madness; if one of us read voraciously and wrote something, the other two would edit out what was not pertinent. Then, our notes were sent to all the seniors in the contributors' team for review. It was heart breaking when some of the chapters came back with outright rejection.

By then, we had caught on to the theme of ONGC, the birth, growth and coming of age of a colossus. Though it appeared impossible to capture this unbounded spirit in the confines of a small book, an interesting storyline gradually took shape.

Part one (1955-58) tries to relive the agony and ecstasy of giving birth to a dream. The chapters have tried to capture the initial struggle for money, men and material and above all the confidence of those who mattered, to raise the first army of oil men and women in independent India.

Part two (1958-60) describes the tentative venturing out into the open. In this phase, ONGC drilled its first well in Jwalamukhi, opened up a new basin in Gujarat with oil strikes in Cambay and Ankleswar and discovered oil in Assam at Rudrasagar. The courage and perseverance of the pioneers, struggling without much wherewithal, in the mountains and marshy lands using pure instinct and ingenuity leaves one with a sense of awe and admiration.

Part three (1960-65) is called the hundred metre dash. It starts with a tragedy when the commission lost one rig in a blowout. But, the commission took the loss in its stride and galloped ahead by carrying out a trial production, within 15 months from discovery, in Ankleswar and sending it in a railway rake to refineries in Mumbai. It built a research institute and went overseas in search of equity oil. By 1963, Malaviya had launched a Blitzkrieg to take ONGC straight into adulthood. After his departure, fatigue, so common in intense bursts of activity, set in.

Part four (1965-70) depicts the hurdle race as the commission, getting over the shock of Malaviya's exit, came back from behind to organize itself. Establishment of a control room, developing Assam oilfields through a series of specialized 'operations', conducting offshore seismic surveys and boldly venturing offshore at such a young age to drill in the shallow waters of Aliabet, bear more testimony to its pioneering zeal.

Part five (1974-82) records the sparkling achievements of ONGC in its run up to the silver jubilee. Discovery of the giant 'Bombay High', developing it in record time, laying hundreds of kilometres of sub-sea pipelines, building the Uran plant and successful forays overseas discovering fields in Iraq and Tanzania are but a few examples in this shining era of ONGC history.

Part six (1982-90) prepares you to run the marathon alongside ONGC. The story here is dominated by the intensity of operations in Mumbai High development, discovery of new fields in K-G, Cauvery and Gandhar. The commission saw all round growth in profits, manpower, facilities. These were momentous times of growth.

Part seven (1990-1995) is a sobering walk through the after success blues. The company again went into spasms after the Blitzkrieg of the preceding decade. Corporatisation, increasing competition and threats of some of the fields going out of its hands - the times were turbulent and challenging.

Part eight (1995-2001) takes you across the slogging miles as the company tried to redeem its honour through a series of new initiatives, and came to terms with more competition in the New Exploration Licensing Policy (NELP) regime.

Part nine (2001-05) is the surge forward. ONGC took a slew of measures to organize its resources, gave itself a new corporate goal called Vision-2020, spread wings over countries across the world through its subsidiary OVL, acquired and turned around MRPL and forayed in to retailing activity at the far end of downstream. On the stroke of fifty, it achieved its avowed objective of straddling the entire spectrum of hydrocarbon industry from drilling to dispensing.

We have attempted to weave into a canvas of words, the feelings of ordinary engineers and geoscientists, as they fought the sea exploring oil, ventured across mountains to reach the tough oil pool underneath and watched their colleague roughnecks who braved the hot steam to close a valve and never came out. We believe ONGC is the story of these magnificent people. The present generation owes its deep gratitude to the pioneers at all levels in the hierarchy of ONGC over the past five decades.

In spite of the extreme care taken to ensure best attention to detail and accuracy, in a job of this magnitude, mistakes might still persist. Some important events might have been left out and some important personalities might not have found a mention. We would like to seek the indulgence of the understanding readership towards such lapses and assure that we shall try to incorporate any corrections and improvements communicated to us in future editions of the book.

Editorial team

Acknowledgements

The ONGC history project might go down on record as one of the largest knowledge management exercises ever launched for preserving institutional memory of a company. Initially, the task looked uphill when one looked at the vast ground to be covered in the available time.

A Contributors' team, consisting of past and present decision makers, made the task much more manageable as they brainstormed over several days to chalk out a clear path. They created the architecture for the publication. The distinguished panel included, Padmashri Dr. N.B. Prasad, Padma Bhushan Col. S.P. Wahi, S.K. Manglik, L.L. Bhandari and P.K. Chandra - all former Chairmen of ONGC; Dr. Hari Narain, Dr. A.K. Mitra, S.N. Talukdar, T.N. Seshan, R. Srinivasan, D.N. Avasthi, Dr. S. Ramanathan, D.P. Bansal, G.D. Dhingra, I.A. Farooqi, , former Members/ Directors/ Heads of erstwhile Directorates, Dr. S.N. Visvanath, former GM (Ops.), OIL and P.K. Kaul, former Secretary, Ministry of Petroleum and Natural Gas, Government of India.

The members were of the view that the essence of ONGC, a knowledge company with an action-packed history of five decades, could possibly be never captured in one book. The transformation of ONGC into the Most Valuable Company in India is a saga of the triumph of ordinary men and women, tremendous technology thrust and massive knowledge building. It was decided to come out with three publications. The narrative history to tell the story in a free-flowing, non-technical rendition for the common reader. The Coffee Table version, as a pictorial essay, for easy reading. A technical memoir capturing the growth of technology in every field of oil exploration, production and processing would complete the compendium for students, young professionals and connoisseurs of the industry.

For the narrative history of ONGC, Raj Kanwar was invited as the Consulting Editor. With a reputation for fine journalism, he has been associated with the journey of ONGC since its inception. In the early sixties, Raj had joined the nascent Public Relations Department of the Commission. Though he quit ONGC within a few years to start his own business, his umbilical with ONGC was never severed. He continued his literary pursuits as well. He brought with him first hand knowledge of the early days of ONGC and personal association with several transformational leaders of the organisation in the past five decades. The in-house associates, young and enthusiastic, Aniruddha Pattnaik, a driller by profession, and Shobha Singh, a geologist, turned out to be prime movers in the

task. During my frequent interactions with the group, I always felt happy to see the meticulous efforts in compiling information from various sources. The editorial team deserves appreciation for a job well done.

With a clear roadmap, the onerous task of going through over millions of pages of archival documents, regulations, minutes of meetings and publications, started. The former senior officers in the document research team proved a match to this daunting task. We are indebted to the tireless efforts of B.L. Ahuja, Lakshman Singh, R.C. Garg, Dr. K.L. Goyal, K.G. Gupta, Chiman Lal, Ashok Malaviya, O.P. Sharma, M.L. Dora and D.L. Vohra. The archival Photo-research team of P.K. Shrivastava, G.L. Aggarwal, P.K. Ganguly and U.K. Chachra researched, collected and selected photographs from thousands, tracing the milestones of the last fifty years.

The effort was smoothly coordinated by Maj. Vinod Krishna and his team, A.K. Srinivasan, V. Banerjee, S. Jandial and Rahul Verma,. The contribution towards data mining by Narayani Mahil, A. Ravi, J.M.S. Rawat, A.P. Singh, Partha P. Mitra and A. Kumaria deserves a mention.

The discipline-wise history was compiled by a group of writers – S.H.A. Jaffri, S.K. Goyal, S.N. Shukla, Gurucharan Singh, R.C. Garg, Chiman Lal, P.P. Gupta, Lakshman Singh, Sujit Sen, S.K. Singh and Shailendra Saxena. Their effort is gratefully acknowledged.

Teams of ONGCians were formed in every Basin and Asset. These groups prepared comprehensive Basin histories. All the Basin and Asset Managers and their teams deserve accolade for their contribution.

A questionnaire was sent to retired ONGCians and thousands of responses were received. Conclaves of retired officers were held. Photographs, write-ups and memorabilia were received. The attachments of the former ONGCians to the organisation, and their concern to ensure faithful reflection of the achievement and growth of the organisation are highly appreciated and acknowledged.

We are indebted to K.N. Bhave, S.C. RoyChoudhury, Dr. Hari Narain, Dr. S. Ramanathan, Amitava Mukherjea, T.S. Balakrishnan, A.K. Gupta, H.S. Cheema, D.N. Avasthi, K.S. Shankar, V. Kumar, Dr. V.S. Aithal and I.S. Kalsi for providing us write-ups based on their memories. Dr. S.N. Visvanath gave us the invaluable hand-written memoir of Padma Bhushan Late M.B.R. Rao. Chris Johnson, son of former Chairman Late L.J. Johnson, was kind enough to send us his father's memoirs. We express our sincere thanks to all of them.

In addition to the notes and memoirs, many ONGCians gave details of their times in personal interviews. We are thankful to V.C. Mohan, Dr. S.K. Biswas, A.T.R. Raju, G.C. Agarwal, A.K. Handoo, C.L. Dhar, Janamanchi Rao, Ishwari Dutt, R.K. Dhir, P.K. Kulkarni, Kuldeep Chandra, Ms. Ruby Kumar, Y.P. Mathur. Abha Bhattasali, A.M. Awasthi, S. Neyogi, Sant Kumar, S.S. Agarwal, Ajay

Saran, O.P. Sharma, W.M. Mahajan, C.P. Shah, R.M. Kochar, S.S. Paintal, K.M. Khalid, Harbans Lal, Krishna Veer, Mrs. P. Jain, K.R. Shenoy, R. Nath, N.C. Nanda, D.K. Trehan, O.P. Sharma, P.V. Krishnan, and many others.

Ms. Asha Malaviya Sheth, daughter of Late Shri K.D. Malaviya, gave us hours of interview, recounting the earlier days of growing up under her legendary father. She gave the history team timeless photographs and write-ups from her personal collection. We place on record our deep gratitude for this kind gesture.

Thanks are also due to Padmashri Sadashiv Gorakshakar, eminent Museologist and former Director, Prince of Wales Museum, Mumbai and his associates, D.S. Chauhan and Vrunda Pathare, who helped us in collecting thousands of invaluable documents from Malaviya Archives at Teen Murti and from Parliament Archives.

Special mention needs to be made of M. Rajagopala Rao, Head, ONGC Museum Project and Coordinator, ONGC History Project, and his team of S.K. Shrivastava, V.K. Gupta, Ashish Garg and others. They did a magnificient job of bringing synergy in such a intellectually varied, and geographically spread out effort.

We would like to express our gratitude to P.K. Chandra and Dr. S.N. Visvanath who took out valuable time to go through the manuscript and suggest vital course corrections. The efforts of M Rajagopala Rao and Gautam Sen in going through the manuscript thoroughly are appreciated.

Subir Raha, former C&MD, envisioned the project and guided it through challenging target with uncompromising demand for quality.

This Project could not have been carried out without active and direct support of Y.B. Sinha, former Director (Exploration), Nathu Lal, former Director (T&FS), A.K. Hazarika, Director (Onshore), U.N. Bose, Director (T&FS), D.K. Pande, Director (Exploration). R.S. Sharma, Director (Finance) and C&MD gave valuable suggestions, inputs and thoughtful insights at every stage. We gratefully acknowledge their support.

The scale of association and involvement is large and widespread. There may be some omissions in our acknowledgement. We offer unqualified recognition to those multitude who were associated with this noble venture.

At a personal level, the project has been a gratifying experience, particularly due to the participation and interaction of a wide section of people and the opportunity to know the company better. Let the book be a testimony of efforts and achievements of ONGC.

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

PROLOGUE

FIFTY STEPS TO A GIANT LEAP

Fifty years since its first, tentative step out of cradle, Oil & Natural Gas Corporation Ltd (ONGC) is a household name in India today, touching the lives of a billion people. In the world oil market, ONGC has stood up to the best in the business, stamping its unique mark of excellence and professionalism in countries across continents.

Aptly enough, the Corporation has chosen to celebrate its 50th year by notching up several creditable firsts:

- For the fiscal ending March 31, 2006, ONGC group recorded its highest ever revenue, exceeding Rs. 743 billion, 20% higher than that of the previous year, and it has a net worth of Rs. 564 billion.
- Profit after Tax (PAT) for the same period was Rs. 153 billion, the highest ever in the Indian corporate world. In fact, the net profit would have been higher by Rs. 72 billion but for the subsidy paid to government-owned refining and marketing companies as incremental discount on crude prices.
- This fiscal also saw the highest ever dividend at the rate of 450%, Rs. 64.17 billion, unheard of in the annals of Indian corporate history, thus sharing prosperity with the share holders.

Indeed, it's difficult to imagine now that it all began in 1955, when the Oil and Gas division, as ONGC was first called, was barely a speck on the industrial and economic horizon of India, a mere appendage of the Geological Survey of India. At its nucleus were just a couple of senior geoscientists and a handful of clerical staff.

But, progress was rapid. A few months later, the fledgling entity was converted into a directorate with a small office within the GSI premises at Kolkata (erstwhile Calcutta). In the winter of that historic year came the shift to Patiala House in Dehra Dun. Then, on Independence Day eve, 1956, the directorate was re-christened Oil & Natural Gas Commission. It was a humble beginning, by any standards, with no ceremony. It had 60 employees on the payroll.

Today, with 35,000 men and women, ONGC enjoys a formidable reputation in the global playing field, keeping pace with the frontrunners in the business in the race for oil equity. Led by some of the best brains in the corporate world, it is the proud recipient of numerous national and international awards.

So, how did this alchemy happen? How was this organization steered through these 50 golden years? This narrative will recapture the defining moments in ONGC's history. Each line bears the imprint of the heroic and painstaking efforts of a group of people, who epitomized the indomitable spirit of human endeavour, braving the harshest of environments, taking on the heaviest of odds.

The seeds of this giant were sowed in the vision of one man, Keshava Dev Malaviya, the man who laid the foundation of India's oil sector with unstinted support from its first Prime Minister Pandit Jawaharlal Nehru.

Malaviya was focused, resolute and determined in exhorting young men to find oil to meet the fledgling nation's energy needs. With battle-hardened stalwarts like A.M.N. Ghosh, M.B. Ramachandra Rao, L.P. Mathur, B.S. Negi, and 130 fresh post-graduates from varied disciplines, answering his call, the beginning was tentative at best. However, with the Russians and Rumanians lending a helping hand, they set out to "nose" for oil in the sedimentary basins of India spread over 3.14 million square kilometres across the country.

Their dreams, and the efforts of successive generations, have helped the company discover 181 fields, giving it 55% control over hydrocarbon-producing acreage. So far, it has produced 736 Million Metric Tonnes (MMT) of crude oil and 418 Billion Cubic Metres (BCM) of natural gas from 115 fields. It has discovered all the producing basins in India except Assam shelf with oil and gas finds in Cambay, Assam and Assam Arakan fold belt (A&AAFB), Mumbai (erstwhile Bombay) Offshore, Krishna-Godavari (K-G), Cauvery and Rajasthan.

Every day, ONGC produces one million barrels of oil and oil equivalent, 80% of India's domestic production, from its 225 production installations onshore and 131 well platforms offshore. It owns and operates more than 11,000 kilometres of pipelines in India, equal in length almost to the earth's mean diameter. Of this, 3,200 kilometres are sub-sea pipelines.

Annually, over 3.5 MMT of Value-Added Products (VAP) including C2/C3, Naptha, High Speed Diesel (HSD) and Superior Kerosene Oil (SKO) are produced from its Hazira and Uran processing complexes It is the largest producer of LPG in India; every sixth cylinder of domestic cooking gas comes from ONGC. With its unique Tatipaka refinery, and MRPL refinery, it has 1/10th of India's refining capacity. From a lone overseas property in 2001, it has spread its wings across 21 oil and gas projects in 13 countries across the globe and made investments of USD 3.5 billion, becoming the first Public Sector MNC. It ranks as one of the biggest Exploration and Production (E&P) companies with a market capitalization of more than USD 25 billion. In fact, ONGC's mega public offer of more than USD 2 billion was oversubscribed in 11 minutes.

ONGC has established 6 billion tonnes of in-place hydrocarbon reserves in the country and paid back to the nation USD 20 billion over 50 years. The people of India had reposed their faith with equity of Rs. 3.4 billion in ONGC spread over twenty two years, from 1959 to 1981. As it entered its fiftieth year in 2005, it had paid back a dividend of Rs. 144.59 billion to the nation, Rs. 2.9 billion to other share holders and Rs. 1428 billion in royalty, taxes, cess and duties to the central and state governments together.

To enhance its knowledge base, ONGC has established six premier research institutes and many regional training facilities all over the country. It uses one of the top 10 virtual-reality data interpretation facilities in the world. Next to India's defence establishment, ONGC has one of the biggest computing facilities in the country. With the rolling out of Information Consolidation for Efficiency (ICE) project, the corporation has one of the biggest ERP implementations in the world.

Yet, increasing population and rising aspirations steeply driving up India's energy requirements, ONGC's production is able to meet only 30% of the country's annual requirement now.

ONGC stands at the crossroads again. The world has changed. Our economic realities have changed. ONGC now has to draw upon all of its experience gained over the last five decades to provide energy security to the nation. There are a few concerns that the corporation has to address as it launches some of the biggest initiatives ever taken in the country.

In search of the untapped potential, ONGC has launched a massive deepwater exploration project, christened *Sagar Sammriddhi* (Prosperity from the ocean). The project is the biggest deepwater exploration campaign ever undertaken by a single operator anywhere in the world. It has gone in for massive investments to increase recovery from existing fields, establish newer reserves, acquire overseas properties, harness clean coal resources and set up newer businesses. ONGC has embarked upon intense soul-searching to identify the lacunae in every single step to produce the elusive incremental barrel under the Own Oil Recovery (OOR) initiative of Subir Raha, the former C&MD.

The President of India, Dr. A.P.J. Abdul Kalam, while inaugurating the ONGC Golden Jubilee Museum at Dehra Dun on August 14, 2005, gave a new vision: "I would suggest ONGC to give world leadership in management of energy sources, exploration of energy sources, diversification of energy sources, technology in Underground Coal Gasification, and above all, finding new ways of tapping energy, wherever it is, to meet the ever-growing demand of the country."

THE BIRTH PANGS

"The most important thing before us is to acquire an intimate knowledge of every link in the value chain of exploration and development of mineral oil. Such knowledge is absolutely essential since it would equip us to negotiate with multinational oil companies with confidence and self-assurance."

Malaviya made this statement 51 years ago, on March 30, 1955, in Parliament, responding to the concerns expressed on India's total dependence on foreign oil companies. That statement set in motion India's daring foray into the business of oil.

Three factors were to play a major role in the birth of ONGC in 1956, roughly 100 years after the first commercial discovery of oil at Titusville, Pennsylvania, USA:

- The geopolitical and oligopolist nature of oil.
- The neglected state of oil in pre-independent India and the exhorbitant price structure put in place by foreign oil companies.
- The internal challenge: an absence of awareness of the challenges ahead.

Soon after Col. Drake's discovery well, John D. Rockefeller had started the Standard Oil Company in 1870 to market predominantly kerosene. In the east, Royal Dutch Company started oil exploration in Indonesia in 1899; Anglo-Persian Oil Company, which later became British Petroleum (BP), discovered oil in Iran in 1908. Marcus Samuel started the Shell Transport and Trading Company to ship oil across the sea by tankers. Using innovation and entrepreneurship, the companies spread throughout the world to increase the usage of oil.

By the beginning of the twentieth century, Henry Ford and his model 'T' car had already given the world a taste of faster mobility. In 1903, man took to the skies when Wright brothers invented the aeroplane. As World War I raged across Europe, the reverberations were felt throughout the world. Oil had given the warring factions unimaginable speed and destructive weapons. Navies turned to oil for power and speed; tanks ran on oil.

The world was moving away from coal, the fuel of the Industrial Revolution in the 17th century, to oil. Science turned its attention to the fractionable nature of oil to churn out various products. The myriad utilities of these products made everyone want more of them. The near-total dependence on oil by affluent economies drove them to perpetuate to a newer version of colonization. A few companies, with government support, ruled the roost.

Rising supplies spurred warring factions, with Rockefeller in the lead, to undercut prices to gain contemporary markets. The major companies got together to protect against attrition, and formed the world's first oligopoly. They held a secret conclave in the English island of Achnacarry in 1928, and laid down the most intricate set of rules. From then on, till the arrival of OPEC in the 1960s, they would control every facet of oil - from exploration and production to distribution throughout the world. The seven companies, Standard Oil of New Jersey (later Exxon), Royal Dutch Shell, Anglo-Persian Oil Company (Later BP), Standard Oil of New York (Later Mobil), Texaco, Standard Oil California (later Chevron) and Gulf Oil were euphemistically called the 'Seven Sisters'.

Russia's oil resources were developed by the legendary Nobel and Rothschilds families; unable to manage the sheer magnitude of the operations, they had been forced to sell to Shell. But the Bolshevik revolution of 1917 saw Russia's doors close on all foreigners, creating a shortfall in world oil availability. However, to the Sisters' luck, the Middle East was showing signs of becoming a major source.

By 1945, as World War II raged, the multinational oil companies implanted their footprints in every oil-producing country, America, Russia, Mexico, Venezuela, Indonesia and the Middle East. They were all Anglo-American and Dutch companies backed by the respective governments who were desperate for energy security and prosperity.

The USA, the largest oil producer of the world at that time, supplied 70% of the Allies' war needs. Very soon, it would lose out to the giant oil fields of the Middle East.

By the end of World War II, Western nations had moved from kerosene to diesel and gasoline. The developed nations were riding on a wave of unprecedented growth fuelled by cheap oil.

At the same time, emerging technologies gave newer tools to explorers. The mid-30s had seen the advent of geophysics as a tool to locate hitherto unknown sources of oil by sending sound and electrical waves into the bowels of the earth. The war and the frenetic pace of technological advances placed the developed countries 100 years ahead of the about-to-be independent nations. They had the capital, labour and oil, available or secured with guile and force.

Thus, the first challenge before India's infant national oil company was to telescope 100 years of growth and technology into a few years and, sometimes, months.

Apart from the mention in the Vedic scriptures, the earliest references to oil in India are found in the memoirs and military dispatches of British army officers on survey expeditions in the Brahmaputra Valley's rain forests in Assam. The reports spoke of 'petroleum exuding from river banks, bubbling gas and thin seams of coal'. The principal names associated with these discoveries were Lt. R. Wilcox of the 46th Regiment Native Infantry (1826), Major A. White and Captain P.S. Hannay.

Joining them in traversing this difficult terrain were planters searching for suitable land for growing tea, and 'coal-searchers'. They also stumbled upon oil and gas seepages.

A scientific edge to these sightings was given by geologists of the Geological Survey of India. H.B Medlicott was instrumental in starting exploratory drilling in Upper Assam in 1865. Some oil and gas was found by the Assam Railways & Trading Company (A.R.&T.Co.) in the Makum-Namdang area in 1869. After a brief lull due to transportation difficulties, prospecting was resumed by the A.R.&T.Co. in 1883. The resumption led to the discovery of the Digboi field in 1890. That marked the beginning of modern petroleum era in India.

After drilling about a dozen wells, the Assam Oil Company (AOC) was formed to develop the field. Transportation by railways, roads and rivers steadily improved, and there was a surge in oil production. A small refinery was also set up. The boom, however, did not last long. Technical and financial mismanagement brought the company to the brink. In 1921, the Burmah Oil Company Ltd (BOC) took over the operations at Digboi. Their expertise helped raise Digboi production from 350 barrel per day (bpd) in 1921 to 4500 bpd in 1937.

The BOC also carried out exploratory drilling between 1922 and 1932 in 10 other structures but without any success. Geophysical surveys were carried out in 1937 jointly with British Petroleum and Burmah Shell in the alluvial tracts west of Digboi, and a broad seismic 'high' was identified at Nahorkatiya. But just as the surveys were nearing completion, World War II broke out and a moratorium was imposed on exploratory activities.

On the cessation of hostilities, a well was drilled on the Nahorkatiya seismic high and completed in 1953. This discovery influenced the outlook of oil prospecting in India. The fact that the discovery came after drilling 216 unproductive wells (excluding the wells drilled in the Digboi field and the 63 wells in the Badarpur field in Surma valley in Cachar area of Assam), reflected a tenacity and persistence unknown in the world of petroleum.

Standard Oil Company was a pioneer in generating the demand for kerosene throughout the world. Eventually, it landed in India, giving a taste of the fuel to the affluent section of the population.

In no time, kerosene had replaced vegetable oil in the street lamps in Mumbai. It was a volatile product and to ensure its safe handling, a Petroleum Bill was introduced by the British Government in 1881. Soon, for the first time, a Petroleum Act was put in place, regulating the import, storage and transportation of petroleum products.

In those days, there was no control on the prices of petroleum products, either by the government or by any other authority. During World War II and later, the oil companies maintained price pools for major products; they were in total control.

In 1948, there was a feeble attempt to regulate the prices, based on a very complicated Valued Stock Account (VSA) agreement between the Government of India and Burmah Shell. The President of Burmah Shell was the chairman of the pricing committee too and their control on oil pricing and its movement remained unchallenged till the entry of Malaviya.

Survey of India, established in the 18th century, carried out pioneering geoscientific work in India. Systematic exploration for minerals was initiated by the Geological Survey of India (GSI), set-up in 1851, with the major task of prospecting for coal. In fact, the men who would guide ONGC in its formative years joined GSI in the mid 1930s, and fanned out into the remotest corners of the country, mapping out prospects. After independence, the government had set up an oil panel to carry out preliminary geological surveys. The oil panel, during 1947 to 1955 carried out reconnaissance surveys in Gujarat, the Jwalamukhi area and some other areas.

India's first Industrial Policy resolution was announced in 1948. It showed both the determination, and helplessness, of the new policy-makers. Coal, steel and mineral oil were under government control. Foreign capital would be allowed in areas like mineral oil, where indigenous capacity was inadequate, but national interest and sovereignty were to be the foremost factors during negotiations.

This unavoidable dependence on foreign capital was a harsh reality after Independence. In a 'supposedly' altruistic posture, the prosperous nations of the West formed three entities in 1944, International Bank for Reconstruction and Development (IBRD), commonly known as the World Bank, International Monetary Fund (IMF) and General Agreement on Trade and Tariff (GATT) to bring order to the market place. They advocated a theory called 'Comparative Advantage' to keep newly independent nations from developing indigenous capability in industry.

The basic premise was innocuous. If one nation can produce rice more efficiently, and the other steel, there was no need for each to get into the other's core business. It was better economics to import or allow the other nation to set up a factory. It was a subtle way of 'Economic Imperialism'. Nehru didn't subscribe to that theory. He believed that this logic put a consumer nation at a disadvantage forever. He wanted India to be self-sufficient in every aspect.

In those turbulent times after Independence, the policy makers saw merit in setting up refineries with the help of three existing multinationals: BOC, Standard Vacuum (Stanvac) and Caltex. The British-controlled BOC owned the oilfields in

Assam, and the Digboi refinery. The other two were American companies having smaller stakes in the growing lubricants market.

It was at that time that Dr. Shanti Swarup Bhatnagar, Secretary in the Ministry of Natural Resources and Scientific Research (NR&SR) opted for the setting up of refineries with the Seven Sisters' help to guard against any supply disruption arising from rumblings in the Middle East. The government set up a negotiating committee to discuss the modalities with the Sisters.

But when the two sides sat across the table, it was an unequal match. The oil companies, with their collective guile, tried to extract a series of concessions. The most prominent was the commitment of non-nationalisation for 30 years. The second, import parity with Gulf of Mexico crude price, even though their oil fields were much closer in Indonesia and Iran. The other demands included exemption from income tax, exclusion from provisions of the Companies Act and even compensation for New York office expenses. The negotiations dragged on. Meanwhile, there was a devaluation of the Indian Rupee in 1949. Other state matters took precedence and the deal went into a limbo.

In 1951, Iran virtually burst into flames. Mohammad Mossadegh, its flamboyant Prime Minister, ordered the seizure of its oil fields from the Anglo Iranian Oil Company (AIOC), including the Abadan refinery. The Shah fled the country. The Anglo-American combine took this as a frontal assault and a massive naval blockade was imposed on Iran, which was slowly choked into submission. Mossadegh was ousted and the Shah returned triumphantly. Things were back to normal. Stung by Iran, the Sisters wanted to diversify their field of operations. Thus, negotiations were reopened with India in 1952.

In the meantime, a Planning Commission had been formed with Nehru as its chairman and Gulzarilal Nanda as vice-chairman. Its members soon saw the merit of having one's own refineries at any cost. Reluctantly, most of the demands made by the Sisters were agreed to. BOC wrested the biggest refinery to be set up in Mumbai. Stanvac was to set up a smaller one, again in Mumbai; Caltex got the smallest at Vishakhapatnam.

But, as facts tumbled out in the subsequent years, it became known that the companies had reneged on most promises. They ended up building larger refineries, with no Indian trainees to learn the technology and business processes. Besides, using their obfuscating pricing policy, the companies were selling petroleum products at prices higher than the prevailing prices even in Pakistan, Bangladesh and Sri Lanka.

On the exploration front, the same negotiating team, operating with the same handicap, conceded large tracts of the then promising Bengal basin to Stanvac.The government was to be a minor partner in the new Indo-Stanvac project. The exploration cost was to be offset against profits from the refinery operation of the same company. Having extracted the most suitable agreement for itself, Stanvac was later found to be dithering in its efforts.

Although these agreements were concluded by 1953, Nehru had his reservations about them, especially the land leasing and licensing part, which gave exclusive right to the companies for decades. Nevertheless, he went by consensus on the issues. Besides, the country's precarious foreign exchange situation deterred him from looking any farther. However, the intransigence of the multinationals was proving to be a bigger headache with every passing day. And all these factors weighed heavily on his mind as he called on Malaviya to enter the portals of the Ministry of NR & SR in 1952.

Expressing his determination, Malaviya enunciated his dream in Parliament: "Whether we like it or not, the agreements are there. But, there are ways and means to bypass unhappy things, if they are unhappy. It is precisely with that object that we have taken upon ourselves the responsibility of discovering more crude oil in this country".

Thus, Malaviya began his journey. But, it was easier said than done. He turned to Nehru, the visionary.

PART ONE

THE FALTERING STEPS

NEHRU - THE VISIONARY

With the end of World War II, the world had become polarized between two blocks: Pax Americana and Pax Russiana. With the help of science and technology, the war over natural resources continued long after the guns fell silent. Oil had become absolutely indispensable. The USA had already come out with a draft policy in 1947 called the National Security Act, in which energy topped the agenda. The policy of 'securing energy' sources would forever vitiate the world affairs.

Undaunted, Nehru set about the economic revival of the nation. India became one of the first countries to adopt science and technology as the cornerstone of planned industrialization. In the early years of the 20th century, a new element had been added to the classical economist's theory of land, labour and capital. That was technology.

India would also have to follow the new paradigm to regain her lost place in the world. Nehru was undoubtedly aware that long before colonization by the British, India was fabulously rich; its GDP was 1/4th of the world. But now America, a nation barely 200 years old and Western Europe had overtaken the rest of the world. The difference was technology, coal-driven till the beginning of the 20th century and oil-driven later.

In 1951, he began the most massive and ambitious planned development in the history of any third world country. The first priority was to combat the 'curse of poverty'. As days progressed, the importance of oil in the scheme of development started dawning.

But certain world events had raised an alarm in Nehru's mind. The creation of Israel in 1948 had thrown the Middle East, the world's largest source of oil, into turmoil. Added to this was the potential trouble in Iran. On the domestic front, the demand for oil was rising almost at 10%, one of the highest in the world. The demand arose mostly from the requirements of new industries and expansion of the rail network.

India's early refinery agreements didn't leave him happy, either. Nehru could foresee the monopoly exploitation of natural resources as a distressing outcome of economic imperialism.

In a letter dated February 21, 1954, Nehru explained his thinking to Malaviya: "I do not see how we can do away with foreign oil. But, certainly, it is desirable not to hand over the whole business to foreign prospectors."

Malaviya soon learnt that the prospective Jaisalmer area was about to be given away to Standard Vacuum. He requested Nehru to stop the deal. The Prime Minister stopped the process but said, "It is not clear to me how we, with our present resources, can carry out exploration effectively?"

But Malaviya went on to explode each and every myth about India's lack of oil and technology. A point came when Nehru started consulting him on every important oil issue. Nehru also taught Malaviya the tact of dealing with foreign countries, using his immaculate knowledge of world history.

At every turning point in the history of ONGC in the early years, Nehru would turn up and get Malaviya and his 'boys' whatever they needed.

There were soon murmurs in the corridors of power, instigated by powerful oil companies' lobbyists, about the Industrial Policy Resolution of 1956, which placed oil within the purview of the public sector. To quash any ambivalence, Nehru declared, "The policy is, I repeat, that oil is one of the major commodities in the public sector." That statement made Malaviya more resolute.

Nehru's policy was dictated by another show of disregard for international law by countries driven by lust for oil, the Suez Canal crisis. The Suez Canal, linking the Mediterranean and Red Sea, was the lifeline of the oil-driven economies of Western Europe. When the nationalist leader of Egypt, Nasser, decided to nationalise the waterway, the combined forces of Britain, France and Israel attacked the hapless nation. Russia came to Egypt's rescue, and even America condemned the imperialist forces. Soon, a truce was enforced by the two superpowers and Egypt gained control over the Suez. The incident sharply brought home to the whole world the importance of oil in world affairs.

Soon enough, the uncertainty on India's oil policy was settled on March 21, 1956, when Nehru wrote to Malaviya: "I hope you are satisfied with the position in regard to the exploration and exploitation of oil so far as the financial arrangements are concerned. I think they are adequate and you will certainly get more money as and when needed. I might tell you, however, that at a meeting of our Defence committee, the question of oil came up. It arose in a different context, but the point was the need of our Defence forces for oil in an emergency. In this connection, it was pointed out that the sooner we could increase our own supply of oil, the better for defence. For this reason, apart from others, it was made clear that we must go ahead as fast as we can with oil exploration and exploitation."

Thus, Malaviya began his lone pursuit.

MALAVIYA - THE INDOMITABLE FIGHTER

Malaviya made a quiet and unheralded entry into the world of oil in 1952, initially as a parliamentary secretary. For the next 29 years, until 1981, he would eat, sleep and dream just one thing: oil. By then, the face of the Indian oil industry had changed for ever.

Malaviya was the lone ranger who lived a dream and saw it fulfilled. The sobriquet, 'Father of the Indian Oil Industry' will always be his. His vision of self-sufficiency in oil was far ahead of his times; in the middle of the 20th century, he had thought of the 'road ahead' for the 21st century.

Malaviya was a nephew of the legendary Pandit Madan Mohan Malaviya, an ardent worshipper of science and technology. Pandit Malaviya had strived hard, in the face of strong opposition, to set up the Benaras Hindu University. The nephew, too, inherited the love for natural sciences.

Malaviya's daughter, Asha Sheth, remembers that her father was curious, free-spirited and always questioned some of the rituals that prevailed then, quite unusual for a boy from an orthodox Brahmin family. His father died at a relatively young age. Malaviya stayed with benevolent relatives in Moradabad, Allahabad, Kanpur and other places in Uttar Pradesh to complete his education.

The Chauri Chara massacre of hundreds of innocent people in 1922 was a turning point in his political life. For the first time, he came in contact with Nehru in jail. Once freed, he turned into a revolutionary. Between 1929 and 1942, he went to jail 11 times. In due course, Nehru persuaded him to join mainstream politics.

Malaviya shared Nehru's vision of a socialistic pattern of development. Self-reliance and economic emancipation were the guiding principles of his life.

Nehru made him a deputy minister in the Ministry of NR & SR, headed by Maulana Abdul Kalam Azad. I.P. Tiwari, a press information officer, remembers the tact with which Malaviya was inducted into the ministry: the official communiqué was worded in a diplomatic way so as not to ruffle Maulana's feathers.

Initially, Malaviya was given the Natural Resources division, sans oil and CSIR. Dr. Bhatnagar had kept both the portfolios to himself. A negotiating committee was formed with a group of secretaries headed by Cabinet Secretary, Sir N.R. Pillai to handle multinational oil companies. It had just concluded the three refinery agreements and the Indo-Stanvac oil exploration deal in West Bengal in 1953.

Dr. Bhatnagar wanted to adopt in India the model that was being followed by countries such as Brazil, Argentina and others, which permitted multinationals to prospect for oil.

The Stanvac Company raised the issue of exploitation of natural resources in areas bordering two countries. Stanvac had carried out the first aeromagnetic survey over the Indo-Gangetic delta in Bengal and adjoining East Pakistan in 1951-52. It now wanted the exploration licence for the Jaisalmer desert.

Dr. Bhatnagar, meanwhile, had gone on a whirlwind tour of the USA, Brazil and Argentina. Top geologists of Standard Oil Company had shown him the contour maps of areas in Pakistan and expressed confidence of its extension into Indian territory. Accordingly, in a letter to Nehru, Bhatnagar apprised him about the possibility of giving prospecting licence rights in Jaisalmer to Stanvac. The then chief minister of Rajasthan was only too eager to have oil in his state. He immediately set the licensing process in motion.

But Malaviya got a whiff of these developments. In a series of letters, he requested Nehru not to give away Jaisalmer. Nehru kept the Jaisalmer affair in abeyance. Malaviya requested Nehru to at least keep Jaisalmer for the national exploration endeavour as the other two prospective areas of Assam and Bengal had gone to the multinationals. Despite Nehru's worries over the lack of technical know-how and resources, Malaviya could substantiate his claims with ground realities. He had done his homework well.

But he had to move fast.

On August 13, 1954, Dr. Bhatnagar met the media with the good news of the foreign firms' willingness to explore for oil in India.

On August 18, 1954, Malaviya went on All India Radio (AIR) announcing the setting up of an oil prospecting division within GSI. During the broadcast, he enumerated the importance of oil and the need for a national agency.

He had achieved his objective. The national endeavour was now a public knowledge. Two days later, Malaviya wrote a letter to Maulana Azad stating his reasons: "I have been of the view that although drilling for oil is a complicated and costly process, yet it is not too big a task to be handled only by magnates and cartels like Stanvac and Burmah-Shell."

Exuding tremendous confidence, he concluded: "I wanted this matter to be brought to the forefront. This has been my experience everywhere that things are done by working under pressure. I may be wrong in my estimate but I am sure, if left to me, I will have the oil prospecting division and the drilling program within this year."

Sensing Nehru's silent assent, Maulana Azad and Dr. Bhatnagar had no other option but to give the go-ahead to Malaviya.

He faced two more obstacles: the Planning Commission and the Finance Ministry. Despite his support, Nehru wanted every activity to run in conformity with the planned objective.

The Planning Commission had its own doubts about the soundness of a national oil organization. The dominant thinking was about atomic energy and the possibility of solving all problems using that energy source.

Malaviya tried to reason it out: the prohibitive cost of atomic energy could never allow it to compete with oil. There could be thousands of by-products from oil that affect every aspect of modern economy. Oil had to be the 'engine' for the progress of the Indian industrial revolution. To face opposition, Malaviya had collected all available information on oil, its politics and its usages.

Malaviya prepared a proposed structure of the oil division and sent it to the Planning Commission. J.C. Ghosh, a member of the Commission, sent it back with a counter-proposal. He suggested the creation of a post of Director, Oil and Gas Exploration, to be based at Jodhpur in Rajasthan. He even identified some vacant palaces in Jodhpur for starting the office. But Malaviya would not have any of it.

Faced with intransigence on all fronts, Malaviya decided to open the proposed Oil and Gas Directorate immediately. As he went about getting expert opinions from people of eminence like Dr M.S. Krishnan and Dr D.N. Wadia, he was relentless in disseminating the 'truth' about the oil business. Public opinion would be his best weapon.

Malaviya went about exposing the fallacy of the three bogeys raised by multinationals:

- Lack of know-how: How did the multinationals learn the business, he asked. It is only by doing something with your own hands that you learn, he reasoned.
- Lack of technical personnel: He pointed out that the oil installations in the Nahorkatiya oil fields in Assam were being manned mostly by Indians.
- Lack of money: He reeled out foreign exchange outgo figures and also those indicating the future drain.

The most important reason for a national endeavour was to know the 'business' of oil, he said.

With Nehru's go-ahead, the Planning Commission and Finance Ministry eventually agreed to the creation of an oil prospecting division. Malaviya quietly faced the derision from certain quarter. Some promised to weigh him in gold if he got oil; others accused him of being 'doctrinaire'.

By then, his sincere and dedicated approach had earned him a lot of respect from Parliament members like Narayana Kutty Menon, Hem Baruah, D.C. Sharmah and others. They were incensed at the dilly-dallying on the oil front. Besides, Malaviya dazzled the House with his knowledge about the oil business.

Some other members rued the lack of effort on the mineral resources front.

In January 1955, Malaviya met geophysicist M.B.R. Rao in Kolkata and heard his assessment about the potential of prospective regions. Malaviya asked him to put together a 'Jaisalmer plan' within the next 15 days. When a somewhat surprised Rao asked about the money, Malaviya told him that the financial sanction would be coming and he should go ahead with the job.

Mid-1955, the petroleum division within GSI was upgraded to a Directorate. A.M.N. Ghosh, with the reputation as a competent geologist and administrator, headed the Directorate. L.P. Mathur, Gautam Kohli and others from the oil panel also joined the directorate. B.S. Negi, an old Rajasthan hand, was sent by M.B.R. Rao to organize a geophysical survey in Jaisalmer.

The proposed structure of the directorate envisaged:

- A finance man
- A mechanical engineer
- A senior geologist of GSI to look after the preparation of maps and other records, and the setting up of a small museum
- Support staff: public relations officer, statistician, legal advisor and civil engineer.

The equipment to be purchased included a gravimeter, a magnetometer and seismic instruments. The total cost involved was Rs. 40 to 50 million.

Malaviya had drawn up a roadmap, provided the money was made available immediately. While he wanted to hire foreign advisors at Rs. 6000 per month, the Finance Ministry wouldn't agree to any sum beyond Rs. 3000. Exasperated, Malaviya wrote to Nehru who advised him to get it sanctioned through the Cabinet Committee on Appointments. As the files kept going from desk to desk, Malaviya would rue the weeks of lost progress.

Finally, the secretarial staff was recruited by the end of 1955. A batch of eight drillers was employed and sent for training to the AOC oilfields in Digboi. The funds required for the directorate was met by the GSI, which drew the allotted budget of Rs. 10,689,000 from the Consolidated Fund of India. From that amount, the directorate spent Rs. 7, 980,000 in 1956-57.

Now, Malaviya started looking desperately for some expert help to carry out a detailed drilling program.

A policy decision of the Soviets held a clue to Malaviya's problems. In 1952, with the revival of the Soviet oil industry after World War II, the Soviet Union had decided to help newly independent countries establish national oil industries. In 1955, after Nehru's successful August visit to Russia, they invited an oil delegation from India. Led by Malaviya, the delegation left for Russia in September 1955.

The team was awe-struck by the organized Russian oil industry. Malaviya carefully noted down minute details like use of laboratories in search of oil, shallow water drilling in the Caspian Sea and modern factories producing all oil-related equipment. He was especially amazed at the enthusiasm of the oil workers.

Malaviya got a commitment from the Russians to send a high-powered delegation to India in December 1955. He also signed an agreement for the purchase of three oil rigs besides other equipment, for the coal mining industry. He persuaded the Russians to provide training to Indians, too.

Subsequently, Malaviya visited Rumania, where he persuaded Rajeswar Dayal, the Indian ambassador in Belgrade, to negotiate for a rig.

However, he was not prepared for the hostile reception at home. The media had gone on the offensive: he was described as a junior minister who had no authority to make commitments. A Delhi newspaper commented: "The sovereign authority in a democracy is the Parliament, but, in actual practice, decisions are taken by the Cabinet; the issue is whether Malaviya's announcements were within the framework of the decisions reached by the Cabinet; it is a fact that he signed an agreement in Moscow. The issue, therefore, is whether he was authorized by the Cabinet to do so."

Nehru broadly approved of Malaviya's approach but cautioned him against getting too tied with any particular country. He advised Malaviya to exercise restraint. Nehru reassured Malaviya about the high priority that he attached to oil exploration but he wanted him to take along his Cabinet colleagues. He also asked him to be careful about the media.

Even Nehru had not understood the method in Malaviya's so-called madness. The 'press thing' was done, as he confided to Nehru, to prepare the ground for some of the steps he had taken. That statement, he claimed, brought him quicker results from private oil companies than persuasive efforts.

On another front, he had started a campaign to change the mineral concession rules which conferred rights for 60 years. He would quietly pass on to Nehru tips from the Mexican oil market, where the Mexicans had nationalized the cartel.

If multinationals used the media to spread rumours and myths, Malaviya would pay them back in the same coin. He was not happy with the efforts of Stanvac. One day, Tiwari, the press information officer, got a strange request from Malaviya. He was asked to 'leak' to the Kolkata correspondent of a prominent English newspaper that the Indo-Stanvac agreement might be revised. It had the desired effect. Both AOC and Stanvac eventually agreed to train Malaviya's boys.

At one point, he would be poring over test results with scientists; at the other, he would be explaining his decisions in Parliament. Nurturing young talent was Malaviya's passion; he wouldn't mind talking to junior technicians if he wanted to learn about some new technique. Often, he was seen having tea with young apprentices to encourage them and learn about their field experience.

He was like a protective umbrella for oil workers. Once, audit officials objected to a field superintendent, Dr. B.G. Deshpande for exceeding the sanctioned amount to meet some emergency in the field. Malaviya said: "I had asked him to spend the money." That settled the matter.

Malaviya looked at oil in its totality. He knew that the simple carbon and hydrogen molecules could generate thousands of vital economic products. It could change lives and the fate of a nation. He was also aware of the 'finite' nature of oil. From 1956, he had done extensive studies on coal gasification, synthetic fuel, solar energy and wind power. His visions were not limited to dreaming. For each of his proposals, he would consult experts, read all available journals and lay out a detailed road map.

His ingenuity and entrepreneurship were exemplary. On one occasion, he even suggested to the Finance Minister to issue equity to public to raise money for oil exploration.

By the time he relinquished charge in 1963 he had set in motion the irreversible growth of the oil and gas sector. Within a year, his mentor, philosopher and inspiration, Nehru, died. But, he wouldn't give up.

He would write to all successive Prime Ministers reminding them not to waver from the path chalked out by Nehru and the socialist goals. In the early 70s, he headed a committee to look into the organisational loopholes in ONGC and the state of the Indian oil industry in general. His report stands as a classic study of the oil industry. As luck would have it, he was to take over the reins of the ministry just at the time oil was struck in Mumbai High. The record development, as N.B. Prasad, the chairman at that time admits, wouldn't have been possible without Malaviya's drive. His enthusiasm for oil never waned.

Indeed, Malaviya's vision, conceptualization skills, enthusiasm and tenacity remain firmly etched in the annals of oil industry in India.

ONGC's history tells the story of this extraordinary man and his three mantras: cautious optimism, controlled imagination and calculated risk. His two beloved lieutenants deeply shared his vision and infectious optimism.

THE EARLY STALWARTS

Those who formed the nucleus of ONGC were persons of integrity, high calibre and with rich experience in geology and geophysics. Except for a few, everyone came on deputation from the GSI.

What they lacked in petroleum experience, they made up with their enthusiasm and missionary zeal. In a very short time, they mastered the nitty-gritty of petroleum sciences.

Austin Manindra Nath Ghosh was the first among the equals. He epitomized the power of sheer determination. He was a Superintending Geologist at GSI and became the first Director of ONGC. He spent the last four years of his life giving shape to an organization which many had first dismissed as a pipedream. When Malaviya zeroed in on Ghosh to head the ONGC directorate, he would attribute his choice to his impeccable reputation in GSI. A trait they shared was reposing faith in local talent. Ghosh inspired a generation of young pioneers. He evoked fear, respect and loyalty. Ghosh was a field geologist *non-pareil.*

Born on June 14, 1902, Ghosh grew up in Kolkata, and graduated in geology from the Presidency College. He joined the ranks of field geologists in GSI in 1924. By 1928, he was on his way to the University of London to pursue higher studies where he earned a first class master's degree. His brilliance brought him an associateship of the Royal College of Sciences.

Having been chosen by Malaviya to lay a strong foundation for the nascent directorate, he put all his experience to work. Brought up in the British tradition, he would enforce discipline with an iron hand; he demanded perfection in everything and had a special liking for hard workers. In those early days, life was hectic. Ghosh would leave office very late at night, sometimes at 11. One night, as he was climbing down the stairs of Patiala House, he heard the clanking of a typewriter. He asked his personal secretary, J.J. Bhattasali, to find out. A young man was trying to meet a deadline. He asked the boy to wind up, and dropped him home.

Ghosh's moments of great triumph were the oil discoveries in Cambay and Ankleswar. But the effort took its toll. He suffered a heart attack on a train as he was on his way from Cambay to Dehra Dun; he never recovered. Ghosh died on January 2, 1961. He was only 59.

In a rare gesture, the Government of India issued a black-bordered notification after his death: *On his passing away, India has lost an able and trusted public* *servant who served his country with distinction in the geological field...the credit of achieving the results of the Oil and Natural Gas Commission's work in record time goes to him...he had the gift of organization and of quick and sound judgment. He will long be remembered for his meritorious service to the cause of oil geology of India.*

Though Mandagere Bhardwaj Ramachandra Rao had a geologist's background, during the course of a distinguished career he had acquired expertise in the science of geophysics. In a way, it was fortuitous that Rao was deputed for geophysical training to the USA, the UK and Canada in 1947-48. Thus, he became one of the few geoscientists with equal felicity in geology and geophysics.

Rao was born on August 5, 1906, at Mandagere village in Mandya district of, what is now, Karnataka. At the age of 20, he secured a bachelor's degree in science with geology as major. Rao's first job was with the Mysore Geological Department. He worked hard and learnt fast. In the midst of strenuous fieldwork, Rao managed time to pursue his studies and obtain an M.Sc degree in 1933 from Mysore University with a first class and a gold medal.

The story of how Rao got involved with geophysics is interesting. In 1937, the Kolar Gold Mining Industry secured the services of one A.B. Broghton Edge for investigating gold bearing quartz veins. Rao volunteered to work with his party. That association brought out in full measure the geophysicist in Rao. Soon, he was the architect of the geophysical section of the Mysore Geological Department. That was a few years before the Geological Survey of India was to set up its own geophysical wing. No wonder, M.B.R. Rao will always be known as the Father of Indian Geophysics.

On his return from the US in 1949, Rao was asked to head the newly formed geophysical wing at GSI. The unassuming scientist was only 43. Geophysical investigations for oil in Cambay and Cauvery basins in the pre-ONGC days were among his achievements at the GSI.

At 51, Rao was made the Director of geophysics in ONGC. His task was to provide dynamic leadership in the planning and execution of magnetic gravity, seismic and electrologging operations all over the country. When ONGC became a statutory body in 1959, Rao was elevated to the rank of Member (Technical and Administration).

In his long professional career, there have been many milestones. He was a father figure to the scores of young geoscientists. Rao's professional credentials were impeccable. He was large-hearted too. Simplicity and modesty were his credos.

He was a prolific writer on geophysical investigations; over 65 published papers bore testimony to his mastery over his pet subject. His much acclaimed book *Outlines of Geophysical Prospecting* published in 1975, long after he had laid down his tools as a practicing exploration geophysicist, demonstrated his abiding interest.

He was a man for all seasons, as much at home among members of geological and seismic field parties as he was in the company of Indian and foreign scientists.

Nehru too, began to like this scholarly geoscientist. Once, when the Prime Minister wanted someone to address Parliament on the fundamentals of oil exploration and to underline its importance in India's economic development and self-reliance, his choice fell on Rao. Nehru endearingly gave him the sobriquet 'oil man'.

For his meritorious and distinguished services to the country, M.B.R. was awarded the *Padma Bhushan* in 1972.

Kalinin performs a Caesarian

The eminent Russian geologist N.A. Kalinin landed in Delhi in December 1955, accompanied by drilling consultant, A.I. Tagiev and geologist, N.P. Tchounarev. Kalinin's reputation as an eminent geologist had preceded him. Kalinin had played a key role in the great revival of the Soviet oil industry after World War II. Short in stature, with calmness written all over his face, he would convince everyone that India had oil potential. In the six months of his stay in India, he gave 'oil pessimism' a death blow with his scientific and rational theories.

Before he arrived, he had made a thorough evaluation of India's oil potential through the theory of generation and entrapment. He was a hardcore optimist and wanted to start on a clean slate. He went through all available data including the report by W.B. Agcos on the airborne magnetic survey carried over alluvial tracts of Ganges valley and parts of Rajasthan by Canadian Aero Services under the Colombo plan. Later, he held discussions with some of the most astute geological minds, Dr. M.S. Krishnan, Dr. D.N. Wadia, A.M.N. Ghosh, M.B.R. Rao and others.

Then, his team hit the road with L.P. Mathur. Mathur, who had been trained as an oil geologist in AOC had a reputation for his instincts and expertise in geological contour mapping.

Travelling across the length and breadth of the country in trains, and even on horses and mules, he firmed up his ideas about the sedimentary basins of India. Kalinin returned convinced that India could produce her own oil. His assumption was based on geological sequencing. It was presumed by then, that a broad belt of potential oil and gas bearing areas stretched across the country from Iran and Pakistan to the Philippines and Japan.

After physical verification, Kalinin sat down to work. It was a monumental effort. There were many missing links that he overcame with his imagination. The Russian team, with the help of Indian understudies, prepared a geological map showing the sedimentary basins, their approximate size, and oil potential. He used concepts of mathematics, statistics, physics and chemistry to prepare a roadmap for oil exploration.

His assessment followed a logical reasoning: "India has got an approximate prospective area for the availability of oil and natural gas to the tune of 400,000 square miles (643,600 square kilometres). If the approximate method of estimating reserves is accepted on the basis of the availability of about 10,000 tonnes of hydrocarbons per square kilometre (in the USSR and USA, it is 23,000 and 26,000 tonnes respectively and in other countries, an average of 15,000 tonnes), we can expect recoverable reserves of oil amounting to four billion tonnes (considering geological reserves to be eight billion tonnes) and about two trillion cubic metres of gas in the above-mentioned prospective territories. If we take the annual recovery to be 5 percent, we find that there are prospects that India can produce annually 150 to 200 million tonnes of oil and one billion cubic metres of gas."

It was music to Malaviya's ears. Kalinin would also map the road ahead in minute detail: "At present, the world output amounts to 1.2 billion tonnes per year. Compared to the average world production of oil per capita, India should produce 150-200 million tonnes of oil per year. Such a target of production can be achieved in the future. The possibility of an addition of oil and gas bearing structures in the offshore areas should also be kept in view."

Statistical modelling followed next, enumerating the quantified amount of work to be done. It was proved that with certain variables, every metre drilled was capable of yielding 130 tonnes of oil. Hence, to discover one million tonnes of probable reserves, one needed to drill about 140 to 145 wells, with an average depth of 2750 metres. A minimum of 52 deep drilling rigs would be required. That was a tall order.

He gave the exact requirement of geologists and geophysicists for the mammoth work. Kalinin suggested providing four seismic crews per rig. That meant organising almost 200 seismic crews. Seismic survey was a necessity because of the nature of Indian sedimentary basins - most of it was covered by a thick alluvium deposited over time by perennial rivers. In the Gangetic plains, the thickness of sediments was in the range of 15,000 feet; in the Himalayan foothills, the thickness was almost 10,000 feet. They needed deciphering by seismic studies. A tall order indeed!

Kalinin's first suggestion was to elevate the Directorate to a Commission with enhanced powers. That move was a prerequisite, considering the magnitude of work. He drew up a five-year plan to coincide with the launching of the Second Five-Year Plan (1956-61). The plan had every detail, including a cost component for each year, gradual growth of manpower, equipment needed, and number of divisions to be created. It was an outstanding document.

If the road ahead was given, the way to move on it was also given. The budget was calculated to be Rs. 300 million, roughly, Rs. 60 million per annum. Kalinin was aware of Malaviya's running battle in the corridors of power. According to him, it was a modest amount.

But for Malaviya, that was the tallest order.

Meanwhile, Nehru met Kalinin thrice. "I thought I had convinced him," he told *Sovietland* magazine after the last meeting.

On April 19, 1956, at 10.30 a.m., the marathon meeting started. It was the acid test. The list of participants was the Who's Who in the corridors of power: members from the Planning Commission, Finance Ministry, top-ranking Russian embassy officials and members of the ONG Directorate. The stated objective was to know the Soviet oil experts' views about the organization and requirements for oil prospecting in India.

In a deft way, Malaviya conducted the meeting, trying to allay lingering doubts in certain quarters. The Planning Commission members wanted to know about the choice of locations selected by the Russian experts. About the Ganga valley, Kalinin pointed to the aero-magnetic survey results and the uncanny similarity to Second Baku (where oil was struck though no investigations had been carried out for a long time). He explained the need for massive scientific investigations in areas like Punjab, Jaisalmer, Ganga Valley, Cambay, West Bengal and the coastal areas.

Malaviya then asked Kalinin about his views on the organizational structure of the proposed Commission, and about the structure Russia had adopted. He quoted Dr. Krishnan who had advocated a compact organisation with full powers of appointment, purchasing and appropriation of funds.

Kalinin described the working of the Russian system. In Russia, the head of oil exploration had very wide powers. After the ministry sanctioned the annual budget, funds were allocated and targets fixed for the year. He had the liberty to make appointments for the year and spend whatever he liked on procurement of equipment within the allocated budget. The minister appointed the head of the organization, his deputies and the chief accounts officer. All other staff was recruited by the head of the Department of Oil. This procedure rendered the organization more efficient and productive.

Malaviya then prodded Kalinin on purchasing powers. Kalinin explained that the purchases were done by the head of the oil organization. Most important, Kalinin gave a guideline for recruitment of young graduates and training them in different fields of operation. He underlined the need for a five-year plan for the Indian oil effort, as compared to the annual program of Russia, to enable the nascent organization to get a comprehensive picture about the volume of work to be carried out.

Sensing a conciliatory mood among skeptics, Malaviya hammered in the proposed, rather 'decided' course of action. During the first year, nearly Rs. 55 million was needed for carrying out exploration in Jaisalmer, Cambay, UP and Punjab. Three rigs, already ordered from Russia, would be deployed in the

Himalayan foothills - exploration in the area would be close to the Siwaliks and would be conducted as quickly as possible. The head of the oil organization would be empowered to make the necessary purchases.

In every sense, Malaviya's wish-list was backed by the respected Russian specialist. In those five months, Kalinin and his team had a profound impact in the corridors of power. Nehru was very impressed with Kalinin's approach.

Kalinin added a masterstroke by saying that India, at that stage, was better equipped with technical talent than Russia had been when it started oil exploration. If a powerful organization could be set up from the beginning, India could advance much in a short while, he suggested. He had, thus, turned the tide in favour of Malaviya.

But Malaviya knew that the battle had just begun; at least, he was armed with a blueprint for his program. To bolster his claim, he invited Leverson, a renowned petroleum consultant from Oklahoma, USA, to give his views. Leverson didn't differ much with Kalinin's prognostication.

Kalinin was soon working overtime to organize the Commission and its work program. In a matter of months, some of the best minds in the Soviet oil business reached India to help build ONGC from scratch.

On a philosophical level, Kalinin's contribution can never be quantified. Every success story of ONGC has a little bit of the 'Kalinin factor' in it. His effect on the birth, growth and expansion of ONGC was enormous. He exerted a greater influence on the scientific line of thinking of that era. A whole generation of ONGC geoscientists was groomed by Kalinin and his team of dedicated Russians. He brought out the potential of the vast coastal areas of India. He was a man of conviction. But he would not ride roughshod over anyone. In some of the meetings to decide the locations of drill sites, he would convince everyone about his hunches based on solid ground realities. His association with ONGC continued for over a decade. ONGC and its stunning early success made Kalinin a celebrity throughout the world.

In 1956 Kalinin left for Moscow to arrange wherewithal for ONGC, his foster baby. When he left, ONGC was still on paper. He would come back to India every year. Sometime in 1965, somewhat poignantly he admitted: "Since 1955, I have visited India every year and here, a small portion of my labour has been put in; here, my friends and colleagues live and work with whom I share the joys and disappointments connected with confirmation or otherwise of forecasts, bitterness of irreconcilable differences and unity of action in selecting the ways for the building of a most important and new branch of industry."

The 'fighting it out' was left to Malaviya.

The Oil & Natural Gas Commission was established on August 14, 1956. The initial budget of Rs 300 million was rejected by the Finance Ministry. It reasoned that it was too risky to commit that kind of money for an enterprise, the results of which were in the realms of speculation. Malaviya had seen a ray of hope when mineral oil was about to be included in Category A of the new Industrial Policy 1956. But to his dismay, oil was not included in the core group of industries to be developed exclusively by state.

In a missive to C.D. Deshmukh, Finance Minister, he reproduced a letter of the Prime Minister to the Deputy Chairman of the Planning Commission, which stated: "I gather that the Russian engineers have drawn up a very detailed and thorough program for oil drilling in various places. If we accept this program, then naturally, we have to go through with it."

The Planning Commission was still skeptical about Malaviya's endeavour. It agreed to sanction Rs. 105 million for the oil ministry, which included outgo towards the government's 25% equity in the Indo-Stanvac project. It wouldn't agree to the complete proposal; it would watch the progress of work and provide finances as and when necessary. To avoid more controversies, Nehru advised Malaviya to go ahead with the program.

The functions of the Commission were:

- To advise the Central government on matters relating to exploration, exploitation, refining and marketing of mineral oil and natural gas reserves.
- Undertake geological and geophysical surveys, drilling and other prospecting operations for exploitation of mineral oil and natural gas.
- Prove and estimate workable reserves of oil and natural gas deposits when such deposits are discovered.
- Produce, process and store mineral oil.
- Administer and implement agreements with oil companies, inspect oil fields held by private concerns to ensure that there is no wastage and introduce improved methods of recovery.
- Set up and organize geological and chemical laboratories, geophysical and engineering workshops in connection with the exploration, production or refining of oil.
- Compile and analyse information in respect of production, trade and other related matters with the oil and natural gas.
- Publish journals and bulletins on matters relating to oil and gas.
- Undertake any other function entrusted to the Commission by the Government of India.

There was no doubt about Malaviya's vision for ONGC. It was supposed to be an integrated oil company in addition to being the oil sector regulator.

The Commission was delegated these powers:

- To sanction expenditure, not exceeding Rs. 500,000 for any one project.

- To enter into contract and purchase of equipment required for oil exploration, on government-to-government basis.
- To make local purchase of stores required on an emergency basis, i.e. delivery required within six months, subject to an annual limit of Rs 1 million.
- To sanction the creation of temporary posts in prescribed scale of pay, the minimum of which does not exceed Rs. 600 rupees (anything beyond Rs. 600 was to be sanctioned by the ministry, and in some cases, by the appointments committee of the Cabinet).
- To appoint experts (foreign or Indian) on contract, on ad hoc scales of pay, with the approval of the Ministry of NR & SR.
- To allow land acquisition or payment of compensation to be guided by the advice of the collector or deputy commissioner of a district.

On the whole, the concurrence of the Ministry of NR & SR was a prerequisite. Malaviya also became the first Chairman of ONGC in addition to being the Minister of NR & SR.

It was decided to have the Commission's headquarters in Dehra Dun.

DEHRA DUN AND PATIALA HOUSE

ONGC had a small beginning. Its offices were established in Patiala House, the summer palace of Rajmata Bakhtawar Kaur of Patiala, at Dehra Dun.

But why at Dehra Dun? That's a question that has baffled many over the past 50 years. Why did Prime Minister Nehru zero in on Dehra Dun as the headquarters of a new organization that had dreamt of becoming a great national oil company?

Nehru, even in the mid-1950s, had the vision to realize that Delhi was getting overcrowded and would soon burst at the seams if unregulated growth was not checked. He was thus against the setting up of any new offices of government departments or other organizations in Delhi.

Once Delhi was ruled out, Dehra Dun emerged as a favourite alternative. One, it was only 150 miles from Delhi. In the mid-50s, it was only a drive of four hours from Delhi. Two, Dehra Dun had good rail connections with the rest of the country.

Then there were several reputed institutes of international fame like Indian Military Academy (IMA), Forest Research Institute (FRI) and the Survey of India.

Dehra Dun also exuded a cosmopolitan façade and proudly carried its reputation of a green town.

Though all of these favourable attributes substantially strengthened the town's credentials to become the headquarters of ONGC, the most important factor was the town's proximity to the lower Himalayas where the initial exploratory efforts were to be concentrated. Thus, Dehra Dun was destined to become the Oil Capital of India.

The scene soon shifted from Chowringhee Road in Kolkata to Patiala House in Dehra Dun. Malaviya's pointsman M.B.R. Rao was sent to Dehra Dun to search for suitable premises for the headquarters of the Oil & Natural Gas Directorate. Finally Patiala House, a stately mansion, at 6 Young Road was selected and hired at a monthly rent of only Rs 2,500.

Patiala House as is generally believed, was not the summer palace of the Maharaja of Patiala. It was actually bought by Rajamata Bakhtawar Kaur, wife of His Highness Maharaja Bhupender Singh. The Rajmata later gifted the palatial Patiala House to her daughter Maharani Yadunandan Kumari.

Patiala House along with a 28-acre estate, was purchased by the President of India from Rani Yadunandan Kumari for Rs 6, 20,000.

A dozen-odd employees, recruited by GSI for the ONG Directorate, boarded the Dehra Dun Express at Howrah station one night towards the end of 1955. Destination Dehra Dun, a town that was just a name for these young recruits. Among them were B. Guha Roy, A.N. Sen, J. B. Choudhary, P.R. Aich and J.J. Bhattasali. Sen was in general administration and among other things, assisted in the purchase of Patiala House. Bhattasali, a selection grade stenographer, became private secretary to A.M.N. Ghosh.

Recruitment for Dehra Dun continued in Kolkata. Eight more staffers arrived on August 16, 1956, two days after the birth of ONGC. Among them was ONGC's first woman employee, Abha Ball, a head assistant. A couple of months earlier, three more Kolkata recruits, P.K. Ganguly (photographer) and two senior assistants, H.N. Mazumdar and N.K. Datta had arrived.

Miss Nagarkatti from Pune University, was the first woman geologist to join ONGC in 1958. She had insisted on being posted in the field or as a well-site geologist. But the establishment was afraid to post her in the field as the Mines Act forbade any women to work on the night shift.

Malaviya knew that raising an army of drillers, geo-scientists and engineers was not going to be a smooth affair. They would need hands-on training, equipment, laboratories, expert guidance and foreign training for exposure to latest technology. The process involved personal contacts, institutional help, foreign aid and international relations.

RAISING THE ARMY

Malaviya had the entire blueprint mapped in his mind. By the middle of May 1955, he had the nucleus of the ONG Directorate in place. Advertisements, calling for the largest ever recruitment of geologists and geophysicists, were published in newspapers and the selection process by the Union Public Service Commission had begun. One concern however, remained. In one of his diaries, Malaviya would lament: "How do I convince the UPSC that there are no oil well drillers in the country? They think that an ordinary plumber or a tube well drilling operator can be an oil well driller."

Drilling was as crucial to the oil industry as the steering wheel to an automobile. Malaviya realized that if there were no drillers, there would be no oil. *After all, oil is where you find it*, industry insiders say.

There were no formal training schools or colleges for drillers. They came from varied backgrounds.

He was also aware of the fact that a large majority of foreign workers in the British controlled Anglo-Iranian Oil Company in Iran in the 1930s were Indians. Malaviya planned to 'poach' some experienced Indian drillers from oil companies.

After some persuasion, Malaviya was able to obtain a no-objection certificate from the UPSC, permitting the ONG Directorate to recruit drillers directly. He asked the GSI stalwarts to let the word out that they were looking for oil well drillers with a good educational background and some practical experience. Soon, wannabe drillers responded. By the beginning of February 1956, they started trickling in.

K.C. Chandra, with a B.Sc. degree and some practical experience with the Indian Bureau of Mines, walked in to face the venerable Ghosh. The first question Ghosh asked was, "Can you do hard, physical labour?" Chandra nodded. He was appointed.

M.D. Nautiyal, V.K. Arora, S.K. Das, I.B. Roy, Digin Ray, R.S. Morton and Inderjit Singh Bhai followed. Nautiyal and Ray were from IIT Kharagpur and Arora from the Delhi College of Engineering. They all joined as drilling assistants and were promptly sent to Assam Oil Company for on-the-job training. The destinations were Nahorkatiya and Digboi oil field, among the oldest in the world.

The drillers were assigned different shifts: eight hours every day with no break. Night shifts always seemed the longest. They all had to start from scratch.

When the drillers came back after six months, they had been promoted as assistant drillers. On reaching Kolkata, towards the middle of 1956, they were asked to undergo a crash course in the Russian language. They were to go to Russia for training in drilling technology for two years.

Malaviya and Ghosh met them in the Parliament House annexe on the eve of their departure to Russia. Malaviya underscored the importance of their mission, and asked them to be good ambassadors. Ghosh asked them, in a fatherly manner, to learn well and take care not to fall ill.

Tagiev, ONGC's Russian drilling consultant, met them in Moscow, and detailed the training schedule. After a while, they travelled southwards to the oil capital of Baku. If Baku had impressed Malaviya, it was to overwhelm the rookie drillers in every way. For some, Baku was the experience of a lifetime.

As official state guests, the Indian drillers were extended all courtesy and hospitality. They got 40 Roubles per month as pocket money.

On the professional front, Professor Saftarkulif had a well-designed curriculum for them. They were taken to Neftekamin for practical training.This first batch of drillers would spread out to all corners of the country to successfully take over operations from Russian and Rumanian experts.

The drillers would require the exact drilling location to be pointed out to them by the geo-scientists who painstakingly acquire and study the data to select the most prospective location.

Not too many readers of mainstream English newspapers then would have noticed a single column advertisement published by the Union Public Service Commission (UPSC) on May 19, 1956. It was the kind of advertisement that UPSC routinely issued by the dozen, inviting applications for gazetted jobs in the Central Government.

52 apprentice geologists and 77 apprentice geophysicists were sought to be recruited. Those were not run-of-the mill jobs that would attract applicants in droves. For geologists, the minimum prescribed academic qualification was a second-class masters or an equivalent honours degree in geology. A diploma in geology and applied geology from the Indian School of Mines was also acceptable. For geophysicists, a second-class master's or equivalent honours degree in exploration geophysics, physics, radio physics, electronics or applied mathematics was stipulated.

At that time about 12 universities offered courses for masters' degree in geology: Aligarh, Chennai, Andhra, Osmania, Nagpur, Lucknow, Benaras, Kolkata (Presidency College), Mysore, Mumbai, Vadodara (erstwhile Baroda) and Sagar. But hardly any offered geophysics as a subject. Benaras University taught it as part of geology while Andhra University's meteorology course covered it.

There was another unusual feature. The UPSC did not disclose the name of the employer-to-be, leaving the 'hopefuls' in suspense. There was no ONGC at that time; only its nucleus had been set up.

In order to ensure that the advertisement evoked good response, the employer advised the UPSC to request select universities to recommend eligible candidates from among their students or alumni. It was perhaps for the first time that the UPSC had taken such an unusual step of directly soliciting applications from universities. It probably was the precursor of today's campus interview or recruitment.

Most of the eligible candidates were attracted only because it was a Class-I gazetted post.

Looking back at the sequence of events in 1956, it is clear that recruitment for these posts was given a top priority. UPSC accelerated an otherwise lengthy process and completed the given task in record time. It had advertised on May 19, 1956, with June 9, 1956, as the last date for receipt of applications. The interviews conducted at its office on Shahjahan Road, New Delhi, were over by the end of July, 1956.

Offers of appointment were signed by A.M.N. Ghosh, then Director of Oil & Natural Gas Directorate. The recruits were to be absorbed as Class-I officers, subject to passing an examination after classroom and field training. The pay scale was very confusing for the young boys of those days: Rs 350-350-380-380-30-650 E.B. 40-850. It was as big a mystery as the job itself.

Yet, most of the 130-odd young men, with first class Master's degree in geology, physics, geophysics and mathematics were in their training classes in Kolkata within a week of ONGC's birth. That was the end-result of a systematic strategy, conceived and initiated by Malaviya himself. Thus began the exciting odyssey of those young pioneers. The time had come to go back to the classroom.

August 25, 1956. The 129 young men, gathered in the hallowed precincts of Kolkata's Scottish Church College were an excited lot. In the large British era classroom, the noise of the antique ceiling fans was the only distraction. Ghosh chatted with a couple of dignitaries. They were all waiting for the minister, also their Chairman. It was the first time that the young apprentices were meeting Malaviya. It was a big occasion.

Malaviya arrived and the proceedings began. Ghosh gave them a graphic picture of the oil exploration scenario. He gave figures that showed the amount of huge foreign exchange that could be saved if India found her own oil. R.K. Ramdhyani, Secretary, Ministry of NR & SR, cautioned the trainees to take the program seriously and exhorted them not to take the opportunity as a 'jumping ground' for higher posts.

Malaviya took over. Varied tones, from serious to soothing and cautionary marked his speech that stressed the importance of the classes.

In a sombre tone, he said: "This program of oil is entirely new to us, not only to the government, but to the nation. There are some geophysicists amongst you and there are geologists also. These two groups know what oil exploration is about. But the larger number of young apprentices who are gathered here and who have done their studies in mathematics and physics perhaps do not yet realise what they are up against. I hope they will very soon realise what they have to do."

He told the young geoscientists-to-be, "I want to tell you that the government has every intention to be serious in its effort and, if necessary, to be merciless in its outlook. Those who will not be found fit to execute the work that is expected of them will surely not be included in this army of workers merely for the sake of giving employment to them."

He exhorted them not to have a text-book attitude and gave them examples of big oil finds by field personnel. Calling on the gathering to find oil through relentless efforts,,Malaviya formally declared the school open. They were imbued with the new doctrine of service in an important national cause.

The next stop was the Mecca of learning: Presidency College. Classes started in the Baker laboratories. Initially, there were common classes for both the groups; they were taught petroleum geology and exploration geophysics. The timings were unusual: from 9 to 11 in the morning, and 5 to 7 in the evening. They were given homework for the night, too. Most of the faculty members were professionals from outside who did their own work during the day and took classes before and after their work stint. They felt delighted at making their modest contribution to a national cause after duty hours. As K.N. Bhave recalls, "We had the entire afternoon free so many of us watched English movies at Metro and Light House theatres at concessional matinee show rates."

Some others visited the premises of two national heritage institutions, The Asiatic Society with a Geological Museum and the Indian Museum.

In September 1956, separate classes began for geologists and geophysics.

The geologists were exposed to some of the best minds of those days: Ghosh, Dr. A.K. Dey, A.B. Dasgupta and Dr. A. Kauffmann. Dr. D.K. Chandra gave lectures on field practices. The head of the geology of Presidency College, Prof. Santosh Roy talked to them about the latest nuances in the world of geology. Malaviya had arranged for experts from some of the finest institutions in India. Professor D.K. Chakraborty came down from the BHU to deliver lectures. S.P. Nautiyal from the GSI was also a regular face in the classroom.

The first theoretical lecture to the geophysicists was by Dr. A. Kauffman from Stanvac. He began with discourses on The Tectonics of the Eastern Hemisphere and The Tectonics of the Western Hemisphere. M.B.R. Rao, the father of petroleum geophysics in India, gave them rare insights into the subject. Dr. Hari Narain lectured on gravity-magnetic surveys; S.N. Sengupta taught them the theory behind seismic survey; Dr. G Ramaswamy from Stanvac who later joined ONGC as a Member, taught them the importance of aero-magnetic survey.

In their off-time, some of the trainees expressed their apprehensions. Everyone talked of one thing: the uncertainties regarding the oil find. Some worried about their future in case of failure to find oil. Some even consulted the railway timetable to catch the next train back home. A few did leave. But the majority hung on. They chose to live another day, eventually years and then decades.

Four months of classroom training were over in a flash. The geophysicists headed for Pandua, near Kolkata for field training.

The geologists came to Dehra Dun for the field training. They initially had a tough time getting accommodation in Dehra Dun. It was a small town and the sudden influx was a surprise for the inhabitants.

At the field camp, they were taught the use of two key instruments: clino-compass to mark location and theodolite to measure different heights. Sharp chisels and hammers were used to scrape and collect the rock samples. Another vital lesson taught was that contour mapping was not a simple matter of drawing lines. The studying of the general contours of an area of interest was like a hurdle race, jumping over water and other barriers.

Gradually, the instructor, S.N. Talukdar, raised the toughness bar. The trainees were made to traverse up and down the old winding goat-track to Mussoorie. As the oxygen level came down at those heights, it was a struggle balancing the body and the instruments.

Initially, the evenings were enjoyable. As the physical exertions increased, sound sleep at the end of the day became a dream.

By middle of January 1957, the camp shifted to Mohand Pass, in close proximity to the dense forests, now the famed Rajaji National Park.

T. Banerjee took over the mantle of field instructor. One night, the cook threw the waste pieces of meat outside the tent. Soon, he heard crunching sounds and came out to find a leopard gorging on the leftover. He was terrified; the fear had a cascading effect. Some of the young geologists remember everyone going through Jim Corbett's book, listing out ways to sense and ward off tigers. They learnt to sense the direction of wind and look for the paths to follow, hone their sense of hearing and look for pugmarks. Thus, the aliens in the jungle learnt to co-exist with the natural inhabitants. Their course schedule also took them to the hills of Mansa Devi in Haridwar.

It was a memorable and demanding assignment. More so, because that was the last simulated training of its kind they would ever undergo. They knew the road ahead was insecure, and the terrain would be some of the most daunting in India, nevertheless they felt imbued with confidence and reassurance.

One day, the camp had a surprise visitor - their Chairman-cum-Minister Malaviya. He never lost any opportunity to interact with the 'boys'. It was the middle of December and the freezing cold had taken the campers unawares. They gathered round Malaviya as he reviewed their work. He wanted to know about their difficulties. There were none. Someone mentioned in passing thebitterly cold, uncomfortable nights. Promptly, Malaviya advised them to arrange for straw. That was the only solution, he opined. Thus, beds of straw, of paper, stuffed shirts and socks became a routine feature.

In January 1957, Dr. A.K. Dey came to assess their performance. He announced that they had to appear for an examination to be conducted by the UPSC. The test was the final hurdle before they could become Class One gazetted officers. The boys lamented the lack of preparation time. Dey assured the anxious group about the nature of the test, and asked them to fall back on the storehouse of knowledge that they had assimilated in the classroom and the field. The examination was to be held after a month.

With the geologists in Dehra Dun, the geophysicists knew that they were in for a longer haul in Kolkata. Their field training was with the Indo-Stanvac field party. Stanvac had agreed to provide the field accommodation and basic instruments for geophysical studies but there were to be no meals. Thus, the first community kitchen came up in the plains of Bengal.

Dr. Jagdeo Singh was camp-in-charge. A brilliant teacher from Benaras Hindu University with valuable practical experience, he taught them gravity and magnetic field work. With the Worden Gravimeter and magnetometer, borrowed from GSI, he taught them the intricacies of traversing pre-determined routes. For the first time, they saw what they had read in books. Dr. Hari Narain and S.N. Sengupta would add to the knowledge base with their frequent visits and helpful tips.

They were about to be introduced to the most revolutionary technological innovation of the oil industry since its inception. Worldwide, seismic reflection technology was opening up giant oil fields. The burly and imposing American instructor Jackson from Geophysical Services International, had prepared a very thorough training schedule for them. He needed explosives and detonators. As per the training agreement, ONGC was to supply the explosives. But no one in that motley group had ever dealt with them before.

A.M. Awasthi, another veteran of AOC, was sent to handle the explosives, as ONGC personnel were yet to obtain licence to do that. Awasthi proceeded to Gomia in south Bihar where officials of Indian Explosives Limited supplied him with gelatine sticks and detonators.

In the meantime, Jackson divided the boys into pairs. Under the hot sun, the teams were told about a contest. They had to do actual drilling. A T-shaped drill with a long horizontal handle and a small bit was shown to them. A couple of labourers showed them how to go about in rounds; simultaneously, the pair put their full body weight to push the rod down. They had to go down 30 to 40 feet like that, using sheer physical strength. After the demonstration, the boys were given hands-on training. The back-breaking work took the wind out of their lungs. But they did have a competition, which the pair of Moolchand and Krishan Kumar won. The young men liked the charged-up atmosphere, the rush of blood and adrenaline and, of course, hurrahs from bystanders. Was the whole oil business some kind of a Russian circus, some wondered.

Once explosives were received, the crucial task of placing the sticks of gelatine in the hand-bored wells was demonstrated. Then they learnt the intricacies of wiring and final detonation to record the seismic traces on a camera. The last step was the plotting and interpretation.

After checking the readings, the papers were sent to Kolkata. The boys-in-waiting utilised the period to learn interpretation from the seniors. After two months, the wiser but tired field group returned to Kolkata and the other group joined Jackson's school.

There was some compensation in field jobs. Once in a while, a pick-up truck drove about 30 or 35 of the boys to the nearby French colonial town of Chandannagar (it had not by then become part of India). They watched movies and ate fancy meals, a delicious change from the insipid camp food.

For both the groups, Dr. A.K. Dey was the guiding spirit who influenced them deeply. His calm and serene demeanour reassured the boys in every way. When he found jute rope-woven cots in Pandua camp resting on bricks, he physically demonstrated to the boys the ideal way to rest their bodies on the cots.

Samarendra Nath Talukdar was a subaltern in those early days of 1957. He had already meticulously planned the field training of the apprentice geologists. One day, before the arrival of the apprentices, A.M.N. Ghosh gave him one more task. He was told to organize the geological laboratories. For a 27 year old, those responsibilities, Talukdar now recalls, were challenging. With only a handful of staffers, he went about the job of setting up the organizational structure. First, he needed to find suitable premises, large enough to accommodate the laboratories. He zeroed in on the Naaz building complex, behind the landmark Kwality restaurant. It took some more time to acquire the elementary necessities like laboratory counters, tables, chairs, few microscopes and other sundry items.

The stalwarts went scouting for suitable talent in that batch of 'apprentice' geoscientists; Malaviya, Ghosh and others used all their persuasive skills to lure talent from universities and multinationals. They were looking for people with aptitude in applied research in basic life sciences like botany, zoology and chemistry. All those who subsequently joined had some inkling of the subjects. But none had an idea of the role of those sciences in oil exploration. They were to work in three laboratories: chemistry, palynology and paleontology. Chemistry was fine but the other two tongue-twisters were too new to be in the 1955 dictionary. In fact, the term 'palynology' had become part of the geoscientific lexicon only in 1943.

Rivers, foliage, animals, weather and temperature, everything leaves a trace as time goes by. The palynologist looks at the pollens and spores found in the rocks to reconstruct the geological conditions millions of years ago when the rocks were deposited. The paleontologist looks at the fossils, remains of animals embedded in the rocks. All these inputs are correlated with the findings of the geological, geophysical and logging data.

The knowledge base is a win-win tool. If one discovers a big oil find, these facts help determine the extent of the field. If one doesn't, these very facts help to look further and far beyond, millions of years down the ages. Thus, they were to look at the footprints of Earth's history.

A.K. Ghosh was brought in from the Bose Research Institute of Kolkata to head the Palynology Laboratory. He had already earned the sobriquet 'Cambrian Ghosh' owing to his pioneering work with the Cambrian (550 million years ago on the Geologic Time Scale) rocks of the Vindhyan mountains. Next to follow was Dr. C.P. Verma from the Birbal Sahni Institute of Lucknow.

The chemists were on their own. When M.M. Dey joined as a field chemist in Jwalamukhi, he was in the twilight of his career. He had a wealth of experience in the oilfields of Burma, Pakistan and Assam. On one occasion, Tagiev, the Russian drilling consultant, blamed the mud system for some of the problems in the first well at Jwalamukhi. Dey, feeling slighted, brandished his experience in three different countries, as opposed to the Russian's experience in just one country. Tagiev was somewhat chastened and later spoke highly of Dey. Such was the confidence of some of the chemists those days. They carried the same confidence into the corridors of the chemistry laboratory. And Dey would keep the lab crowd spellbound with his exploits in the 1940s.

In the absence of a centrifuge, the chemists would fix the test tube with mud to a fan. Sometimes, the tube broke and the ceiling and walls bore the brunt of the scattering mud. Dr. P.R. Sinha became a source of inspiration for generations of chemists. S.N. Bhattacharya, Dr. M.K. Indra and others gave that vital push into understanding the intricacies of drilling mud.

All of them, with basic scientific knowledge, awaited the arrival of the Soviet expert, Dr. Natalay Dmitrievna Mtchedlishvili from VINGRI (Oil Institute) of Leningrad. She came with five others, leaving behind her family in Leningrad for a year, to teach the basics to these neo-scientists. In the absence of computers in the early days, her hand-prepared atlases of pollens and spores would prove to be invaluable.

Nina Nikolaevna Subbotina and Paula Severyanovna Lubimova took charge of the micro-palaeontology laboratory. Prof. V.B. Tatarsky and Victor K. Vassilenko took over the reins of the sedimentary petrology division. They introduced an unconventional culture in laboratory work - there were no fixed working hours. If there was a job at hand it had to be done without looking at the clock. The Russians were a hard-working lot and their attitude had a cascading effect on everyone.

The geophysical laboratories were set up in the rented Santiniketan building. M.A. Ganapathy with his GSI background, was put in charge. He was given the unenviable task of organizing the logistics for the field parties, equipment and repairs. Krishan Kumar, Thirumalai and Joseph Koithare from the 1956 batch, were asked to join the labs. The laboratories housed the machine shop, the seismic and electro-logging section. A vehicle repair shop, surprisingly, was also added. Ganapathy and his team spent days and nights poring over electronics books, manuals and any available source material to understand the specifications of a variety of equipment and instruments. Everything had to be organized from scratch: explosives, detonators, miles of electrical wires, geophones, vehicles, repair kits and vital instruments.

The logistics of dispatching the equipment to far-flung areas of the country was another ponderous job. In the off-season from August to October, all the instruments would be brought to Dehra Dun for routine maintenance and repairs. As luck would have it, the Commission could get some of the most gifted mechanics to join its ranks. Usman Khan, a strapping Pathan from Afghanistan, could repair anything mechanical. Another person who joined would ultimately leave his footprint in every oil province. He was G.D. Sharma. Whether it was a simple vehicle or machine repair or book binding or shot hole rig or electronics repair, G.D. could 'fix' anything and everything.

A library section came up in Naaz building. Every week, Ghosh checked the new arrivals and asked photographer P.K. Ganguly, to get important chapters cyclostyled. Later, they were distributed among the scientific community. The books reflected the immediate need of the hour. Some of the earliest collections included titles like *Sheet Metal Shop Practice, Fundamentals of Carpentry, Electronics, Physical Chemistry of the Hydrocarbons, The Science of Petroleum, Slide Rule, Radio Circuits, This Fascinating Oil Business* and many others.

A newsletter started appearing on the shelves. The ONGC newsletter would be a one-stop window for all ongoing activities. Employees were encouraged to write articles in their respective areas of specialization.

The unique crash course in field geology and geophysics had given some idea of the life ahead. The apprentice batch had to cross another barrier, a written test to qualify as officers of the Commission.

The training concluded around the end of January 1957. Their jobs were still not confirmed. Dr. Dey's promised examination date, in February, was fast approaching. It was time to hit the books.

The Naaz building was made the centre for the UPSC examination. There were two written papers, each of 3-hour duration, held in morning and afternoon sessions.

Soon, the geophysicists left the confines of the old city for the salubrious climes of Dehra Dun. It was to be a short stay before they dispersed to the far flung areas for the first field season. However, 15 of the apprentices were held back in Kolkata. They were to be sent to Assam for seismic surveys under the overall leadership of S.N. Sengupta. Thus, this group of 15 cut its 'seismic' teeth under a brilliant leader.

Life in Dehra Dun further livened up when, four months later, the 50-strong batch of geophysicists arrived after completing their stint of training at Pandua.

Foreign experts and other doubting Thomases had forecast the 'impossibility' of the training scheme. They had estimated a minimum five years to groom a geoscientist. Here, in a matter of eight months, they were ready to go to all four corners of the country. This time, they would be specifically looking for oil.

The equation given by the famed American geologist, Leverson to oilfield geoscientists became their new *mantra*: S=I+J+L (Success = Imagination + Judgement + Luck). Rudimentary theoretical knowledge and improvised practical training had given them a sense of direction. The 'boys', stood on the threshold of manhood, ready to use their imagination and judgment to venture into the wilderness. They, however, had no control over the luck part.

But then, someone reminded them of the adage "Luck favours the brave".

SEARCH IN THE WILDERNESS

It was time to grapple with the harsh ground reality. The area to be explored was vast and inhospitable. That was where the real test of both knowledge and character lay. The intensive classroom lessons and rigorous field training had given the young pioneers rudimentary knowledge of techniques of exploration. A few among them developed cold feet and quit; some others left for greener pastures. But the vast majority hung on. And, it is those the country salutes.

In the middle of 1957, the army of young explorers began their preparations. Things had to be planned to the last detail: type of tents, furniture, variety of equipment, personal belongings, contingent money et al.

They were formed into groups of 4-5 under a party chief. There were 15 geological parties, nine gravity-cum-magnetic parties and six seismic parties. That was the modest beginning of search for oil which gradually, in the later years, grew into a massive exploration expedition.

Initially, L.P. Mathur, B.G. Deshpande and M.C. Poddar were to be their field supervisors. Mathur was the geologist-in-charge of Punjab and Uttar Pradesh. Deshpande looked after Cambay and Rajasthan. Poddar was to look after Kutch, Himachal Pradesh and Jammu and Kashmir.

The geological field parties normally comprised four to five apprentice geologists. Experienced senior geologists, Dr. D.K. Chandra, C.K.R. Sastry, A.C. Rangachari, R.S. Mittal, S. Aditya, D. Venkataraman, S.V. Deshikacher, S.N. Talukdar and T. Banerjee acted as party chiefs. They had to carry the basic necessities: topo-sheets, compass, small pickaxe and canvas bags to collect samples, tents and a Geiger Muller counter to look for any atomic minerals. A couple of jeeps provided the transportation.

A.P. Ghosh supervised the gravity-magnetic parties in Bombay region (3) and Rajasthan (1). S.K. Verma looked after the UP (2) and Punjab (2) parties. Additionally, three surveyors, three or four drivers, two *khalasis* and one clerk joined the parties as they left. Their wherewithal also included topo-sheets, survey equipment for plane tabling and levelling, gravimetre and magnetometre, four or five jeeps, tents and camp equipment.

In the geophysics directorate, B.S. Negi was in charge of seismic and electro-logging. Dr. Hari Narain headed the gravity-cum-magnetic parties. He looked after the statistical section as well. The six seismic parties were led by a handful of experienced geophysicists: S.N. Sengupta, A.N. Dutta, T.S. Balakrishnan and

A.M. Awasthi, who spread out in Uttar Pradesh (2 parties), Punjab (2), Rajasthan (1) and Assam (1). The seismic parties were the biggest: three surveyors, three shot-hole drillers, two explosive specialists, two auto mechanics, four class-IV staff, a store keeper and three ministerial staff. There were about 15 drivers. They would be hiring another 50 local labourers, engaged on daily wages. In total, the party chief had to manage 100-odd persons.

There was an additional worry for party chiefs. They had to account for every nail and peg, bucket and mug...almost everything. If something got lost, they had to pay for it from their pockets.

The instructions were clear. They had to reach their assigned posts, find out the nearest railhead, liaise with neighbourhood rail and postal authorities, earn the confidence of the local population, make arrangements to hire help for fieldwork, organize and plan out logistics. If necessary, they were to seek help from government officials or army authorities. Each group had set targets. Funds would reach them by money order, they were told. They were to be out for seven to eight months at a stretch. They were to contact Dehra Dun by telegram. Distress calls and leave were discouraged. It was an army on the move, without any arms and ammunition. Faith and goodwill were their only weapons.

The geologist had to map the areas of promise by trudging over miles. The surface outcrops, folds and faults had to be studied in conjunction with local geography, logistics, environment and general information on the area, vegetation growth and age of the rocks. He was armed with local topography sheets, compass, hammer and a variety of other tools to examine the area, imagine the movement of rocks and look for a trap for oil and gas to accumulate. Imagination was the key.

The geophysicist had to study the gravity and magnetic differences over a large tract of land to know the subsurface behaviour of rocks. The seismologist had to create small earthquakes 10 to 50 metres inside the earth, and pick up the reflection of sound waves to know the composition of rocks and fluids, thousands of metres below the surface. Mathematical precision was the key. They were endowed with a positive belief that they would find oil. And that was what really mattered.

B.S. Negi was 'god' in the deserts of Jaisalmer. He had been working there from the early 50s as a GSI geophysicist. It had taken a lot of effort and charm to win over the villagers. The last railhead was at Pokhran, beyond which was harsh desert with ever-changing sand dunes. One had to go to the field camps, sometimes bordering Pakistan, in a four-wheeler called *Gattu*, a World War II army disposal workhorse. It was not unusual to stray into unmarked Pakistan territory. But the Pakistani rangers and Indian border guards took such 'incursions' in their stride. Slowly, the jeeps came. But they would get stuck in the sand dunes, some of which were 50 feet high. The tyres had to be deflated a little to ease the movement through sand.

Negi would also hire camels to facilitate movement. It was not just work. The villagers took the bunch of educated young men toiling in the heat and cold to be harbingers of prosperity.

Surja Ram, a simple villager from Ramgarh, started his 'career' with ONGC as a *khalasi* or a daily wage earner. He used to carry the flagged staff during survey work. One day, a villager, Kashi Singh, was bitten by a desert snake. Surja remembers Negi lending his camel to carry the man home and save his life. Tales like these would do the rounds across the desert.

Negi would eventually pass on the goodwill and expertise to the new generation of geoscientists. That was to be his *guru mantra*, this legacy.

A.M. Awasthi was the first one to inherit the legacy. Negi asked him to carry on from where he had left. In early 1957, Awasthi left for Jaisalmer desert with three geophysical assistants. He established the camp in Ramgarh. The experienced villagers joined the camp. Slowly, the trainees landed up in the camp.

Chaturbhuj Maharaj, who joined as a driver, recalls once cautioning A.M. Awasthi against pitching tents on higher ground. His native sense could smell danger. It was not heeded. When the sandstorm finally hit, it blew away everything. A hapless driver, Pratap Singh, was thrown high into the air. It was not uncommon for people and things to be hurled up 40 metres. Incidents like those helped the field parties develop a 'nose' for trouble, sandstorms, dacoits, scorpions and snakes.

They also learned the tricks of shot-hole drilling. For creating those simulated earthquakes, the geoscientists had to drill 50 to 100 feet holes and encase each with a protrusion on the surface. Water was scarce and tube wells the only source. It had to be carried in small trailer-mounted jeeps for drilling those holes: 10 to 15 drilled over an area covering a few square kilometres.

Their knowledge would also help in creating a bond of trust with the society. Ram Dhan Singh, a local driver, recalls the then Jaisalmer collector, Vinod Chandra Pande, visiting a field party led by Dr. K. Narayanan and asking for help in pinpointing a suitable tube well site for Dabla village. Narayanan helped and when water came gushing out, there was jubilation all around.

The field parties in Assam faced their own set of problems. It was one of the most promising areas. P.K. Chandra reminisces seeing a red cloth tied to a tree when doing field work in the jungles of Silchar. The locals were apprehensive. But the work continued. A group of insurgents from across the border confronted the party, rattled by the Sola hat and thick belts which resembled bullet pouches. Chandra calmly explained the purpose of their work and that defused the crisis.

Every morning, in some of the most desolate areas around the country, a pattern emerged. The party would be up before dawn; it would take long to the get the kitchen-fire burning and longer to get the jeeps started. Then, camels and mules had to be fed. As they got down to breakfast, "Tuck in as much as you can," became the common refrain. No one was sure when and if, lunch would be served. Field work would take the party miles away from base camp. As the sun went down, it was time to return. In places like Assam where the sun set sooner, they had to return much earlier. Some of the virgin forests with thick tree cover made even sunny days appear dreary.

Back in the relative safety of camps, there still remained a lot to do: take a wash in the open, write reports, discuss the next day's work over a cup of tea or an occasional drink and eat dinner under the open sky. Playing cards, volleyball and badminton were the only pastimes. Everyone was encouraged to make reading a habit. The reading material varied from Tolstoy to technical brochures. But bed-time chores had everyone alert. The tents had to be thoroughly checked. No one could afford to sleep with snakes and scorpions who loved the tents for their warmth.

As nights turned into days and days into months, the youngsters lost count of time. Each day brought in its wake newer problems and challenges. Throughout India, in all remote locations, the railhead and the post office became their only contact with the outside world. When equipment arrived at the railhead, the station became their home. These 'nomads' had the local postmaster as official contact address for any communication. Money orders were secondary; you do not need much money to survive in the wilds. Only a handful of field personnel were married at that time. They regularly wrote letters to their wives. The bachelors too, occasionally sent letters to their parents and siblings. Some even sent home sketches of the field life. It was their way of fighting the pangs of loneliness during the lengthy field season.

When some equipment failed to operate, drivers, cooks and flag carriers, the whole family of 20-odd people, got together to set it right. Necessity brought about improvisations. The seismic party faced a typical problem. Five to six explosive-laden holes and an equal numbers of recording stations were established at considerable distance from one another. Simultaneous firing of explosives and recordings posed a big problem due to lack of instant communication equipment. The BBC came to their rescue. The third beep of its five o'clock world news became the signal.

As time passed on, some of the field scientists got married and had children. The whole family would stay in makeshift camps. Without much money, except a Rs 20 increment in dearness allowance, life was tough. The families suffered during rains, floods and sandstorms. Medical facilities were non-existent. Children walked miles to reach a school and studied under kerosene lanterns. In low-lying areas of Assam, Tripura and Bengal, snakes, scorpions and leeches were the biggest worries. In Kutch, it was wolves and wild boars who were their companions in wilderness.

But as some veterans recall, field life was too exciting to think about the problems of life. After 50 years, many of them who are still alive thank the resilience and the sacrifices of their family members.

Everyone fondly remembered the indefatigable Russian geophysical advisor, Yarpolk who would go all over the tough terrain to guide field persons. They would return with urgent requirements. Logistics was a nightmare in those days. But no one complained.

Whether it was camels in the desert or mules in the hills or wild elephants in the jungles, adaptation to the local culture and respect for regional values helped the scientists map the entire country in a matter of years. The early young pioneers were the first to mount the oil search on a massive scale. Field work in those virgin areas made them feel like destiny-ordained pioneers. They also felt instinctively that the knowledge they generated would act as the beacon for all subsequent searches for oil in the country.

As monsoon clouds started appearing in the sky, the crew would start the process of dismantling the field set-up. Those were nostalgic times. The villagers would congregate to bid goodbye to the party. No one knew of his posting in the next field season. A large number of rock samples had to be tagged and transported to Dehra Dun for further testing. They never forgot to include their folding tables and chairs and scales in their personal belongings. There was a dearth of chairs and tables in Dehra Dun.

Back home in Dehra Dun and Mussoorie, there was no time to relax. The geophysical party would be busy making reports and drawing gravity and magnetic anomalies: these differences were a rough clue to the rocks underneath. The equipment had to be overhauled. Spare parts for most of the Russian equipment were hard to come by. Improvisation was the name of the game. An advance party had to leave for field destinations to repair the vehicles left behind and arrange logistics for the following season. The rates for hiring camels and mules kept changing every field season.

The geologists had a similar grinding schedule. They had an office in Mussoorie where they prepared reports, maps and charts of the geological field work.

In August 1958, Nehru paid a visit to Dehra Dun to boost the morale of the fledgling Commission. The employees who were then just back in Mussoorie after their first field season were all summoned to Dehra Dun. The dress code was formal.

Nehru went around the laboratories and was highly impressed with the motivational level of technicians. In his speech on the lawns of Patiala House, he appreciated their single-mindedness of purpose. The gathering felt enthused, being in the close proximity to the famous statesman.

The last phase of the knowledge-building exercise took a little longer to fall in place. It had to do with international relations and diplomacy. Nehru's tremendous image in world politics came handy in arranging training in the latest technology for the scientists and engineers. India was an emerging market for everyone. In every trade negotiation, one clause was never compromised with - the mandatory training of ONGCians.

Thus, the seeds of a knowledge company were sown. It would be the most lasting legacy of the early pioneers.

As the scientists were mapping and sending sound waves to sniff for deposits of oil, it was time to put a drilling bit into the bowels of earth. And, that was a different ballgame altogether.

PART TWO

VENTURING OUT

The Eternal Flame

Picturesquely nestled in the Siwalik range, Jwalamukhi, with its constellation of nine flames, is believed to have been the abode of *Shakti* (Power). About 800 years ago, the constellation was named Dhumra Devi and a temple was built around the flames on the side of a ravine. There was no idol.

Jwalamukhi lies 34 kilometres to the south-east of Kangra town in Himachal Pradesh (then in the undivided Punjab). Trains from Delhi came up to Pathankot on broad-gauge. From Pathankot, a narrow gauge rail brought trains chugging to the sleepy town of Ranital, a distance of 120 kilometres. From there, Jwalamukhi was a winding 20 kilometres away.

After Independence, in 1948, GSI appointed a petroleum geologist, Boileau, to assess oil potential outside the concessions given to multinationals. L.P. Mathur soon took over from Boileau. Between 1948 and 1953, Mathur, Gautam Kohli, A.C. Rangachari and B.N. Shukla of GSI (they all joined ONGC subsequently) had done extensive work at the foothills of Himalayas. They had mapped the Jwalamukhi structure.

The first question that Kalinin had asked Mathur during their introductory meeting in 1955 was the reason for special focus on Jaisalmer. Mathur had apprised him of the gas strike in Pakistan across the border. He also briefed Kalinin of the scientific studies on Jwalamukhi.

Kalinin saw the justification when he visited Jwalamukhi. He singled out Jwalamukhi for the first wildcat drilling. When questioned, Kalinin pointed out the similarities between Jwalamukhi and other identical oil bearing provinces in the world.

Earlier on March 23, 1954, India and Rumania had entered into a trade agreement. Rajeshwar Dayal, Indian ambassador to Yugoslavia, then undertook a study tour of Rumania on November 1, 1955. He was impressed with the advanced Rumanian oil industry. The Rumanians agreed to send a drilling rig as an exhibit for the upcoming Indian industrial exhibition.

True to their word, they brought a rig in February 1956. The oil rig was a big attraction. It was the first time that most Indians had seen a drilling rig. It drew massive crowds. Malaviya had made an agreement for the purchase of three Russian rigs. But since the Russians needed more time for delivery, he convinced the government to buy the Rumanian rig. Even before ONGC was born, the rig was purchased on March 19, 1956. It cost Rs. 16, 00,000.

Then, in a bizarre incident, the rig caught fire at the Pragati Maidan exhibition grounds. On inspection, its major components were found to be intact but it still took some months to repair the damage.

With the die cast in favour of Jwalamukhi, B.G. Deshpande, then a superintending geologist, was given the unenviable task of moving the rig from Delhi to Jwalamukhi. He began preparations towards the end of 1956 but the job was easier said than done as there were serious logistic problems. The chosen drill site was three miles up from the temple on a small hill. There was no road. The CPWD laid and strengthened the winding road uphill with proper strengthening to counter the weight of the oncoming massive components of the rig. Deshpande had assigned Asim Mukherjee, an East Bengal football player, to look after the logistics in Delhi.

Dr R.S. Mittal, a geologist, was the officer-in-charge of the project. He took up the onerous job of organizing the logistics and accommodation for the crew. Mittal was later to earn fame as the pro vice-chancellor of Roorkee university. A bachelors' colony came up at Sapri village with spartan accommodation. Near the drill site, wooden huts were built for the Rumanian crew; others had their huts covered in aluminum sheets.

With the arrival of 21 Rumanians, the rig building process began. H.K. Banerjee, a strapping six-foot tall mechanical engineer from Jadavpur University, matched the Rumanians in build as well as skill. Material for the drill site would be dumped at the railway yard in Ranital. It was left to Banerjee and the Rumanians to haul the equipment onto the trailers for transportation to the drill site. Occasionally, they also borrowed cranes from a local army unit.

In January 1957, the second batch of six engineers joined as drilling assistants in Dehra Dun. They were sent to Jwalamukhi. Stir and Petco, the Rumanians, were the toolpushers-in-charge. They were both feared and respected for their courage and skills. It was hard work for the new ONGC engineers. They learned their skills fast and made some innovative improvisations for the lifting and deployment of the heavy equipment.

By end of March 1957, the 5-LD rig was up with all its ancillary units like engines, mud pumps put on line. April 20 was the chosen day for spudding, the first time the drilling bit was to touch the ground. Minister Malaviya and other dignitaries arrived the night before to oversee last minute preparations.

The next day, a little before noon, C.P.N. Singh, Governor of Punjab arrived to the welcoming tunes of the Sikh Regiment band. After traditional speeches, the Governor did a ceremonial spudding.

Prime Minister Nehru considered the event epoch-making and sent a special message. He described it as a "new and major step" in search for oil and the "beginning of a great venture". He believed that success in finding considerable quantities of oil would make a tremendous difference to India and her economy. "We have in recent months and years realised how vital is oil, not only in the world's economy but world's politics," Nehru declared.

K.D. Malaviya's speech was pragmatic: "We have gathered here in a spirit of dedication to a new cause. If we succeed, it is bound to revolutionise the entire concept of our economy."

Describing drilling operations as "a thrilling adventure", he nevertheless cautioned against the misconceived notion in newspapers that oil had been found or was about to be found. "We have not gathered here to see the inauguration ceremony of deep drilling of a well which has struck oil. This is the first essential and unavoidable process of undertaking deep drilling - that is technically called exploration drilling."

Other dignitaries at the spudding ceremony were the Chief Minister of Punjab, the Rumanian Ambassador and the Economic Counsellor in the Soviet Embassy.

The historic drilling of the first well thus got underway. Rumania with its own oil history of over 100 years was again to become a part of oil history in another continent.

The rookie young Indian drillers soon became used to the grinding life. It was A.K. Gupta's first posting as assistant driller in October 1958 and he found the cold unbearable. "I used to wear two pairs of socks, two vests, two shirts, a full sleeved woollen pullover, and a monkey cap," recalls the veteran who retired as a Regional Director. The Rumanians had three drilling crews that worked in three-week shifts, eight hours a day. At the end of the three weeks, everyone got 56 hours off. However, the off was contingent upon situational exigency. Emergencies were frequent so it meant longer working hours, cutting into the rest time. After duty hours, they had to go back to the Sapri colony, three kilometres away. That was the genesis of need-based recruitment.

The next to join were the chemists, M.M. Dey and Krishna Kant. The progress of drilling was very slow. The Rumanian drill bits were not designed for the extremely hard rock formation that they encountered. It took almost one year to reach a depth of 885 metres. There was a prospective oil horizon at that depth. The first electro-logging of the well was done at 600 metres by Dr S.N. Sinha of GSI. Electro-logging involved sending electrical signals down the hole with a cable.

ONGC formed an electro-logging group from the pool of geophysicists. The Russian logging unit, OKC-52, was transported from Bombay by road to Jwalamukhi. When the logging unit arrived, there was no storage space for the neutron source box. Inadvertently, someone placed it under well site geologist P. Mitra's bed. For one whole night, he slept over the radioactive source material. The frantic search for the neutron box next morning, led to its discovery under the bed.

The logging was carried out by Russians with geophysicists of ONGC's logging party as understudies. The Commission had then started an incentive scheme to encourage learning of the Russian language. Some Russians too picked up Hindi words. How long could gesticulation with head, hand and shoulders have continued? Gradually, sign language gave way to a pidgin of Russian and Hindi.

The logging showed oil and gas indication at 885 metres. A production testing had to be carried out to physically ascertain the presence of the actual fluids. A new department, production engineering, had to be established.

Another new recruitment need arose. S.K. Manglik, studying engineering at Benaras Hindu University, had seen the Rumanian rig at the Industrial Fair in 1956. Two years later, as fate would have it, he joined ONGC in the drilling department. Manglik was shifted to production. His first assignment was to rush to Delhi to have a U-tube fabricated at Delhi for production testing. After the teething troubles, the well was finally ready for testing.

Malaviya and some senior officers were present at the drill site when the actual testing of the zone was done. There was a spurt of gas which was burnt as there was no way to store it. As the gas came out, Malaviya instinctively asked someone to run down to the temple to see if the holy flame was still burning. He was scared of public uproar and the consequences. To his relief, the holy flame was burning.

In the meantime, the experts decided to drill further in the hope of encountering oil at a deeper depth. The zone was closed by cementing. M.B.R. Rao regretted the lack of effort to measure the quantity of gas.

Then, the problems started. It was decided to drill down to the target depth of 3,500 metres. As the drilling progressed, a section of tubulars and a drill bit fell inside the well. It needed to be fished out. The fishing equipment had to be requisitioned from Rumania and that took months. Parliament criticised the lack of preparedness in facing emergencies. Malaviya defended and attributed all of it to inexperience and lack of money.

That was not the end of the woes. As the depth increased, the drilling progress slowed down to just as four or five metres per day. The Russians also got involved in solving the complications at Jwalamukhi.

After the target depth was reached in 1959, three kilometres of the drilled hole was electro-logged. There was no show of any oil or gas. The earlier depth at 885 metres was perforated in the hope that some gas might come out. Cement had already closed all the pores of that horizon.

Malaviya had earlier announced in the Parliament the presence of gas in Jwalamukhi. There was much clapping and jubilation. In the excitement that followed, some Parliamentarians, especially from the Punjab, wanted proper schemes for utilization of gas. The jubilation had come a bit too soon. The well was declared dry.

But the completion of the well was a major event for the organization. In less than two years, Malaviya had exploded the myth of Indian "incapability".

Being the first venture of its kind in northern India, Jwalamukhi became the destination of "pilgrims" of a different kind. Indira Gandhi, who then held no office, visited the site on June 29, 1958. Later, in October, Swaran Singh, minister of steel, mines and fuel, paid a visit. The Rumanian deputy minister for industries and petroleum, too, made a trip to encourage the team.

During the long drilling period, Jwalamukhi became a training ground for scores of drillers, chemists and geologists. ONGC opened a drilling training school at the drill site where Rumanians would share their rich experience in oil field operations.

The Commission, then, turned its attention to the prospective areas of Punjab and Uttar Pradesh. Hoshiarpur was the new location. The deep well didn't result in any discovery. Subsequently, Janauri and Ujhani, in Uttar Pradesh, also saw intense activities. The results were not very encouraging, either. The Commission was doing everything possible to discover oil. But at one point of time, the oil business really looked very "uncertain and slippery." The policy makers started questioning the rationale behind the unsuccessful venture.

Undaunted by criticism, Malaviya stood like a rock, defending the Commission and its activities. Every activity of the Commission was under the scanner: they included the problems in Jwalamukhi, non-functioning of imported equipment and other teething problems.

Everyone questioned Malaviya's attempts. To add to his woes, Cambay was mired in an intellectual tussle. Fortunately, for ONGC and the country the crisis did not last for long.

WILDCAT CAMBAY MAKES A DREAM DEBUT

If drilling in Jwalamukhi was guided by sheer geological instincts, Cambay was chosen on the basis of purely geophysical investigations.

It was one man and his conviction that tilted the scales in Cambay's favour. When M.B.R. Rao first broached the name of Cambay, he didn't find many takers. Jaisalmer and Punjab (including Himachal Pradesh) then enjoyed high priority in the drilling of deep wells. Luckily, however, Rao received solid backing from Dr M.S. Krishnan and Dr D.N. Wadia.

In the 1920s and 30s, a few enterprising prospectors had tried to drill shallow wells near gas shows of Gogha, Baroda, Hajat and Jagadia. They had all given up as their wells blew off at very shallow depths. Dr Krishnan, in his book *Geology of India* had postulated on the possibility of that area being oil-bearing because a few marine rocks and outcrops had aroused his curiosity. Marine rocks and signs of life would invariably excite an oil prospector.

From 1947 onwards, Cambay was the focal point of intense geophysical surveys. In 1948-49, Dr S.L. Banerjee of the Central Water and Power Commission, did a marathon 10,000-square mile reconnaissance magnetic survey over an area extending from Ahmedabad in the north to Cambay in the south. Even with archaic instruments, he discovered many interesting features. The follow-up gravity survey was carried out by B.S. Negi in 1950-51. When M.S. Krishnan became the first Indian director of GSI in 1951, Rao found him both supportive and generous. The first instruments that Rao got were the latest versions of Worden gravimeter and portable seismic unit. Negi was back on the road armed with the new gravimeter. In 1952, and again in 1954, Negi was able to find gravity high near Sokhda, in close proximity to Cambay town. Finally, it was time for the last step in the geophysical surveys: the seismic shots. In 1955, L.N. Kailasam and R.S. Chellam, both from GSI, shot a seismic profile, and they were able to pin-point an anticline with its top near Lunej.

When Rao moved from GSI to ONG Directorate, he had all the records with him. Malaviya was convinced but Kalinin wasn't. Then, in a great show of camaraderie, Kalinin deputed Malushin and Rao designated Kaila for recomputation of the data. The two teams worked non-stop in seclusion for over a week. When the data was put on the table, Lunej emerged as the clear choice. In later years, Rao would rate that period as the most taxing in his life. All those confabulations happened in the first few weeks of 1958.

Amid all this confusion, Malaviya invited Rao for dinner at his place and told him about the persistent doubts expressed in all quarters. Nevertheless, he assured the beleaguered Rao with comforting words: "Let them say anything; it is only by drilling we will know what lies under the ground. So long as we have some definite evidence to drill, we shall not waver." And, to Rao's relief, Malaviya stuck to his promise.

Meanwhile, the young geophysicist, R.C. Garg, was deputed to Bombay for dispatching the OKC-52 logging unit to Jwalamukhi. Negi gave him a terse brief about his mission. Even though he had never seen a port before, he was asked to liaise with clearing agents Guzdar & Company. With great difficulty, he could locate the logging unit, and managed to send the same to Jwalamukhi by train. He was excited about going back to Jwalamukhi to be a participant in the first logging operations. He sent a telegram to Negi for permission to catch the next available train to Dehra Dun. Negi asked him to stand by, and continue with the clearing job at Bombay Port. Disheartened, Garg got busy forwarding thousands of tonnes of equipment arriving from Russia and Rumania.

One day, a drilling rig with hundreds of components landed at Bombay port. Garg didn't know where to send it. He met everyone possible: Dr Dey, Zagrabiants and others. They asked him to stand by. He sent frantic telegrams to his boss, Negi. The replies were curt: stand by. Only drilling advisor Zagrabiants dropped a hint of Cambay, the possible drilling location. In the all-pervading confusion, the rig and its components were moved to Cambay in November 1957.

On January 30, 1958, the site was pinpointed. It was situated seven miles north-west of Cambay, in Kaira district of the composite Bombay state. By February the Russians started trickling in. An office was opened in a 200-year old building known as Kothi House. The Russian drilling team was led by drilling engineer Alenchikov and master driller Fatkukiev. The team had an expert rig builder in Solomonko. A team of Russian-trained Indian drilling engineers also joined the fray.

The small railway platform looked like a junkyard - a thousand components and parts of Uralmash-3-D rig, weighing 300 tonnes, were piled upon one another. There was no space even for movement and no way for identifying the heavy boxes. The scene was chaotic. But fortunately, that was the only consignment in the yard and ONGC the only consignee. The parcel clerk was until then accustomed to receiving at most, scores of baskets and boxes. All this was beyond his imagination. I.B. Roy, a driller, was stationed at the railway yard to arrange the transportation of rig components to Lunej. He hired about 20 local laborers to push and roll the smaller components onto the trailers. The locals were tough but inexperienced in handling odd-sized heavy components and that slowed down the progress.

Dr Deshpande, veteran of Jwalamukhi was sent as an officer-in-charge to expedite the process. He was a man of exceptional qualities and enterprise. He went to Bombay and came back with a score of hardened port laborers. That did the trick; the pace picked up. But, when it came to heavier components like mud pumps and engines, human labour, however tough, was no substitute for cranes. Then the army moved in.

With their characteristic efficiency, the Armymen completed the job by July 1958. However, the intervening period generated fresh doubts. Some of the foreign oil experts advised against venturing into the virgin fields of Cambay. The half-erected rig faced the possibility of being dismantled.

On February 14, 1958, Kalinin had landed in Baroda with the ministry's Secretary S.S. Khera. He had summoned all geologists and geophysicists doing field work in the adjacent areas to be present at 8:30 that night. After much brainstorming, the issue was clinched in the early hours of the following morning.

Lunej #1 was, finally, spudded on July 25, 1958.

On the spudding day, the Nawab of Cambay presided over the function. Thus began the saga of Lunej. Everyone waited with a bated breath for the outcome.

The drilling was a scary affair. There was a hot lava flow that had deterred all earlier explorers. The temperature of the drilling mud was so high that arrangements had to be made for procurement of ice blocks. The hoses would burst due to the high temperature. Burn injuries became common. As the depth increased, the temperature would touch almost 130 degrees centigrade. The dry heat and dust gave the crew a harrowing time. The Indian crew gathered courage from the example of the extremely tough Russians. Tea was a rarity at the drill site. With some persuasion, a 'local' set up a tea stall.

Around 9 a.m. on September 5, 1958 Lakshman Singh, a shift geologist on his first posting was monitoring the mud flowline. Suddenly the young man noticed dark brown patches in the flowing mud. Not knowing its significance, Singh rushed to the Russian shift driller. Immediately, a jeep was sent to fetch master driller Fatkukiev and drilling engineer Alenchikov. When the Russians arrived, all hell broke loose. "It is an oil show!" the two declared in unison.

Recalling that historic event today, Singh says, "I was overjoyed. I could then proudly claim that I was the first person to have seen the maiden oil discovery by ONGC." In those early days, the well site laboratory didn't have a fluoroscope; but then one didn't need a fluoroscope to know that it was an oil strike

That historic day, Malaviya was in Basti, his constituency. A coded telegram was delivered to him. He could decipher the message: crude oil flowing with mud. He made a trunk call to Ghosh in Dehra Dun. Ghosh was instantly on his way to Cambay. Next day, Ghosh called up Malaviya and confirmed that an oil horizon had indeed been encountered between 1550 and 1605 metres. Malaviya informed the Prime Minister. Nehru wanted to see a sample. Ghosh was asked to carry a bottle of crude for the Prime Minister.

Malaviya couldn't hide his excitement. Afraid of censure for keeping Parliament in the dark, Malaviya gave a statement on September 12. He briefly recounted the events but advised the excited House to exercise "cautious optimism". He quoted a well-known poet: "Learn to labour and to wait". He had good reasons to be cautious.

The drilling was resumed. The drill string had reached a depth of 2191.45 metres on October 10, 1958.

Earlier on August 19, 1958, at 1694 metres, I.B. Roy was connecting a new string of drill pipe to carry further drilling. The time was an unearthly 4 in the morning. He couldn't properly screw the pipe as hot, steaming gas started blowing through, rising to a height of 30 feet. The smell of oil was all over. The crew immediately shut off the Blow out Preventer (BOP). With great difficulty, the flow was controlled. The situation was so serious that Malaviya felt compelled to arrange a plane to fly in the experts including Kosorotov, Zagrabiants, M.B.R. Rao, Mathur, Rahaman and Barua to help Alenchikov and the crew. The crisis was sorted out and the situation brought under control.

The well was cased. Then the long wait began as there was just one electro-logging unit in faraway Jwalamukhi.

During this interlude, crude oil surfaced from behind the casing pipe. It was coming out at a rate of 10 to 15 barrels a day and it came out in spurts. It was good quality crude (API 33) but the high paraffin content that made the oil viscous. The production testing lasted two months, from December 1958 to February 1959. All that while, the viscous oil played a game of hide and seek. It baffled everyone. Ghosh would become very disheartened. Mathur didn't move from Cambay. P.K. Kulkarni, a geologist who joined at Cambay, remembers Mathur rejecting all leave applications - he didn't want anyone missing the sight of crude oil flowing!

Lunej #1 made everyone introspective. Malaviya felt relieved; his decision for dispersion of drilling locations had paid dividends. Ghosh mused: "The concept of drilling a number of dry holes before striking a wet one has received a rude shock on the oilfields of Lunej." No doubt Cambay had made history in wildcatting.

Before oil was struck, the foreign media were relentless in its attempts to show the futility of oil search in India. In 1958, *Oil and Gas Journal*, an American publication, had commented: "India is a second-rate country in terms of oil supplies except in the already explored Assam area. Geological surveys show that there is little likelihood of finding oil in India in considerable quantities."

If Cambay were not found, ONGC would have been groping in the dark possibly for several years. In the meantime, the morale might have gone down to the lowest ebb. The critics of ONGC including foreign oil companies would have had a field day and ONGC's credibility would have taken a beating.

The myth of no oil outside Assam lay shattered in the sands of Lunej. The face of Gujarat was about to be changed forever. Now 47 years down the line, the yellowing well completion report with a file No. 1W8500827, prepared by geologist M.N. Vasantha Kumar, evokes much respect amongst the new generation of oilmen going through the archives. Then, it was time to move on.

Cambay #2, with the same rig, proved to be another hit. Cambay #3 was also a success. It was drilled with a Rumanian rig with the full complement of drillers and technicians. The drilling was a normal affair till a human tragedy shocked everyone.

K.S. Shankar had joined the Cambay work force in 1958 as a drilling assistant. The Russian chief drilling engineer, Alenchikov, had sent him to expedite the dispatch of the new Rumanian 4 LD rig from Mumbai Port. Gopi, a driller with previous experience, was made the Indian drilling supervisor of the rig. Shankar was attached to a Rumanian master driller to learn on the job.

On that fateful day, both of them had finished their eight-hour shift and had gone to bed. Unknown to Shankar, the Rumanian driller was called back to the drill site for some emergency work. Sometime after midnight, the accident took place. There was a blow-out situation with gas escaping at very high pressure. The BOP had developed leaks. The flowing gas had created an artificial cloud all around. To regain control of the well, two Rumanians, including the driller, and two Indian workers were trapped in the gas cloud. They never came out alive.

The gas flow subsided on its own during the night. At the break of dawn, the four bodies were found at different places: two were under the sub-structure of the rig, two others were flung in different directions. The bodies of Rumanians were flown to Bucharest for funeral. The last rites of the Indians were on the banks of the Mahi River.

Cambay had turned into a throbbing hub of activity, as the number of rigs increased. It included the Rumanian Bu-75 and Russian rigs. A Russian language training school was opened to help everyone read the technical manuals and help in communicating with the Russian drillers; even a smattering of Russian would help.

It was time for the Prime Minister to make a visit and further motivate the young army of workers. On April 4, 1960, Nehru landed by an IAF plane near Vadodara. On his way, he met a field party of geophysicists at Dharmaj. He visited well #5 where the Uralmash rig was drilling its third well. He named the rig *Vijaya*. Later, when Nehru was watching the crude flow, a gust of air threw a few drops on his immaculate white *sherwani*. He proudly declared that the spots on his *sherwani* symbolised the aspirations of a nation and carried that as a souvenir back to Delhi.

Meanwhile, thousands had gathered to hear Nehru. Addressing the villagers in the language they understood, he lauded the cultural mix of oil workers where people from all over the country were working shoulder to shoulder with Russian and Rumanian friends. He told them of the complexity of investigations that included sending electricity down the surface of earth in search of oil.

The Nawab had invited the Prime Minister for dinner at his palace. The dress code was formal. I.B. Roy didn't have time to get a formal dress stitched. Dejected, he was standing on the road when I.P. Kaushik, the dapper transport officer, saw him from his jeep. Roy was the drilling engineer of the rig *Vijaya*. Kaushik drove him to his house, and lent him a spare dress. Both of them joined the others for the lavish banquet spread at the palace. A.M.N. Ghosh thanked the Prime Minister for the encouragement and told him of the problems in purchasing, and of other teething troubles.

Ghosh promised: "Our first well was drilled in 91 days; the fifth was completed in 38 days; our Chairman now wants us to bring it down to 20 days." Malaviya would push everyone to the limit, and expected nothing but the best from everyone.

Vijaya, the Uralmash Rig, brought Cambay on the world oil map. But, after drilling a couple of high temperature and high pressure wells, its systems started failing. It was decided to move the rig to the fields of Assam.

Cambay would still need some more time before becoming a major gas field. In the meantime, a small village, Hajat, witnessed considerable activity in the early part of 1960. That was a prelude to Ankleshwar, the most prolific of the on-land fields.

Malaviya received a boost with the discovery of Cambay. From then on, there would be no stopping him.

MALAVIYA GETS BOLDER

The Cambay oil discovery was striking in many ways. The veil over the myth was exposed - ONGC had opened up a virgin oil field *and a new basin*. For Malaviya, this was the opportune time to strike. He wouldn't let the excitement die. The 'lucky' drill bit from Cambay was a big attraction at the annual industrial exhibition in 1958. The technicians from ONGC had designed a beautiful tableau depicting the oil business. Thousands of visitors felt enthused. Policy makers too visited the stall. The wind was turning in favour of Malaviya. Because of his single-mindedness, he could smell an opportunity from miles away. His moment to strike had come.

When Mrs. Durga Devi, wife of Malaviya, presented a bottle of Cambay crude to Nehru, he became pensive. His daughter, Indira Gandhi was overjoyed. But Malaviya understood Nehru's mood. Questions flooded his mind as he thought of the future. Was there a light at the end of the seemingly blind alley? Could the multinationals be reined in? Could a newly independent nation break the monopoly of the companies? Would the country be able to really own its oilfields? How fast could he silence the critics of national oil policy?

The earlier concession rules had allowed petroleum licence for 40 years. The companies had also presumed that refining their own oil was their 'right'. Malaviya wouldn't agree to that clause. He knew that the real value comes from refining the oil, breaking it into hundreds of other products and selling it at a higher profit. The Digboi oil was refined in BOC's own refinery. But Malaviya felt that the Nahorkatiya oil had to be refined the way government wanted. The government would have two refineries: at Noonmati in Assam and Barauni in Bihar. BOC had to build a pipeline from Moran to Noonmati to Barauni. The government had another rider: any further exploitation of Nahorkatiya, Moran and Hugrijan had to be carried out by a company with government participation. BOC cried foul. With the world waking up to the oil multinationals' exploitative ways, India's earlier submissiveness was gone. It was advantage Malaviya.

The companies in turn, activated their most potent weapon, the media. The Press was flooded with condemnation of Malaviya's posture. But as usual, Malaviya shrugged them off. The fact was that oil was finally gaining a place in the national consciousness. And when matters reached a head, Malaviya received backing from Cabinet colleagues like Babu Jagjivan Ram and Defence Minister K. Krishna Menon. Nehru, of course, was always behind Malaviya.

BOC cited the paucity of steel in world markets. It wanted a refinery for Nahorkatiya oil to be set up at Kolkata so that they could ship petrol and aviation fuel to friendly countries. Nehru wanted a refinery to be built in Assam, considering the backward condition of the state, then. In case of a worldwide shortage of pipes, Malaviya proposed that oil could be transported to Noonmati by river. He reeled off carefully calculated tonnage of ships and the number of engines required. His meticulous groundwork left everyone dumbfounded. The BOC president gave a statement in London: "India was no more a safe place to do business." Finally, Malaviya was left smiling as BOC agreed to all of his demands.

The country was to have its longest cross-country oil and gas pipeline. It was also agreed to have government participation in BOC operations to the extent of 33 %. This signalled the birth of Oil India Private Limited.

One problem was solved, another remained. Who would man the two refineries and who would build them? Malaviya turned to two of his most trusted sources: Rumania agreed to build the 0.5 MMT Noonmati refinery with soft loans and rupee payment. Russia offered to build the 2 MMT Barauni refinery.

Two new entities were born. The Indian Refinery Limited was formed to manage the refineries and a public sector marketing company was formed to market the cheaper Russian diesel and kerosene. The country was reeling under the price increase enforced by the foreign oil companies after the Suez Canal crisis of 1956. After the war, there was a fall in price worldwide, except in India.

On the exploration front, the Indo-Stanvac project had come a cropper. After drilling 10 dry wells, Stanvac called off the exploration. The government's share in the failed project came to a whopping Rs. 70 million. All this happened in 1959-60 in the aftermath of Cambay but ONGC was still struggling in its attempts in every sphere. It still functioned like a government department.

In two scathing letters, chief drilling advisor Tagiev, with Kalinin's assent, reeled out the deficiencies in ONGC. One of the examples he quoted was that of Member (Technical) who hardly had any powers to get even small things done. Files were jumping back and forth between Delhi, Dehra Dun and other work centres. There was lack of reliable logging and testing equipment, which led to the idling of multi-million rupee oil rigs. Tagiev urged the setting up of an engineering directorate, production wing, maintenance wing, workshops and more training schools. The Commission needed powers to recruit people. In the preceding two field seasons, the many difficulties faced were due to procedural delays. The field party chiefs spent a lot of time preparing vouchers, bills and replies to queries.

Soon enough, Malaviya began the reorganization of ONGC. A dilemma emerged: whether to go in for a statutory body with enhanced powers or form a company. Ghosh, Rao, Khera and Bose had a brainstorming session. Khera suggested that a company be formed. The stalwarts from ONG Directorate preferred a statutory commission, aware that the stringent conditions of the Companies Act would thwart operations of ONGC, considering its nature of business. In Malaviya's view, the purpose of a statutory body was to enable the Minister to share his policy-making functions with it; a statutory body was usually found necessary in those spheres where policy making at the political level required an understanding of the scientific-technological problems. A statute gave the sanction of the sovereign body, namely Parliament, for such sharing of the function.

The proposal was approved by the Union Cabinet and the Law Ministry formulated guidelines to set up a statutory Commission. It then went to Parliament. The Finance Ministry had reservations about delegation of powers in financial matters. However, Malaviya could convince everyone to accept the concept. After scores of amendments, ONGC finally became a statutory body under an Act of Parliament (Act 43 of 1959) on October 15, 1959.

Its basic powers and functions were:

- To plan, promote, organize and implement programs for the development of petroleum resources and the production and sale of petroleum and petroleum products produced by it and to perform such functions as the Central Government may, from time to time, assign to the Commission.

Apart from the right to explore and drill for locating petroleum reserves, it had to undertake, encourage and promote the production of petroleum from such reserves and refine it. It was to undertake transportation and disposal of natural gas and refinery gases thus produced. It was to undertake, encourage and promote geological, chemical and other scientific research in the field and in laboratories.

The Member (Finance) of the Commission was a nominee of the Finance Ministry. For any amount beyond Rs. Three million, the Commission would need to take the Finance Ministry's sanction. The Finance Member was responsible for the preparation of the Commission's budget and proper maintenance of its records. As a public sector entity, it was answerable to Parliament and therefore, to the Parliamentary Committee on Public Undertakings. All investment by government became the assets of the Commission. After October 15, 1959, further capital requirements would be provided by the Government under Section 16 of the ONGC Act.

A new accounts wing was established within ONGC. Till that time, the treasury functions of the Commission was carried out by the Accountant General of Uttar Pradesh and Assam. The accounts of Delhi and Kolkata offices were looked after by the Deputy Director of Food, Rehabilitation and Supply of the Government of India. From March 1, 1960, the accounts were finally handled by the accounts wing of the Commission.

On the Human Resources side, ONGC was given a free hand to recruit personnel as and when the requirement arose. Taking into consideration the advanced age of most of its stalwarts, a clause was inserted wherein the Commission could retain their services provided the total emoluments didn't cross Rs. 2,750. This retention clause was deleted by an Act 23 of 1977. The Act also allowed the transfer of services of current employees to the Commission. Some of the early stalwarts, who were unsure of their position, could finally become employees of the statutory body. It could also formulate its own regulations regarding human resources like TA & DA rules, leave and other regulations. Overnight, the status of ONGC changed. But, it also came under various regulations such as the Mines Regulation Act, the Factories Act, the Bonus Act, and the Industrial Disputes Act.

Malaviya continued as the minister-cum-chairman of the statutory body, but that decision was not easy. As a policy, Nehru was not in favour of any minister or public servant holding high positions in technical organizations. When he had announced the proposed restructuring in May 1959, the Press had pestered him with the same question: will Malaviya continue as chairman? One correspondent brazenly asked whether the ministry of oil would be abolished.

Nehru set all doubts at rest: "This ministry has done extraordinarily good work. I would say that the ministry, the Oil and Natural Gas Commission, and all those engaged in it, have done more work in the last two or three years in regard to oil exploration than many other countries in the last decade."

Considering the nature of business, Malaviya continued as chairman "to get the work going". But, he had two important messages: one was for the representatives of people, the other for ONGCians.

During deliberation on the proposed amendments to the statute, he requested the members of Parliament to remember a vital reality of the oil business: "There is another aspect which I would like the House to bear in mind. Every oil and gas pool is unique by itself. There is none exactly like that in any part of the world just as every man has his own individuality, and he is separate from the rest of the humanity. The first discovery of oil in a well alone cannot enable one to predict that the field will be one million, two million or half a million tonne." He was responding to the impatience shown by the members regarding the exact date of production of oil from Cambay. He apprised the House of the need for further drilling, appraisal of temperature, pressure and other characteristics. Above all, he asked everyone to be patient.

In December 1959, Malaviya wrote a letter to greet ONGCians on the New Year. That message was to be cyclostyled and distributed to the remotest corners of the country where crews were operating. The message was brief: "Now, the whole nation expects results from you."

By that time, Ankleshwar was popping up prominently on the contour maps. It was time to move a rig to test the structures outlined by seismic surveys.

ANKLESHWAR GOES ONE BETTER

Not far from Bharuch's little-known taluka of Ankleshwar, Jhagadia was just a tiny speck on the map of the then undivided Mumbai State. A pond existed in the middle of nowhere, in a still tinier dot called Hajat. It produced bubbles in abundance. Tata Engineering Company, then headed by the dynamic Jamshedji Tata, drilled a couple of holes in the area. The Gaekwad of Vadodara had given his moral support. The gas show was labled "Marsh Gas", only a surface phenomenon. The Tatas gave up.

In the 1930s, oil prospector Sultan Chinoy managed to drill a shallow well in the compound of Vadodara Maharaja's palace. He struck gas at a very shallow depth. Without institutional support, he gave up, too. Legend has it that whatever little gas he had discovered was used in the palace kitchen for cooking.

The seepages continued to draw ascetics and devotees to the Hajat pond. A field party (1957-58) of S.C. Roy Choudhuri, T.K. Roy and M.N. Vasantha Kumar came across an ascetic who guided them to the hitherto unknown places where these seepages occurred. Dr Deshpande, in addition to many other challenging responsibilities, was the field superintendent of the Mumbai region then. He used to collect and send all samples to Dehra Dun for analysis. T.K. Roy was invited to visit the ascetic's hut near the Hajat pond. The ascetic then showed Roy the bubbles in the middle of the pond and even permitted him to stay in a hut behind his Ashram. When confronted, the ascetic took time off from blessing disciples to narrate his story. He was an ex-policeman who had given up his job in search of truth. He arranged for a couple of local swimmers who swam to the middle of the pond and collected samples in kerosene tins after several attempts. The laboratories found 90% methane in them. K.N. Khattri and his party members conducted gravity-magnetic surveys. The seismic party led by Mool Chand conducted the seismic surveys.

The field season (1957-58) was a crucial one in the western region. The Commission had just made the Cambay discovery. The geological and geophysical surveys were intensified. In that field season, there were about six field parties, geological, gravity-magnetic and seismic working in the area. Kalinin wanted Vadodara to be explored for gas. Hence, T.K. Roy went scouting for an office in the city. The Maharaja of Vadodara had built five huge bungalows for his policemen which were vacant. They were located in a desolate area near the Pratapnagar Railway station. Roy hired one of them for Rs 120 per month.

Two Russian URB truck-mounted shot-hole drilling rigs had been diverted for drilling shallow wells in and around Vadodara town. They were part of a consignment of six such trucks that arrived by a ship in Mumbai which was refused berthing there and diverted to Visakhapatnam. The trucks were driven from Andhra Pradesh to Orissa, Mumbai and Vadodara.

Fifteen shallow holes were drilled all around Vadodara. Some gave water and some wells faced a minor blowout of gas. But one became a landmark. The well drilled near Manjilpur village struck a patch of oil at 163 metres in 1959. The oil blew out at very high pressure. Armed guards were deployed, but the gusher subsided on its own after two hours. The fallout was predictable: warring villagers fought over land rights. Sardar Swaran Singh, Minister of Oil, also visited the site.

Kalinin gave the final go-ahead for Ankleshwar after checking the relevant data, especially the gravity-magnetic report. The hopefuls kept their fingers crossed for months. With prayers in their heart, everyone hoped for a second successive wildcat strike after Cambay.

Initially, a few rig-builders with a drilling crew arrived in early 1960. Ankleshwar, then a dusty town of 2,000 to 3,000 people known for its small cotton industry, boasted of a nondescript railway station lit with kerosene lamps. The station master was kind enough to let the crew stay in the waiting room but they were soon driven to the nearby *dharamsala* by the swarm of mosquitoes. The ONGC men were nicknamed *teli* by the townsfolk. The only source of entertainment for off-duty crew was a tin shed, passing off as a movie hall. Gradually, the growing number of *telis* settled down.

The officers and Russians took up residence in Bharuch town, 10 miles away. The Uralmash 5D rig went up 300 feet in the sky. In the daytime, the cowherds would let their cattle graze in nearby areas, and they themselves would sit and watch the proceedings with amusement. Slowly, a barricade came up all around the drill site. By 1960, the Commission had acquired some expertise in rig-building.

Ankleshwar#1 was spudded on February 26, 1960. The drilling was smooth, unlike the Cambay experience where every well spewed gas, oil and steam at regular intervals. The crew had settled down to the routine of six-day work and two-day off. A.K. Mitra was made the drilling-in-charge of Ankleshwar. "Once the drilling crew went up to the rig floor, they would come down only after the end of the shift, otherwise Mitra would hang us," recalls Chiman Lal, a young driller.

Except for a tight pull (which occurs when the drilling string gets stuck in a subsurface formation and massive force has to be applied to free it) at 1338 metres, the target of 1969.29 metres was reached on April 25, 1960 without any notable event. At the depth at 1625 metres, the well was electro-logged. The logs showed some promising sand zones but the crew was skeptical of finding any oil.

They were all lulled into a strange complacency. The lull had also sent the big guns away on other important jobs by the time production testing started on May 13, 1960. The sand zone, S-1, between 1170-1188 metres was perforated with 150 bullets. Nothing happened immediately. The well was kept open, and people got busy with other miscellaneous chores. The Russian master driller, nevertheless, kept a close watch on the behaviour of the well.

The following day, May 14, 1960, a chemist, with a couple of helpers, was cleaning the mud channel with a canvas hose pipe when the crude started spurting out, throwing the chemist away by several yards. The alert master driller immediately shut the BOP around the pipe to avoid a blow-out. In those days, the BOP had to be manually operated with long handles. Control was established and the crude flow was regulated. At first, everyone thought it was drilling mud because of its dark brown colour, the thick and waxy Cambay crude being their benchmark.

One helper attached to a geologist struck upon a novel idea. He took a sample in a container, poured it into a primus and lit it. The stove kept burning till that small sample lasted. It was crude, after all, and Ankleshwar was flowing like a dream. It had a greenish hue and a specific gravity of 44 degrees API with negligible (0.05%) sulphur content. The crude was collected. The yield for the day was magnificent: 225 cubic metres of oil and 25,200 cubic metres of gas.

Malaviya got the news over phone. There was a new excitement all over. He called for a press conference to inform the people of India of the "best discovery" of the country yet.

Ankleshwar became famous overnight. The first to arrive were the stalwarts of ONGC led by Malaviya. They had come with Mumbai sweets for the crew. They couldn't hide their elation as they touched the crude.

Nehru, the philosopher, guide and patriarch of the nation, arrived in June, 1960. But due to a sudden shower, his motorcade couldn't make it to the Ankleshwar #1 drill site. Nevertheless, he chose to walk down to the nearest place, Sajod, interacting with villagers on the way. He named the well *Vasudhara* - the stream of prosperity and the rig *Saphala* - success. Ironically, *Saphala* would be lost forever to one of the worst blowouts in the history of the Commission within a year.

As the successes on the Western front brought much joy and hope to the Commission, the action on the Eastern sector was picking up momentum. Assam was ready for ONGC.

ASSAM - A NATURAL CHOICE

The Nahorkatiya oil find in Upper Assam had given a new lease of life to oil prospects. In 1952, Burmah Oil Company (BOC), the parent company of Assam Oil Company (AOC), had conducted an aeromagnetic survey over the Assam belt. There were interesting areas available. AOC also had done some preliminary gravity-magnetic studies. But they decided to concentrate on Nahorkatiya. By 1955, the multinationals were getting very jittery over the new oil finds since it brought down crude prices further.

After the formation of the Commission, a petroleum exploration licence (PEL) was granted to ONGC for scientific investigations in the Sibsagar area. Very early on, the Commission decided to carry out a seismic survey. Fifteen of the 64 apprentice-geophysicists were asked to stay on in Kolkata; they were to undertake seismic and gravity-magnetic surveys in Assam under the stewardship of S.N. Sengupta.

He opened an office at 3 Gurusaday Road, Kolkata. That was to be ONGC's Kolkata headquarters for a long time. Sengupta had started his career as a geophysical assistant in GSI in 1947. The pioneers were unassuming and passionately devoted to their cause. Sengupta set about overcoming the logistics nightmare in Assam.

Before Independence, most of the railway tracks passed through the erstwhile East Pakistan. With Partition, Assam and rest of the Northeast found themselves almost completely cut-off from mainland India. The only gateway to Assam was a small chicken's neck in North Bengal. But the Indian railways constructed a new metre gauge line that linked Katihar and Guwahati through Indian territory via Siliguri in 1950.

About two-thirds of Assam was dotted with hills and ravines. The mighty Brahmaputra, running from north-east to south-west, cut through the state. Together with its tributaries, it formed the principal inland transport in the absence of any roads in 1957.

M.M. Goswami, an apprentice-geophysicist in Dehra Dun, was asked to report to the Kolkata office by end of June 1957. With a few instruments and some contingent money, he boarded the Darjeeling Mail to Assam. In those days, the Farakka Barrage had not come up across the Ganges. The Mail went up to Sakri Gali Ghat in Bihar across the Rajmahal Mountain and then stopped. The passengers scampered to the banks of Ganges, boarded a steamer to Manihari Ghat on the other side and got into Darjeeling Mail-2. The second part of journey ended in Siliguri. Another two days by train from Siliguri took the weary passengers to Simalguri, the nearest railhead to Sibsagar, 16 kilometres away from the quiet town.

Sibsagar, 369 kilometres east of Guwahati, was the capital of the mighty Ahom Kingdom, which ruled Assam for over 600 years before the British conquest.

During those days, the Railways had a category of employees, called 'wagon chasers'. They would track the movement of a wagon booked by a client from railway stations en-route. The clients had to make a special payment for this service. But the wagon chasers were not responsible for expediting the journey. This did not suit ONGC. It, therefore, made an arrangement with the Railways that allowed an ONGC officer (Class I grade) to do the job, who was also armed with authority to ensure priority movement of its wagons. The usual charge for wagon chasing service was, however, payable to Railways.

In the meantime, Sengupta arrived with Subrata Ray, another geophysicist, with more equipment from Kolkata. Sparbah Lyngdoh and K.K. Geevargheese chased the heavier equipment from Dehra Dun. 'Chasing' equipment-laden railway wagons would ultimately become an art for all future explorers.

The team got the jungle cleared for selective seismic shooting with an army of workers from nearby villages. They could not afford a 'No'- in their lexicon. If one of the colleagues found the slope too steep, Lyngdoh, the strongest of the lot, moved with a heavier load on his head.

The actual field work started in October, 1957. The biggest problem was the rain for almost six months in a year. The winter would bring in mist and fog to make things difficult for oil exploration. And, the silent tormenters were the leeches and mosquitoes, proliferating in the swampy land. When the party returned to the confines of their tents, the blood-soaked shirts and vests were just washed and dried for the next day. The sheer physical exertion acted as the biggest antidote to all problems. No one ever fell ill. The amiable nature of the first batch of geoscientists created a tremendous amount of goodwill among paddy field owners and tea garden managers.

In that season of 1957-58, the field party delineated the Disangmukh structure and the location was released on it. During the field work, P.K. Chandra was deputed to look for suitable clay to make drilling mud. He collected several samples and finally found one.

As the experts were pondering over the seismic results, the party moved southwards to Rudrasagar. But before that, they didn't forget to tell the would-be rig builders one thing: the low-lying location in Disangmukh was like a sea in the monsoons. And it was just around the monsoons of 1958 that the Uralmash 3D rig parts started arriving.

Disangmukh, six miles north of Sibsagar, was a quiet hamlet with a few bamboo huts. The monsoon fury had finally abated around August 1958. The location, pinpointed after delineation, was in a low-lying area. When the rig-builders arrived, they found a couple of urchins swimming in that pool of water and catching fish.

A.K. Mitra, senior driller, an old hand of AOC and familiar with Assam environs, was sent as officer-in-charge. An office was opened in Dhai Ali Road in Sibsagar. Then, K.C. Chandra landed up at Simalguri railway station, followed by R.N. Ghosh and S.C. Chakravorty, all assistant drillers. Then Russians arrived. Zagrabiants, chief drilling advisor, the Russian and Indian drilling crews arrived next. T.L Barua, officer-on-special duty, came to help the crew. Barua had spent a lifetime in the oilfields of AOC. He was given a gallantry award for his exploits in World War II.

But to everyone's horror, the location would swell up even with moderate rain. It was decided to have a protective wall all around the drill site. The Public Works Department (PWD) was contacted, as the ONGC didn't have its own civil engineering department then. Every hundred metres, the PWD had to be called in to strengthen a small culvert or repair a bridge or prepare a make-shift road so that heavy trailers could pass.

Meanwhile, out at the Kidderpore docks on Kolkata's Hoogly River, demurrage charges were piling up by the day for the rig parts lying there. It took one year to move 2,000 tonnes of rig equipment to reach the site, including ancillaries like mud tanks and water tanks. When some particularly long equipment could not be loaded onto the wagons, trailers or barges, the Russians advised them on how the parts could be cut so that no problem was encountered.

The equipment coming from north India had responsible officers doing the 'chasing'. Two flat bed wagons containing the hi-tech OKC-56 logging unit and cementing unit, accompanied by D.K. Gupta, geophysicist turned electro-logger, reached Simalguri after a harrowing 20 days. From Simalguri, the distance of 16 kilometres to the drill site was the last hurdle. Again, the Commission owed it to the Indian Army and its jawans for ensuring that the equipment reached Disangmukh.

Almost everything had to be procured from outside the state. For drilling mud, locally available black clay was mobilized by truck loads. There had to be sufficient stock of it. The Commission had become wiser in the wake of the drilling problems of Jwalamukhi and Cambay. Before the onset of the monsoon, the crew of Russians and Indians was ready for the spudding. On June 9, 1959, the spudding of DS#1 was done, creating a different kind of history. ONGC was drilling within three years of its formation, just outside the mining licence of AOC. They had set themselves a very deep target of 4,000 metres.

With no recreational facilities in Sibsagar, the off-duty crew preferred to hang around the drill site and share their happiness and sorrow over *Lal Sa*, the heady brew of Assam tea leaves and boiling water.

Baba Khan, a resourceful local, would repair vehicles and rescue them when they got stuck in wetlands. Very soon, he became the official trouble-shooter. Ali, an office assistant and Baba took on the roles of facilitators between newly-recruited local crew and ONGCians.

The most harried of the lot was the veteran chemist M.M. Dey. At that time, the Commission had opened up three fronts: Jwalamukhi and Hoshiarpur in the north, Cambay in the west and a new one in the extreme north-eastern tip. One day, Dey, having just arrived at Sibsagar, got a telegram to report back to Cambay.

Disangmukh had one chemist Thapliyal to assist the Russian expert Ghoncharov. Slowly, the duo got intelligent laborers to help them in their work. Badam Chandra Saikia, a villager from Dhuliapar in Sibsagar, was one of them. He would stay on to watch Thapliyal work and eventually, he retired as assistant chemist!

In 1959, Dey and Thapliyal opened the first local chemistry laboratory in a hut behind the Sibsagar post office. That was the pre-cursor to the present Regional Chemistry Laboratory (RCL).

It took as long as 215 days and 60 round trips to reach a depth of 3,811 metres. OKC-56 was used for the first time in Assam to electrolog the well. To everyone's disappointment, the well gave only feeble indications of oil and gas. It was decided to terminate drilling at 3,811 metres. Yet, from the geological point of view, it was a landmark well, the deepest in 100 years of Assam exploration.

It was decided to go south of Disangmukh. In the 1958-59 field season, the Rudrasagar structure, hardly 11 kilometres south, was delineated. But those 11 kilometres would turn out to be one of the longest journeys in ONGC history.

The drilling location was on relatively higher ground, at the outskirts of Sibsagar town. In fact, preparations for Rudrasagar drilling had started even as work was going on in Disangmukh. Land acquisition, mobilization of vehicles, cement, clay and a thousand other requirements were being worked out.

A.K. Mitra on arrival undertook a recce of a little-used road from Disangmukh to Sibsagar which had been built a long time ago by Ahom rulers. It had fallen into disuse due to lack of movement. This, Mitra realized, would be the road to Rudrasagar. CPWD was requested to inspect the route. The Dikhu bridge over the Dikhumukh River was the main hurdle. The maximum load ever transported over Dikhu was less than eight tonnes. The minimum requirement for rig movement was 25 tonnes.

A suggestion for putting a thick mattress of straw over the bridge and use multi-axial vehicles was given. Straw was available and luckily, the Russian workhorse KARZ, a 25-tonne trailer with six axles, had arrived in Assam.

Officially, the dismantled parts of Uralmash started moving out on January 10, 1960. They started piling on the Disangmukh side of the bridge. The first trailer movement was one of suspense, drama and fear. Two surveyors were positioned on either side of the bridge with theodolite to check for any buckling during movement. The first trailer, with 25 tonnes, was driven by Vikram Singh. Asim Mukherjee of the Jwalamukhi rig transport fame, hung on to the side. The Russian advisors and senior ONGC officers moved to the middle of the bridge. The time was an unearthly 10 p.m. The bridge creaked, groaned, buckled a little, but held. After the 200 feet slow-motion drive, Singh simply collapsed out of excitement. Over the next few months, the remainder of the 2,000 tonnes of equipment would move across the bridge. The work could only be done between 10 p.m. and 5 a.m. To everyone's amazement, the job was finished just before the onset of monsoons when the roads would have become rivers.

The well was spudded on May 28, 1960, exactly 140 days after the completion of the Disangmukh well. As drilling progressed, the anticipation grew. The geologists were getting more excited. At around 2,555 metres, oil-soaked sand samples were collected. For the first time, ONGC went for coring.

The core sample had a magnificent oil streak all around. It was sent to Dehra Dun for further testing. Meanwhile, drilling was resumed. More oil shows were spotted between 3116 and 3130 metres. The well was drilled up to 3,817 metres in 117 days. It was decided not to go to the target depth of 4,000 metres. As per practice, electro-logging was carried out.

The interpretation team of Russians and ONGCians decided on the zones to be tested. By then, the Central Government had constituted a team of AOC and ONGC officers to meet once every month and review activities. It was decided to have another logging done by the French Schlumberger unit available with AOC. The process was no different from the one by the Russian OKC-56.

Soon, the interesting zones were tested and the Barail Main Sand (BMS) showed potential for oil. The Commission had just one production testing equipment, and the oil search had already spread across three corners of the country. The equipment took a long time to reach Sibsagar and it took almost 132 days to conduct the testing. In spite of all the troubles, pain, frustration and endless waiting, the smell of crude during testing had a cathartic effect. The celebrations continued night after night.

The Commission had tasted success once again. Sibsagar was all set to become the next 'Oil Town' of Assam. The names Barail and Tipam, two of the producing sands, were the toast of the season.

VISIONS GET ENLARGED

Two wells in Assam had taken almost two years. More drilling rigs were needed to prove the Cambay field. Ankleshwar remained a potential goldmine with an estimated reserve of 100 million tonnes. To instill confidence in the new organization and to give an optimistic outlook to policy makers, Kalinin had put forward a plan to establish a mini-refinery near Cambay well #2 at the end of the 60s. Assam was finally on the oil map with Rudrasagar. But all the three provinces, including the elusive Northern belt, needed more men, material and money to develop the oil fields.

Now the attention was focussed on two fronts. The first was to develop the oil fields. It was the toughest of any jobs. It needed imagination, scientific insight and knowledge to decide the development of an oil field, spread over hundreds of kilometres. The second was to get ONGC sufficient funds.

It was felt that a fast-moving trailer-mounted rig would be the ideal for Ankleshwar, considering the relatively shallow depth of its pay-zones. The Russian rig, though efficient, was very cumbersome to dismantle and re-assemble. Malaviya was asked to get a proposal ready for the Planning Commission with an eye on American equipment.

It was decided to purchase Nat-45 rigs from USA. The purchase required a foreign exchange component of $500,000. Malaviya approached the Finance Ministry, which directed him to the Planning Commission. The rupee had once again been devalued due to a sudden paucity of foreign exchange which made the Planning Commission more circumspect. Malaviya went back to Nehru, who asked for a special meeting of the Planning Commission to be called immediately. Within no time, Nehru convinced the Planning Commission members about the importance of the matter, and asked them to accord the highest priority to ONGC's requirements. The matter was settled and the amount was sanctioned.

All this while, A.M.N. Ghosh and M.B.R. Rao were standing in the corridor near the room's entrance. As Nehru stormed out after the meeting, he spotted them and said: "I have got you the money, don't let me down." ONGC was provided a budget grant of Rs. 62.19 million for the year 1959-60. The total funds advanced to the Commission by the government stood at Rs. 84.27 million. The news spread through ONGC circles like wildfire with staff being inspired by this kind of support from the highest quarter.

Another chain of events would now turn the 'boys' into men.

In those days, ONGC published a monthly newsletter, a valuable source of information for people working in far-flung areas. From 1957, it started publishing valuable articles on every important aspect of the oil industry. Apart from technical articles, it had a section enumerating the technological advancement in other parts of the world.

Around 1959, excerpts from the columns national and international newspapers on pricing issue were reproduced repeatedly in the news letter. One issue caught the attention of readers. Oil companies had agreed to give up duty protection with simultaneous price reduction. The government stood to gain Rs. 150 million from the price cut.

Meanwhile, the gushing Russian oil was wreaking havoc in the world markets. The carefully worked-out deal of 1928 by the Seven Sisters was under increasing threat. Iraq was threatening to nationalize Iraq Petroleum Company (IPC) and the falling world crude price was a constant source of worry. This fear was stoked by Nasser, the original rebel from Egypt. He advocated the use of oil as a weapon. Finally, the multinationals blinked. Despite different sheikhdoms uniting against price cuts, Exxon reduced its posted price by 10 cents. As per the agreement, all the other six majors also lowered prices.

Immediately, the oil producing countries decided to take some drastic steps. On September 9, 1960, representatives of five countries, Saudi Arabia, Iraq, Iran, Kuwait and Venezuela, met in Baghdad. Their combined output then constituted 80% of the world oil production.

OPEC was formed with headquarters in Vienna. But it was not able to do much in its early years because of internal rivalries and the fact that America had surplus stock and Russia was flooding the market with cheaper oil. But its birth had given a shock to the multinationals.

Two reports landed on Nehru's desk in 1960. The author of one of them was Lord Moncton of BOC. It was passed on to him by India's last viceroy, Lord Mountbatten. The other was a World Bank-sponsored article on the oil industry in developing nations by journalist Walter Levy of New York. Nehru decided to reply to Mountbatten personally, considering his friendship, and handed the Levy Report to Malaviya for perusal. He in turn passed it on to Ghosh.

When Ghosh got the Levy report, he was recovering from a massive heart attack. The constant travelling had taken its toll. Ghosh asked petrologist V. Raghavendra Rao to prepare a reply. Ghosh signed it and gave it to his wife for safe custody and then died.

The Commission was in shock. It had lost a father figure. Ghosh's final missive couldn't have been a better endorsement of his boys. In a long reply, he was at his best. Inflated figures of American exploration costs were not pertinent in India's context, he argued. He opposed the comparison to other third world countries as India had already established its credentials with a new oil province in Gujarat.

Riding on a wave of confidence ONGC moved on. Yet, in 1960, it was at the crossroads. Rudrasagar in Assam was proving to be a bigger problem than anticipated - the initial oil flow became water flow after some time. The rig was under repair. However, the Cambay oil field was showing more presence of gas.

The Commission enthusiastically set foot in the three provinces of Assam, Punjab and Gujarat. There were 17 geological parties spread across the country scouring the southern coastline, climbing hills in Jammu and Kashmir, going over the plains of Orissa, Bengal, Bihar, Kutch and Saurashtra. An equal number of gravity-magnetic and seismic parties were operating in places far and wide.

An oil discovery brings in many posers after the initial euphoria: How big is the field? Where to place the wells? How many wells to drill? At what rate would the oil be brought to surface? How to organize the rigs required for development of an oil field? How to lay pipelines and connect wells? Where the oil would be collected? How would it be transported?

In 1959, a Design and Manufacturing Unit (DMU) was established to make small working drawings of equipment and spare parts. Young mechanical engineers were assigned to the unit. Some Russian engineers came over to train the understudies.

A production department came up, too. H.P. Arahna was made the chief production engineer. A group of assistant drillers with mechanical engineering background were inducted into the department. S.K. Manglik, A.K. Gupta, K. Damodaran, A.V. Anand, P.N. Palaniappan and others from the drilling department were inducted into that department.

Some of the newly-chosen production engineers were sent to Digboi oilfields to learn production techniques. It was a good experience to see the almost 100-years-old oil wells being coaxed back into life. The production chief of AOC, N.D. Mahant took keen interest in the training. He later joined ONGC as Director (Production). The motley crew was also sent to Iranian oilfields of NIOC for a few months. Back home, the Russian engineers were there to give them hands-on training. Some young engineers also were sent to the oil fields of Baku to learn the Russian techniques of oil production.

The people of that era could never forget the services of Nikolai Sevostyanov who along with Yarapolk, taught the basics of geophysical interpretation to a whole new generation. The early-day ONGC loggers owe their knowledge to Anis Shakirov. He once repaired an electronics-loaded logging unit in 20 days after it fell into a ditch. Prof Itenberg, another well log interpreter and a UN sponsored expert, taught the young crew vital lessons in interpretation and formation evaluation techniques. The geologists had the rare opportunity to learn from experts like Naugolny, Zubov, Nikitin and Nikolay Zapivalov.

This bonding would provide the base for Ankleshwar field development and all future collaboration. But no one knew about reservoir management. As Leverson put it, "The problem of reservoir management was about producing the greatest possible amount of oil and gas from a pool and bringing it to the surface at the lowest possible cost." Dr Inderjit Singh was the first to be chosen for reservoir discipline. Simultaneously, a Production and Development Group (P&DG) was formed with C.K.R. Sastry as its head.

In addition to Russian help, Malaviya had developed friendship with Enrico Mattei of Italy who had started Ente Nazionale Idrocarburi (ENI) as a state enterprise like ONGC without a single barrel of oil. In 1961, ENI agreed to give a loan of Rs. 460 million to help the Indian oil industry. It had already agreed to train Indian understudies at its institute and drill a well in Raxaul in Bihar with its own rig. Later, they drilled more wells in Mohand, Bahl and Janauri. Mattei died in a plane crash, which remains a mystery even today. His successor, Professor Boldrini, maintained close contacts with ONGC in subsequent years.

Malaviya's other friend was an equally dynamic Prof. Navarre of IFP France. Right from the inception of ONGC, Navarre was a constant source of support to Malaviya. It was he who suggested a research institute on the lines of IFP for India. France provided the loan and the Indian Institute of Petroleum (IIP) came up in Dehra Dun. As the French had gained worldwide reputation for the discovery of oil and gas in the Sahara Desert of Africa, Malaviya enlisted their help for geophysical investigation in the deserts of Jaisalmer. Thus, a new wave of exploratory surveys in Jaisalmer was initiated.

The Commission had by then taken keen interest in organizing oil seminars too. Young apprentices were encouraged to present papers for discussion. The first such seminar was the 'Ganga Valley Symposium' held at the Doon School in 1958. Malaviya then persuaded the headquarters of the Economic Conference of Asia and Far-East (ECAFE) in Bangkok to hold a seminar on 'Oil Prospects in ECAFE Region' in Delhi. Held in December 1958, the seminar attracted oil field experts from all over the world. It stressed the need for research in oil exploration in the ECAFE region.

Subsequent visits to foreign research institutes highlighted the need for a full-fledged research institute. ONGC's own laboratories were already overloaded with thousands of samples from all over waiting to be tested. The United Nations Development Project (UNDP) agreed to fund the setting up of a research institute, which was set up at Dehra Dun in 1963 headed by Dr Hari Narain. It was named Research and Training Institute (R&TI).

Malaviya also wanted a refinery to come on stream to coincide with the development of the Ankleshwar oil field. Kalinin had given an approximate figure of 2 million tonnes per annum. Accordingly the Russians, already working on the Barauni refinery, were approached to help establish a refinery in Gujarat.

On February 21, 1961, the Government of India signed an agreement with the USSR for the Gujarat Refinery and oil field equipment for ONGC. A committee was formed consisting of representatives from ONGC, Indian Refineries Limited, government of Gujarat and other agencies. Koyali, near Vadodara, was chosen as the site. It was to go on stream in May 1964.

Then Malaviya turned his attention to petrochemicals. A team was asked to conduct feasibility studies on a Petrochemical Division.

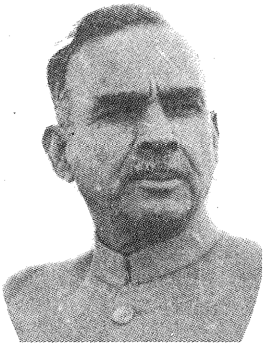
Meanwhile, three field seasons (1957 to 1959) had vindicated Kalinin's hunch of an oil bearing structure beyond the shores of Gujarat. Geological and geophysical surveys in areas like Olpad, Kim and others pointed to the Cambay Basin extending beyond the Gulf of Cambay and into the deep sea.

Initially it was thought desirable to take the help of French authorities to conduct seismic surveys in the Gulf and adjoining areas. But the cost turned out to be on the higher side. B.S. Negi was then asked to explore the possibilities of ONGC doing an offshore survey on its own.

ONGC had its hands full. Once again, Malaviya had set a target and was leading from the front. He knew that there would be mounting scrutiny of the Commission's activities. He set up a publication and publicity division and inducted a Public Relations officer. A petroleum information service was also created under Sailen Ghosh in the Ministry of Mines and Oil to present a correct perspective of the Government's oil policy to the public at large. An exhibition division was also established within ONGC.

Armed with essential ingredients and dreams, the next four years (1961 - 1964) would see ONGC operate on a war footing. Later, some would name it 'The Blitzkreig'. Ankleshwar became the battleground. It was decided to drill four to five wells to ascertain the underground reservoir behaviour. The Uralmash, now lovingly called *Saphala* was put on the job.

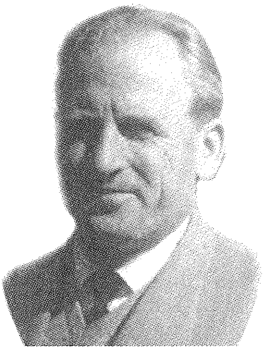
Pandit Jawahar Lal Nehru



K.D. Malviya

A.M.N. Ghosh

Visionaries

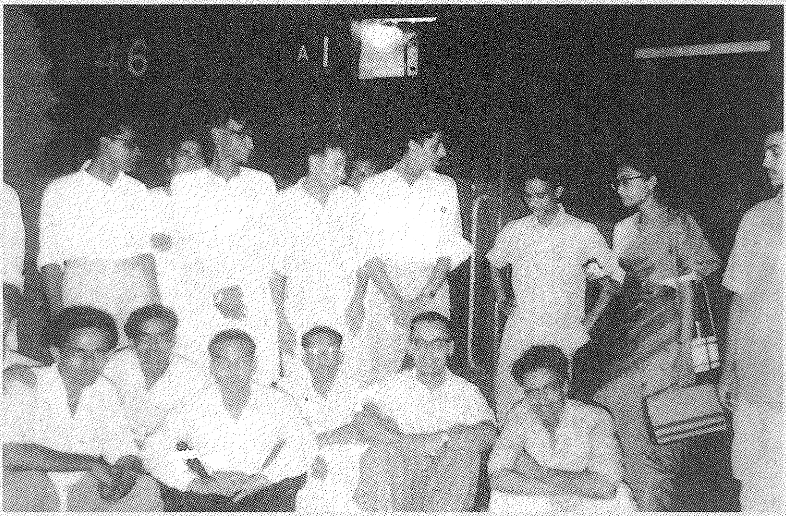


N.A. Kalinin

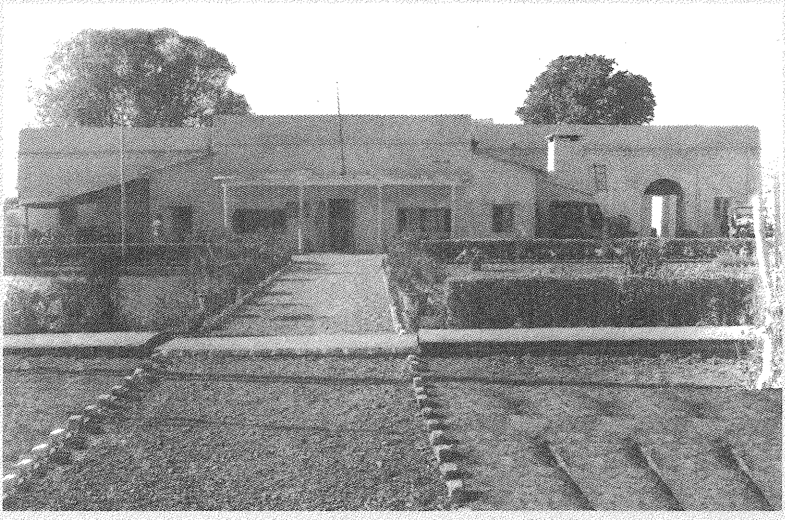
M.B.R. Rao

KD Malaviya and AMN Ghosh in Russia in 1955

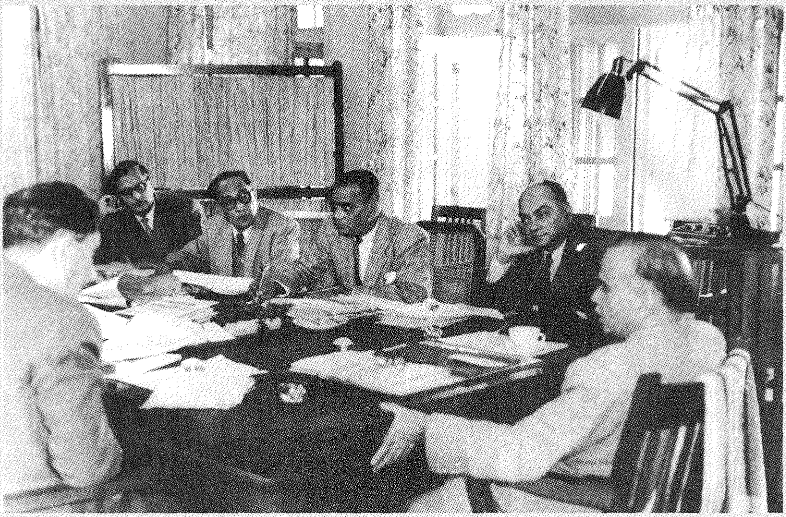
Patial House in 1956



Employees of the Directorate board train for Dehra Dun in 1956

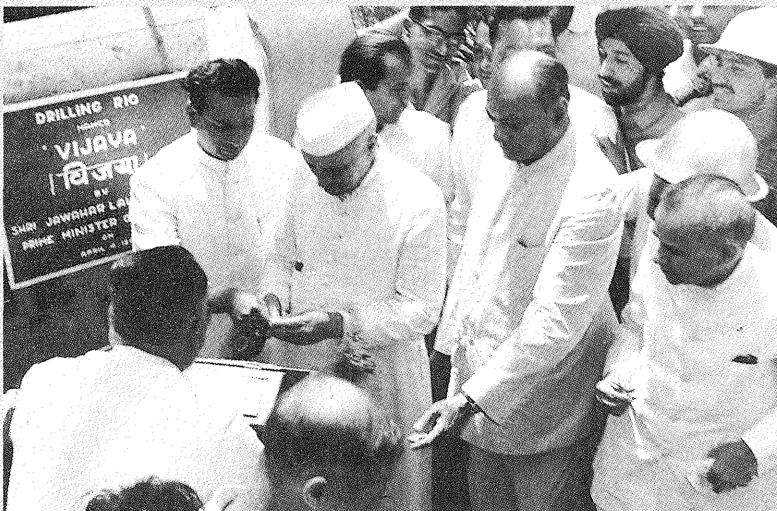


Laboratories come up at Naaz building, Dehra Dun

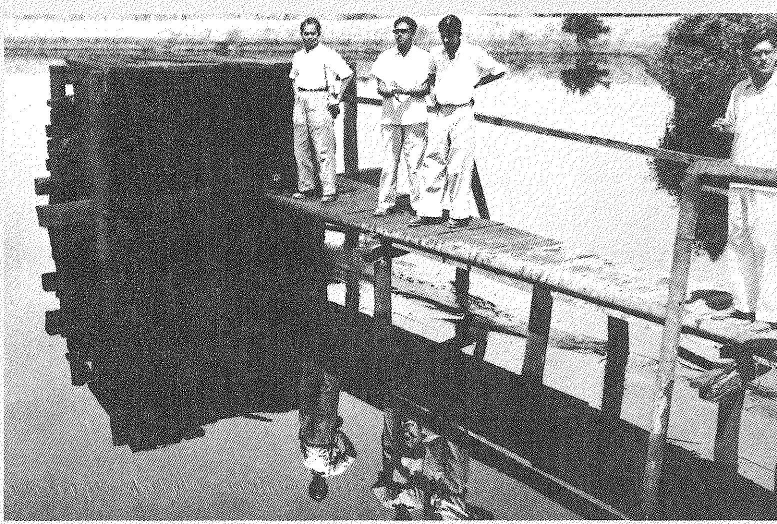


Malaviya chairing Commission's meeting

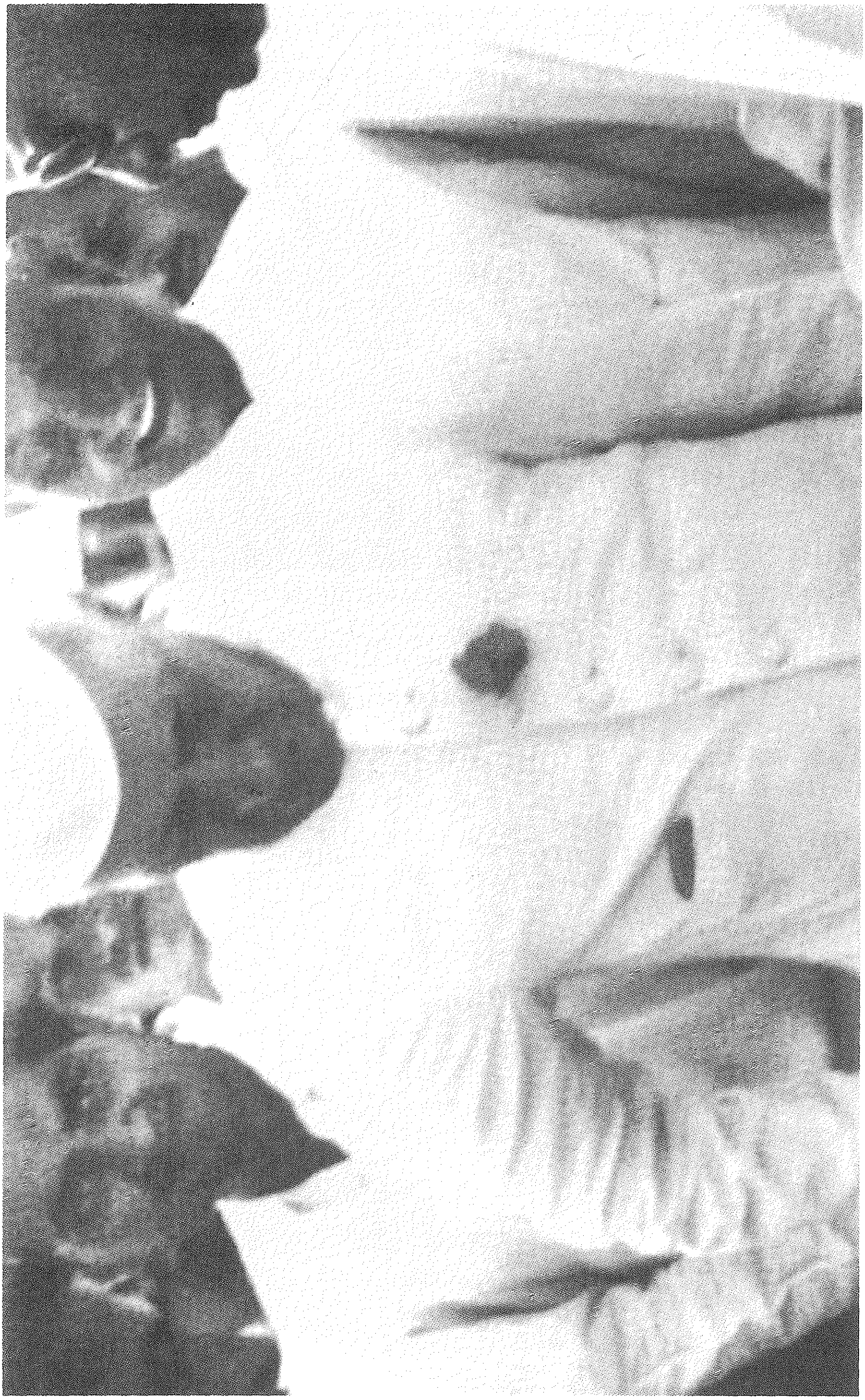
Kalinin and ONGC veterans brainstorm



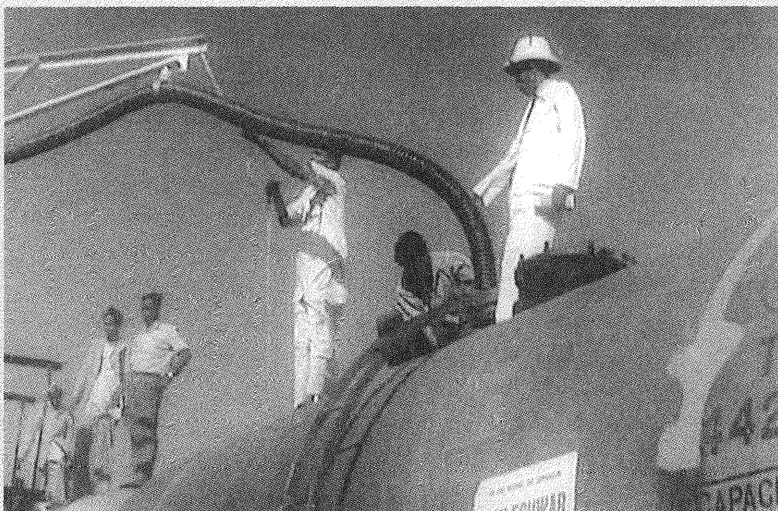
Nehru christens the rig *'Vijaya'*



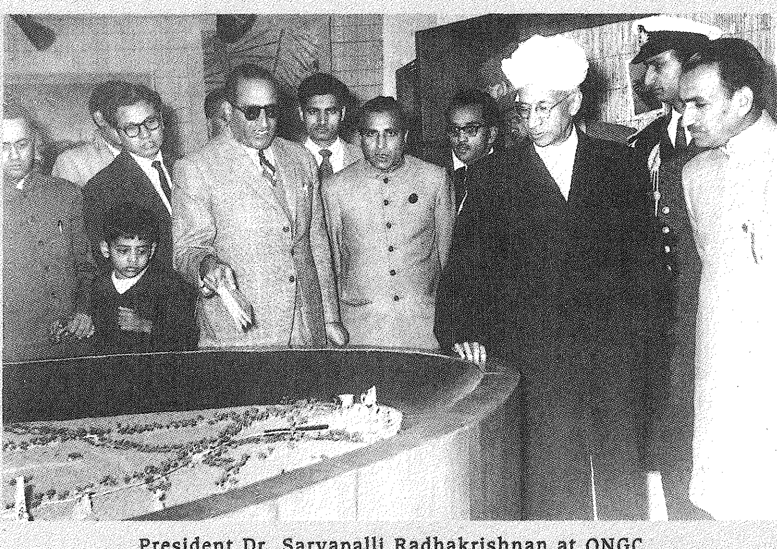
Oil pit at Cambay #1



Oil drops on Nehru's *Sherwani*

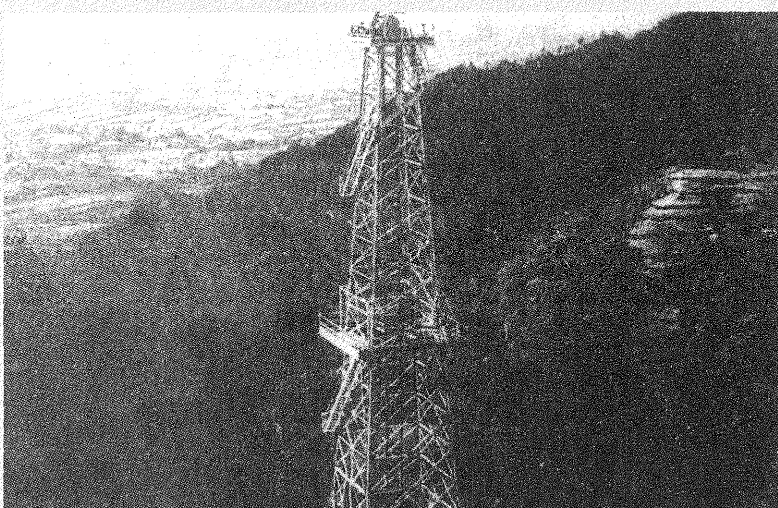


Ankleshwar oil heads for refinery



President Dr. Sarvapalli Radhakrishnan at ONGC

Glimpses from the past



Rumanian Rig 5-LD at first well of ONGC at Jwalamukhi

PART THREE

THE HUNDRED METRE DASH

THE TRAGIC BEGINNING

"My God! We have lost it!"

The string of successes with rig *Saphala* was suddenly punctuated by an unexpected event. In a blowout which went out of control, the earth caved in swallowing the entire rig.

Nat-45 was yet to arrive. The Ankleshwar discovery well was capped (temporarily closed). Within a year, *Saphala* drilled five wells including a directional well at location # 5. Directional drilling was a developing technology worldwide.

The site of the tragedy, Well #7, was located very near to the pond. The rig building was over. The drilling started according to plan. There was no indication of an impending disaster.

On May 19, 1961, while drilling at 450 metre, gas started surfacing. Uncontrolled shallow gas flow was one of the biggest tormentors in the Cambay Basin. From 1958 onwards, each well in Cambay had faced gas or superheated steam flow of one kind or the other. All of the 15 shallow wells drilled in Vadodara also had problems with gas.

This was a new complication. The gas flow was between two strings of casing. As one drills deeper, the intervening depths are cased off and cemented to isolate different zones. The problem was with cementing. The isolation was not proper, and cement had developed cracks, allowing gas to leak through. The BOP couldn't do anything.

At 12 noon, the hissing sound of gas became a roar. Frantic messages were sent. It was 'May Day!' the call sign of distress.

The Russian master driller and the Indian crew were not prepared for the ferocity of gas flow. The whole drill site was covered in a thick blanket of gas. The crew fought to control the well. Ankleshwar town didn't have any fire-fighting engines. There was an imminent threat of fire. All off-duty crew rushed to the drill site. Then everyone started praying for the gas flow to subside. But, there was no sign of it. Anxiously, they waited for the second best thing to happen, for the formation to collapse and smother the gas flow. That also didn't happen.

Seeing a real fire hazard, people were evacuated. By evening, the area around the rig developed cracks and the soil turned loose. After a few hours, a small crater started forming. The crew watched helplessly as the crater became bigger and bigger. The rig was shaking violently and there was gas all around the crater. By the night of May 20, 1961, half the rig had gone down.

May 21, 1961: With tears in their eyes, the crew watched helplessly as the entire 150-foot rig weighing 2,000 tonnes went under. All they could see was a few feet of the rig jutting out of the surface. The gas flow had also stopped. No one said anything. They waited for a few more hours. The gas had subsided. With a couple of tractors, the night shift crew dragged away the remaining two mud pumps and two diesel engines. That was how the valiant rig *Saphala* went down fighting. Forty-five years down the line, a small part of the rig can still be seen near the Hajat pond.

This sent shockwaves in every quarter. Parliament was stunned. Malaviya felt very helpless. All his dreams for the speedy development of Ankleshwar were under threat. There was one more problem. There were no rigs for Ankleshwar. The ever-optimistic Malaviya consoled everybody.

Another Uralmash 5D, operating in Cambay was mobilized. In the meantime, the Nat-45 had also arrived. As per the agreement, an American engineer arrived to check the packing list. After checking the equipment and giving guarded replies, he left.

The Indian agent, Greaves Cotton, had supplied the layout of the rig. Using all of his experience and familiarity with American rigs in AOC, A.K. Mitra got his crew to assemble the rig from scratch. When it extended into the sky, everyone exclaimed: "Beautiful!" It was an engineering marvel. After completion of drilling, it could be folded and a truck would carry it to a new location. Whereas it took almost 20 days to dismantle and reassemble a Russian rig, it took only six hours in case of NAT-45.

NAT changed the pace of drilling. Most of the pay horizons were in 1,400 to 1,500 metres depth range. In the first couple of wells, the progress was a little slow. Men needed to know their machine. Once they had a feel of its strengths and weaknesses, drilling speed increased. From 20 days to drill a well, it came down to 10 days. There were no 'off days'.

The distance from the Ankleshwar oil fields to Bharuch was hardly 20 kilometres but that short distance looked a lot longer when time was short. When one could finally manage a break, some emergency would always crop up and it would be back into overalls again for work. No one was taking any chances. The loss of *Saphala* was enough to shake off any complacency.

Now the people followed a pattern: Drill a well, case it, and pause before cementing. Bad cementation was the cause of the earlier blowout. Oil well cement is different. The country didn't produce any. It was too expensive to import. With the help of Russian friends, the scientists had developed a retarder to mix with locally available *Japala* cement. Moreover, there was just one cementing unit. Mud pumps were used as substitutes for cementing units. Pumping was a tricky affair. The catch was in giving cement enough time to travel all the way down the drill pipe, climb up the annulus between the pipe and formation and set slowly. People took out engineering manuals to study flow characteristics. They did learn their lessons well - the quality of their cementation has stood the test of time for the last 45 years.

After logging, a Christmas tree was installed on the well and the tractors would move the rig to the next location. This was a clever way to drill faster. Once the rig was moved out of place, the production people came with their Work-Over Rig (50 -Tonne capacity) to do the production testing.

The pace of activities and the excitement of an oil find called for distribution of sweets. Every success was celebrated.

VADODARA BECOMES THE HUB

Ekbal Chand, Secretary to the Commission, was sent to Vadodara as the Chief Administrator to set up a regional office in 1960. He hired the other four bungalows available at Makarpura. In another prudent move, ONGC bought 150 acres of land behind those quarters.

Vadodara town was on the other side of the railway tracks. There were no buses plying between the town and the Makarpura village where the ONGC office was.

As time passed, the Vadodara region extending to just two projects, Cambay and Ankleshwar would encompass many more like Ahmedabad, Nawagam, Mehsana and others. The Chief Administrator was replaced by a General Manager. A project had Project Manager to look after day-to-day operations. Each installation was designated as a mine and a Mining Lease (ML) was obtained for operation of the mine. The General Manager, as the head of the region, was called the Mines Owner. The Project Manager was the Mines Manager.

In May 1963, a residential colony with 250 units for workers was inaugurated by Prime Minister Nehru. Separate houses were hired for the Russian and Rumanian experts in the Alkapuri area.

The central workshop at Vadodara was conceived in the early 60s. C.D. Mirchandani had the responsibility of setting up the workshop, with Rumanian help. The first phase of the project was commissioned in 1965. Spread over 40 acres of land, the workshop made a tremendous difference to the efficacy of operations. It had the facilities to undertake major repairs and overhaul drilling rigs, heavy transportation vehicles and tubulars. It could even indigenise smaller spare parts.

Dr M.K. Indra was moved from Dehra Dun central laboratories to set up a regional laboratory in Vadodara. It helped to instantly check the samples and cores.

With the anticipated increase in work in the western region, the need for a specialized design institute became imperative. In 1962, a small group of mechanical engineers was chosen to start work on the design of production installations for the Ankleshwar oil field development. They were under the supervision of Russian design engineers, M.V. Movsumzade and T. Markariatz from the Baku oil design institute. That was the beginning of the Hind Oil Design Institute (HODI).

Later, the institute was shifted to Dehra Dun under the supervision of I.A. Mezhlumov who was the Chief Design Consultant and Director of the Institute. P.T. Cherian, an experienced mechnical engineer, joined as Assistant Director. For the first time, the integrated project design concept took root in the Commission. It took every factor into account: techno-economic, mechanical, instrumentation, site-planning, sanitary, structural and electrical.

These moves made a world of difference to the working of the Commission.

With the basic infrastructure in place, the Commission decided to start selling its crude and earn the first rupee. But there were no buyers for its oil. The multinational refineries had their own arrangement with their principals for crude supply. Malaviya had a small battle on his hands. The scene of action now moved to three different places: Delhi, Mumbai and Dehra Dun.

ANKLESHWAR OIL HEADS FOR THE REFINERY

As the pace of drilling increased, Malaviya asked ONGC to prepare the roadmap for Ankleshwar oil. A small marketing wing was established in 1961. When they approached the two multinational refineries in Mumbai, the response was lukewarm at best. The reasons given were frivolous: the Ankleshwar crude would not suit their plant, there was no capacity, and the handling facilities were inadequate and so on. Pricing was another issue. They were not prepared to pay the price the crude deserved.

Malaviya was incensed. He donned battle gear once again. With direct and indirect threats, the companies relented. But the pricing issue remained unresolved. Malaviya's main concern was to get that crude cracking in their tall columns. Boothalingam, an experienced ICS officer, had just been brought in as a Member (Refineries). S.S. Khera, Petroleum Secretary, was also a shrewd negotiator. He had been with Malaviya for more than three years. The pricing negotiations went on for a long time.

Meanwhile, the 'first 100 tonnes' were ready by August 15, 1961, five years after the birth of ONGC. After the trial production, it was ready for transportation.

The production engineering crew was busy tying up wells left behind by the drilling crew. The first Group Gathering Station (GGS-1) came up. One could not just take out crude oil and sell it. When it surfaced, it carried a lot of water molecules, gas and other sediments. The GGS was the solution. From the wells, the oil flowed through a 4" or 8" pipeline connected to a tank. Using diverse methods like heating or cooling, oil, gas and water were separated.

In the early 1960s, there was a tremendous shortage of steel tubulars. Rourkela Steel Plant, Orissa, had a pipe shop which was yet to come on line. As such, oil field tubular had to be made from special steel to take care of very high temperature and pressure. The country was ready for water pipe lines only. ONGC, however, had managed to secure supplies from Russia, Italy and other friendly countries. The design institute went on supplying simple and working Russian designs for the installations.

A few engineers and technicians descended on the Panoli railway station, where Railway authorities had granted permission to set up an oil terminal at one end. The area was cleared of dry vegetation and a temporary arrangement was made to pump the oil into the wagons. With grit, determination and innovation, good quality oil was brought till the Panoli railway siding.

September 1, 1961: On that red letter day in the history of ONGC, a tanker moved in to the railway siding at Panoli for carrying Ankleshwar crude. Action had started early that morning. The rake was decorated with marigolds. Coconuts and conches were arranged. The media arrived. It was a big day, a day for celebrations. Trial production, within 15 months from the day of discovery was stunning news in the world of oil

Malaviya, with all senior officers of the Commission, was there to flag off the train. The oil was transferred to the 5,000 cubic metre wagons. S.K. Manglik had to accompany the train. Ankleshwar oil was no less valuable than gold. Climbing on to the guard's cabin, he saw the flag come down. The train was on its way to Mumbai.

However, the Burmah-Shell people were not very co-operative. They had extracted a concession that ONGC would arrange the onward movement from the railway siding to their refineries. The initial behaviour of the Ankleshwar wells was a big relief to everyone. The oil flow was consistent.

By the end of 1962, 37 wells were drilled in Ankleshwar; all except four were oil-bearing. Those had to be put on line. In four and a half months, four GGS came up. Each GGS was designed to handle 1,000 tonnes of crude per day from 20 wells. A Central Tank Farm (CTF) came up at the Pilodra village nearby. It was where the oil, devoid of any contamination, was stored. It had 21 steel storage tanks of varying sizes, 11 gas/oil separators, 4 boilers and 12 electric pumps. The first CTF was built with 90% indigenous material. It had a pumping station, a fire brigade house and a small production workshop. The GGSs and CTF needed 15 kilometres of good roads to connect with the Panoli railway siding.

The Gujarat Government had sensed a bonanza coming. All these installations needed continuous electric supply. A separate cell had come up with representatives of the government and ONGC. The Chief Secretary to the State Government was made the chief coordinator. All decisions were taken on an emergency basis. The interaction between industry and the state government became a case study. Gujarat stood at the threshold of becoming the most industrialized state in the country.

By the end of 1962 it became apparent that Cambay was turning out to be a gas field. The utilization of gas was an issue. In Ankleshwar, the associated gas, produced along with the oil, was being flared. The wastage of gas was discussed in Parliament. There was a shortage of coal in Gujarat. The state government requested ONGC to supply Cambay gas to Dhuwaran power generation plant. They agreed to change their system to use gas as a feedstock. ONGC started supplying gas to this 700 MW power station. Seeing the opportunity, Gujarat Electricity Board (GEB) took up another coal-based power plant, Uttran, near Vadodara, for conversion to a gas-fired one.

Planning for any type of pipeline project often begins years in advance of actual construction. Initial steps in the planning process include determining the market need, pipeline design, specifications of pipe and components, route selection, soil investigations, environmental assessments, public consultation, land acquisition and permissions. A separate pipeline division, Gujarat Pipelines Project, came up within ONGC. To liaise with Government authorities, K.K. Dhar, IAS, was made the administrative head of the group. One young and energetic mechanical Engineer, K.K. Rao, was given the responsibility to kick-start the project.

A Pipeline Act 1962 was formulated and passed by Parliament. A pricing committee was formed to negotiate with potential customers, including the Gujarat government. The pipelines proposed were as follows:

- Ankleshwar- Koyali crude line of 14" diameter (AKCL)
- Ankleshwar-Vadodara gas line of 14" diameter (ABGL)
- Ankleshwar- Uttran gas line of 16" diameter (AUGL)
- Cambay- Dhuvaran gas line of 14" diameter (CDGL)
- Koyali- Sabarmati (Ahmedabad) pipeline of 8" diameter (KAPL)

Bechtel Corporation of USA was appointed as technical consultants to the project. ENI's subsidiary SNAM was given the contract to build. They co-opted Mumbai based Dodsal as an Indian partner who were to look after the construction.

ONGC would own, operate and maintain the lines. Accordingly, freshly recruited mechanical engineers were sent to Italy, USA and other places to be trained in various aspects of pipeline projects. They would ultimately establish the Construction and Maintenance (C&M) division at Vadodara.

The cumulative distance to be covered by the pipelines was about 365 kilometres. Besides negotiating major and minor river systems, the pipelines had to avoid human habitation. Gujarat had never seen this kind of activity before. Additional men and material were organized from Mumbai, Rajasthan and other neighbouring states. It was very uneconomical to construct separate bridges to carry the pipelines over rivers. The negotiations went on for months as the ground work proceeded on schedule. Finally, Railway authorities agreed to allow under-pinning of lines across the rail bridge over river Narmada and the Gujarat Public Works Department allowed under-pinning over river Mahi.

Work went on day and night. It followed an assembly-line model in a factory. The forward party cleared the path of any obstructions. The second group dug up trenches and built concrete support for the pipelines. The third group laid the pipelines with cranes. Welders worked on hundreds of joints. Pressure testing was done with water which was the biggest challenge. Pipes burst and valves leaked.

The completion of the project was definitely rewarding for the state of Gujarat.

Subsequently, provisions were made for gas supply to Vadodara Municipal Corporation for domestic use. Thus, Vadodara became the first city in the country to boast of piped natural gas as cooking fuel.

All these projects had one target: coincide with the commissioning of the Koyali refinery. Accordingly, the Ankleshwar-Koyali crude pipeline was commissioned on September 11, 1965. Ankleshwar-Vadodara (fertilizer factory) associated gas pipeline was completed in November 1965. Ankleshwar-Uttran power house gas line reached the target in September 1965. Cambay-Dhuvaran 'free' gas line started supplying in December 1964. Koyali-Ahmedabad products pipeline was commissioned in April 1966.

All these projects were dependent on the development of the oil fields in hand. In 1961, Kalol, to the north of Ankleshwar, was discovered. Nawagam also appeared on the oil horizon. Kalinin advised the development of Ankleshwar, and simultaneously, to carry out exploration and drilling in other areas. A group of reservoir specialists, led by Dr Orlov, landed in 1963.

The first assignment for the team of Russian and Indian specialists was to understand the petroleum accumulation of the area. The Russian reservoir engineers taught the Indian geologists the first lesson in reservoir management. It was a vital lesson. By 1963, the basic behaviour of the field had given some leads. Based on those conclusions, Dr Orlov drew up a working plan for the development of Ankleshwar. He estimated the in-place reserves to be 46 million tonnes. ONGC aimed at an ambitious 60% recovery from the field. Dr Orlov prepared a plan for specific producing sand zones (S2 and S3+S4) in minute detail. A total of 114 production wells were to be drilled. A preemptive water injection from the periphery of the field was designed. Additional energy was to be provided by 11 water-injection wells as the natural energy depleted. A committee was formed to keep a careful eye on the exploitation of oil fields.

R.D. Verma from the UP Irrigation Department had joined as Member (Production). Wells were drilled in Tapi River in Surat district. The water was pumped for about a distance of 40 miles to a water treatment plant. Four water injection pumping stations were established in the northern fringe of Ankleshwar field. It was an engineering feat.

The onus now shifted to the drilling directorate. The target was stiff: 200 wells in two years. They took up the challenge. The number of rigs had increased to eight, which included Russian, American and Rumanian rigs. Spare parts were hard to come by. The central workshop at Vadodara was trying its best to meet the increasing demands of repairs. It started encouraging local manufacturers to start producing on a mass scale. But sensing the seasonality of demand, the local industries were not much enthused. Each rig was a factory by itself; roads had to be laid, transportation arranged. It needed chemicals, diesel for power generation, tubulars, BOPs and assorted spares.

Like the American Nat-45, Russians had supplied truck-mounted BU-75 Rigs. BU-75 usually took 20 days to complete a well of 1700 metres. In addition, the old work horse 5-D and Rumanian 4LD were also operating in the field. This wide variety of rigs posed a challenge in maintenance management. Another immediate need was of trained manpower.

The Commission went on a recruitment drive. Each rig needed around 100 people: fitters, welders, diesel mechanics, contingent laborers, rig men, top men, carpenters and so on. Each one was given a short training in the technical training school which had come up in Cambay. When they arrived bewildered at the drill site, the seniors would take pains to point out each and every facet of operations. Within a few days, they were to be on their own in regular shifts.

Ancillary departments came up equally fast. A transport department started functioning under I.P. Kaushik. A stores and purchase directorate came up. Col. K.B. Menon was brought in as Director (Stores). Using his contacts with the then Defence Minister, V.K. Krishna Menon, Malaviya had arranged for retired brigadiers and colonels to bring in some order in the expanding projects. After some time, nearly all the projects of the Commission had an Army officer as its head. Brig. S.C. Vyas was brought in as Director (Administration) at Dehra Dun.

Making short-term arrangements for equipment, nearly 200 wells were drilled in Ankleshwar. If a well turned dry, the well head was cut to be used in a new well. Casings were retrieved. No wastage was tolerated. It was, in fact, an army operation. The drill site in-charges used to report to the Drilling Director at 8 a.m. sharp. After getting crisp instructions, eight brand new jeeps went in eight different directions to carry out the operation. The Ankleshwar success story had spread far and wide. A group of generals from the Pakistan army came to visit the Ankleshwar fields. They were amazed at the efficiency of the operations.

The oil operations came under the Director General of Mines Safety (DGMS). People took as much precaution as possible. Yet, there were a lot of minor and major injuries. The supervisors used to go through the 'Safety' column in ONGC Newsletter that highlighted various safety topics.

The Logging crew with OKC-56 was the most harried lot. They were equally bitten by the 'get more oil' bug. They would rush to the drill site, take the electrical logs, come back to the make-shift laboratory for log interpretation, and be on the road again.

The Ankleshwar oil field is a tribute to all those known and unknown faces. It also became an open school of sorts for the Commission. Workers and managers graduated from the fields of Ankleshwar. The very expression "I worked in Ankleshwar" drew respect from every quarter. Ankleshwar entered the school geography books. It was no more a mere *taluka* in the district of Bharuch.

Ankleshwar oil production reached a maximum of 8,300 tonnes per day by

1969. The cumulative oil production was 3.03 million tonnes per year. For the next 10 years, till 1979, the same production level was maintained, thus achieving a recovery rate of 50%. It was a world record by any standards. All subsequent field development of ONGC followed the Ankleshwar model.

Meanwhile, Ankleshwar colony flourished at it colorful best. Because of its small size, healthy social interaction brought in a new form of closeness. This camaraderie of community life withstood the fury of wars, floods and earthquakes.

No one can forget the experience of the effects of the war on the operations in 1965. All field personnel were asked to camp at the work centres. Gas flaring was very common in those days. Overnight, tall columns were designed and installed to release gas at a height for cold flaring. Civil defence drills were held amidst rumours of enemy agents parachuting down to destroy oil fields.

The flood of 1968 was a real challenge. The whole of Ankleshwar oil field remained submerged under water for more than 10 days. Road and railway lines were washed away. Communication was cut off. The Commission survived the flood. Production was brought back to normal as soon as the flood waters receded.

The massive earthquake of 1970 had a different effect on ONGC. Though none of its installations was damaged, some myths were born. Some people blamed ONGC's underground operations for the earthquake. But the rumours never affected the relationship between field workers and the local population. At the time of any disaster, it was ONGC and its crew which came to the rescue of people in far-flung areas.

The indefatigable team of geoscientists was discovering new structures at regular intervals - Sanand, Kalol, Mehsana, Kathana, Olpad, North and South Kadi, Sobhasan, and Wavel. The structures were both in the north as well as south of Cambay. An interesting pattern was observed. All structures north of Cambay contained heavy oil; all structures south of Cambay, which included Ankleshwar, had light oil. There was improvisation in every area: geophysical equipment, drilling rigs, production installations.

The blitzkrieg had its sad moments also. There were fires and more blowouts. The blowout at Olpad #7 resulted in one death and complete loss of the rig. Like Saphala, it just vanished into a big crater. In some cases, Army help was sought to move in tanks to fire explosives at the well mouth. The temporary absence of oxygen caused by the explosion killed the fire.

ONGC had become a model company. Each unit was an industry. The moment it landed in a desolate area, the place was cleared up with bulldozers. Tube wells were dug. Metalled roads were built. Compensations were paid to the villagers for the lands acquired. Local people were recruited. Temporary houses were built for the crew. Local markets were swamped with orders to cater to the varying needs of the oilmen from different countries. Electricity lines were drawn for production and pipeline operations.

Once the rig moved away, the infrastructure was handed over to the villagers although Corporate Social Responsibility (CSR) had not then entered the business lexicon. The oil and gas supplies changed the face of Gujarat. Hundreds of factories came up in and around Vadodara, Ankleshwar and Surat. New oil provinces of Kalol and Nawagam were planned to be connected to Koyali. 'Operation Cheetah' was launched in 1968. A 150-kilometre-long network consisting of a 12" oil line from Kalol to Nawagam and a 14" oil line, connecting Nawagam and Koyali, was completed in 1971.

As the Commission was peaking in performance, it was least aware that a shock was in store.

DREAM RUN COMES TO A STOP

On June 24, 1963, Malaviya resigned from the union ministry and chairmanship of ONGC. He had created enough enemies in every quarter. With Malaviya's exit, ONGC stood exposed without his paternal protection.

ONGC had by then, spread its wings over the four corners of the country.

The French company CGG was carrying out geophysical investigations using modern techniques in Jaisalmer. In the Cambay Basin, Kalol, Nawagam and Sanand were on the verge of trial production. In the north, ENI was drilling a well in Raxaul in UP. In Hoshiarpur and Janauri, drilling was going on. Increasing number of field parties had delineated more structures in all parts of the country. Karaikal near Chennai awaited drilling.

On May 10, 1963, Prime Minister Nehru had formally laid the foundation stone of Koyali Refinery. He thanked the Russians with whose help the refinery was being built. Koyali was a dream project for the Commission. It was learning the new engineering venture of refinery building. Keeping in view the deadline, the pipelines were nearing completion. Refinery work had reached an advanced stage. Soil investigation was over. Samples of Ankleshwar oil were sent to Russia for laboratory testing. Engineers India Limited (EIL), an offspring of ONGC itself, had started construction work. Keeping in view the enhanced production from Ankleshwar, the design of the refinery was upgraded to handle three million tonnes.

In September 1964, Indian Refineries Limited and the Marketing Division were merged into a new entity. It was named Indian Oil Corporation (IOC). The Koyali Refinery and the product pipeline from Koyali to Ahmedabad were handed over to IOC.

In 1960, based on Dr Kane committee report on feasibility of petrochemical industries in India, ONGC had set up a small petrochemical division.In the 1965-66 annual report, one page was devoted to the activities in this division of the Commission. The announcement went like this:

'The commencement of the production of oil and gas on a regular basis from the Gujarat fields and the favourable results of further exploration in that region led to an increasing interest in proposals for establishing petrochemical industries, which would utilize natural gas as well as the by-products of crude oil and for refinery operations to provide a large number of raw and finished materials ranging from polyethylene, acrylic, carbon black, synthetic rubber, insecticides, fertilizers and chemicals, plastic pipes, buckets, baskets and other household articles'.

Roping in IFP, Malaviya had initiated a techno-economic study of a petrochemical complex near Koyali Refinery. ONGC had sent out feelers to some multinationals. Philips Petroleum Company, an American independent, was trying to spread its operations. Philips had been allowed to set up a refinery in Cochin. It wanted to enter the emerging petrochemical market with Imperial Chemical Industries (ICI), based in England, as a partner. Another proposal came up from a consortium of Union Carbide Limited and Dow Chemicals. Both negotiations went on for months. The talks ultimately failed to fructify because of three demands: management control, preferential treatment and guaranteed price.

The government decided to create a separate public sector company for petrochemicals. Thus, Indian Petrochemicals Co. Ltd. (IPCL) was formed in 1969.

R&TI COMES UP

Without a single barrel of oil in 1960, the think-tank of the Commission had set itself a very ambitious target, to follow the best practices in business. Starting from 1959, young geoscientists of the Commission went all over the world to receive training in various aspects of oil exploration and exploitation. The advanced state of research in petroleum sciences was an eye-opener. Right from its inception, the Commission had established laboratories and had procured the best equipment available.

The world had moved away from 'seepages' and 'isolated wells' to basin modeling and geochemical research to understand the reservoirs in a better way. A study group was established under Dr Hari Narain. They conducted a study of state of scientific research in the oil industry and the expenses involved. By that time, the major oil companies were found to be spending up to 2% of their budget for research projects. Major companies employed about 3% of their manpower in research and development.

The Commission submitted the study report to the Planning Commission for the approval of budget under the Third Plan (1961-1965). The Planning Commission had approved a budget of Rs. 1,800 million that included Rs. 25 million for research and training. An additional Rs. 100 million was approved for offices, colonies and laboratories for the proposed Research and Training Institute (R&TI).

In 1960, the United Nations Special fund (UNSF), the finance wing of UNDP, granted an amount of USD 800,000, and the government committed Rs. 6 million as a matching contribution. The UNDP project would have a Russian as the Project Manager. Thus, Professor N.A. Eremenko arrived in December 1962. The project got rolling in 1963.

The earlier study report of 1959 was found to be inadequate considering the explosive growth of the Commission. A new scientific committee was formed. L.P. Mathur was the Chairman of the committee, which included M.B.R. Rao, who had become a consultant to ONGC after retirement.

The committee accepted the 2% formula for research. The 3% formula for manpower was also accepted. Based on a projected manpower growth to 13,000, roughly 650 scientific officers were planned to be diverted, or recruited, for research work. It was originally envisaged as a separate entity with manpower drawn from different directorates. To attract talent, a 15% research allowance for people posted at R&TI was included in the revised proposal. It also envisaged direct recruitment of scientists.

The main objective of the Institute was to act as a nodal agency for applied research into all aspects of oil exploration and development. The first task was to undertake basin studies of different sedimentary basins in India and to submit recommendations regarding oil prospects in different regions. The second objective was to submit to the Commission a second opinion based on reinterpretation and reassessment of scientific and technical data regarding exploration including drilling.

Five divisions, Geology, Geophysics, Geochemistry, Drilling and Training and Economics, were created in the Research Institute. The sprawling Kaulagarh Tea Estate was bought. Work started immediately on the proposed 84,000 square feet building with 9500 square feet basement for storage of rocks, cores and crude oil samples. The initial estimate for the work, including a hostel for fifty people and a 5,000 square feet workshop, was Rs. 5.4 million. A hostel was a necessity for oil workers coming from all over the ECAFE region. UNDP had that clause in the agreement.

The Institute gave a big boost to studies in Sedimentology, Palynology and Geochemistry. GSI came up with a tectonic map of India based on the theories of formation of the Indian sub-continent and plate tectonics of Dr M.S. Krishnan, Director GSI. In 10 years of field work, ONGC scientists had come out with newer facts. Thus, in 1966, a group of scientists came out with a revised Tectonic Map of India on a scale 1:2,000,000.

A number of research scientists joined R&TI. It started getting trainees from Philippines, Sri Lanka, Iraq and other neighbouring countries. A group of Nigerians were given theoretical training and later sent to the oil fields of Nazira for learning the practical aspects. In 1971, R&TI was officially renamed Institute of Petroleum Exploration (IPE).

Utilising the UNDP funds, IPE got its first hi-tech gadget for its laboratories. It was a GE-made X-ray Diffractometer. The XRD made a tremendous impact in the study of sedimentary rocks. One of the three Honeywell-400 computers gifted to India under an international program was given to ONGC. K.N. Bhave was heading the computerisation drive. Scores of scientists were trained on the new computer. ONGC scientists developed application programs from scratch for their use on this valve-based second generation computer system.

That was the humble beginning of the present day premier research institute, KDMIPE.

ONE MORE DREAM IS BORN

The beginning of that dream dated back to 1959. Even in those early days, Malaviya's knowledge of the oil potential of the world was phenomenal.

In 1958, Iran had tried to reach out to friendly countries. In one instance, it sent a feeler through Indian Ambassador Tara Chand to Nehru for permission to set up a refinery in Saurashtra. As per practice, Nehru had passed on the letter to Malaviya. For some reasons, the talks didn't materialize into anything concrete. But Malaviya's passion for 'equity oil abroad' remained strong.

In 1963, Iran put on offer 7,960 square kilometres of offshore lease in the Persian Gulf. ONGC did not have the wherewithal for offshore work. Hence, the pre-qualification bid disqualified India. AGIP s.p.a of Italy, another subsidiary of ENI, wanted to bid for the block, and was on the look-out for partners. At that time, Malaviya's friendship with Italy was at its peak. Hence, ONGC was offered a partnership. ONGC formed a wholly owned subsidiary, Hydrocarbons India Limited (HIL) in 1965.

AGIP suggested co-opting Philips Petroleum for a joint venture. Things started moving fast. A new company Iranian Marine International Company (IMINCO) was formed. The National Iranian Oil Company (NIOC) held 50% of the shares. The remaining 50% was to be shared by the three partners, AGIP, HIL and Philips Petroleum. In that project, ONGC was the "sleeping" partner. But, each partner had the right of inspection and observation of operations, inspection of books of accounts and other relevant data. That clause would come in handy later.

On January 17, 1965, the agreement was signed. Sheikh Ahmed Farhi was the Chairman of the IMINCO Board. P.R. Nayak, Chairman of ONGC, also took over as the Chairman of Hydrocarbons India Limited. On February 13, 1965, the Shah of Iran put his royal signature on the document. A cash bonus of USD 34 million was paid to the Iranian Government by the consortium. The lease was for 12 years and the second party had a commitment to spend USD 48 million. ONGC paid its subsidiary Rs 500,000 as initial capital.

On May 29, 1965, the first well in the 'D' structure, IM-D1, was spudded with Italian Rig, Gatto Selvatico. The well was dry. The rig was moved to the 'R' structure. After a lot of drilling complications, it struck oil in well # IM-R1. On testing, it produced 1,100 to 2,200 barrels a day at different bean sizes (chokes). Thus, IMINCO had its first field 'Rostam'.On September 23, 1966, the company faced one of the worst blow-outs in well # IM-T1 on the 'T' structure.

Later on, two more structures were taken up. That led to the discovery of 'Raksh' field. Every year, ONGC was pumping in almost Rs 100 million into HIL. It wanted the oil badly. Then, the foreign partners dropped a bombshell. They were not developing the fields. They cited poor recovery rate, 7% to 8%, as the reason. They wanted the "sleeping" partner to back out so that they can share the spoils amongst themselves.

This was in 1971. But, the sleeping partner had gained confidence with the development of Gujarat and Assam. The Russians had built up a sizeable cadre of development geologists. B.S. Negi, by then Member (Exploration) formed a team to give a second opinion on the reserve estimates. The team predicted a minimum recovery rate of 15% to 18% which was a viable option. The other two partners found the "sleeping" partner quite awake.

The field development was taken up. ONGC started getting its share of oil. But, it faced a problem. The coastal refineries, still in multinational hands, refused to accept the crude. Barauni and Koyali were inland refineries. It would have been uneconomical to transport the crude all the way to them. A marketing wing was formed. They went scouting all over in Europe to sell the oil. Finally, Spain agreed to buy the oil at 15% discount! After some years, with the Cochin refinery coming on line, ONGC's share of 'profit' oil was processed in that refinery.

Thus began the odyssey of Hydrocarbons India Limited.

In the 1960s, there were some chinks in the armour and the company faced its first identity crisis.

PART FOUR

THE HURDLE RACE

CHINKS IN THE ARMOUR

Malaviya was directing the operations with his lieutenants in the field. He had complete understanding of the pulse of the organization. When he left, the sudden deceleration had a bone-cracking effect on the organization. Over 20,000 employees felt rudderless. The Blitzkrieg showed signs of fatigue.

S.S. Khera, Secretary in the Ministry of mines and oil, succeeded him. Khera played a big role in the growth of the Commission. He had vast experience in oil politics. Khera retired within six months on December 21, 1963.

Then P.R. Nayak, ICS, a part-time government nominee in the Commission, was made the Chairman. He too left within fifteen months. Member (Finance), A. Zaman, took over as the next incumbent. A year later, he went on a four-month leave and never came back.

The Commission was on its own and cracks started to appear within. The Directorates were getting into isolated havens. Support services such as administration, accounts, finance and transport gained more importance. Technical personnel felt marginalized. Field requirements were submerged in procedures. ONGC was turning into a typical government department with files flying from one table to another.

Taking a cue from the chaos at top, workers' unions had started flexing their muscles. The technical people, feeling the requirement of a voice of their own, formed the Association of Scientific and Technical Officers (ASTO). S. Ramanathan, from the 1956 batch, was the first President of ASTO.

It looked as if some kind of a brake had been applied on the spectacular growth profile of the Company. It was at this difficult moment in ONGC's history that Leslie James Johnson, ICS, was brought in as the Chairman. He took charge on May 7, 1966.

TAKING STOCK

Leslie James Johnson was the fourth Indian Civil Service (ICS) officer to have been appointed as the Chairman of ONGC. But, he was different from his predecessors.

Johnson weighed all the pros and cons. His tenure as the Chief Administrator in the Dandakaranya Project in Orissa had earned him a good reputation. He didn't want to be tied down to a desk job. He had grown up in the salubrious climes of Mussoorie and it was homecoming for him.

Initially, Johnson was skeptical about heading a purely technical organization. Soon, he got down to the task of understanding the basics of oil exploration. To his surprise, he learnt that a 'Christmas tree' had nothing to do with Christmas: it was conglomeration of valves. A 'crow's nest' had nothing to do with crows: it was the highest point of an oil rig.

Then, he started observing the growing cracks within the organization. He remembered the brief given by the Petroleum Minister. The Ministry had also suffered from the number of short-tenure ministers. It had seen three ministers come and go in as many years. Asoka Mehta, the new minister, meant business.

Mehta gave him a time frame to turn the company around. Johnson had his task cut out for the next few years.

Around the same time, some funny news, called 'the story of liveries', appeared in the ONGC Newsletter under a pseudonym. A proposal had emanated from the oil fields for kits and liveries. And more than a dozen officers passed on the file with comments. No one gave any definite suggestions. The file was in perpetual circulation.

As Johnson put it: "The prime object was to make a comment and pass the file upwards or sideways for another clerk or officer to add to the comments or arguments already made. Notings on the file was an end in itself."

To his horror, Johnson also found that the Chairman of ONGC had no powers. Malaviya never faced the problem because he was the Minister also besides being the Chairman of ONGC.

Johnson found out that the crux of the problem lay in non-delegation of power. Everyone clung to their powers, thus resulting in endless notings. The problem was discussed threadbare.

A consensus emerged. Henceforth, a limit would be placed on the time taken for action. Disciplinary action was agreed to in case of non-compliance.

Responsibilities and delegation of powers were realigned to the emerging needs of the Commission. The minutes of the Commission's meetings were noted down verbatim but the final proposal carried the consensual decision. In case a member vehemently opposed any proposal, he was free to put in his dissent with valid reasons on record. With the streamlining of administrative procedures, Johnson turned his attention to field operations.

The headquarters and various field operations had a major communication gap. The workers had become restless as they felt left out and neglected. One communication from Assam took almost five days to travel to Dehra Dun and it took another five days for the reply to travel back. By that time, the Commission had 38 deep drilling rigs, numerous shallow drilling rigs, hundreds of field workers spread out all over the country, scores of production installations. Lack of fast communication had resulted in complete alienation of the average worker.

Johnson started direct communication with the workers who could air their grievances. Hundreds of letters arrived. Everywhere, the problem was the same: alienation, lack of growth opportunities, stagnating pay scales and numerous other genuine complaints.

Some of Johnson's actions were not liked by a section of influential workers. They didn't like his ways of curbing their freedom. Just around this time, there were another 300 clerical posts waiting to be filled up in Dehra Dun. He stalled it.

But Johnson was fast becoming unpopular. He had just formed a committee to look after pay scale restructuring when the bubble burst. It was the first industrial unrest in the history of the Commission.

The worst affected were Dehra Dun and the Western Region. The ASTO decided to wear black badges as a show of solidarity with the workers' strike. Operations came to a complete standstill. The Koyali refinery in 1967 was not geared to accept the total production from Gujarat oil fields. Some amount of crude was still being sent by railway tankers to the Mumbai refineries. The officers kept the operations going.

The workers' union demanded an across-the-board increase of 20% in salary. Johnson wouldn't have any of it. He wanted a structured increase considering the nature of work. Johnson argued for maximum rise for the field workers at the drill sites, production installations and operational areas. Political support came in with the Petroleum Minister endorsing Johnson's stand on wage revision. The stand-off continued for 13 days, one of the longest in the history of ONGC.

The workers became restive with the stubbornness of the union leaders. They finally rebelled. The strike was called off with the unions accepting the staggered pay structure. The number of pay scales was reduced to 27, bringing some rationalization in the pay structure. Bonus agreement was signed as per the existing Bonus Act. A new incentive scheme was worked out. The earlier disparity between geo-scientists and engineers was done away with. The Efficiency Bar in the pay scale was removed.

The R&TI was not able to attract any field geoscientist to its fold. In those days, one could get almost Rs. 150 extra to work in the fields. As a result, an R&TI posting was the least preferred one. Johnson introduced the research allowance, equivalent to field allowance.

Officers who kept the operations going during the strike were given advance increments as a reward for loyalty to the organization.

One anomaly remained. The Commission could not do much about the growing problems of stagnation in every discipline. It needed government approval for any change. The help was not forthcoming. Johnson tried to adopt the policies existing in the ICS cadre of the government. He introduced something called a selection grade for the scientists. But, they would remain vacancy-based avenues. It didn't exactly solve the problem.

Housing colonies for officers and staff had become a much neglected affair. The Commission entered into an agreement with Life Insurance Corporation (LIC) to provide loans for house construction.

To bring in more interaction at various levels, the concept of Works Committee came up. With members drawn from every quarter, the committees stated functioning at Cambay, Ankleshwar, Sibsagar, Hoshiarpur and Dehra Dun.

Cash awards for meritorious work were earlier decided from Dehra Dun. Now, the regional heads were empowered to give cash awards for good work.

A separate Member for Personnel was still nowhere on the horizon. Instead, a "Durbar Day" was introduced in all work centers. On that day, the local grievance committee listened to the complaints of workers. The restiveness amongst the workers became much less vociferous.

All this laid the foundations of Human Resource Management (HRM) functions. All the policy decisions were implemented. Then, the government was informed. This impudence alienated Johnson from the corridors of power. But he had a target, and these moves were vital for reaching the ultimate goal.

Then, he turned his attention to the urgent need for resurrecting the failing field performance. On the operational side, he found no real-time monitoring of field work.

Control Room

Young statistician M.B Deshmukh came out with a proposal for a control room. When Johnson saw the far-reaching implications of the proposal, he jumped at the idea. It was like the last ray of hope in what seemed a losing battle to have a control of the organization. It was an improvised Management Information System (MIS) of today. Deshmukh was given the green signal to set up the Control Room.

The basement, under the administrative block of Tel Bhavan, was cleared of all files and cabinets. Eighty blackboards were set up. They were divided into regions; each region was divided into different operational activities: drilling, production, transportation, workshops, and field parties. It was supposed to act as an 'organized memory' in respect of all the aspects of the operations of the Commission.

A group of dedicated people constituted the re-organised planning and control division of the Commission. It was to be a 24-hour operation. The progress of each and every activity of the Commission was monitored on an hourly basis. The basic objectives were:

- Detailed operational progress reports and their immediate evaluation indicating the action to be taken at various levels.
- Expediting the process of decision-making by various agencies at control room meetings attended by senior officers, including the members and the Chairman.
- Close personal supervision by all senior officers at the project, regional and headquarters level.
- Immediate appreciation of good performance of individuals as well as groups through telegrams, letters and other communications, as well as monetary rewards.
- Work out a ready frame of reference for evaluating any occurrence requiring immediate attention.
- Preparation of quarterly, half-yearly and annual schedules of drilling, production and other activities.

The operations started on a smaller scale. Within months, Johnson had the complete picture in front of him. He gave an example: one rig was always falling behind schedule. On enquiry, a strange fact emerged. The start of the morning shift had to coincide with sunrise. Accordingly, the crew had to wait for sunrise to start the work. This delay led to more delays in the whole chain of events. After discussions, shift timings were changed.

Congratulatory messages from the Chairman landed on the same day whenever the crew performed well. Problems could be pinpointed and solutions given as fast as possible. As an example, one problem would be discussed at 4 pm, the decision would be taken at 4:30 pm and by 5 pm hours the field superintendent would have the solution in his hands.

Control room activities were time-bound. The Chairman, Members and Directors got a control room bulletin on the hour, every hour. According to Johnson: "Under the new system, we got to know where every piece of major equipment or major assembly was and after a survey of the whole field stores and equipment, steps were taken to see that the required level of stores and equipment existed in every region."

The icing on the cake was the rising morale of the field workers in some of the most remote areas of the country. They no more felt isolated and forgotten; their dedication and efficiency didn't go unnoticed.

With the success of the control room, the Company's sagging morale took a reverse turn. In fact, the drilling rate of ONGC overtook that of the USSR! It became a tourist attraction for people from different organizations. The GM of Heavy Engineering Corporation (HEC), Ranchi, wanted a short-term deputation of Deshmukh to set up a similar facility in his corporation. Ashok Mehta didn't forget to congratulate Johnson on the turnaround.

The letter from HEC was the result of the observation of a Parliamentarian, Professor Shanti Kothari, who was highly impressed by the performance of the control room. She had suggested a similar project implementation in all major public sectors of the country. In no time, it became a must-see for IAS probationers undergoing training in Mussoorie.

With great difficulty, a wireless link was established between Assam, Vadodara and Dehra Dun. No one felt neglected and forgotten anymore. It also helped inventory control and the use of CPM/PERT became a possibility.

The first seeds of modern management techniques were sown in those days. With the Honeywell-400 computer system at IPE, the stores, purchase and finance functions were automated. R.K. Verma from the stores and purchase department and O.P. Gupta from finance, had learnt the COBOL programming language. K.N. Bhave, the first head of the computer division, remembers these two people as the first major users of the computer for business data processing. The pay-roll data of Dehra Dun and the CPF accounts of ONGC were streamlined and computerized.

The post of Member (Exploration) was abolished. To bring in more synergy between geology and geophysics, Johnson established a Central Interpretation Group in the geo-physics directorate with a geologist placed in the group.

The biggest challenge remained: to cross the threshold and go into the sea. The preparations began. On land, it was time to take up new structures.

With the control room in places, new structures like Port Canning in Bengal, Karaikal in Tamil Nadu and Baramuara in Tripura were taken up. The horizon of exploration was expanding.

ASSAM FOLLOWS THE GUJARAT MODEL

A D.O letter No BOC/2/9/5 on May 13, 1963 set the corridors of power buzzing. It was a suggestion from J.C. Finley of BOC to take over ONGC operations to augment the production from Assam. Oil India, the subsidiary of BOC, was producing 3 million tonnes of oil and ONGC was expected to produce 0.75 million tonnes. There was no sign of ONGC oil because of myriad problems. The government was desperate to increase oil production from Assam. It had further granted mining lease of 1,866 square miles in the Moran and Nahorkatiya area to OIL. It wanted OIL to intensify exploration in the recently granted areas. The British in OIL had other ideas: why spend extra money in developing new fields; why not coax the government to ask ONGC to hand over their discovered fields? It was always cheaper anyway. The government, luckily, didn't agree.

ONGC in Assam was beset with internal as well as external problems. The oilfields of Assam were proving to be a geologically tough area. The early explorers had discovered three big fields: Rudrasagar, Lakwa-Lakhmani and Geleki. Each field was unique in nature. The discoveries were a test of knowledge. Added to the correlation problem, two wars, frequent floods, prolonged land acquisition process and difficult logistics stymied Commission's efforts. The early explorers faced all difficulties with equanimity and courage.

After the first discovery well, eight wells had been drilled in Rudrasagar field till 1964. Only three wells, #1, 2 and 4 showed presence of oil and gas. The two wars had a devastating effect on Assam operations. Added to that, there was the Royalty issue which rocked Assam in the 1959. Temporarily, Exploration licence was rescinded for ONGC operations. With Morarji Desai, then Finance Minister, acting as an arbitrator, the matter was settled.

In 1962, there was near panic as the Chinese troops were within the striking distance of ONGC oil fields in Rudrasagar. Dr B.G. Deshpande had just landed in Sibsagar to do some trouble-shooting. The wells were hastily killed with whatever cement available. The expat Russians and their families were evacuated. The crew moved out to safer locations. There was chaos everywhere. The war ended as abruptly as it had begun. It took one more year to get the operations back on the track. In 1965, the war between India and Pakistan spilled over to Assam because of its proximity to erstwhile East Pakistan. The wells were again cemented, to be revived later.

The silver lining was the discovery of the Lakwa structure. A new geological truth was discovered by ONGC in Assam oil history. All fields in Assam, including those of OIL, were oil producers from Barail sands. The first well in Lakwa, L-1, was spudded on August 26, 1963. When it passed through the 'Tipam' sands, not much attention was paid at first. There had never been any oil from the Tipams in Upper Assam Valley but the geologists found the sands soaked in oil. The electrolog also confirmed the oil show in Tipam. Initially, they were scared of derision from the higher-ups. L.P. Mathur wanted it retested. The test was carried out again. It was a definite oil show. Only production testing would confirm the show. The geologists wanted the drilling to reach the target depth. The Barail sand also indicated oil shows. They had opened a new oil horizon in Assam.

On testing, it produced 85 cubic metres a day. To their disappointment, the well developed drilling complications. But they couldn't let anything deter them. The well was side tracked. On completion and testing, the same positive results were obtained. There was jubilation.

Subsequently, Lakhmani and Geleki fields were discovered. They proved to be the main producing fields for ONGC. But the alternating sequence of sands needed a real scientific approach to develop the field.

When the Commission was recovering from the effects of war and floods, Rudrasagar burst into frenetic activity. By 1966, Rudrasagar had 27 exploratory wells already drilled and awaited trial production. The field was put on trial production by tying up three wells (R-1, 2 and 12) and, in the absence of GGS, the crude was sent by tankers to Noonmati Refinery.

Sometime in August 1966, well #R-25 had developed some complications. Productions engineers tried to solve the problem. There was a leakage between the casings, the same reason that had caused the blow-out in Ankleshwar. Without giving any indication, gas surfaced and started blowing out. It caught fire. The fire became so intense that Grand Trunk Road traffic had to be diverted. It continued for weeks. There was no proper fire fighting equipment in the Commission. OIL couldn't help. The situation was deteriorating by the day. In sheer desperation, the fire chief of West Bengal was sent an SOS. In consultation with a specialist Russian team, he worked out a plan. More fire tenders were mobilized from Kolkata.

On the 25th day, with the training of massive jets of water around the well mouth, the fire was controlled. That was ONGC's first encounter with tragedy in Assam. The rig was severely damaged. The well was brought back to production. The group of engineers, led by driller K.M. Khalid, played a magnificent role in regaining the control.

Undaunted, the Commission decided to launch a Blitzkrieg in Assam.

Operations galore

The number of rigs was increased to nine. R.N. Mishra, a mechanical engineer, was asked to expand the workshop at Sibsagar. Started as a small project in temporary sheds in 1960, the workshop construction was put on a war footing. By mid-sixties, it had seven spacious sheds with ten major repair shops. Considering the logistics problems in Assam, the workshop took up all kinds of repairs, including reclamation of used parts.

Johnson wanted commercial production to start as soon as possible. A scheme called Operation Quick Summer was worked out in September 1967. It entailed the construction of a GGS at Lakwa and a tank farm at Moran. Brigadier K.S. Dhillon was sent in as the General Manager for Assam. The headquarter was shifted from Sibsagar to Nazira. The 'students from Ankleshwar' descended on Assam in droves. S.K. Manglik led the production crew. K.K. Rao came with his pipeline specialists.

There would be no trial production. A GGS came up in Lakwa considering its bigger potential. Lakwa # 1 was put on production. Later, L#3 was tied up. They produced 61 cubic metres per day. Initially, the crude was sent by tankers to Noonmati refinery near Guwahati. An agreement was then reached with AOC to share their pipeline from Moran oil fields to Noonmati refinery. ONGC had to pay special fees for crude conditioning, in addition to a specific amount for using the pipeline.

The next operation was launched to connect Lakwa with Moran with a 12" oil line. By 1968, Operation Quick Summer ended with the completion of the line. Brig. Dhillon virtually walked through the 17.5 kilometre long route to commission the line as per schedule. It had taken just nine months to lay the line across some of the most difficult terrain. Over 1,000 farmers had to be convinced to give right of way. For the pipeline, the land acquisition was the toughest part. A public relations officer was specifically employed to talk to the villagers.

On July 20, 1968, B.P. Chaliha, Assam Chief Minister, commissioned the line. ONGC and OIL cooperated with each other. Chairman Johnson declared: "The beginning of commercial production from an oil field is always a major event, and so today is a red letter day for ONGC."

In 1968, Operation Quick Oil was launched. T. Banerjee replaced Brig. Dhillon as General Manager for Assam in 1971. C.K.R. Sastry took over from Banerjee in 1973. It was a very ambitious scheme. Lakwa would be the hub to which all other fields of Assam were to be connected. In the first phase, seven GGSs were to come up in Lakwa connected to the CTF. The next operation was the bigger challenge. Rudrasagar structure lay on West of Lakwa; Dikhu River was the barrier separating the two.

When the Rudrasagar-Lakwa pipeline work was started, it was beset with numerous problems; the biggest being test pressure. The pipes were from Rourkela Steel Plant and a length of pipeline would be laid with a great difficulty. When it came to testing the line with water to the designed pressure of 1500 psi, there would inevitably be a leakage somewhere. Locating the leakage took weeks as the pipelines got submerged in incessant rain. After much discussion, it was decided to bring down the test pressure to 600 psi. The lines were fine, but, with that kind of low pressure, it wouldn't be possible to pump the oil all the way to Lakwa. One more pumping station, Dhiku Junction Point (DJP), was established on the Rudrasagar side of Dikhu River. The oil was pumped through another 8" line to Lakwa. From there, the oil was pumped to the OIL pipeline network.

As all these activities picked up momentum, the increased production from ONGC fields posed another problem. The Moran- Noonmati- Barauni pipeline of AOC had limited capacity. As long as ONGC production was low, there was no problem. The pipeline needed upgradation to meet the increased volume of both the companies. AOC cited paucity of funds and dithered over the decision to make any changes in the existing system. As a result, ONGC could not fully exploit its oil fields till the Bongaigaon refinery came up in the mid-1970s.

Numerous obstacles saw Operation Quick Oil take almost eight years for completion in 1976. It took almost 10 years to develop the infrastructure for oil in Assam.

In 1970, ONGC geoscientists created history by discovering oil in the 'fractured basement' in Borholla. Borholla was on a contiguous land between the Dhansiri valley in Assam and Nagaland. In Nagaland, it was called Champang. Acting on the clue, a few more structures were discovered in Nagaland. In later times, the contiguous area would become the bone of contention between the two states.

By 1976, Assam was finally on the world oil map with newer discoveries in Geleki, Borholla and Amguri. Cumulative annual production reached one million tonne. As C.K.R. Sastry remembers, the success was due to the efforts of imaginative geologists, hard working drillers, mechanics, fitters and the local people. It had a few hiccups though such as the 1971 war and the subsequent massive refugee influx.

As in Gujarat, ONGC, due to its typical 'moving-factory' nature of operation, was bringing about a silent change in the state's infrastructure. As ONGC entered virgin areas like Cachar, Barak and Dhansiri valleys for oil, the hitherto unknown places swarmed with geoscientists, drillers, production operators and others. Small hamlets came up. Tube wells were drilled. Hundreds of kilometres of hill roads were built. Local youth were trained in various jobs and workshops became busy. The biggest change was in the small towns of Sibsagar and Nazira.

In 1960, Sibsagar had a few thousand people. Initially, it was difficult to get accommodation for ONGCians. Slowly, workers' colonies came up in much the same way as in Gujarat. The Russians were joined by Rumanians, Yugoslavians and Italians. ONGC had entered into an agreement with RUDIS of Yugoslavia for contract drilling in Assam. ONGC provided the rig and RUDIS provided the staff for drilling operations. They drilled a couple of wells.

This strange cosmopolitan crowd did a world of good to the township. Enterprising businessmen started stocking goods for the oilmen. Everyone celebrated the local Bihu festival together. One seven-year-old Russian girl, Elmeera, daughter of M.F. Faskhutdinova, a design engineer from HODI, Dehra Dun, became the toast of the town with her Kathak performance.

This period also saw the family members of senior officers and staff take active interest in community development and employee welfare. The schooling of ONGC kids was paid special attention. At all work centres, it started with kindergarten schools. The Commission then tied up with local Lions Clubs to operate schools with an annual grant. Children from nearby localities too were encouraged to study in these schools.

Meanwhile, the state government had started getting bigger revenues as royalty. The first gas sales to Lakwa tea estate brought about a new thinking in natural resources utilization. With ONGC's entry into Assam, the state was poised to embrace change. ONGC decided to spread its wing further into more difficult areas like Cachar and Tripura.

But a real big discovery like Gujarat and Assam still eluded the Commission. It had to look further into the prospects of difficult oil horizons. Its geoscientists were already in those provinces from 1958. They had come across some interesting clues. New provinces, like Andamans, Ladakh and Kashmir, were some of the horizons where the Commission went in for the first time.

Expanding horizons

The Bengal Basin remained uppermost on the minds of 'never-say-die' geoscientists for a long time.

In the 1950s, Stanvac of US had conducted gravity-magnetic and seismic surveys where 10 wells had also been drilled. The basin was given up as non-productive by Stanvac.

In 1963, ONGC ventured out in the Basin again. The data collected by Stanvac was re-examined. During the Stanvac drilling phase, little gas was encountered at Port Canning area, about 40 miles to the south of Kolkata. ONGC decided to resume drilling in Bengal in that area in 1966. On August 18, 1966, Chief Minister, P.C. Sen, spudded Bodra #1. Unbridled optimism made ONGC drill its first well in Miocene prospect down to 4,197 metres. It was a difficult well with many drilling complications and was unsuccessful.

In 1970, for the first time in India, sophisticated digital field recording instruments were used in West Bengal. In the next 15 years, with Soviet help, ONGC carried out extensive surveys in Krishannagar and Diamond Harbour-Bodra areas. A special seismic survey was carried out over the busy Kolkata metropolis to confirm the proverbial Kolkata High. Between 1982 and 1984, surveys were carried out with Vibroseis, a vibrating energy source in place of dynamites to avoid any damage to the city structures. The surveys could only be carried out in a small window during mid-night hours to avoid interference from the bustling traffic and other distractions.

After acquiring 2D and 3D seismic data in Amtala-Golf Green area, well Golf Green #1 was drilled, which gave traces of oil, gas and water. Ichapur #I followed with little self flow. In its endeavour to unravel the mystery of the Bengal Basin, ONGC drilled 30 wells in various parts without any commercial success.

In the offshore, the story was much the same. The Carlsberg-Natomas Group had acquired seismic data covering an area of about 21,500 square kilometres in 1974-75. Two wells, BB-A-1R and BB-B-1, gave no commercial breakthrough, but gave definite hydrocarbon indications. However, the company did not have the patience and ultimately it relinquished the contract.

After a few years, Western Geophysical of USA acquired 2750 line kilometres of seismic data. ONGC drilled five exploratory wells during 1986-90.

Later in 1996, noted petroleum geologist John Kingston expressed his optimism of possible hydrocarbon discovery despite the earlier disappointing results. He felt that there was a substantial amount of hydrocarbons, 83.8 million tonnes of oil and 285.3 billion cubic metres of gas in Bengal Basin. He ascribed the failure to the "historical limits of exploration technology (those of 2D seismic survey) and present day economies (deep drilling costs) in the basin of deep, subtle traps."

In 1999, ONGC tried its luck in Ichapur again. Then it took a four-year pause in drilling activity. The period was used to collate geological, geochemical, geophysical and seismic data of different vintages. In 2003, ONGC spudded its 46th well in Gobindpur #1, with no success.

In the Thar Desert, the ONGC leadership realized that mere grit would be of no help. It needed technology. The French had proved themselves masters of desert surveys. They had discovered the new oil fields in the Sahara. In 1963, ONGC entered into an agreement with Campagnie Generale De Geophysique (CGG) of France for seismic data acquisition.

They had brought Dodge Power Wagons with wide tyres and four wheel drives. The trucks were so huge that they could accommodate compressors for air supply and water tanks. They used compressed air to drill the shallow holes. They used better explosives. The French mapped Bakhri Tibba, Manhera Tibba, Khartar and several other structures.

Subsequent to the discovery of the structures, ONGC signed a contract with the French company IFP for drilling exploratory wells. IFP brought in Forasol, a reputed French drilling company, to start the operations. They drilled six wells in Khartar, Bakhri Tibba and Manhera Tibba. Gas was discovered in Manhera Tibba in 1967. Gas was also discovered in small quantities in other wells.

The French and Indian counterparts carried out the operations amidst the war with Pakistan in 1965. There are many heroic tales. In Bakhri Tibba, two jeeps were in flames after the Pak shelling. The crew didn't stop drilling. Finally, as the shelling increased, they had to virtually crawl out from Bakhri. One well-site junior chemist, S.S. Negi, had played a heroic role in saving the lives of a couple of French and Indian technicians. He was sanctioned an advance increment by the Commission. The war left a trail of destruction. The ONGC crew came across hundreds of mines. Each time, the army was contacted and the mines defused.

The French contract came to an end in 1968. All the French equipment was bought by the Commission. ONGC resumed seismic exploration on its own in 1970.

The French had concentrated on the rocky desert areas: a relatively easier option. ONGC, with the second-hand French equipment, took up the difficult sandy areas for exploration.

A poignant story tells the camaraderie of the desert troops of ONGC. Surja Ram, a villager from Banda in Ramgarh, had become a permanent employee of ONGC. He had started his 'oil' work with B.S. Negi in 1955. In 1970, he was an experienced worker in the oldest geophysical party GP-26 but he still lived in his village. One day, his party chief informed him about his transfer to Jammu. Shell-shocked, Surja walked back to his village and suffered for a couple of days in silence. Someone advised him to write to Negi who was officiating Chairman. When the postcard reached Negi's table, he was moved. He asked for Surja's file and ordered the cancellation of the transfer, saying that it was not right to shift a villager from his habitat. Surja stayed on.

ONGC carried on the desert operations in phases, spanning 50 years. In each phase, it went in with more advanced equipment. The explorationists discovered new structures like Ghotaru, Sumarwali, Talai and others. Luck has eluded the Commission of any big-time discovery.

Then in 1960s, Johnson initiated the southern foray.

ONGC once again decided to go into virgin areas. The southern venture is a story of three big rivers, Cauvery, Krishna and Godavari, and the hidden wealth beneath their deltas.

In 1957, southern geology remained a complete mystery. It was a culturally rich and prosperous land of the famous Chola Kings. Thousands of temples dotted the landscape. The River Cauvery was Tamil Nadu's lifeline. The vast alluvial tract between Pondicherry and Tuticorin was the rice bowl of the state and also considered prospective for oil accumulation.

The Geological Survey of India had done some mineral study, but there was no aerial survey report on the southern peninsula. Initially, individual geologists were sent to check all reported seepages.

In 1958, S.V. Desikachar came with a fully equipped geological field party to start detailed investigation. To their excitement, there were many tertiary outcrops with marine sediments, two of the biggest leads for any geologist. Encouraged by the initial results, gravity-magnetic and seismic studies were conducted. The scientists closed in on Pattukotai. One shallow hole drilling rig, URB-4, was sent to the town.

There was unusual curiosity amongst the villagers of Pattukotai. They would linger around as the crew, led by driller S.D. Sharma, prepared to drill a hole. It started in November 1963. The well drilled down to 839 metres. It was abandoned due to drilling complications. Eight more structural wells were drilled. Then, Karaikal #1 was chosen for deep drilling based on studies.

In 1967, a Russian 3D rig was mobilized, and the drilling program in Cauvery basin was taken up. S. Ramanathan was sent to Karaikal as geologist-in-charge; he was joined by veteran driller, Kannabiran, with much experience in Gujarat oil fields. The drilling was a peaceful affair.

On first testing, nothing came out. Ramanathan insisted on re-testing and 100 litres surfaced. Then, it stopped. Repeated attempts to coax the oil out resulted in a few hundred litres more. The first well was abandoned. It was not declared dry.

On the records, a new oil province was discovered, but it needed a concerted effort to understand the structure. There were strong geological indications of more structures beyond the shore: in Palk Bay and Gulf of Mannar, beyond the southern most tip of India. Any company with profit as its only driving force would have abandoned the field. ONGC followed a different philosophy in exploration and development; it would not give up if the basic conditions for oil generation existed in an area.

The southern venture was a classic case of perseverance and determination of a national oil company. It would take almost three decades of research, drilling holidays, reinterpretation, rethinking before ONGC could convert the small oil discovery in 1967 into a productive Cauvery basin.

ONGC sent its geologists to every nook and corner of the country in quest of hydrocarbon finds. The heartland of India saw a big contingent moving around and collecting samples; Bihar, Uttar Pradesh, Punjab and Madhya Pradesh, Andaman and Nicobar islands, Jammu and Kashmir including Ladakh, every mile of geological importance was mapped followed by gravity-magnetic and seismic surveys.

As the quest for oil on land gathered momentum, the time had come to cross the barrier and go offshore.

OFFSHORE SEISMIC

Around 1961, B.S. Negi directed T.S. Balakrishnan, a young geophysicist, to set in motion ONGC's venture in offshore exploration. Many at that time thought that the job should be given out on contract because of the dangerous tidal conditions in the Gulf of Cambay. The project was daunting.

The Gulf of Cambay is a nightmare in navigation. There is a six-hour rise and fall pattern of water to the extent of 30-40 feet. At high tide, the Gulf is filled with water which also overflows into the dock at Bhavnagar. The gate is then closed, and the water locked in so that at low tide, the dock still retains water. At low tide, much of the Gulf is dry and sandbars are exposed. To add to these hostile conditions, the rise and fall of water causes currents racing to 10 knots. So, a vessel was needed that could do better than 10 knots and could navigate in 30 feet of water during high tide and not be damaged by sand during low tide. And one that was fitted with electronic, seismic and mechanical equipment as also a positioning system! "You couldn't get that kind of ship for love or money," quipped a bemused Balakrishnan. Negi asked Balakrishnan, literally at sea, to spearhead the first offshore survey mission. Such was his implicit trust and confidence in his men!

The search for a suitable vessel started in Mumbai. Balakrishnan met the Principal Officer of Mercantile Marine Department and sought his guidance. The officer was duly aware of the risks involved, but ultimately recommended a triple-screw, flat-bottomed barge that was in service with Shaparia Docks and Steel Company Ltd.

Shaparia Docks offered this 140-foot long barge, the crew and master, insurance and maintenance at Rs 1,300 per day. At that time ONGC was unwilling to consider it. Shaparia wrote to K.D. Malaviya, reiterating their offer and asked for a quick reply. Malaviya asked Negi to negotiate the deal, and finally the contract was signed.

That was MV *Mahindra*. The main difficulty was that it had a speed of only six knots which would render it unsuitable in currents of 10 knots. To get over this, engine power was raised and a larger propeller was put. Accommodation for about 40 people was built that cost Rs 300,000. The initial tests were carried out at Karwar port but a speed of only 8-9 knots was attained, barely enough for the purpose.

Then, the problem of seismograph and other accessories arose. Due to paucity of foreign exchange, there was no option but to use the existing seismograph HTL-7000B. For the floating cables and hydrophones, Negi managed to get Rs 700,000 in foreign exchange. It was, however, decided to fabricate the winch locally. G.D. Sharma, an innovative shot-hole driller and a very practical man, got it fabricated at an engineering workshop in Dehra Dun. It was relatively crude equipment, but did its job well enough. The winch was transported by rail to Bhavnagar and installed on *Mahindra*.

The electronic positioning system proved to be the most difficult of the problems. Surveying at sea is very different from that on land. And the lack of proper instruments would have rendered the whole project infructuous. After much deliberation, it was decided to use Decca Hi Fix. Balakrishnan consulted the Naval Hydrographic office at Dehra Dun, which was hesitant to recommend it as the one in Kolkata Port Trust was non-functional. However, in view of the stakes involved, it was decided to go ahead and purchase the system in spite of the risks. As a precaution, it was proposed in the tender conditions that an engineer from Decca would come to India to install and commission it on site.

The base stations for the Hi-fix were located at remote coastal points. On that barren stretch of land, even the basic means of sustenance were absent. At each station, onboard Mahindra and at the base station at Bhavnagar, high-frequency communication sets were put up. When everything was switched on, the integrated system worked beautifully. The stage was thus set for launching the seismic operations.

The operation however, faced many hazards because of sandbars, shoals and strong tidal currents. In the first half of 1963, the team largely worked on the sandbars off the island of Aliabet, at the mouth of Narmada. The main innovation required in this work was drilling shot holes in the loose wet sand. A light plastic pipe was put in sand and sea water jetted through it as the pipe went down. The pipe was then pulled out and explosives immediately lowered into the hole after which the hole collapsed. Survey had to be completed before the tide reversed.

"We sailed in that rickety-rackety vessel. When the water was low, we would work on sandbars and when water came up, we did our regular marine work. It was a dangerous game to play, because any time you miscalculate and water comes up, you would be drowned like a rat. We could take only three to four shots per day," recalls Balakrishnan.

The entry and exit at Bhavnagar port had to be regulated, according to the tide times, too. Limited storage facilities for milk, vegetables, drinking water etc. were a big constraint. The feast on the first day would be sumptuous: rice, dal, potato, milk, vegetables; then followed gradual austerity. Milk was the first to be exhausted, followed by vegetables. When the water supply ran out, it was the signal to return to the port.

Despite all these problems, the crew, with no previous experience or training, discovered and mapped the Aliabet anticline. Negi visited Bhavnagar and went out to sea for a day in Mahindra. Impressed with what he saw, he went back and returned again, this time with Member (Finance). A 20% allowance was announced for the job for which the crew had risked their lives!

The work continued for the next two years under the capable leadership of V.C. Mohan. He worked largely on the marine part of the operations. This time it was a two-boat operation. The seismograph, winch and cable were mounted on Mahindra while a smaller launch, Sagar Kanya, with explosives and a shooter onboard, did the actual firing. It was a closely coordinated job, conducted very successfully. The work resulted in the mapping of the large North Tapti structure.

Simultaneously, a contract between Technoexport and ONGC was signed on June 15, 1964 to carry out seismic surveys in the offshore waters. On July 4, the same year, a special seismic ship, Akademik Arkhangelsky, sailed from the Black Sea port of Novorossisk under Captain A.D. Kuzmin, an experienced man who had sailed for years on the high seas. In spite of the adverse weather, including a strong southwest monsoon that raged in the Arabian Sea, the crew handled its job well enough and the vessel reached Chennai on August 1, 1964, four days ahead of schedule.

Akademik Arkhangelsky was a vessel about the size of *Mahindra*, but unlike the latter, it was certified as a sea-going vessel licensed to go anywhere in the world. It was a fully equipped seismic vessel, sporting a neutral density marine streamer containing in-built piezo-electric geophones. It had an electronic positioning system of Russian design. The seismograph was quite primitive by Western standards. It relied mainly on photographic paper recording. The energy source for the seismic recording was explosives. The explosives were hooked on the marine streamer and it slid back as the streamer was dragged forward by the ship. When it reached the end of streamer, it detonated automatically.

There were altogether 15 to 20 men onboard, about half of them technicians. Life was Spartan. One portly lady-cook took care of the meals which were available only at fixed hours. Cabins were cramped and uninviting. There was no shift system for the men onboard.

The expedition started in September. A shelf south of Chennai, from Pondicherry up to Nagapatnam was selected as the first area for survey. The party chief Dr Malovitsky, technical leader G. Shishanov, operator V. Slipchenko and others applied all their effort, knowledge, experience and technical skills to the job. The conditions in the Indian Ocean were somewhat unusual and unfamiliar to them but they were soon to master them. From 1964 to 1968 the Russian ship covered the entire Indian continental shelf from Kutch to Bengal acquiring nearly 19,000 line kilometres of seismic data.

Processing of the photopaper records was partly carried out onboard by one or two interpreters and seismic sections prepared. The major difficulty in marine seismic recording was the presence of 'ringing'. This was due to the resonance of the water depth column under the impact of the explosion. The resonant oscillations masked the true reflection signals. In modern digital recording and processing, the resonant frequency is filtered out by special computer programs. Such digital recording systems were not available in the Russian vessels and the interpreters used their personal skills in separating the signal from ringing. In spite of these handicaps, the Russians did an admirable job of interpretation and delineation of the structures.

As a result, several structural features were discovered, the largest being off Mumbai. It was christened Mumbai High.

Recalls L.L. Bhandari: "We were sitting in the ONGC guest house at South Extension in New Delhi. It was nine in the evening. Kalinin was poring over the seismic section of the Mumbai Shelf which was just then shot by the Russian vessel. He observed two lines crossing each other and a large high. Kalinin promptly called B.S. Negi and told him that a High was there."

Thus in 1968, ONGC had two offshore structures: the shallow but treacherous Aliabet and Mumbai High in deeper waters. But there was no way that ONGC could get a rig for the deeper waters. But criticism of inertia had started mounting again. Parliament was in a furore over the delay in offshore exploration. Johnson decided to give Aliabet a try.

OPERATION LEAPFROG

Operation LeapFrog is the fascinating story of India's first foray in offshore drilling, albeit in shallow waters. Though the fixed platform was designed by Technoexport of the Soviet Union in conjunction with ONGC's own Hind Oil Design Institute (HODI), it was entirely built by an Indian yard. The story was scripted by Chairman Johnson in association with S.S. Raina, Member (Engineering). Nearly 100 dedicated men from engineering, drilling and logistics played major and minor roles in enacting Operation LeapFrog. Though Aliabet #1 did not give indications of any commercial quantity of oil, it built up the winning spirit of the country and ONGC.

A seismic party headed by S.K. Verma of ONGC chose Bharbhut on the north bank of Aliabet for all its journeys from the mainland to the island and back. This had several locational advantages despite the fact that one had to wade, on most occasions, through knee-deep slush before reaching the boat or the shore.

The party established its base camp first at Ankleshwar and then at Bharuch. A one-man unit with a vehicle and a driver was set up at Bharbhut to ensure adequate drinking water supply to the personnel at Aliabet and to communicate urgent messages for the party chief and vice versa. The party's first crew at Aliabet was of surveyors.

Aliabet is completely uninhabited and cut off from the mainland by a vast stretch of water. Plying is possible only by boats and that too during high tide. Because of the varying and uncertain timings of the high tide, sometimes the journey had to be performed during the night, particularly for transporting water. Depending on the mercurial temperament of the wind, at times a distance of 15 kilometres which could normally be covered in 1½ hours in favourable conditions, would take as long as 18 hours.

Veteran driller A.K. Mitra recalls: "In early January 1964, four or five of us, including Russian geologist Kosorotov, chief drilling engineer Barkskov and Jitendra Swarup, were doing a recce. We were about 12 kilometres from Ankleshwar #3 which was at the extreme end of the structure. The widely fluctuating tides made conditions worse. With great difficulty, some geophysical work could be done by using extra long spikes. We all thought it would be impossible to set up a drilling rig in a stable position."

Then a directive came from the headquarters that a party should go and work out the logistics. On January 19, a government launch was hired. The party included member R.D. Verma, Chief Soviet advisor Kachlisvilli, Gautam Kohli, Swarup, S.K. Verma of the seismic party and interpreter V. Kumar.

"Fortunately," recalls Kumar, "a small 'Donkey' motor launch, as per the government regulations, was carried along. Even after four hours, we were still four kilometres away from the location. Then suddenly the tide receded, necessitating the anchoring of the boat. The consensus was to await the return of the high tide. As was his wont, Verma would have none of that. He insisted on walking up to the site. It was suicidal; the exposed land was slushy and everyone had to jump and hop on to the exposed solid ground. We had hardly gone about a kilometre and-a-half, when the tides reappeared in the distant horizon. We all tried to scamper back towards the boat but it was futile. Panic and fear gripped us. The current was so fast, that within 10 minutes we were knee-deep in the water. There was no time to count; the boat looked too far. Luckily, the 'Donkey' boat captain saw our plight. He cranked his motor and rushed towards the stranded passengers. It was the sweetest moment of our lives when we hauled ourselves onto the dingy."

During the field season of 1969-70, a seismic party was working in the Ankleshwar-Hansot area under party Chief Dr V.S. Aithal. S.K. Dey, a geophysicist in that group got a directive from the Director, S.N. Sengupta, to immediately proceed to Aliabet. Their job was to tie up the Aliabet structure with the Ankleshwar anticline.

Having learnt a near-tragic lesson from the earlier experience, they hired three country boats and conducted the shooting. As it had become a high profile project, the veterans descended on the island. The crew took a month to do the ground preparations. Sengupta directed the operations, leading from the front. The seismic operation was completed in two days. Sengupta had brought with him two geophysicists, 'desert fox' A.M. Awasthi and V.C. Mohan to oversee the job. Thus, Operation Seismic tied up the structure as an extension of Ankleshwar.

Much thought had gone into preparing the working drawings of the fixed platform. HODI, headed by Russian engineer L.A. Mezhlumov, was entrusted with this exacting task. Preliminary drawings covered the blocks of the platform, its various joints, housing unit, storage tanks, derrick substructure, fire-fighting trestles, decking details, etc. Special care was taken to strengthening the barges as well as the alignments between the blocks and crane movement. Layout plans were drawn up for a variety of components of the drilling rig.

Furthermore, the meteorological and hydrographical conditions of the Gulf of Cambay were very difficult. In order to take care of these conditions in the designs, it was decided to send two design engineers, G.V. Bhanu Prakash and S.K.A. Rao from HODI, to Russia to participate in the preparation of the basic designs for the platform, the contract for which had been given to Technoexport. Indian engineers and their Russian counterparts spent weeks together to complete the drawings on time.

Since at least two to three months were needed to complete the drilling of the first offshore well before the monsoons made the operation impossible, it was necessary to have the platform ready, and install the rig by March 31, 1970. It was a tight schedule and the men had no illusions about the magnitude of the task which had to be compressed into a span of six months. Nothing short of the most meticulous planning, utmost urgency in procurement and fast fabrication was called for.

First, various contracts had to be finalized and logistics had to be arranged: vessels, cranes, tugs and barges. Bhavnagar was selected as the operational base. It had access to the sea, it was not too far from the ONGC's land installations or from the drill site and above all, it had a workshop where the blocks for the platform could be fabricated and launched down the slipways. A contract for the fabrication of blocks was concluded in September 1969 with Alcock & Ashdown of Mumbai which also owned the Bhavnagar workshop. It stipulated that fabrication would begin by October 1 and be completed by December 31, 1969.

In order to meet the deadline, it was necessary to procure more than a thousand tonnes of tubulars and structures. This task was made even more difficult by the fact that steel at that time was in short supply in the country. Hindustan Steel Ltd and Stewards & Llyods Ltd came to the rescue and agreed to rejig their production schedules to meet the requirements of the Commission. The procurement was completed in three weeks. Contracts for hiring a 120- tonne Periyar crane from the Cochin Port Trust, a Saeed-1 tug from a private owner, a launch and several barges were also concluded.

It was followed by a period of hectic activity. Buildings were hired for offices in Bhavnagar, a base for operations was built and godowns constructed. A rig, specially selected and repaired for the drilling had to be sent to Bhavnagar and a special slip-way for the fabrication and launching of the blocks had to be laid at the workshop. And the fabrication began in right earnest.

A drilling rig with all its supporting components weighs about 500 tonnes. The platform needed to be strong enough to bear this weight and to withstand the furious lashing of the monsoon storms and the 30-foot high tide. This was a hazardous operation since it called for split-second timing, precise positioning and accurate mooring of the barges. To reach the slip-way, the 120-tonne crane had to be guided nine kilometres up a long creek to a specially deepened pool at the bottom of the slipways. The whole operation had to be completed before the low tide made it impossible for the crane to operate. Any delay would have meant the grounding of the crane and possible damage to it.

The launching of the first block on December 13 took one hour and 35 minutes and was completed just in time for the crane and the barges to move out with the tide. The succeeding blocks were launched at intervals of 30 to 40 minutes each without a single mishap. The seven blocks, after being launched, had to be taken on the barges for some distance from the port where they were moored. One night, the spring tide lifted the barges and carried one of the blocks inland for some distance where the ebbing tide left it stranded about 10 kilometres from the port. Here it remained for 15 days till the next spring tide, a grim reminder of the hidden forces that lurked in the Gulf.

The erection of the blocks posed a slew of technical and marine problems. The operation of lifting each massive block off the barges and lowering it on to the bottom of the sea so that it stood upright posed a challenge both to the courage and ingenuity of the engineers, drillers and the respective crews of the crane, the tugs and the barges.

Since the operation could only be undertaken in the short period of still water between high and low tides, it sometimes had to be carried out in the late hours of the evening. Some of the work, towards the close of the operations, was done in the dim lights from the crane and a single false step or a single weak grasp could have meant a 60 feet fall for the brave men who climbed to the top of the block to release the slings after the job was done.

A large boat served as the lodging and boarding base during these operations. The men slept on the other side under a tarpaulin cover. The passenger boat Sagar Kanya, which ferried men between Bhavnagar port and the platform, was a single motor engine boat and would pitch and roll all the way making even the strongest of the men sick. "Sheer determination and grit kept us going," says S.C. Upadhyay, one of the first to be associated with the maiden offshore venture.

Finally, after the seven blocks were erected, the platform had to be anchored to the sea bottom by driving piles, and then grouting these piles with cement. Once the anchoring was complete, all that remained was to erect the rig, section by section.

But while erecting the rig, one of the four legs, accidentally fell into the sea. A.K. Mitra thought of a novel idea and got the fourth leg fabricated from drill pipes with the help of local machinists. Eventually, the rig was put up and the engines, pumps, tanks and all the paraphernalia of drilling was mounted on the platform.

The first offshore well, Aliabet #1 was spudded by Prime Minister Indira Gandhi on March 19, 1970, 12 days before the scheduled day. In a stirring speech, she said: "It is said that some people dream while others do deeds; my experience, however, is that we cannot achieve anything worthwhile unless we have the capacity to dream and to think big; only those who can see far can go far. No individual or nation can prosper unless they have the courage to face dangers and difficulties. Once again, I salute the engineers and workers of this project."

Johnson paid a glowing tribute: "The doctrine of self-reliance, the doctrine of faith and confidence in the ability of Indians to engage in great ventures, to launch ambitious schemes and to bring them to a triumphant conclusion has gained acceptance and will henceforward be at the heart, not only of what we in the ONGC will be doing but at the heart of what we in this country undertake in the future. In helping to strengthen this doctrine and to justify its acceptance, the success of Operation LeapFrog will have played its part."

Although the oil strike in this well was not commercially exploitable, it nevertheless paved the way for ONGC's future offshore operations and revealed for the first time the presence of oil in the Miocene. Thus the experience gained at Aliabet came in very handy in the subsequent offshore operations. And that was ONGC's biggest gain.

Johnson left soon after the Aliabet venture. That also marked the end of the second Blitzkrieg. He had achieved remarkable progress in all areas of operations without much administrative help from the government.

Under these circumstances, Johnson handed over charge to B.S. Negi who was also Member (Exploration) in 1971. Negi was to remain the officiating Chairman till he retired in 1974.

As S. Ramanathan remembers, there was a written communication from the Government to reduce the manpower strength by a quarter. The pay package of 1968 which was due for a revision in 1971, got delayed. In the officers' cadre once again, stagnation had started affecting morale. Promotions were strictly as per government regulations.

The workers' union decided to hit the streets again. It was not an all-out strike but operations in Gujarat came to a standstill. The officers again kept things moving. The Commission went in for a scheme to collectively insure the officers. That was the genesis of the Group Insurance Scheme.

Malaviya, who was watching from the sidelines, was asked to head a committee of eminent people to suggest the restructuring of the Commission in 1971. He was back in the business.

A FEW OUESTIONS RAISED

The Commission had indications of prospective areas in geologically difficult regions. It needed technology, equipment upgradation and massive inputs of capital. Its meagre income from the sale of crude was not sufficient for intensive exploration.

The two basins, Gujarat and Assam, were giving different problems. In the case of Gujarat, Ankleshwar was as prolific as ever but fields like Kalol, Sanand and others to the north had heavy oil. They needed infusion of secondary methods of recovery. Assam still needed more time for development. Environmental problems were the biggest bottle-neck in the state. Assam had huge potential but it needed new technologies to turn the prognosticated reserves into geological reserves. Despite sporadic attempts, the huge Gangetic basin and Himalayan region remained a mystery.

ONGC was heavily dependent on government help to carry out operations. Financially, it was better economics to invest in existing fields because the returns were certain and higher. The Commission was following the worldwide trend.

Foreign exchange was scarce. Files for purchasing equipment followed the circuitous route through different ministries. It took time. But time was money in a business like oil. With every delay, project costs became unviable.

There were problems, Malaviya knew.

His first observation was: "It has neither the status of a Commission nor the flexibility of a Corporation; in fact, it has the disadvantages of both." Chastising the false economizing which had resulted in deterioration of drilling rigs, vital equipment like BOPs, non-induction of cutting-edge technologies like seismic refraction, Common Depth Point (CDP), logging, Drill-stem Testing (DST) and others. In a prophetic way, the Committee noted: "We would like to place before the country that in the world of oil, there is a principle which is accepted as an axiomatic truth, i.e, oil exploration is such a business that if one has to launch it, one should do it on a grand scale or not at all. A middle course here is ruinous."

Despite Johnson's successful turnaround, newer problems on the manpower side kept cropping up at regular intervals. The Ministry of Petroleum and Chemicals requested Malaviya to suggest a restructuring of the Commission. Malaviya agreed to have another look at the organization he had built up from scratch. He invited the surviving stalwarts of ONGC who had shared his vision in those days of 1955. M.B.R. Rao came on board. Veteran journalist, Sailen Ghosh, was invited to join as the Member-Secretary of the Malaviya Committee. Other prominent figures in the Commission were M.S. Pathak, Member, Planning Commission and Chairman, Engineers India Limited (EIL), Dr G. Ramaswamy, Chief of Exploration, Planning and Development, Ministry of Petroleum and Chemicals and N. Krishnan, Chief Cost Accounts Officer, Ministry of Finance.

ONGC was asked to comment on several incisive issues pertaining to offshore operations, including:

- Technical information on offshore operations.
- Computer program systems developed.
- Technical back-up organization developed.
- Whether a comparison was done with the Mexican offshore venture, especially for time lags.
- Reasons for the delay in offshore operations.
- Anticipated outlays over the next five years if no oil is found in Mumbai High and otherwise.
- Planning done regarding post-exploration in Mumbai High.
- Journals and books on offshore available.
- Project for control of oil spillage.
- Project for oceanographic data collection.

Malaviya had a similar set of questions for the lack of intensified exploration in new areas. He sent M.B.R. Rao to Dehra Dun to personally feel the pulse of the organization. Rao was happy to be back amidst old acquaintances. But he felt a simmering dissatisfaction among the scientific community. They were feeling marginalized in the bigger scheme of things. As there was no career planning (the Commission still didn't have a Member Personnel), there was widespread stagnation. The Bonus scheme had made a lot of people unhappy. The drilling crew got a bonus on achieving a certain metreage. But the well-site geologist who was the deciding authority for metreage, was himself excluded from the scheme. Ultimately, the scheme was scrapped.

It was time for some soul searching for the seniors of the Commission. Malaviya knew that the downslide couldn't have been a one sided affair.

He sent a questionnaire to the government:

- What according to you are the ills of ONGC?
- Would you agree that without technical orientation of the Administrative Ministry and the Ministry of Finance, there cannot be any substantial improvement of ONGC?
- If so, what changes would you suggest in the secretarial set-up?
- Would you agree that the Ministry of Finance as well as the Department of Audit have become a bureaucracy within the bureaucracy? If so, what changes would you suggest in the Finance Ministry and the Department

of Audit? How can they be given an enterprise orientation?
- In countries like France, there is a two-way traffic: between the top level of the enterprise and the top level of the Ministry. Would you accept periodic rotation of top executives of public enterprise and top executives of the Ministry in our country?
- It has been reported that in answer to ONGC's request for foreign exchange for three deep wells to be drilled, the Ministry of Finance has asked for project reports for each of the three deep drilling projects. Do you think any oil exploration company can function on this basis? Don't you think this is a wrong approach that cuts at the root of the very purpose for which ONGC was made into an autonomous body?
- Can you cite instances where the Ministry has given policy directives to ONGC?
- I have gone through some of the correspondence between the Ministry and ONGC regarding computers. Now, some in the Ministry tend to blame ONGC for not having bought a big enough computer. But in 1969, it is the Ministry that had advised ONGC that what it needed was a mere processor, and that ONGC should time-share a processor with others.
- The decision that ONGC should do the drilling at Mumbai High with technical assistance from some foreign experts was taken in 1969.
- What did you do to ensure that the detailed seismic survey with the help of the latest equipment (i.e. digital) was carried out simultaneously?
- Why does the ONGC, at this late stage, depend on hiring a contractor for doing the digital seismic survey in Mumbai High?
- Again, I find that the Ministry did not clear the ONGC's proposal for purchase of marine seismic data acquisition unit "until ONGC gives guarantee of procurement of an ocean going vessel." Thus, there is a vicious circle. The Ministry refuses to release foreign exchange unless ONGC gives guarantee of procurement of an ocean-going vessel. ONGC feels it cannot procure anything in time due to lack of timely clearance from the government about foreign exchange. What is the solution to this?
- The Members of the Commission are appointed for one year. Do you think this is a right procedure? Does it not reduce the members to utter dependence on the Ministry?

The questions stunned ONGC and the Ministry in equal measure. From day one, Malaviya had proposed an independent Commission. In those times, it was unacceptable. When he came out with his recommendations in 1972, it was again unacceptable. No one wanted to relinquish his turf.

It had different suggestions under headings such as Shortcomings of ONGC, Organization, ONGC exploration policy, Personnel Policy, Oil Equity Abroad and various other activities.

The Malaviya Committee suggested a future course of action which rested on five pillars:

- Review of the country's (onshore) sedimentary basins.
- Comprehensive exploration program for the continental shelves.
- Exploration for oil abroad.
- Emphasis on the production of synthetic oil.
- Containment of oil demand by better utilization of our coal and other indigenously available resources.

Malaviya suggested the repeal of the statutory act of 1959 by Parliament. ONGC should be broken up into separate companies, one for onshore and one for offshore. A common Chairman of a holding company with Managing Directors of the different companies under his administrative control was proposed. The two companies were to share a number of common services and they could conceivably have exchange of personnel and close integration so as to extrapolate offshore and onshore data.

To circumvent the file-doing-rounds phenomenon, he had mooted the establishment of a National Commission on Oil Exploration with full delegated powers. He had urged the government to clearly enunciate its responsibilities with regard to exploration and production of oil and natural gas and this should be explicitly made known to ONGC. The Committee had even suggested that the Prime Minister take up the oil portfolio in addition to space exploration and atomic energy because oil business had similar traits and needed guidance from the top.

Though the report didn't find immediate takers, it remained a classic study on the oil sector. All subsequent changes borrowed from its contents to come out with newer policies.

Meanwhile, Negi decided to go to a new province in the North-East.

TRIPURA WELCOMES THE OILMEN

In 1962, Tripura was surrounded on three sides by the erstwhile East Bengal. It was a picturesque land which provided a warm and humid climate with abundant rainfall. The hills were interspersed with thousands of streams, brooks and wooden bridges. It consisted mostly of different tribes who lived in thatched bamboo huts on raised platforms. There were no industries and hardly any schools.

The Baramura structure was mapped by Franklin of AOC in 1949. But the structure was too difficult to conduct geo-physical survey.

ONGC entered the area in the early 60s to start detailed mapping of the structure. In subsequent years, the geology of the area had become clearer. The field parties were based in Kolkata. It was decided to set up a separate office in Tripura.

Negi, accompanied by the Petroleum Minister, came down to Tripura to scout for locations. With project manager M.B. Deshmukh of Control Room fame, they visited several sites such as Indranagar, Nandan Nagar, Kunjaban and others. It was the time of great social and military upheaval in that area. The entire selected plot was occupied by the army. The army authorities were willing to sell the land to ONGC later.

A plot of land in Badarghat on the Agartala-Bishalgarh road was chosen for the office and 80 acres were purchased. The project was officially open. A Russian rig, 3D-20, was mobilized from Assam in 1971. The only road connection was the National Highway #44 running through Shillong via Badarpur in Silchar to Dharam Nagar in Tripura.

The rig took almost a year to reach the Baramura #1 drill site. The Chief Minister of Tripura, Sukhomoy Sengupta, was invited to spud the well on July 18, 1972. The original planned depth was 4,500 metres. The first well gave an indication of the future. The structure which contained very high pressures gas, encountered numerous drilling problems. The drilling was terminated at 2,800 metres. But production testing opened up a new horizon in the region. One zone produced almost 65,000 cubic metre of gas per day.

Buoyed by the initial success, ONGC moved another Russian rig to drill Baramura # 2 in 1975. By the year 1980, there were three rigs in Tripura, which could drill four wells. That included the superior deep drilling rig, ARMCO-1320-UE-11, which joined the fleet in 1980.

The drilling was one of the scariest events for everyone involved in the project. With determination, a couple of other structures like Rokhia and Gojalia were discovered by the end of 70s. But there were no takers for Tripura gas. Later, the company entered the Cachar hills in Silchar. Similar problems would greet the small pools of discovery.

Meanwhile, ONGC had struck a goldmine in Mumbai offshore. It would change the face and the fate of the Commission forever.

PART FIVE

THE SILVER

ONGC ORDERS A SAMRAT

The decision to let ONGC explore the Bombay High structure mapped on seismic section was taken by none other than Prime Minister Indira Gandhi. It was a courageous decision taken in the toughest of times.

India was following the rest of the world in consumption of oil. The economies were firing on all cylinders in every sphere of life. From 1948 till the beginning of 70s, oil consumption had grown by leaps and bounds all over the world. India was following suit with a five-fold increase in consumption.

The rising demand in India was fuelled by the dieselisation of the transport sector and increased industrial growth. It was increasing at a rate which was more than India's GDP growth: 6-7% growth with periodic jumps to 10%. Two axioms became the guidelines for the future: one, oil consumption grew at roughly 1.5 times the GDP growth; two, the inelastic nature of oil consumption: there was, and still remains, no viable substitute for oil.

Thus, economic necessity, need for sovereignity and vitiated geo-politics prompted Indira Gandhi to ask her Petroleum Minister to explore the possibility of going beyond the shores.

ONGC could not keep up with the galloping demand for oil. In 1968, it was producing 3.5 MT in a total production 6 MT. The consumption was a runaway 15 MT. It drew up an ambitious plan for the next 10 years. It had plans to reach a production of 10 MT with 4.5 MT coming from offshore.

In 10 years, ONGC had grown in confidence. It had built up a sizeable cadre of trained scientists and technicians in all facets of oil business. Some sections of the government however didn't share the same confidence. The same excuses were floated around: lack of expertise, huge amounts of foreign exchange, lack of marine and communications equipment. But they had Malaviya on the other side. Even though he had no official status, oil was his life. ONGC was his baby. He would continuously write letters to Indira Gandhi, P.N.Haskar and other influential members, reminding them of the decisive role played by Nehru to build a vibrant national oil industry from scratch. The unrelenting stream of letters stands witness to the man's passion.

The prospective Bombay High Structure lay under a water column of 260 to 300 feet. The Russians had the limited experience of shallow water drilling off the

Caspian Sea, which they had passed on to ONGC for the first Aliabet well. In deeper waters, Western technology held sway, Americans had the edge, and, by the end of the 1960s, 200 offshore rigs were operating worldwide. Every day, newer technologies were taking offshore exploration to newer vistas. The troubled Middle East and the increased oil consumption had forced the US to explore the tough Alaskan oil and Britain was about to start the exploration of North Sea oil prospects.

There was a worldwide shortage of offshore rigs. The big companies, looking at other big finds, didn't evince much interest. Instead, small independents came into the field.

In 1968, the government started weighing the pros and cons of the four proposals it had received. Teneco and Zapata, both American, and Bomin, a West German company, offered to conduct the exploration and exploitation of Bombay High at varying costs. But Malaviya urged against handing over a potentially prolific field to foreign hands for the next 30 years.

Triguna Sen, the Petroleum Minister, asked ONGC Chairman Leslie Johnson to prepare a techno-economic study of the prospect. Accordingly, Johnson formed a committee to study the fourth proposal, a Japanese offer. Mitsubishi had roped in the pioneers of offshore engineering, Offshore International S.A (OISA). They jointly offered to build a mobile drilling rig at competitive prices. The committee dithered over the decision and Johnson lost patience. He studied the proposal in detail and announced his decision to go for a jack-up operation.

Two other vital realities tilted the decision in favour of ONGC: the 1965 foray with foreign partners in the Persian Gulf and the recent experience acquired in Aliabet. The Principal Secretary to the Prime Minister, P.N. Haskar, finally put all the pros and cons in the right perspective. Indira Gandhi zeroed in on ONGC to carry out the job. Thus in 1970, Negi initiated the purchase order for a jack-up for Rs 125 million. It was to be self-propelled: a ship which would be a drilling rig, too, with an opening in its centre.

Initially, it was the government that entered into agreement with Mitsubishi. Later, in 1971, the ownership rights were transferred to ONGC. Things started moving fast. H.G.T Woodward and A.K. Mitra were stationed in the historic city of Hiroshima in Japan to oversee the techno-economic aspects of rig construction.

Soon S.M. Malhotra, S.C. Upadhyay, S.M. Kukreja, U.A. Paul, D.S. Nandal and many other young and energetic engineers joined the shipyard to learn and remember every nook and corner of the rig. As massive blocks of steel were being welded to give shape to the ship, the theatre of action on the Indian shores became more frenetic.

The French company, CGG, was hired to carry out detailed seismic survey. They had closed in on ten possible locations. They were all in water depths ranging from 250 to 300 feet. Next, the tide, wave and wind conditions were studied by a newly formed marine survey wing within the company. The sea bed survey was the most vexing problem. The clay on the sea bed was almost ten metres thick. Soil strength varied from place to place, in some places, by metres.

K.S. Shankar of the drilling directorate started the well planning. The first well was to be a real 'wildcat'. Well planning involved imagination of the sub-surface conditions: down-hole pressures, temperatures, type of formation, all these were anticipated according to the rough geophysical data given by CGG. It was also time to recruit fresh crew for offshore-roughnecks, derrickmen and roustabouts. In May 1973, about 50 new employees joined and awaited the arrival of Samrat. The project was already six months behind schedule.

By the middle of March, 1973, the rig was ready for sea trial. She was the size of a football field. The 10,000-tonne ship had four massive legs of 337 feet length.

On April 3, 1973, the drillship set sail from Hiroshima. Before she could take to the open sea, the insurers, Noble Denton, wanted the length of the legs to be shortened. As per their calculation, sailing with the full set of legs was a risky affair. Accordingly, 20 feet of each leg was removed and kept on the deck.

She was a slow moving ship, logging only 5 knots per hour. Captain Suklikar, in the wheel house, was extra careful. As it sailed out of Singapore, after a 10-day stopover, the ship faced a very rough sea.

The days of satellite-based navigation were still in their infancy. S.C. Upadhyay reminisces: "One night, at 2 a.m, the abandon-ship alarm went on ringing. Everyone rushed to their respective life boat stations with life jackets on. And then the 'all clear' announcement was made on the public address system. Everyone heaved a sigh of relief." Later on, it was found that the chief engineer on watch duty had triggered the alarm when he found a hot water had pipe burst. The ship's bearing was taken after the sea became calm. They had drifted off course by 42 nautical miles and that too, in the wrong direction!"

Finally, after 54 days at sea, the crew breathed the air of India on May 25, 1973.The ship was asked to reach the Bombay High location directly. The crew was put on a supply vessel and sent to Bombay Port. The Project Manager of newly formed Bombay Offshore Project, V.K. Verma, gave a warm welcome to the weary passengers. A bonus awaited them. Special sanction had already been taken to provide the crew with air tickets to reach home at the earliest. Their journey ended and Samrat's journey had begun.

The journey was greeted with the rising swells of the Arabian Sea. It was a race against time. First, the four pieces of extra legs had to be fitted in place. That needed the four legs to go all the way down. For that, the engineers needed deep and calmer waters. For one whole night, Mitra and the new crew took it all over the confines of the field. They could neither locate a suitable depth nor find a calm sea. The expatriate consultants termed it an 'intractable problem. Never to give up, they went towards the Tarapore area near Bombay. The ship's sonar could detect one location. The crew immediately went to work. With the ship rolling and pitching, the four extra pieces, around 20 feet long were attached. With that, the insurers, Noble Denton, gave the go-ahead for jacking up in the Bombay High location. They had a rider though: it had to be finished by the end of May. No insurance company allowed any sort of movement or construction work to be carried in the official monsoon period, which lasted from May 31 to September 30.

The crew had a few days left.

At the first location, the massive legs were lowered to rest on solid sea bed; they just kept on going down. The maximum permissible penetration was 18.2 metres. It was moved to the next location, and it was the same story again. It was taken to seven locations. Nowhere could the legs get a solid footing to take the designed load of 5000 tonnes each. The sea bed survey had predicted 10 metres of loose soil. It was more than that. Going beyond that, needed the permission of the underwriter. Noble Denton agreed to allow the increase in length to 25.8 metres, but not during the approaching monsoon. Crestfallen, the crew sailed to Bombay harbour to wait for monsoon to end.

After the initial failure, one newspaper labeled Samrat as a "White Cinderella."

To avoid public criticism, one well was decided to be drilled in the Tarapore structure, not very far from the Aliabet well. Just after the end of monsoon season, Samrat had its first successful jacking up in October, 1973. It was supposed to drill the well # B-14 in Tarapore to 4500 metre. While drilling at 2,781 metre, the well experienced its first gas blowout. It was very hot; some called it steam blowout. It was a scary incident for the new crew. The well spewed huge rocks and boulders up to 150 feet. The crew fought valiantly to control the well. Luckily, it subsided. Other drilling complications forced the abandonment of the well in November, 1973. In the meantime, a more detailed sea bed survey had been done at the Bombay High drilling location. After the completion of the Leg assembly job, it sailed for the location H-1-1 in the last week of January, 1974.

ONGC had faced criticism for all the delays. The reason was an event which sent reverberations throughout the world. At that time, the world was facing its first official world oil crisis.

OPEC members, realizing their pre-eminence and changed supply situations, had started grumbling from early 1971. The $1.88 was no more sacrosanct. Every month from 1971 onwards, oil prices started inching upwards. OPEC, led by the irrepressible Sheikh Yamani from Saudi Arabia and Amouzegar from Iran, led the price war with unilateral declarations from Teheran.

In 1974, using oil as a weapon, OPEC inflicted a twin blow to world economies. It increased the price to USD 5.11 and cut production by 5% across board, taking five million barrels oil off the market.

The price rise stopped at USD 11.65, a price that was most competitive to any other alternate source of energy.

In 1974, the whole world collectively suffered. The richer countries were also affected. Japan suffered the most. It didn't produce a drop of oil but was one of the biggest consumers. Rich countries managed to overcome the crisis by hiking prices of other exports to third world countries.

In India, P.K. Dave, the Petroleum Secretary, dashed off to the capitals of Middle East countries to earn India a reprieve from the embargo. He could manage a small breathing space. But the increase in oil prices was driving the prices of all commodities northwards. The Fifth Plan supposed to start from 1974 got stalled. The import bill of the three largest imports, food, fertlisers and oil, was USD 4.31 billion in 1972-73, which rose to USD 25 billion in 1974-75. The foreign exchange reserve was a surplus at USD 4.31 billion in 1972-73, which turned into a deficit of USD 11.90 billion in 1974-75. The inflation reached double digits with the peak at 20%. It held a lesson for the world. Big was no more beautiful. The need for energy conservation and alternate sources of energy was here to stay.

While all this was happening, Samrat was struggling to jack up and start drilling at the desired location. Some in the Commission debated on the game of probability. ONGC, by that time, had a strange oil strike pattern. Failure at Jwalamukhi was followed by discovery at Lunej; failure at Disangmukh followed by success at Rudrasagar. Offshore foray had little setbacks: Aliabet with small show of gas, initial jacking up problem of Samrat, Tarapore failure. Were good times round the corner?

It had taken Samrat a couple of days to reach well #1 in the Bombay High structure, 160 kilometres from Bombay. The well was termed H-1-1. Samrat reached the location at the end of January 1973. All the while, the engineers were busy making last-minute checks of motors and other equipment for the jacking-up operation.

On January 31, the huge legs started going down simultaneously and hit solid ground under the sea bed. The ship was jacked up, fifty feet above water. Everyone heaved a sigh of relief. They had to wait for a couple of days to test whether the soil could withstand the massive load.

A lot remained to be done before the actual drilling. It was costly, with a foreign exchange component of USD 7,000 every day. OISA had provided a couple of experts as operators and toolpushers. Warrington, Operations Manager, had a pack of cards every time he met any newcomer on the rig. When K.C. Chandra went to greet him, Warrington handed him the pack and asked him to go through the contents for a month. Each card had the operating costs of the rig from one year to each second. Everyone was required to memorize the costs.

Finally, on February 3, 1974, the drill string went down from the rig floor to touch the sea bed. The first well was spudded. The drilling started without any complications.

The crew had settled down to the grind of 12-hour shifts. It was a back-breaking job. L.L. Malim joined as a roustabout in April, 1973. He reminisces: "It was a hard, tough life; no place for slackers or the faint-hearted. All the hard work made our backs strong!" It was fouteen days on and seven days off. The method of commuting was a bowel-churning 14-hour journey by a supply boat from the Victoria Docks.

With a toothy grin, A.R. Dalvi, another veteran, says: "The first time, we wondered where we were going; how long will we travel in this endless sea?" The ship was self-sufficient; there was a 24-hour galley (kitchen); there was a recreation room. Initially, people could not sleep. They spent hours gazing at the changing seascape.

The drillers and geologists were extra careful as the drilling hit deeper depths. Every metre was important. As the giant 1600 HP mud pumps pushed thousands of gallons of drilling mud down the string, the geologists waited on the surface to check the crushed drilled cutting for any oil show.

T.K. Roy, the shift driller, noticed a faster drilling rate at 962 metres. Alarmed, he stopped drilling. He informed the American toolpusher and geologist Arunachalam. Both approved of his action. It took one hour for the drilled cutting of "962" to appear on the surface. Arunachalam took the sample to study under the fluoroscope. It showed "golden yellow" fluorescence, the colour of oil. The ship's radio crackled to life.

It was decided to cut a core of 18 metres. When the core sample was studied, there were beautiful streaks of oil bands on the outer surface of the rock sample. It was too good to be true. Still, no one could say whether there was real oil or it was just a sample. They had to carry out DST (Drill Stem Testing), which was an instantaneous way of going down to the depth, setting a rubber packer to isolate the mud pressure from top and giving oil, gas or water a free run to come up to the surface.

On the western front, there was just one set of DST tools, stationed at Ahmedabad. Gopeswar DST Banerjee, who had joined in that first well at Jwalamukhi, got a call to mobilize the resources to move to Bombay. From Bombay, the DST team had their first ride on the high seas. By February 18, 1974, they were ready to isolate the zone and carry out testing. They had to wait for daylight to break. No one wanted to see anything going wrong in the night.

On February 19, 1974, at the break of dawn, the well was opened. Oil gushed out in great force, at 500 psi (pounds square inch). Next to be measured was its gravity. It was 43.6 degrees, another astounding parametre. In oil parlance, 43.6 degrees API was as good as gold. It kept on flowing. The oil, mixed with small quantities of gas, was "flared", as there was no storage space. Nights became majestic with the bright, orange flame creating rainbows. There was a three-day radio silence. The nation was too sensitive to any wrong information. After technical studies, L.L. Bhandari informed the chairman Negi about the oil find and its size. Negi was skeptical. He enquired about its comparison to the Ankleshwar field. Bhandari estimated that it would be at least twice the size of Ankleshwar.

The news energized the whole nation. The newspapers went berserk. "Oil ahoy on Bombay High!" and similar headlines gave some hope to the beleaguered nation reeling under the USD 11.08 crude price shock.

It was decided to reach the target depth of 2,000 metres. En route, the team came across two more oil shows at 1,400 and 1,600 metres, both equally good. The drilling of the well was completed on April 8, 1974.

The enormity of the finds necessitated a thorough testing of the well, which ended on May 3, 1974. What was music to the ears was the nature of the reservoir rock, the oil find in limestone. The Middle East oil bonanza was all from limestone.

Had ONGC struck a gold mine? Was it a reality? The Commission officials kept their fingers crossed as the data generated from the testing was studied. The oil shock had pushed energy into the forefront again. On February 23, barely four days after the first find, Petroleum Secretary P.K. Dave asked ONGC to prepare a plan for early production. The ONGC think-tank got into a huddle. The draft for the possibilities of first phase of production was prepared after two days of brainstorming on February 27 and 28, 1974.

In the meantime, Negi was about to retire in April. Offshore development needed a technocrat at the helm, the government felt. The public sector had never seen such a manhunt to choose a go-getter to get the oil to surface in the shortest possible time.

They needed a man to take charge of the Commission.

MUMBAI HIGH ON WORLD OIL MAP

A committee was formed with P.N. Haskar, Dr B.D. Nag Choudhury and Dr Raja Ramanna to look for a suitable person to head the Commission. They zeroed in on Nuttaki Bhanu Prasad. Hailing from a wealthy family of industrialists, Prasad was managing a chain of sugar mills in Andhra Pradesh at that time. He was a mechanical engineer from Madras University with post-graduation studies in chemical engineering from Purdue University and industrial engineering from Case Institute of Technology, USA.

In 1954, Homi Bhabha, the father of Atomic energy, had picked him up to head the reactor engineering and operations division of Atomic Energy Commission (AEC). Prasad, in no time, had earned a reputation as a leader, with the timely commissioning of Apsara and other reactors. Recognizing his magnificent contribution, he was given the coveted Padma Shri award at a young age of 31. Always in short-sleeve shirts and hands on his waist, he was the proverbial leader in search of newer challenges.

Prasad wanted a free hand; no bureaucratic interference and no nitpicking. He also wanted secretaries to the government to be made the members of ONGC; it was acceded to immediately.

He became the seventh chairman of ONGC. In an unprecedented move, Finance Secretary M.G. Kaul and Petroleum Secretary Dave joined as ONGC Members. Prime Minister Gandhi had realized the pivotal importance of oil in the overall economic development of the country. She promptly brought back Malaviya as the Minister to guide ONGC.

Bombay High was the last hurrah for Negi, the last of the old guard. He retired gracefully.

As S.S. Raina, Member (Engineering) put it to Negi: "You have been such an intimate part of the ONGC that it is difficult to believe that the day has arrived when your association should end with this organization. In fact, it is difficult even to think of oil exploration in the public sector without you. The years of your Chairmanship have been the years of progress as well as problems in the life of ONGC. We moved to new frontiers of exploration, namely, deep sea drilling in the Arabian Sea and the overseas exploration in Iraq. These two major steps are bound to have a positive and lasting impact on the future of ONGC as well as on the economic scenario of the country."

Soon, the country was in turmoil because of the spiralling effects of the rising oil prices. Dave remembers Finance Minister C. Subramaniam offering to take his shirt off for oil. Money would be no problem for the development of Bombay High.

Samrat drilled the second well. It didn't produce any oil. Was the first well a fluke? In February 1975, Samrat was drilling on H1-1-C. There were no signs of a positive oil show at the expected depth. It was decided to shift to the next structure and drill one more well before the onset of monsoon in May. L-II zone, from which oil flowed the first time, was playing hide and seek. The geologist on board had an inkling when the drill bit was about to enter the L-III zone. Talukdar and A.N. Datta from the directorate of Geophysics, reached Bombay. They got on board Sunfish. They rushed to the geology laboratory onboard and checked the samples. Talukdar insisted on penetrating through the L-III before calling off drilling. He stayed onboard till that zone was drilled.

L-III dwarfed L-II in size and other characteristics. The fourth well was drilled, with excellent results. The field was declared commercial. It was decided to invite PM Indira Gandhi to dedicate the field to the nation. Malaviya wanted to show to the Prime Minister the flow of oil from Samrat.

Prasad got a crack team ready and moved offshore. One simply couldn't start oil production just like that! When crude oil came out, it had to be separated from associated water and gas. A three-stage separation system was fabricated onboard Samrat by procuring necessary equipment from Ankleshwar. A small oil carrying tanker was anchored at a safe distance from the rig. A flexible hose from Samrat was laid across the intervening sea. Empty barrels were strung to the hose to keep it afloat. Prasad insisted on checking, and rechecking the safety of the system.

On April 10, 1975, Mrs. Gandhi landed in an IAF helicopter on Samrat. She went up to the Rig floor to open a valve, and saw the hose pumping oil to the tanker.

Suggestions were mooted how best to commemorate the event by putting Samrat on a coin or a stamp. At that particular point of time, oil had affected everyone, rich and poor. A.K. Mitra suggested placing Samrat on a rupee note, a denomination even the poorest of the poor would possess. Mrs. Gandhi liked the idea.

Thus Samrat was immortalized. When geography books went for a reprint, a new insertion was made in the oil provinces of India. With Ankleshwar, Cambay and Assam, Bombay High entered its rightful place.

It was a matter of pride for everyone in the Bombay Offshore project. Prasad meant business. It was decided to implement the earlier decision, delineate the field; at the same time, put the field on commercial production.

Phase-1 of Bombay High development was launched. The target date was sacrosanct and inviolable: May 1976. Monsoon clouds hovered above as Prasad decided on the timeframe. The managers and crew looked up to the sky. Monsoon would last till the end of September. They would have just eight months after that. Everyone dispersed. It was time for some hard work.

SWEAT AND CHAMPAGNE

Prasad had his priorities worked out. The ONGC Board had been reconstituted earlier. Taking a clue from the Malaviya committee report, he disbanded the directorates. The directorates of geology and geophysics were merged with IPE. Earlier, all exploration decisions were taken by Dehra Dun. After the recast, decision making powers were divested to the regions.

The board had, besides the Government nominees, four members: Dr G Ramaswamy, advisor, Ministry of Petroleum, joined as Member (Offshore); A.P. Ghosh was made Member (Onshore); P.K. Lahiri came in as Member (Materials).

Armed with enhanced powers, the Bombay Offshore Project (BOP) was revamped. Prasad wanted some engineers with marine experience. He picked them from Engineers India Limited (EIL). H.S. Cheema was brought in as General Manager (Offshore). Janamanchi Rao was entrusted with the erection and construction part of the project.

A time frame was set for each and every project. If someone wanted some equipment, he had to follow a laid down procedure: Pick up the international offshore directory; choose six companies with the highest turnover; inform Cheema; send a telex to the company. The telex would have three paragraphs giving the specifications, environmental conditions and request for a quotation by the third day. Once the quotations came, they were to be put up to Cheema who would talk with the stores and purchase section. The foreign exchange component was sent by telex to the office concerned by the fifth day. In case of a problem, Prasad had to be contacted. He got the foreign exchange released within hours. In case of an emergency, the person could fly to Delhi, get the job done and come back in the evening. By the seventh day, the ordering procedure was completed. The onus from the start of the project to its completion rested on one project manager.

With the system in place in the shortest possible time, telexes started going all over the world. The conceptualization of phase-1 was done in June- July, 1975.

Phase-I targeted 40,000 barrels per day. For that, a consensus emerged. Prasad was a brilliant engineer and he had no problems in visualizing the possibilities. ONGC would take recourse to template drilling from a platform, an emerging technology. That was the fastest way to drill more wells.

Each platform was made up of two parts. Normally, the procedure was to install the platform, drill wells for production from three or four slots, complete the well and take out production by connecting pipelines.

The nearest available ship-building yard capable platform fabrication was in Dubai. McDermott, world leaders in platform building and installation, agreed to do the job. But its order book was full with the on-going boom in offshore activities all over the world.

ONGC chose not to wait for the complete platform. The lower part with four massive legs would be piled on to the sea bed; wells would be drilled. The upper part with the completion equipment and a small helicopter deck would be stabbed into the lower part later.

Then, a problem arose. The well spacing from a platform was very small. Four straight wells from a platform might get into the same pay zone. Depletion might be faster. Reservoir characteristics like the extent of the pay horizon could not be known.

Everyone again got together. The think-tank decided to drill deviated wells. That way, four wells could spread over a larger area. Foreign experts advised against it. They said that deviated wells might pose problems in production, and they wanted to know the method of drilling deviated wells. ONGC had drilled a couple of deviated wells in onshore fields. But the deviation had to be controlled and gradual. The technology was still in the development stage. Engineers came out with the 'curved conductor' idea. The conductor pipe was the umbilical connecting the drilling rig to the sea floor. If one could put a curved conductor as the umbilical, the well will follow that angle.

Production engineers, led by Arahna, assured that they could produce from such deviated wells. A curve was improvised by welding a conductor pipe from onshore fields. Samrat drilled the first deviation well in Bombay Offshore from the piled-in lower half of Platform "NA" in 1976.

Another project was going on simultaneously. The crude from the platform was to be transported by underwater pipelines to a Single Buoy Mooring (SBM) system. An SBM was the best choice under the circumstances. It was a huge tank with a piping network on the top. It was to be anchored by dropping heavy anchors. The biggest available oil tanker, christened Jawaharlal Nehru, was to be anchored to the SBM. It had a storage capacity of 87,000 tonnes.

One more SBM was to be put in place, with an export tanker receiving the crude from Jawaharlal Nehru for further transportation to Bombay refineries.

One needed divers for all under-water work. A year earlier, an enthusiastic young man had come to Cheema for a recommendation letter to go to USA for training in saturation diving. After getting the recommendation letter, Nauzar Engineer never intended to come back to India. In the North Sea, divers were some of the most highly paid people. But when Cheema asked Engineer to come back to help ONGC, he immediately packed his bags. He couldn't say no to

Cheema. He organized the diving section which was earlier looked after by a retired Indian navy diver.

Next came the soil survey part. G.D. Sharma, the master craftsman, had fabricated a portable drilling rig. He installed it on the heli deck of Samrat, and cut cores to study the soil conditions. Later, the marine survey division led by S.K.A. Rao did Sparker survey. They used CGG services to do geophysical studies of the sea bottom in a closed grid fashion. In no time, the soil conditions became known. To add to the worries of the engineers, the sea bottom in Bombay High was very soft and clayey. Piling in heavy structures might be a problem, they wondered.

Samrat was having a busy time drilling one well after another. For faster development, ONGC needed more rigs. It was advised to go in for contract drilling. There were no charter rigs available.

Three rigs were hired. Haakon Magnus was a semi-submersible, half of it held on to position by huge anchors. It was ordered during construction at an Oslo shipyard. Viking Offshore was given the contract to operate the ship. Another vessel, Dalmahoy, joined the fleet. It was a drillship, a conventional ship with an opening in its centre.

The third one would make history along with Samrat. The contractor, Atwood Oceanic, provided one of their best jack-up rigs, Shenandoah. It was a magnificent ship with a very competent crew.

It was decided to use Shenandoah for all development drilling from platforms. Samrat was assigned for drilling exploratory wells. The floaters could drill in deeper waters as they had to be anchored with huge anchors.

Thirty years down the line, Samrat and Shenandoah (rechristened Kedarnath) are still operating in Bombay High, a record of sorts.

Meanwhile, the deadline was approaching fast. The mother SBM and tanker Jawaharlal Nehru were in place.

May 20, 1976, 0243 hours: Platform "A" top deck was manoeuvered into place over the lower half of the template. The assembly was completed. Shenandoah was waiting a few hundred metres away.

Chairman Prasad had moved his camp to a barge a few days earlier. The sea was already showing signs of unrest. In 1975, the monsoon had set in early with the occasional cyclone. That somewhat slowed the pace of work. The area in the sea hummed with engines running, people shouting, crane operators on different barges looking at signals, divers going down into the water and mechanics working on the pipelines. No one looked at Prasad. He was like a man possessed. Occasionally, he dropped in to have lunch and dinner with his crew.

Shenandoah was taken closer to the platform. The platform was a behemoth; Shenandoah was equally awesome. With clockwork precision, the floor of the rig slid over the waiting-to-be-produced well, A # 2. A Christmas tree was installed. Last minute checks were done.

May 20, 1976, 9:55 am: the valve was opened. The oil flowed through the pipeline to the SBM. From the SBM, it was pumped to the tanker, Jawaharlal Nehru. Everyone kept an eye on the pressure gauges and watched for any leaks. The master of the tanker signalled the arrival of crude oil in the tanker. On the same day, well A#1 was connected.

The combined output from the two wells: 4,300 barrels of oil on that day. Acid was pumped into the pay zone to open up the pores of limestone. The output increased to 7,500 barrels per day.

That marked the end of Part-I of Phase-I operation. Jubilation was somewhat muted as the project was a few hours behind schedule.

The Times of India commented: "Judging by the tidal and wind velocities, water depths, and distance from the shore, Bombay High is, after the North Sea, the most difficult field in the world...The international oil companies took nearly eight years to start commercial production after they had struck oil in the North Sea. The ONGC, in contrast, has done so in just two years."

The Financial Express ranked the achievement with that of the Atomic Energy Commission's successful nuclear blast in the Rajasthan desert.

The nation was enthused. Prasad knew the media. He knew that the encomiums would turn into criticism if he failed. He asked the radio officer to send a simple message to Malaviya, "All personnel of the Bombay Offshore project have put in dedicated and sustained work to achieve these results."

Malaviya, in his own way, sent a message back reiterating his full trust in ONGC to find large quantities of oil in the country for generations to come. Prasad left the following day. He reminded the managers that though the Part-I was over, Phase-I was not.

Platform "D" was installed. A flare jacket was put a little distance away to burn the associated gas that marked the completion of phase-I. It was on target. On January 13, 1977, 40,000 barrels of oil was flowing out of the eight wells from the two platforms: two million tonnes of oil per annum.

After the completion of Part-I, Prasad threw a party for all the project managers and their family members. Top officials from the Maharashtra government were amongst the invitees. It was time to build up a good rapport with government authorities. But the party didn't last too long. People started moving out earlier than expected. Phase II was already underway.

ATTRACTIVE OIL FLOWS OUT

Buoyed by the initial success, the plans were reworked and simultaneous planning for all the four phases began.

Phase-II envisaged installation of two more well platforms, "B" and "E". With the volume of production increasing, it needed processing before being pumped into the tanker. That needed a process platform to carry out all the stages of separation. A well-cum-production platform, "C", was piled on to the seabed. A second SBM was installed.

Shenandoah was completing development drilling as fast as it could.

January 1978: Phase II was completed.

After completion of both the phases, there were 20 wells from five platforms. The production reached 80,000 barrels per day: 4 MMT per annum. The total cost of the project was estimated to be Rs 1498.9 million. The foreign exchange saving was Rs 8.5 million a day.

Simultaneously, Phase III A was launched.

With commercial oil conclusively established in Bombay High, the next logical step was to undertake its development along with stepout drilling for new structures. Samrat had tested two more structures: Panna in February 1976 and a potentially big gas field, Bassein, in March 1976.

Oil production had started from Bombay High North (BHN) field. Bombay High South (BHS) had indications of much more potential than BHN; and, there was a clear barrier between the two.

It had all the potential of being a giant oil field. ONGC didn't have the expertise in developing an offshore field. Some experts found the carbonate reservoir of Bombay High to be more complex than that of the North Sea.

CFP agreed to give consultancy. Geoman was also invited to give its advice. World Bank was approached to give loans for the ongoing third phase and the proposed fourth one. World Bank appointed De Goyler and MacNaughton as its representatives to see that their money was well spent. They were the three of the largest consultancy companies in the world. All of them entered the fray in different capacities.

A separate reservoir engineering institute was proposed near Ahmedabad. It would be named Institute of Reservoir Studies (IRS). IFP, France, agreed to help set up the Institute. IRS came up in 1978 at Ahmedabad. ONGC acquired its own state-of-the art seismic vessel, MV Anveshak. It would be built by an American company. At the same time, ONGC set up a Institute of Drilling Technology (IDT) in 1978 at Dehra Dun.

To study the increasing volumes of data, IPE got a new generation IBM 370\145 computer with powerful array processor for fast number crunching, equipped with state-of-art seismic processing software.

Prasad, meanwhile, didn't take recourse to the normal course of creating vacancies and filling them up. Instead, he ascertained the competency of people. Depending on the number of competent people, he created higher posts for them. It became a competency-based promotion policy.

He infused new blood into the organization. Taking cue from Bhabha Atomic Research Centre (BARC) scheme, Prasad began the recruitment of Graduate Trainees from the geosciences and engineering disciplines. One hundred and twenty of the brightest candidates successfully emerged from a tough written and an equally grueling interview. The first batch of 1975 was followed by 1976 and 1977 batches. Another batch exclusively from the weaker sections of the society was also recruited. Thus, over 350 future managers joined ONGC during those four years.

How long shall I wait?

On September 6, 1976, Malaviya gave vent to his pent-up feelings. He was addressing the officers at the conference room of Bombay Offshore Project. He asked them to do some introspection: "Why are we able to produce only 7,000-8,000 barrels of oil from our fields? Why is Saudi Arabia producing 20,000 to 100,000 barrels a day? Is it a freak incident? Could it be possible that in our offshore area, we can produce 20,000 barrels a day? Either in the east or west, we didn't go beyond the continental shelf; if it is possible, then further down, there may be more ancient oil. I do not want to give up on the Bengal Delta; I do not want to give up Cauvery basin. That is all really required for oil exploration. I want all of you to think hard...

"A certain situation can arise when coal can be converted into gas. If it is favourable, we may find methane gas. Has ONGC deployed adequate number of geological parties for investigations in the country, whether it is the Deccan Trap or the Himalayas, for mapping or for geochemical work? Has ONGC taken care of small gas patches in the Gondwana region (central part of India)? Those may be small patches of gas but it will be of help poor people living around it. Why can't you get involved in simpler things? The offshore areas of Saurashtra and Lakshadweep are very large and you give us the geological concept, if we are not able to build our castles. Someone else will build these castles...

"Suppose an international company prepares to take the risk and drill in Lakshadweep. Can we give it or not? I know you are formulating a program for these states. I want you to search for a bigger Bombay High in this area. You can claim the Himalayas as your own and we do not know anything about it. In Rajasthan, we have failed to drill satisfactory wells which give us information. Do not give up. In Alberta, Canada, they went on searching for 10 or 20 years, spent huge sums and eventually got oil. Once you get oil, you are excited over it."

He wanted scientists to get excited where they had not got oil. The final question was direct: "How long shall I wait?"

He knew the problems of the Indian oil industry. A cess proposed by him was going to the Oil Industry Development Board (OIDB) for funding research in exploration. With the formation of the Oil Coordination Committee (OCC) in 1974, ONGC would have to forget the anticipated import parity for its oil. It was proposed to pay for domestic oil in a complicated social cost plus formula: a 15% return on the cost incurred.

In the aftermath of the oil shock, petroleum products were heavily taxed, leading to a temporary halt in the rising demand. OCC managed the supplies in a very intricate way. The philosophy was to tax luxury segments like aviation fuel and petrol and keep the poor man's energy requirements, such as kerosene, cheap. Diesel was kept at a very low price to keep the locomotion of economy running: Railways and trucks. That was the beginning of the Administered Price Mechanism (APM) in 1976. The government was desperate for more oil.

After Negi, who was also Member (Exploration) retired there was still no one to replace him. Dr Ramaswamy officiated as the Member (Exploration) in addition to his responsibility as Member (Offshore).

Malaviya couldn't keep the doors closed for long to the foreign companies wanting to explore in India. Two American independents appeared on the horizon. Reading and Bates offered to explore and drill wells in the Kutch Offshore. They carried out surveys and drilled a well, which turned up to be dry. They wanted ONGC to share the cost for the second well. The foreign exchange component was USD 2 million. The negotiations dragged on. They eventually withdrew from the project. They didn't share their "investigations" with ONGC. They just packed up.

A similar experience ensued in the Bengal offshore. Carlos-Natomas drilled a couple of holes. They too gave up without trying any further. Despite the promise to do sustained exploration, they just moved out. Both the operations were called off in 1976.

Another group, Asamera, was given an exploration licence to look for oil in the Cauvery Offshore. After a half-hearted attempt, the group too surrendered the license. The total area licensed was almost 75,000 square kilometres. Later, ONGC would find oil in a couple of structures in that same area.

The winds of change spurred ONGC to develop Bombay High as fast as possible. The theatre of operations in the sea was gathering momentum.

NEW INDUSTRIAL DREAM

Phase III-A was planned on an emergency basis to overcome the fury of the sea.

Year 1977 gave a twist to the earlier program. During monsoons, 'station keeping' (keeping the SBM and the tankers in place) was very difficult. The export tanker Lajpat Rai, was not able to sail in that rough weather.

The target for Phase III-A:

- Installation of production cum process platform "F".
- Lay sub-marine pipeline from Platform "F" to Uran landfall point.
- Bay pipelines from Uran to Trombay.
- Time frame: June 1977 - June 1978. (Target was achieved on June 30, 1978).

Bombay High was to witness a newer form of frenzied activity. The scope of the work was enormous:

1. Laying of a 30" oil trunk pipe line and a 26" gas trunk pipeline from Platform to Uran shore terminal.

2. Laying one 36" oil line and two 18" lines for methane and ethane.

3. Laying one 8" line for LPG from Uran to Trombay where the refineries were situated.

The go-ahead signal was given in July 1977, less than a year before the target day. All orders were placed within a week by telex.

Pipeline Technologists, UK, were appointed as consultants for the entire phase of the work. Brown and Root were the contractors for laying the 203 kilometre-long dual pipe lines from Bombay High to Uran. Before they arrived with their barges, pipes had been procured, corrosion-coated and wet-coated with cement in Singapore.

Then the two barges arrived in November 1977. They were among the largest in the world; one, a side-lay/derrick barge (pipes laid from one side of the ship) and the other a conventional centre-lay barge (pipes laid along the centre of the ship). They resembled a small town-like factory floating in the sea. With numerous cranes and welding shops, it was a dream engineering structure.

Like a centipede, the ship crawled forward. One arm below scoured the sea bed and dug a two-metre deep trench, then pipes were lowered and divers went down to do the securing. With clock-work efficiency, the pipeline laying was completed by May 15, 1978. Platform "F", a giant processing platform towering

140 feet above sea level with living accommodation for 32 persons, was commissioned on June 5, 1978.

The project was completed before time. On June 5, 1978, Prasad asked H.S. Cheema about the land part of the job. The target was 25 days away.

The original land allotted to ONGC was a nightmare, full of marshes and creeks. But what Cheema found suitable was a lonely stretch on another island near Uran. Prasad found the new place ideal. Malaviya who was contacted, got in touch with the Chief Minister of Maharashtra. The land deal was sealed and signed.

The instructions were as clear as ever: recruit, transfer, buy anything; the job had to be finished by June 1978. For those six months, Cheema was taken off normal offshore work.

When the pipelines arrived in March 1978, the project managers and other crew got a strange invitation from the General Manager. They were working day and night to achieve the target. Sunday was the only holiday. Cheema had sent hand-written invitations to everyone to join him for lunch at Uran. They were all happy. On the scheduled Sunday, they went in a caravan to have lunch with Cheema and his German wife, Rose. Everything was properly organized. Cheema requested the ladies and kids to enjoy themselves; off he went with the men folk to the work site. Everyone saw through the ruse of "lunch with the GM." They volunteered to come on Sundays.

By the beginning of May, work was still not satisfactory. A plan was worked out. Initially, the contractors expressed surprise at the proposal. Instead of laying single lines, they would try to pull the lines together. It was never tried before anywhere in the world.

Huge cranes were procured. An advance party dug up four trenches. A crane was placed at one end. The 'pipe pull' method of dragging all four lines (36"-18"-8"-8") proved to be the turning point.

As the deadline neared, a worried Prasad called up Cheema, and in a feeble voice asked him about the progress of work. Cheema promised to stick to the schedule. Later, Cheema came to know that the Chairman had suffered a heart attack and had called him from the ICU.

The line was laid on schedule on June 30, 1978. Cheema described it as the happiest moment of his life. The line was commissioned on July 22, 1978 at Uran. When the oil and gas gurgled in the pipelines and Tata Power received its first supply, their Managing Director Manaktala gave the best compliment that ONGC could ask for. He asked his project team to study and learn from these go-getters.

The main protagonist, Prasad, slowly recovered from the effect of the heart attack. Member (Finance) P.T. Venugopal had taken over as the officiating

Chairman. He reeled out the financial facts: at the end of the day, Rs 100 million were saved from the estimated cost of Rs 2.35 billion. The production was expected to reach 4 MTPA.

Venugopal said that the day was a red letter day in the history of ONGC. The people involved, from the welder to the contingent laborer felt very happy because of the uniqueness of the project. It provided endless supplies of adrenaline to take care of the sheer novelty and complexity of the job.

After the heart attack, Prasad did not revert to ONGC. Later, he went to the government as Secretary in the Ministry of Energy. Thirty years down the line, Prasad says, "Nobody told us to produce oil in four year' time. You set goals for yourself and goals come from a vision."

In 1979, the world burst into flames. Once again, the theatre of confrontation was the Middle East. Iraq and Iran, two of the largest oil producers, went to war with each other.

The oil consumption was going up again: 25.4 MT in 1976-77, 27 MT in 77-78, 28 MT in 78-79 and almost 30 MT in 1979-80. The projected demand was 45.50 MT in 1984-85, and was expected to reach 62 MT in 1989-90. Conservation of energy demanded management of oil; alternate energy sources and research and development entered the national consciousness in a big way.

The planners wondered what would have happened if Bombay High crude had not come on line just when the war broke out. It was a compliment to ONGC, and an encouragement to go all out. Money would never be a constraint. ONGC was saving the nation almost US $1 million a day.

Venugopal had just then taken over as the Chairman of ONGC. He was a quiet and unassuming person. Having been Member (Finance) since 1970, he knew the pulse of the organization. He was witness to the massive growth as a result of Bombay High.

ONGC's financial performance had just started inching northwards. It received little less than USD 5 for its crude. For the first time, it paid a dividend of Rs 120.07 million to the government for the year 1976-77. That was at the rate of 5% on the government capital. In 1978-79, the dividend rate was increased to 8%. ONGC paid a dividend of Rs 180.10 million. The modest profit for the year was Rs 810.52 million (before tax). It was an increase of 38.8% over the previous year. ONGC contributed Rs 380.44 million to the state governments. Royalty on Bombay High was payable to the Union Government. It paid Rs 840.34 million as royalty, cess and dividend. Corporate tax was not included in these payments.

It was time to carry on at the scorching pace set by N.B. Prasad.

In the plan, ONGC was expected to go ahead as fast as possible in executing Phase III of the project.

A crude stabilization plant, gas fractionation and storage facilities came up in Uran. Gas fractioning was a novel technology ONGC would adopt for the first time in the country. A gas fraction plant of the capacity of 400,000 million cubic metres per day sprung up in the Uran complex. That was the first cryogenic plant for recovery of LPG. It had a provision to get the value-adding product C2 (ethane) and C3 (propane). But as ONGC didn't have the permission to go any further, it would sell them to a nearby petrochemical complex. Uran awaited a major makeover.

Communication was proving to be a major problem. Project "Titan" was launched. Platform "F" would be the hub for the control of computerized telemetry and tele-control. The shore facility was to be set up in Uran.

By January 1981, Phase-III B was completed. The massive BHN platform came up as a giant in the sea. More well platforms were added. The production went up to 140,000 barrels per day, 7 million tonnes per annum.

By that time, ONGC had gone on a comprehensive knowledge-building exercise. It had acquired its own seismic vessel; it had gone as an independent contractor to Iraq.

Gaining confidence

Almost a decade earlier, the instrumentation division of the geophysical directorate, headed by M.A. Ganapathy was given the important task of preparing specifications for an integrated seismic vessel. Ganapathy and K Kumar went through voluminous information on seismic vessels, and could prepare a global tender, though they were new to the evolving technology.

In response to global tenders, two leading geophysical companies, Prakala GmbH of West Germany and Seismic Engineering International SA (SEISA) submitted their bids. Both were found technically acceptable. As the price quoted by Prakala was considerably higher, SEISA won the prestigious order. The price tag was USD 4.5 million.

The seismic vessel, aptly called MV Anveshak, was constructed at Jacksonville, Florida, USA, in 1974-75 and was fitted with a satellite navigation system, energy sources, sensors and a digital recording system. This was the first integrated navigation system in the entire sub-continent.

While the construction was in full swing, D.K. Trehan, I.N. Pandey, C.K.R. Rao, I.B. Rao and other geophysicists went to the US for training. In May, the brand-new ship set sail for India with two geophysicists, R.K. Banerjee and N.C. Nanda and a crew from the Indian navy onboard. The sailing was a tough experience considering the size of the boat and the distance it had to cover. Two experts from OISA, Jim Tatent and Ferguson had, in the meantime, flown to Bombay to impart on-site training on its arrival.

As the monsoon lashed the western coast, the ship sailed with around 12 geophysicists to the east coast. Handling of the seismic and navigational systems was to come later. The rough seas had kept all the men in bed for two days. K.N. Bhave, one of the young pioneers of 1956 vintage, was the party manager and it fell upon him to keep the morale of the men high.

Anveshak was equipped with state-of-art digital seismic recording unit and single trace plotters for quick quality review of recorded data on board. The positioning requirements being very stringent, navi-navigation is the correct? satellite system of USA was used in conjunction with Doppler sonar for speed determination and a gyro compass for direction. The vessel also had a gravimetre, magnetometre and continuous recording fathometre. The energy source for seismic survey was a set of eight air guns which were fired every thirty seconds at a pressure of 2000 Psi.

In 1976, Anveshak carried out a detailed seismic survey to map Bombay High. It laid the foundation of the ambitious development plan of Bombay High for the next two decades. The first exploratory well on the South Bassein structure was released on the basis of the raw data acquired on board. The giant gas field of South Bassein was discovered in 1976.

Anveshak's quality of work was enviable, more so since the geophysicists had initially started with little know-how and experience. The third largest field, Neelam, in Western Offshore Basin after Bombay High and south Bassein, was discovered in 1987. K.N. Bhave proudly proclaimed: "Whenever possible, the offshore drilling locations of rigs in operation were confirmed only after Anveshak checked them with satellite navigation."

Seismic technology was advancing fast. To keep pace with the latest techniques, *Anveshak* was upgraded in 1982-83. She worked for five more years. After an eventful life, spanning 22 years, during which she acquired 292,000 line kilometres of 2D seismic data along with gravity and magnetic data, MV *Anveshak* was de-commissioned. The story of *Anveshak* would remain incomplete without mentioning the role A. Kargupata had played at every stage with his uncanny presence of mind, decision making abilities and techno-managerial skills. The work horse, *Anveshak*, had played a yeoman's role in giving confidence to a whole generation of geoscientists.

DESERT PANGS AND SONGO SONGO

In the year 1973, ONGC got a contract to operate in Iraq that had the second largest oil reserves in the world. The country's Rumaila, Mosul and other fields produced over 100 million tonnes of crude per year.

In 1975, Malaviya had secured the Cabinet approval to obtain a block in Iraq where ONGC could explore on profit-sharing basis with the Iraq National Oil Company. He directed ONGC to undertake the task. Negi and Venugopal Member (Finance), subsequently went to Baghdad and signed a contract with INOC.

ONGC was assigned an area of approximately 4,500 square kilometres, about 200 kilometres west of Basra in the forbidding desert adjoining Saudi Arabia. When Chairman N.B. Prasad went to Iraq to see the location, the helicopter pilot couldn't even locate the area. It was only after a couple of attempts that Prasad could get to have a look at the concession area. The contract needed to be ratified by the Revolutionary Command Council of Iraq, presided over by Saddam Hussain. Operations were to start within three months of such ratification.

At that stage, T.S. Balakrishnan was the Project Manager of Cauvery Project. Negi called him, informing him of the developments regarding Iraq and asked him to organize and execute the project. He accepted the offer on phone.

The project had to be started from scratch. The right personnel had to be selected and their terms of service fixed. It was apparent that the terms would be more or less similar to those given to employees in other undertakings deputed abroad. Staff was allowed to take their families too and they were to be given free furnished accommodation at the base. This included air-conditioning and refrigeration equipment. No consideration was given for the fact that they would be operating from a camp far away from the base. After a great deal of resistance, a project allowance was sanctioned. Free food and accommodation at the camp were also agreed upon.

However, the government wouldn't agree to give allowances on parity with employees of RITES, the construction wing of Indian Railways already operating in Iraq. All that the government agreed was to pay an equivalent of that given to clerks in the embassy.

An advance team was sent to Baghdad to arrange accommodation both for the staff and the office. This was arranged at Basra without much difficulty. To arrange accommodation for field personnel at the camp was however another matter. In India, this could be solved by the pitching tents. In the Iraq desert where temperatures soar to over 50°C, tents were out of question.

A truck-mounted seismograph was sent from India. In addition, six URB-2A shot hole drilling rigs and associated equipment, several jeeps, trucks and water tankers were ready for shipment to Iraq. For initial triangulation work, a tellurometre system, in service elsewhere was identified for Iraq. All the above equipment was moved and stored in Bombay for shipment to Basra by the earliest available vessel. At that time, very few vessels plied between Bombay and Basra. Eventually, the whole paraphernalia was placed on board a cargo vessel and shipped to Basra.

The contract was ratified on November 20, 1973. Due to an early start and advance action in putting together men and materials, the project started ahead of schedule.

The camp was established at a place called Abu Khema, about 265 kilometres from the port of Basra. Abu Khema was smaller than even a village. It was then only an intersection of camel tracks. There were a few wells from which the Bedouins collect water. The drinking water had to be brought in trucks from over 100 kilometres. The only visitors were storms and tornadoes.

On the work front, the first shock was that even a heavy rig could not drill more than two feet or so because the ground was so hard. A 12-hole pattern shooting was tried. The results were reasonable, but the pace of operation became very slow. The next attempt was to try and use cord explosives imported from Dubai. A tractor was used to plough the ground and the quality of recording was improved. The pace of work visibly increased. The second seismic crew employed another technique called Vibroseis.

Work went on smoothly in Iraq and a promising structure was identified. For deep drilling, ONGC had placed an order in the USA for a suitable rig. But the firm did not supply the rig within the stipulated time. Once again, Russia's Technoexport came to ONGC's rescue. By June 1975, the new rig arrived. However, as oil was not found in commercial quantities, the project was wound up.

In 1975, it signed a contract with the Tanzania Petroleum Development Corporation (TPDC) for drilling in Songo Songo Island. The 'Songo Songo men' as they were called later, arrived in Dar-es-Salam in January 1976 and marked the beginning of a new era of Indo-Tanzanian collaboration in search of hydrocarbons.

Exploration at Songo Songo was hindered by the usual problems of transportation of men and machine by sea. When the drilling equipment reached Dar-es-Salam from India, suitable vessels were located for taking them to the island.

Maintaining the supply line between Dar-es-Salam and the island was also a challenging task. Daily requirements, including 'sweet water' were brought by chartered planes and dhows to Kilwa Masoko and from there taken in Land Rovers up to Kilwa Kivinje, 36 kilometres from the island.

A medical clinic was set up and the ONGC doctor soon began giving free treatment to 'locals'.

However, a serious blow-out happened during drilling. Prasad went to Dar-es-Salam and succeeded in convincing the Tanzanian authorities that a large gas reservoir existed in the area. Another well was drilled subsequently by mobilizing an idle rig from the Cauvery Basin. Thus, the Songo Songo gas field was discovered.

FINALLY A MEMBER (PERSONNEL)

For the first time, a new Member (Personnel) entered the board of the Commission. T.N. Seshan joined as Member (Personnel). The government proposed to appoint three executive directors to look after Offshore, Onshore and Overseas operations.

From a staff strength of 450 employees in 1956-57, ONGC had grown to over 25,000 in 1978-79. The first seven years had seen an annual manpower growth of 50%; in the next six years, the growth was about 10%; from 1971 onwards, the growth had trickled down to 3-4%. This manpower was spread over four different categories, Class I, II, III and IV, with about 15 broad disciplines.

Upto 1968, the rapid expansion of work had seen some advancement of individuals. Then, there was a slowdown in operation till the Bombay High development took place. From 1974 onwards, new recruitment was undertaken on a large scale.

Almost in its 25th year, a planned development was considered essential as the manpower increased exponentially. The personnel policy had many elements. These included:

- Unified recruitment and promotion policy
- Training and manpower development
- Job rotation and transfer policy
- Salary and wage structure
- Incentives and fringe benefits
- Welfare amenities, such as housing, education and medical benefits.

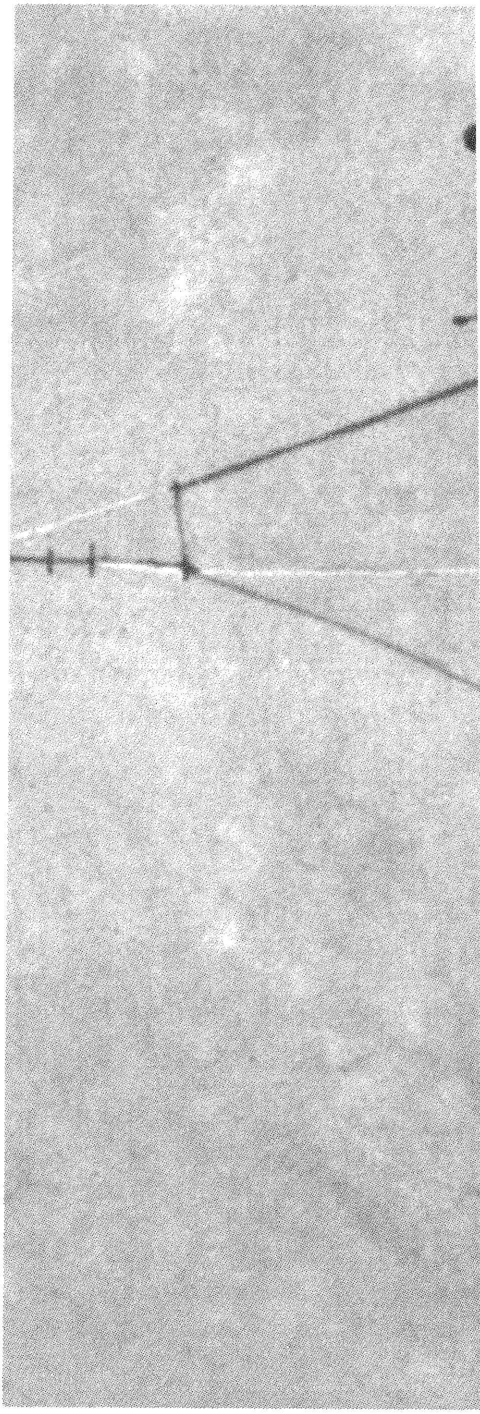
The new R&P (Recruitment and Promotion plocy) was a major undertaking by the Commission. It took care of every aspect of manpower management. The promotion policy was discussed threadbare, involving the unions, ASTO and individuals. The Malaviya committee had suggested at least two promotions in a career span. ASTO and the unions were demanding "fixed time promotion." Seshan didn't agree to that.

Policies were framed keeping in view the requirements of the organization and the aspirations of individuals for advancement with reference to their qualification. The cadre arrangement was planned as a pyramid structure. It recognized the need for educational qualification, merit and minimum years of service as the guiding principle. A selection grade was re-introduced for people with less efficiency and lesser merit. They would get two promotions, but it wouldn't be to a higher post.

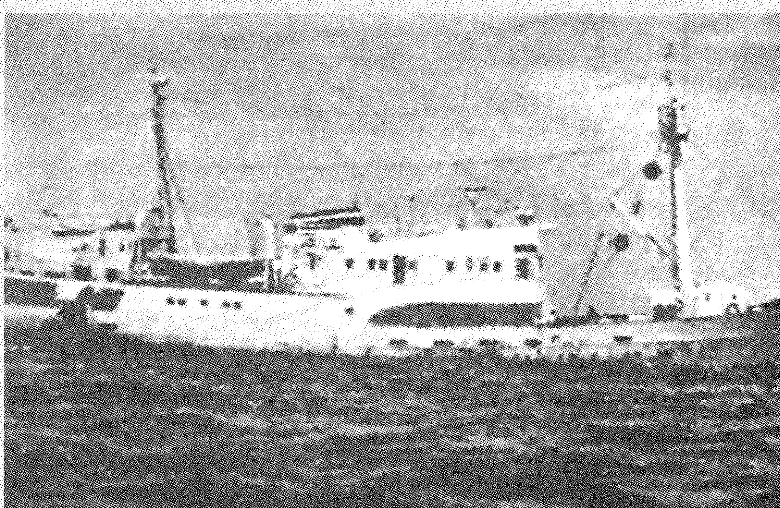
An immediate consequence was that a lot of people were promoted to different levels. A new wage structure was worked out in consultation with the Ministry, unions and ASTO. That was the time when Industrial DA (Dearness Allowance) was introduced. It created a lot of heartburn.

The saga of court cases relating to personnel policy started at that point of time. There were several cases in the Ahmedabad High Court. S. Ramanathan who assisted Seshan in that huge endeavor, had to be present when the court cases came up for hearing. One day, His Lordship wanted an assurance from Ramanthan that the Commission won't change any existing rules after the court gave its verdict. Ramanathan gave that assurance. The Judge disposed off all pending cases in one go. It was in the favor of the Commission.

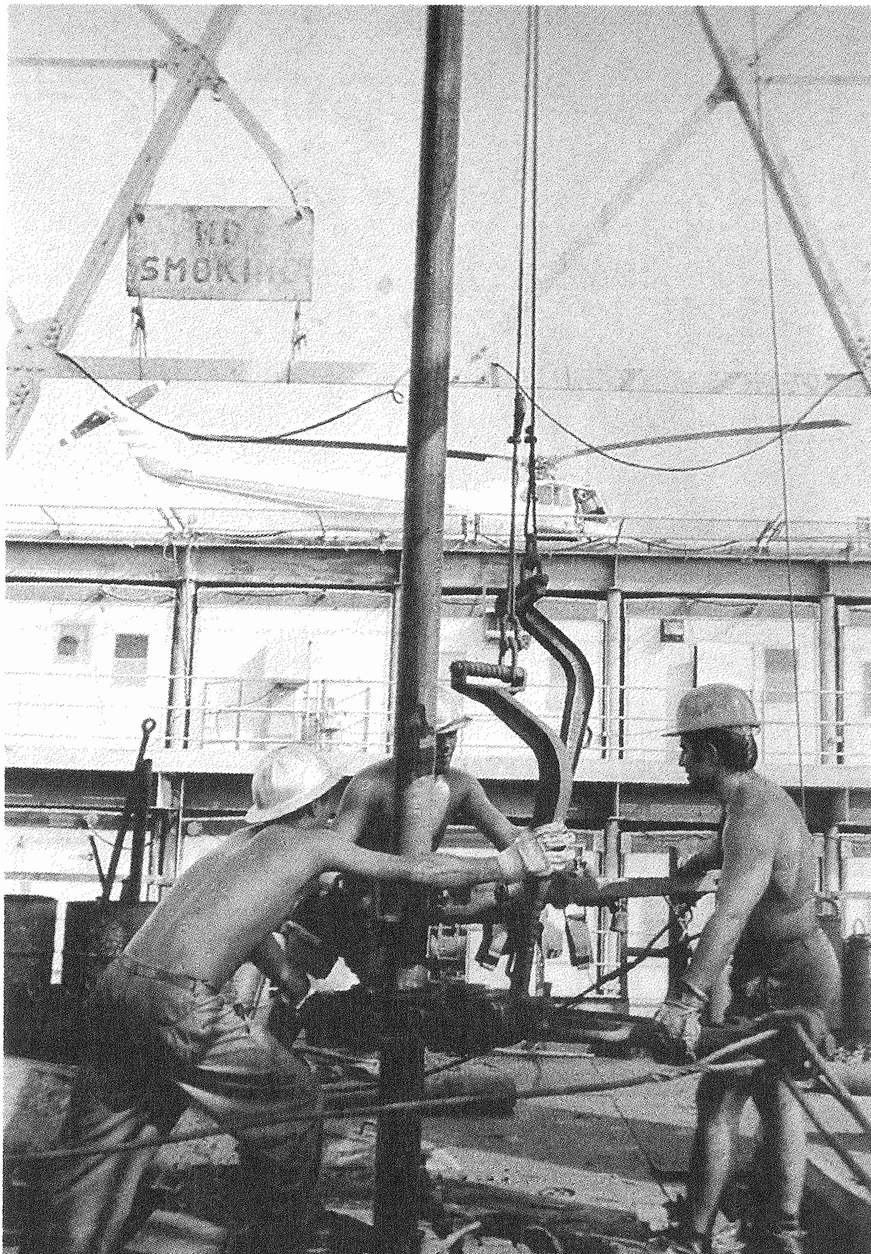
After that, the Commission stuck to the stringent norms of the R&P policy. That made a cross-section of employees very dissatisfied.



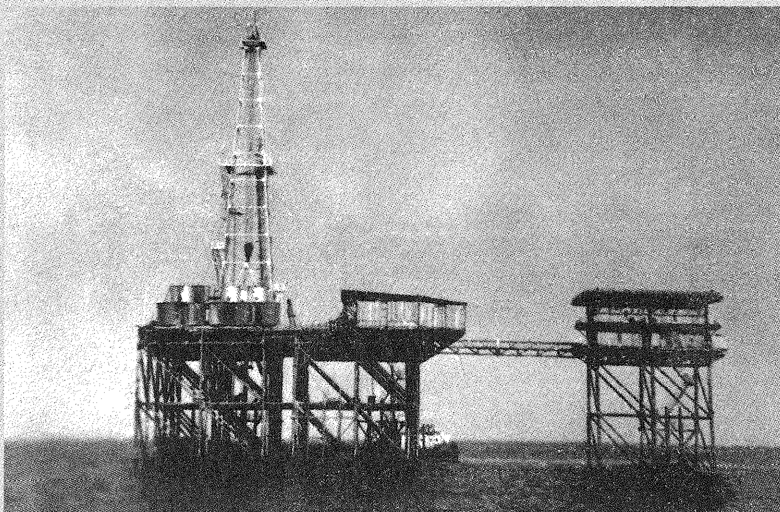
Vadodara housewives get piped cooking gas



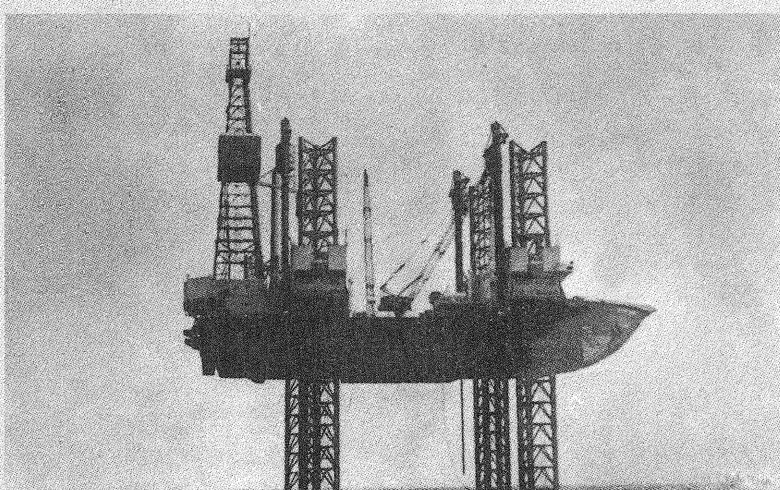
Russian seismic vessel Akademik Arkhangelsky



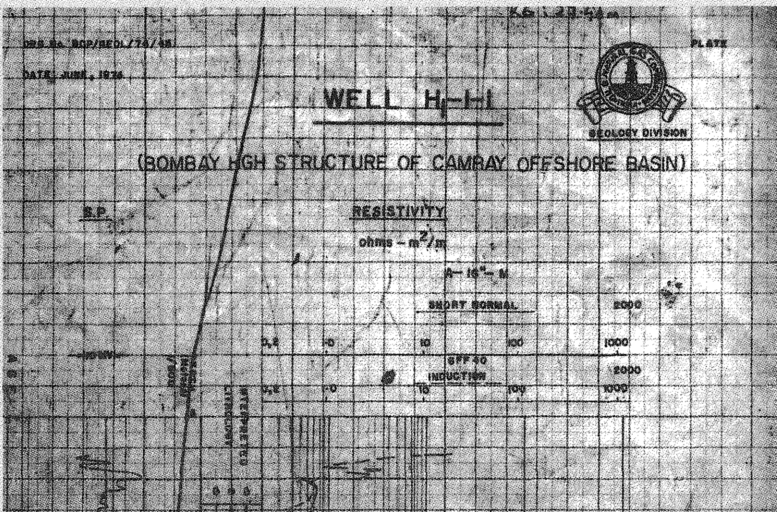
Hydrocarbons India Limited in Iran



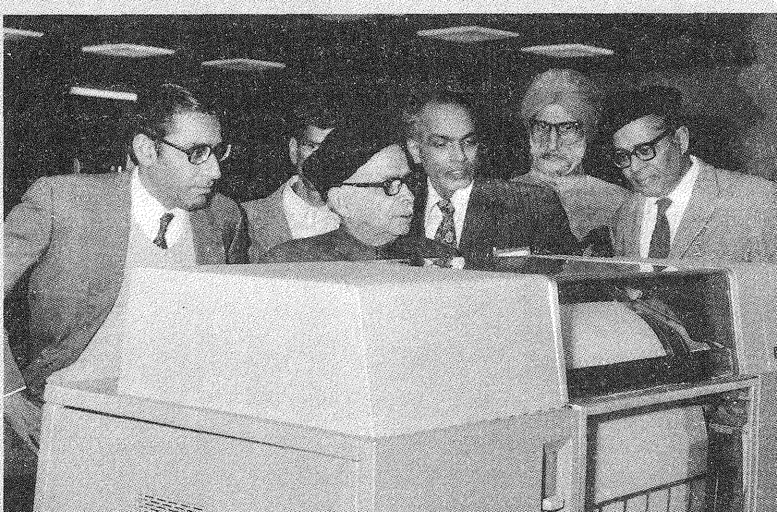
First shallow offshore rig at Aliabet



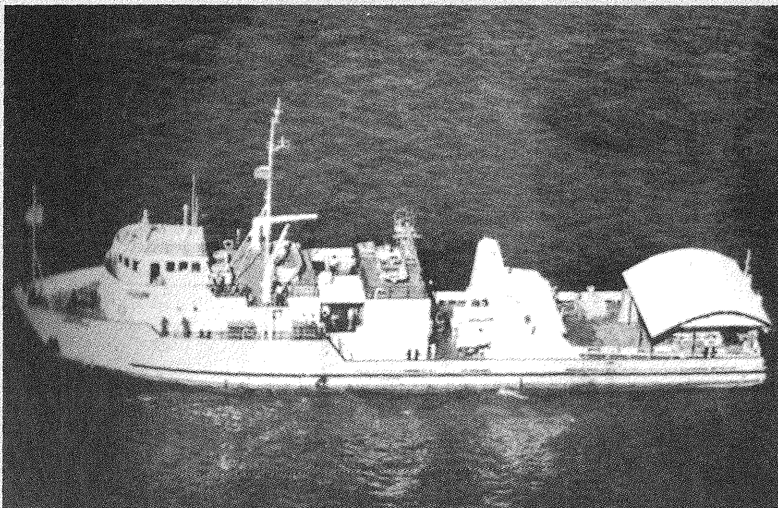
Sagar Samrat



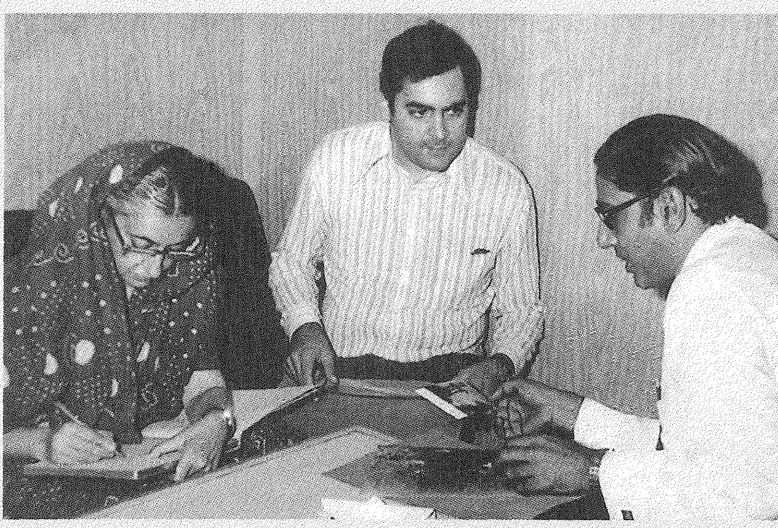
Log report of the discovery oil at Bombay High



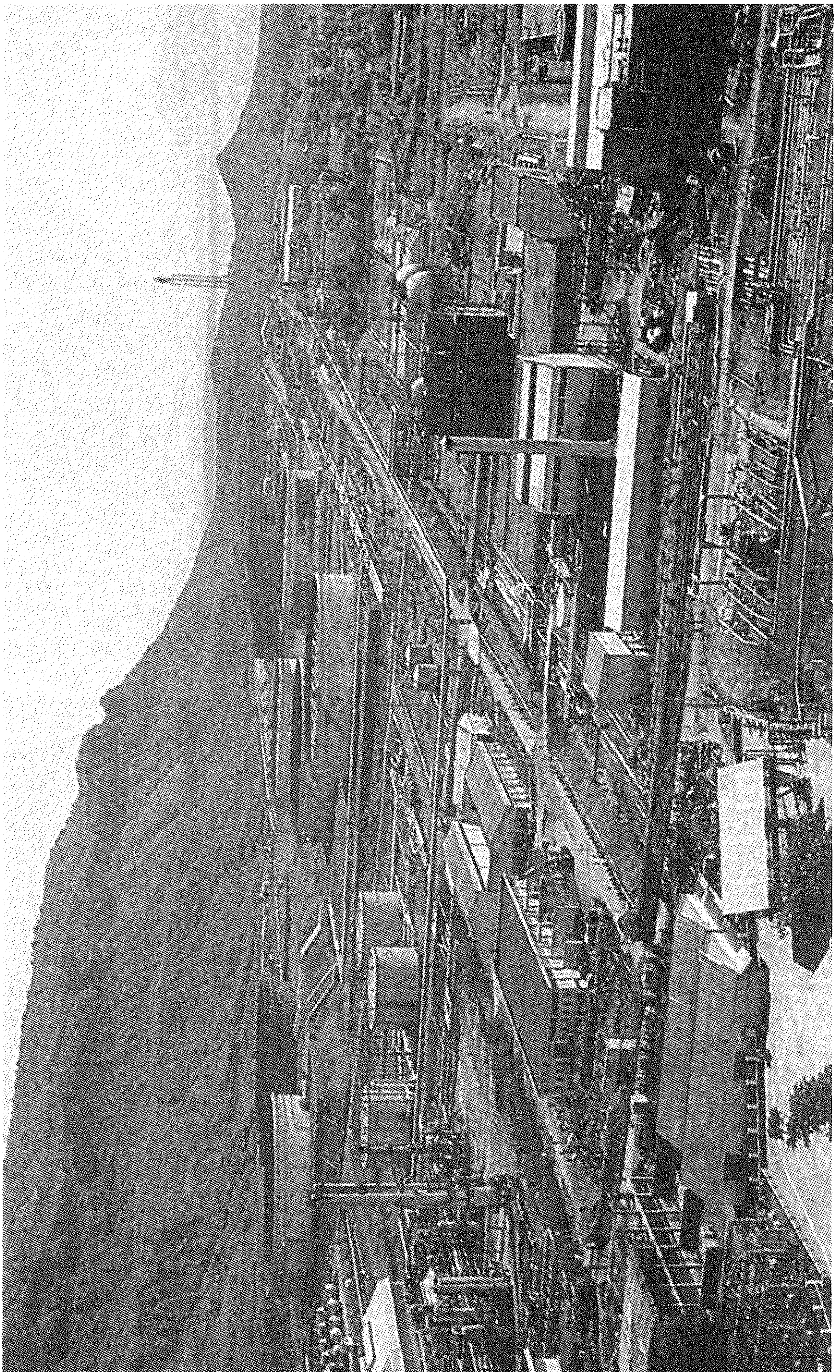
Malviya at the computer centre in Dehra Dun



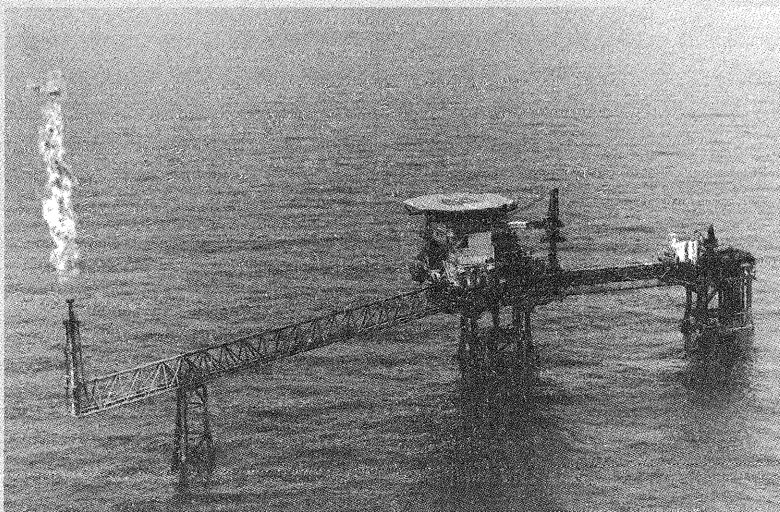
First offshore geophysical survey ship, MV Anveshak



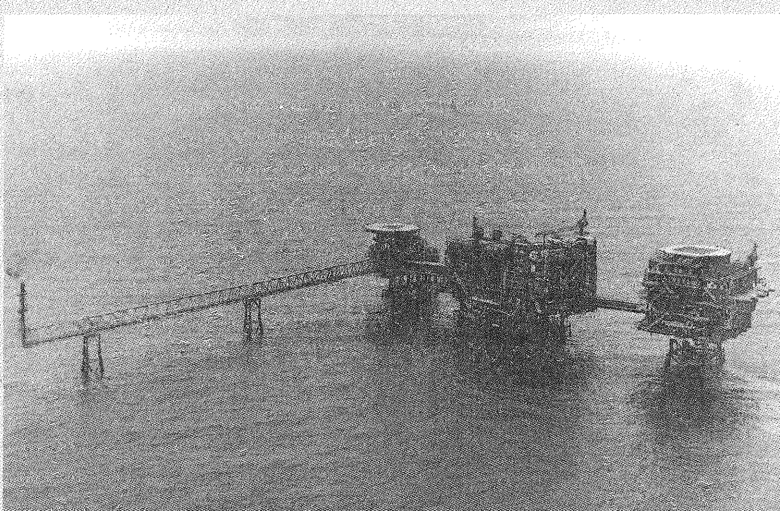
Indira Gandhi and Rajiv Gandhi visit offshore



Uran processing complex



Platform at Neelam & Heera field



Platform at Bassein & satellite field

PART SIX

PREPARING FOR THE MARATHON

CHANGE OF GUARD

P.T. Venugopal retired in September 1981. For his distinguished services, he was conferred the coveted Padmashri award by the Government. The Commission was on the threshold of a major leap into the big league, with a giant field like Mumbai High on its hands. In 11 years, ONGC found itself to be the barometer of India's planned economy. The government started looking for another achiever to head its operations. Its choice fell on Colonel (retd) Satya Pal Wahi.

Wahi had started his life in the Army as an engineer. After a service period that included a stint with the British Army, he entered civilian life looking after the operations of Bharat Heavy Electricals Limited (BHEL) and the Cement Corporation of India (CCI). He had joined as an understudy to Venugopal for three months and chose to spend a lot of his time in the think-tank of the Commission, the Keshava Dev Malaviya Institute of Petroleum Exploration (KDMIPE). IPE was renamed as KDMIPE in 1981 by Prime Minister Indira Gandhi after the sad demise of Malaviya the same year. The purpose of dedicating the institute was to enable it to live up to the ideals Malaviya lived for. The scientists at KDMIPE were pleasantly surprised to find an Army veteran asking them to teach him the basics of oil exploration. Wahi had a purpose.

In 25 years, ONGC had gained confidence in every aspect of oil exploration, production and value addition. Till June 1981, it had drilled 1,689 wells totalling three and half million meters. Out of 198 structures, 58 were oil or gas-bearing. Gujarat was the most developed of all the three regions. Starting from 0.04 MMT in 1961-62, production had reached 4.23 MMT. In Assam, production had gradually picked up to 1.7 MMT.

The thrust areas, however, remained vast and largely untapped:

Tripura (5 wells), Meghalaya (2 wells), Nagaland (3 wells), West Bengal (2 wells), Uttar Pradesh (4 wells), Bihar (2 wells), Punjab and Himachal Pradesh (10 wells), Tamil Nadu and Pondicherry (18 wells), Jammu and Kashmir (3 wells), Andhra Pradesh (1 well), Rajasthan (16 wells). They all needed attention, to change their status from 'indications with good potential' to 'petroliferous' like Gujarat and Assam.

Seismic surveys had adopted newer technologies like CDP from the late 60s. Four Gearhart logging units from the USA were bought to augment the Russian OKC-56 fleet. ONGC had managed to keep some of the old equipment in working order by improvisations and ingenuity. It even surprised the suppliers that the life cycle of machinery could be extended with indigenous improvisation. The Vibroseis trucks were a typical example. The Jaisalmer project of ONGC had bought those at a throwaway price from the French. Except for the expensive desert-worthy tyres, every component was overhauled indigenously. The very thought of importing capital equipment used to cause eyebrows to rise in those days of stringency.

KNOWLEDGE BUILDING

The group of pioneering Russian geoscientists, led by Prof. Eremenko, Prof. Kasianov, Prof. Neruchev, Prof. Itenburg, Dr Nomokonov, Prof. Seregin and others departed after the completion of their contract in 1973. The geoscientists of KDMIPE had gained confidence in every aspect of exploration and research.

In 1973, Prof. Markevich led a team to draw up a three-year program for the evaluation of India's hydrocarbon potential. The Soviets with their conservative attitude were the best in that field. With 12 authors from Russia, 28 authors from ONGC, 600 pages of text, 100 tables and 150 figures, it was a marathon effort.

IPE had one of its biggest breakthroughs the same year. B.S. Negi could manage to persuade the Ministry to sanction money for a Scanning Electron Microscope cum Electron Probe Micro-analyzer (SEM- EPMA). The scientists had been demanding a SEM-EPMA from 1970 onwards. It was the best parting gift from Negi for the Sedimentology laboratory.

This SEM-EPMA was the first one in an oil company on the mainland Asia and the third unit in the country. The other two were in the National Metallurgy Laboratory (NML), Jamshedpur and IIT, Delhi. In 1981, a team of sedimentologists presented their findings on reservoir rocks in India at a symposium on SEM at Dallas, Texas. Amitava Mukherjee, one of the members of that delegation, remembers the disbelief amongst the delegates as the paper was from a third world country with very little oil. It had come from a group of scientists from ONGC, not a very well-known oil company at that time.

Sub-committees of selected scientists from ONGC, OIL and various universities and the IITs were formed. Projects were identified in the fields of origin-migration and accumulation of petroleum, bio-stratigraphy, sedimentary processes and formation of deltas, exploration geophysics (including well-logging), drilling techniques and processes, reservoir studies and transportation of oil and gas.

In 1971, Texas Instruments Office Processing System (TIOPS), a specialized computer for seismic data processing was procured. It had a 192 kilobyte hard disk. All the software required for seismic processing was developed in-house at IPE. V.C. Mohan and K.N. Bhave had the privilege of being the first taught and then the teachers.

N.B. Prasad, banking on his relationship with Prof. M.G.K. Menon, managed to get the latest IBM 370 computer system, one of the large systems available then, for IPE. With the induction of M/V Anveshak in 1975 huge amount of offshore data was going to pour in. Productivity was so high in the offshore surveys that data volume equivalent to one full field season on land could be acquired in a day or two. The IBM 370/145 system with very powerful array processors (special devices which processed data streams in parallel to achieve the massive number crunching needed for seismic data processing) was specifically meant for processing the voluminous data from offshore. It was procured on a priority basis using the fast track clearance from the Electronics Commission, headed by Prof. Menon. A computer centre had come up in the IPE premises. Uttar Pradesh State Electricity Board (UPSEB) was prodded to provide uninterrupted power supply to the computer centre.

Thousands of heavy mineral data had waited for almost 25 years to be put on an electronic screen. Talukdar had chosen V. Raiverman to make an energy-sequence (enseq) of the Himalayan foothills. In a wonderful show of synergy between the field personnel, laboratories and computer applications, the enseq was prepared.

Geo-chemistry was also making rapid strides. Chemical sedimentology had come of age in the late 70s with the acquisition of a spectrometer, pH meter and an atomic absorption spectro-photometer.

In 1982, Col. Wahi asked a group of people to carry out a conceptual study to prepare a long term plan till 2005. It would have a component for the immediate 10 year requirement. The plan would run simultaneously with the Five-Year Plan of the country.

POWER TO DREAM

In a marathon exercise, a team led by D.N. Basu, a very senior geologist took cues from the earlier Markevich Plan to draw up the 20-year perspective plan (1985-2005). It had a smaller component for the remaining period of the Seventh Five-Year Plan (1985 to 1989). It was a monumental work detailing each and every aspect of exploration and development. It gave an estimate of attaining the target of 100 MMT oil plus oil equivalent of gas (O + OEG) by 2005, provided the inputs required were put at the Commission's disposal. Most of the "new oil" had to come from difficult basins like Cauvery, Krishna-Godavari, Bengal and other Category-II basins. The deep waters (beyond 200 meters water depth) were considered the thrust area.

The crux of the plan lay in intensified exploration to close the gap between prognosticated and geological reserves. In 1964, Kalinin had given prognosticated reserves of 5.8 billion tonnes. In 1976, Markevitch had predicted 12.6 billion tonnes. After the knowledge gained from Mumbai High, it had gone up to 18 billion tonnes.

Attainment of these targets was heavily dependent on optimum organizational changes and a flexibility to handle changing political and socio-economic situations. At the same time, indigenization efforts had to be intensified and technology forecasting methods streamlined.

The plan had won the support of the government. The release of foreign exchange till then was the exclusive preserve of the government. As a special case, ONGC was allocated a fixed amount of foreign exchange to be used at its discretion, subject to the broad policy directives. Likewise, obtaining the approval of the Bureau of Public Enterprises (BPE) was also dispensed with on some matters. Thus ONGC was given a limited autonomy. Furthermore, the then strict regime of obtaining prior approval of the Public Investment Board (PIB) was also relaxed, thus giving a leeway to the Commission.

The short term plan of 1985-90 was adopted by the Commission. It aimed at exploring in the Category II basins, in conjunction with the development of Mumbai High. It was during this period that the most explosive growth in the history of ONGC came about.

NEW BUSINESS GROUP MODEL

In 1982, an in-house team did a study on the reorganization of ONGC. Wahi set about implementing the suggestions. He explained the philosophy behind the restructuring. The recommendations were approved by the government in June 1984. Its implementation began from July 1984.

ONGC was restructured into business groups to bring about functional specialization and a Common Basin Approach. Wahi issued the orders himself. A commercial working relationship was established between the business groups, Exploration, Drilling, Operations and Technical services. The concept of Coordination Business Group also came up.

Each business group was to have an in-built functional, autonomous and structured support groups. As part of the reorganization, the Commission's institutes were planned to operate as profit centres, administered and controlled by the relevant business group.

Six Regional Business Centres were created: Mumbai, Eastern, Western, Southern, Central and Northern. Each Regional Business Centre had a Regional Director as its head.

The re-organised set-up continued till 2000.

Consequently, Dr A.K. Malhotra, Member (Offshore) was redesignated as Member (Operations); Member (Onshore) post was turned into that of Member (Drilling); Vice Admiral B.R. Chaudhury, Member (Materials) became Member (Technical). R. Srinivasan continued as Member (Personnel), and S.B. Kabra remained the Member (Finance).

The most significant change was the reintroduction of the post of Member (Exploration) which S.N. Talukdar took over. The first change he effected was to re-establish the Exploration and Development (E&D) directorate.

ONGC's workforce was always a valuable asset. The growth of the company was mind-boggling 500 times in 20 years. The make-or-break role of employees in turning the fortunes of the Commission was too obvious to be missed.

Although ONGC had the best scientists, technicians, engineers and managers in the country, its growth was not commensurate with its intellectual wealth.

In 1982, a SWOT (Strength Weakness Opportunity Threat) analysis was carried out. The weaknesses were "directly traceable to the employees not being able to see their own respective individual role in a vast multi-disciplinary organization, lack of synergy and lack of training and development and career planning." The Commission had a challenge on its hands and thus a new Personnel Policy was formulated.

The policy laid emphasis on a participative style of management. The clogged pores of communications had to be opened and the employee's pride in the Commission restored. The best available men and women had to be inducted and a continuous development and optimum use of human and material resources would become paramount. Individual and group objectives and their alignment with the Commission's social and business objectives were enunciated.

Training and development, manpower planning, welfare measures, sports and culture were the areas where detailed planning was done. Suggestion schemes were launched to encourage innovative ideas to cut costs, increase output, improve quality of work and life, and achieve greater efficiency and higher productivity. Attitude surveys were done to judge the HR climate. The Recruitment and Promotion Regulation 1974 was revised and many loopholes removed. The anomaly at direct entry level was rationalized.

The new personnel policy was embraced with great enthusiasm by the employees. It was evolved with the active participation of ONGC's unions and ASTO. Some of the Malaviya Committee's recommendations were also implemented.

The premier nodal agency for developing human resources, Institute of Management Development (IMD), now called ONGC Academy, emerged out of this SWOT analysis. It was set up in the KDMIPE complex. Eminent professors were invited to give lectures on the latest management techniques. Expert advisory groups on exploration and Human Resource Development (HRD) were formed.

HELL FIGHTERS LIVE TO TELL THE TALE

The jack-up drilling rig, Sagar Vikas, was hardly one year old. It was a three-legged set-up unlike the four-legged Samrat. Delivered in January 1981, Sagar Vikas was the Commission's pride.

Friday, July 30, 1982: As the night shift crew climbed up the rig floor, they had to hold the railings a little harder. The swell of the sea had reached 15 feet. The 30-knot wind was churning the sea into foamy white. With that kind of wind speed, crane operations were not encouraged except in emergencies.

Crane operator M.B. Shinde got down to sundry deck jobs. He was a little apprehensive as were the rest of the crew. They were all asked to be alert. Even off-duty crew resting in their small bunk beds was put on alert. Two days earlier, there was a 'kick' while drilling a six inch hole one and a half kilometers from the sea bed. At 1,660 meters, the drill bit had encountered a high-pressured zone. The pressure exerted by the 1.6 kilometer-long drilling mud column was no match for it. The vagaries of the earth's insides were, and still remain, an enigma. Inside the earth, there are pockets of trapped pressure which are a driller's nightmare. The game of cat and mouse started when the underground pressure overcame the mud-column pressure. It started seeping into the well bore. The driller got the indication. He closed the BOP, a sealing mechanism designed to close in around the pipe and stop the unexpected flow. The crew went on jacking up the mud weight by adding more barites and other chemicals. At one point of time, when the well was thought to be 'killed', the man-made increase in pressure pushed the formation fluid back to where it belonged. They opened the BOP and planned to pull out the string to check if everything was all right with the string.

As soon as they started pulling out the string, the rumblings started once again. The dormant high pressured fluids smothered and held at bay by the increased mud weight started trickling out at the first opportunity. And, the influx was gas!

Once a small volume of gas entered the well bore, it expanded and became bigger. Then, millions of bubbles followed. On first indication, the crew tried to run the string down to the original 1,660 meters. It was impossible. They tried to close the BOP. It wouldn't close. It was a huge ball of gas which had entered the well bore. It was exerting massive pressure on its way up. It was throwing up the entire mud column of 1.6 kilometers in big spurts. It was a blowout, when all controls were lost. The valiant men blinded with mud and disoriented by the noise, still worked on the BOP controls.

Instinctively, Manmohan Singh, the driller-in-charge, ordered the main engines switched off. The vessel plunged into complete darkness. It was the decision of his life. The drill floor had scores of electric motors running. A single spark would have ignited the massive volume of gas. The gas was playing havoc, hissing up 70 to 80 meters, throwing up heavy rig floor equipment like twigs. The 10,000 tonne behemoth was being shaken to the marrow by the billowing gas.

Offshore blowout is a classic case of 'caught between the devil and the deep sea'. In times like these, leadership becomes a protective barrier between life and death. Manmohan Singh with 70 lives dependant on him was like a man possessed. As per standard safety procedures, the frightened crew had congregated near respective lifeboats. Some had written small notes to their family members and kept it in a plastic pouch. The weather was very rough and launching of life boats was a risky affair. Manmohan Singh had other plans.

It was raining as he ran up to the radio room. He wouldn't stop talking even though hearing was impossible; volleys of instructions were being delivered. The first thing he did was to summon the nearby supply vessel. Next, he shouted, "Help! It's a blowout!" Then, he ran down to launch Operation Evacuation. The emergency generator located away from the rig floor was switched on to power the crane. It was a calculated risk.

A shell-shocked Shinde was already on the crane. Shinde, an ex-IAF man, steered the arms of the 105-foot giant to lift up batches of his colleagues and then land this human cargo on the rescue ship that was berthed next to the platform. "I operated the crane, as if there was no tomorrow. Instead of six men at a time in the puggy-net, almost ten hung onto to it and I picked them up and dumped them like a road-dumper," he recalls. The trickiest part was landing the crew on the heaving and pitching boat. The towering waves gave a small window of two to three seconds. The first crew landed on the boat with a thud. In ten minutes, most of the crew had been evacuated and the supply boat moved away from the rig.

A mist had already settled on the rig, the potent mixture of gas, oil and water. Shinde had never felt so lonely.

"When everybody left in the rescue vessel, I climbed down slowly. I waved to my lucky friends who would see their families again. I was left alone. The night was a shade darker than any other night. I wanted to get away from that savage rush of gas. I thought I would climb down the leg of the jack-up and sit near the water. I had tears in my eyes, and I waited for death to blink first," Shinde recalls.

Suddenly, the six-foot mud-caked figure of Manmohan Singh appeared. And there were others too. Shinde was not alone after all. Topman Patel, the barge engineer, another crane operator Mahapatra, the five of them were not going to give up so soon. They decided to use the lifeboat to get away. Topman Patel lowered the lifeboat and asked others to hold it for him while he came down the ladder and joined them in the boat. Those five were the last men standing.

But as soon as the dinghy hit the billowy sea, a 20-foot swell slapped at it and Manmohan Singh had the presence of mind to free it before the next big wave killed them. The raging waters hurled the lifeboat like a stone from a sling and Patel was left hanging from the ladder. For the next half-an-hour, they drifted in the swollen sea "waiting for death." But as providence would have it, a rescue boat saw them and they lived to tell this tale of unusual courage. Another rescue vessel went for Patel. The evacuated crew was taken to Sagar Pragati, another jack-up rig operating about five kms from the ill-fated Sagar Vikas. As the rescue boat pulled away, Manmohan Singh gave a sad look at Vikas. It was pure gas spewing out, waiting for a small spark.

The emergency generator was still running. Everyone had forgotten about it in that melee.

At 9.15 p.m., the night duty radio operator at Maker Towers was preparing reports. As he pored over the reports, his ears were trained on that small radio receiver. And, it cracked to life. Initially, there was a frantic voice at the other end. Then, the line went dead. He had got the message. He started cranking the numbers.

Meanwhile a few miles away, in his plush Altamount Road apartment in South Mumbai, Dr A.K. Malhotra got the news over phone. But what he heard left him aghast. There was no time to ponder, no time to lose. He made phone calls, one after another, summoning his top aides. Then he drove straight to the Radio Room at Maker Towers. From there on, he drove down to the Airport. K.C. Chandra, drilling superintendent, was already near the helicopter. They and a couple of others boarded the chopper to fly into the night. H.S. Cheema took a second helicopter a few hours later while K. Anjaneyan and Atul Chandra were asked to man the Radio Room in the city.

Incidentally, it was only the second time that helicopter sorties were undertaken at night.

A thousand miles away in New Delhi, Col. Wahi was planning to retire for the night, when he received the dreadful message from Dr Malhotra. He took the first flight on Saturday to Mumbai and was at Sagar Pragati by 10.30 a.m. By then, Sagar Pragati had been turned into a veritable combat headquarters: Dr Malhotra and senior aides, K.C. Chandra, S.C. Mittal, S.K. Manglik and I.L. Budhiraja, had already flown out there at midnight.

Much before the dawn on Saturday, a contact was established with Red Adair, the legendary oil-well fire-fighting expert, in far-off Houston, Texas, USA. Messages were flashed world-wide to find out the availability and the present locations of semi-submersible rigs, fire-fighting vessels and multi-support vessels in order to requisition their services without delay.

GulfFleet-46 reached the scene of disaster within four hours and trained its water-jet hoses on Sagar Vikas. Pacific Constructor, a highly efficient multi-support vessel, received the SOS at Mumbai port, where it had come for re-fuelling. It cruised post-haste to the vicinity of Sagar Vikas. This and the assembly of related equipment at such speed, was a spectacular achievement. In the North Sea and the Gulf of Mexico, where the stakes are much higher, multinational oil giants have often taken anything up to a week to mobilise resources to fight a blowout.

The Navy and the Coast Guard moved near the scene to meet any emergency.

On Sunday, the generator in the deserted Sagar Vikas purred on as if nothing had happened. The rig's helipad was virtually invisible because of the misty gas that hung thickly. In a daring operation, a helicopter hovered over the left leg of the drilling rig, a man got out, clambered some 25-feet down the derrick-like structure, switched off the generator and climbed back up the leg. He was hauled back into the chopper. The operation was successful. Col. Wahi, the quintessential army man, had volunteered to do the daredevil's job himself, but his men would not allow him.

6:15 a.m., August 2, 1982: there must have been a small spark somewhere. The gas caught fire. The three-day old blowout turned into a towering inferno. It was described as a 'sight to remember; hellish, yet a dazzling spectacle'. The fire raged for three days. The mast of the rig, a huge truss of steel members, was the first to be devoured by the fire.

Steel loses strength at around 500 degrees centigrade; it melts at around 1500 degrees centigrade. A gas fire generates intense heat to the tune of 1,700 degrees centigrade.

It engulfed the derrick, the crane, parts of the platform and the helipad. The flames shot up to 80 meters, while Gulf Fleet-46 and Pacific Constructor, anchored only 20 feet away, fought valiantly. The water hoses of the two chartered boats spewed 26,000 gallons of water each second to control the flames.

Back in Mumbai, an all-out effort was on to requisition more fire-fighting vessels. Gulf Fleet-47, then anchored at Chennai, was summoned to Mumbai High at once. The semi-submersible rig, Dixilyn Feel 95 was called from Oman to meet the contingency of having to drill a relief well nearby; Felix Service II, another vessel fitted with high-power pumps was fetched from Bahrain. Hercules, a barge berthed at Mumbai was hurriedly equipped with similar pumps flown in from the US.

And as suddenly as it had started, the fire died, leaving a trail of destruction. Sagar Vikas, the USD 40 million rig, custom built at the yard of Hitachi Zosen, the Japanese ship-building giant, was mangled beyond recognition.

Sagar Vikas, the prima donna of ONGC fleet, had won the best safety award as well as the best performance award for the year 1981-82. It had set a record by drilling four wells at Mumbai High's platform SM in just 63 days, on an average of only 15.56 days for each well. Col. Wahi ruefully said, "The present condition is an unbearable sight for most of our men."

During the drama in mid-sea, the control room kept the nation informed about the events as they unfolded. Petroleum Minister, P. Shiv Shankar, informed Parliament on August 2, 1982. Parliament expressed moral support to the ONGC crew fighting it out in the sea. ASTO released a press note appreciating the prompt action taken by the management. It also said that the morale of the officers was very high, and everyone felt involved in meeting the challenge. The Chairman's office was flooded with letters from trade union leaders, expressing their support to meet the crisis.

When Wahi finally landed after the horrifying experience, he went on Doordarshan to assure the nation that things were under control. The papers were full of praise for the prompt action. Everyone was thankful that there were no casualties. In a similar incident, in the Eko-Fisk fields of North Sea, 123 people had perished.

Red Adair arrived and took charge of the operations from the specially-equipped Hercules which had all the blow-out control equipment. There was no fire but gas was still blowing out. Re-ignition was always a possibility. That and the inherent dangers were what brought the best out of Red Adair and his team. With dexterity, he killed the well and handed over the rig to ONGC. It took 28 days to complete the well-capping operation.

In 1987, Vikas, retrofitted with all the essentials of a process platform, moved to Panna fields (formerly North Bassein), which badly needed an Early Production System (EPS). The damaged legs were repaired. It was rechristened Sagar Laxmi. She earned the distinction of being the first offshore mobile EPS.

MUMBAI HIGH ON A ROLL

Oil had started flowing from the SA processing complex on October 31, 1980. That marked the beginning of production from Mumbai High South. With that, MHN and MHS were on line.

In 1981, CFP handed over the revised development plan for Mumbai High to ONGC. The revised estimate of the reservoir was much more than the earlier one and CFP had suggested a development plan. ONGC adopted an Accelerated Production Programme (APP), which commenced from July 1982. A production of 240,000 barrels per day was estimated from Mumbai High during the sixth plan (1980-85). A production of 317,000 barrels of oil per day was envisaged in the terminal year (1985).

The sea became a buzz of 24-hour activity. There were ONGC rigs, rigs on charter, foreign barges and Indian vessels. Helicopters whizzed by, supply vessels roamed like shoals of fish.

Soon, those who attended the 'School of Mumbai' came to be known as the alumni of Mumbai Offshore, after the schools of Ankleshwar and Sibsagar.

Between 1980 and 1985, 55 platforms (10 process and 45 well platforms) were installed, including the giant BHS process platform and WIN (water injection) platform. The only window of calm waters was for six months in a year when platform installation could be carried out. That limitation meant almost two platforms a month. But the pace of activities paid off. BHS installation increased the capacity to 360,000 barrels a day. Accordingly, the crude stabilization plant capacity at Uran was enhanced from 180,000 to 400,000 barrels a day. Mumbai High South structure had proved to be a more prolific field than the Mumbai High North.

Initially, the platforms had four wells. That increased to nine wells and then, it was 12 wells per platform. In no time, it would reach 16 wells. The technology absorption was very critical. Production and process platforms were a maze of electronics, high pressure pipings, valves, oil, gas, condensate, separation, pumping and thousands of other processes. A whole new tribe of production specialists grew up to take charge.

As business grew, so did the equipment and logistics. Right from 1982, the country had faced a dilemma. Total dependence on foreign equipment would have negated any gains from indigenous oil. Mazagaon Dock Limited (MDL), Mumbai, was encouraged to take up oil platform construction. EIL was assigned the conceptualization and designing part of the job. Tying up with international firms, they took up the challenge of manufacturing platforms for ONGC.

Offshore engineering and oil and gas production technology became centre stage with the explosive growth in Mumbai High. Two institutes were planned to take care of the emerging problems in different aspects of offshore business.

The Institute of Engineering and Ocean Technology (IEOT) was set up in 1983 to develop expertise in concept evaluation, risk analysis, geo-technical engineering, structural engineering and material and corrosion engineering.

The Institute of Oil and Gas Production Technology (IOGPT) was set up in 1984 to provide applied research inputs to help hydrocarbon production and processing. Both the institutes came up in the sprawling Panvel area off Mumbai. Then, the attention was turned to logistics for the operations.

THE WHEREWITHAL

Military science places logistics at the core of its planning: personnel (movement, evacuation), material (production, distribution, and maintenance), facilities (construction, operation, distribution) and other related factors.

An offshore operation is akin to military operations. That was the first lesson A.K. Gupta learnt when he started the logistics division.

In the early days of Mumbai High, people went to extremes to keep the operations going. One man carried a three metre long tool from the south of Mumbai to Juhu helibase to be delivered at the offshore, to ensure that the operations didn't stop. The tool was kept in a hand-drawn cart; the cart puller and the man had walked almost 17 kilometres in the night.

Because of lack of storage space and stability considerations on rigs and platforms, timely replenishment held the key to a successful operation. ONGC had taken three berths at 12 Victoria Docks. That was the beginning. Later on, it developed the Nhava base. Containerisation eased the movement of bulk material like chemicals and cement.

For personnel movement, helicopters had become a necessity. First, it was IAF helicopters. Gradually, foreign operators like Okanagan, British Airways and Schriner Airlines entered the fray with the Bell and Sikorsky class of helicopters. In order to reduce foreign exchange outgo, the Public Investment Board (PIB) authorised the IAF to procure 12 helicopters, exclusively for ONGC's use. But that proposal never took off. In 1985, Helicopter India Limited (HCI) was formed. It was later rechristened as Pawan Hans Limited. Subsequently, ONGC acquired equity in Pawan Hans. At any point of time, more than 2,000 personnel needed periodic transfer to and from Mumbai. Most of them worked in 14 days on and off shifts.

Then, the attention was turned to supply vessels to carry bulk products like cement, diesel and food boxes. The first two supply vessels, Sagarika-1 and Sagarika-2, were built by Hindustan Shipyards Limited (HSL). Another crew boat, Sunfish, ferried men. As the pace of operations increased, ONGC ended up owning 33 supply vessels (Sindhu and Samudrika series) built in different shipyards in India and abroad.

With the increasing pipeline network, MSVs were needed to undertake routine repair and maintenance jobs. MSVs were compact units with dynamic positioning, diving units and fire-fighting capabilities. The Pacific Constructor of Vikas fame was the mainstay for a long time. Subsequently, ONGC purchased two more: Samudra Prabha and Samudra Sevak. An Inspection, Maintenance and Repair (IMR) section came up to learn the job from expatriates in pipeline related jobs.

By 1978, Haakon Magnus and Dalmahoy had been de-hired. A new floater, Gettysberg, had joined the fleet of two other rigs, Samrat and Shenandoah. Samrat and Gettysberg were on an exploration spree; Shenandoah was doing pioneering work in development drilling from platforms. These three rigs are still operating in Indian waters; Samrat as the pride of ONGC though now being used as early production unit, Shenandoah as Kedarnath and Gettysberg as Badrinath.

In 1982, two more jack-ups, Sagar Vikas and Sagar Pragati, had started development drilling in Mumbai High. Sagar Prabhat, ONGC's first floater, was bought for deep water operation. It was sent to the southern offshore for drilling.

In 1985, Sagar Jyoti, a jack-up, was inducted. In the same year, another floater, Sagar Vijay, joined the fleet. Vijay was made by Hitachi Zosen, Japan. It was the most modern rig in the ONGC fleet. It could go down to 300 metres water depth, and could drill up to 5,000 to 8,000 metres.

As per the perspective plan, a major portion of the prognosticated reserves lay in deeper waters. Wahi explored the possibility of building a similar ship in one of the Indian shipyards. It was too complex a ship to encourage any Indian yard to take up the job. HSL, Visakhapatnam, not very experienced, showed interest. The Japanese agreed to give the blueprint for a fee of Rs. 26.9 million as a price for the transfer of technology. The provisional cost was estimated to be Rs. 600 million, and the maximum cost was pegged at Rs. 680 million.

The go-ahead was given. There would be no foreign consultants available. Wahi appointed S.R. Athavale, a drilling superintendent, to look after the construction job. On June 16, 1984, Wahi landed in Visakhapatnam to witness the keel-laying of the ship, a big event in any ship building venture. On June 9, 1987, Sagar Bhushan sailed from Visakhapatnam and headed to the Mumbai High waters. Almost three decades later, it is one of the most efficient and decorated rigs in ONGC.

Within years, more jack-up rigs - Sagar Ratna, Sagar Gaurav, Sagar Kiran, and Sagar Uday- were added to the fleet. On land, the Bharat Heavy Electricals Limited (BHEL) was encouraged to set up a rig building division at Hyderabad. Within years, spanking new electrical rigs started replacing the aged rigs of the 60s and 70s vintage.

Indigenization process got a vital boost with the establishment of an Indigenous Development Group (INDEG) in 1988. When DMU was set up in 1964-65, and later HODI, the process of reverse engineering was taken up to develop fast consumable spare parts for Russian and Rumanian drilling rigs with a view to save foreign exchange and for setting up the numerous GGS, CTF and other related equipment. With setting up of the INDEG, the process of reverse engineering was changed to development of equipment, spares and consumable as per the operational needs and with newer designs and concepts. ONGC organized interactive sessions with industries and shipyards to create more awareness about the oil industry requirement. The exercise proved to be worth the efforts in later years when majority of the offshore platforms were built in Indian yards.

The nurturing, and retention, of skilled manpower was a bigger worry. In the beginning, all the offshore rigs had expatriate drilling crew. The foreign exchange outgo was USD 500 a day on each expert, and a little less for technicians. But the induction of graduate engineers paid off when, within two or three years, ONGC operated most of the rigs on its own.

However, the greater challenge lay in developing in-house technical expertise in specialized jobs like directional drilling, cementation, drill stem testing, fishing and the like. These were the preserve of a few companies which charged hefty fees for their domain knowledge, a charge for the intellectual property.

Mumbai High had taken up directional drilling from the beginning. It was an evolving technology in 1976. From day one, a small team of young engineers volunteered to learn the tricks of the game. U.N. Bose, a graduate engineer of the 1976 batch, formed a small group to learn and implement the directional drilling programme. Initially, there was outright derision of Indian ambition. The turning point came about when it was decided to tap the L-II reservoir in Mumbai High-NR-1H and NS-H. That marked the beginning of horizontal drilling and Extended Reach Drilling (ERD), a more advanced version of directional drilling.

However, the demand for directional drillers was a bane for Bose. Every time a group of drillers got trained, they would leave en masse to join a multinational that paid as much as USD 3,000 a month. The drilling section saw maximum attrition and poaching of talent.

With the decommissioning of *Anveshak*, ONGC decided to go in for a second vessel. This vessel would not only be technologically far more advanced, but would also be a replacement for *Anveshak*.

V.L.N. Shastry, K.N. Bhave and D.K. Trehan started the ball rolling and started preparing the detailed specifications. A tender had just then been floated when T.S. Balakrishnan arrived in Mumbai on transfer from Dehra Dun. It then fell upon him to continue the process.

When the offered bids offers were opened, it was found that none of the bids corresponded to the given specifications. The price quoted ranged widely and comparison between the offers was almost impossible. The only offer close to the requirement (and financially comfortable) was one from a Singapore shipyard, which had a hull almost ready and could build on it and fit it out as a survey vessel.

The greatest advantage was the quick delivery. To Balakrishnan, this seemed to be a good bet and he recommended going ahead with the deal. As the bill would exceed USD 20,000,000 in foreign exchange, it had to be cleared by the Steering Committee consisting of representatives from petroleum and finance ministries and members of ONGC. The purchase decision was finalized. It was earlier postponed thrice owing to various reasons.

The vessel was delivered on schedule. The vessel MV Sagar Sandhani was commissioned in 1986. It was equipped with the latest state-of-the-art technology to acquire 2D as well as 3D seismic data.

Anticipating the volume of high resolution data, and to take care of the increased seismic work, it was decided to set up a new institution. The Geodata Processing and Interpretation centre (GEOPIC) was set up in 1987. It was housed in the sprawling KDMIPE campus.

K.N. Bhave was chosen as the first director of GEOPIC. His first job was to remove backlog in data processing and enhance in-house processing and interpretation capabilities. Fighting odds against US sanctions at that time, ONGC could procure a state-of-art IBM 3083-JX3 system with Western Geophysical software and crystal work station for interactive interpretation. The first 3-D data processing and interpretation was taken up. By beginning of 1988, GEOPIC had processed and interpreted the Underground Coal Gasification (UCG) 3-D seismic data. It was a new experience for Gautam Sen and Babanjee to process the data as it involved formulating a new processing methodology. At the same time, P.S. Virdi and his team made maiden attempts in interpreting the data and map the coal seams. This paved the way for GEOPIC to emerge as the nodal center for 3-D seismics.

On the eastern front, the emerging developments in bio-technology and geotectonic research received a boost with the setting up of the Institute of Bio-technology and Geotectonic Studies (INBIGS) at Jorhat in Assam in 1989. Pioneering research in the areas of Microbial Enhanced Oil Recovery (MEOR), oil spill combating and microbial prospecting started in collaboration with Dibrugarh and Tezpur universities.

During Wahi's tenure, ONGC saw a massive infusion of new technology on every front. Computerisation was started in every operation. There were major communication initiatives like Telnet which was basically a satellite based data network, interlinking all operational centres of ONGC with their respective project and the headquarters. When completed in 1993, ONGC became one of the few companies in India with one of the biggest private communication network. Project Supervisory Control and Data Acquisition (SCADA) was launched for Mumbai High and some onshore locations to minimize production losses and to provide voice and data connectivity.

Meanwhile, a fire brought about a new consciousness.

CHASE THE FIRE

The Sagar Vikas experience had given birth to a safety division in the Commission. Oil spillage was always a possibility, but no one had anticipated it so soon. In October 1984, a fire broke out in the engine room of the SCI-owned oil tanker *Lajpat Rai*, full with crude from the fields. It was near the Butcher Island oil terminal. Immediately, A.K. Malhotra rushed an MSV from the Mumbai High field. S.K. Manglik and Y.S. Seroha camped on the MSV. Mumbai Harbour was as notorious as the Gulf of Cambay in tide variations.

But with the massive water flooding by the MSV, the tanker grounded. And a tank developed a leakage. Crude oil started floating on water. It was a marine disaster and a nightmare.

Then, the floating oil caught fire. The fire spread. The sea was again an inferno. Without chemicals, the MSV started chasing individual fire pools and dousing it with water spray. There were other boats in that area. Everyone started pulling their anchors. The MSV was like a grass hopper; sliding near a fire, killing it and moving to the next one. It continued for three days and three nights. The crew was fatigued with fire chasing.

Finally, the captain of *Lajpat Rai* and the MSV went on board the grounded ship and located the source of fire. The MSV water jet was directed towards the source.

It was extinguished on the fifth day.

Oil spill management entered the jargon on that day. The government of India promulgated the Environmental Protection Act (EPA) act in 1986. The Act vested substantial powers with wide-ranging aspects of environment protection including protection of marine environment. The ministry of environment and forests was to give clearance for any industrial activity, including offshore E&P activities in the country. Every project had to prepare an Environment Impact Assessment (EIA), risk analysis and disaster management plan.

With its increasing operations, ONGC had included environment protection as one of its objectives.

Safety of operations was no more a slogan. During Johnson's period, it was one of the activities under the department of inspection. Compliance with the Boiler's Act 1923 was a necessity, with a production engineer being attached to the department. But drilling and exploration activities were not covered under safety aspects.

In the mid-70s, UNDP was requested to assist in the formulation of a safety policy. The offshore foray was the catalyst as an oil spillage was always a possibility. Based on the recommendation of an UNDP expert, ONGC acquired an MSV with all the gadgets for combating marine pollution. In 1976, Z.J.O. Babaev, a Soviet safety management expert, was hired to bring out a safety manual for onshore activities. That was to become the first safety policy of the organization.

In the aftermath of the Vikas blow-out, Wahi called for a meeting of the newly promoted general managers. In his inimitable way, he asked for a volunteer to head the safety department. C. Karunakaran raised his hand.

Thus, ONGC became the first public sector organization to have a full fledged department of Safety and Environment Management (SEM). Things moved fast. By 1985, the company had a Recommended Code of Practices (RCP) for all operations. All General Managers were asked to record non-compliance and report it to the SEM division. In an unprecedented move, Wahi personally issued all orders regarding safety for prompt response.

A decision was taken to set up the Institute of Petroleum Safety and Environment Management (IPSEM) at Goa, in 1989. Initially, it operated from hired premises in Margao. It would take another three years to acquire land on the sea front in Betul. Finally, in 1997, IPSEM had its own campus.

ONGC took steps to help formulate the Oil Mines Regulations (OMR) Act in 1984. The SEM prepared a draft of Offshore Safety Legislation and submitted it to the ministry.

On July 6, 1988, the Piper Alpha, a drilling-cum-process platform in the North Sea caught fire and hundreds of oilmen perished in that incident. The magnitude of the disaster forced the world to look at safety from a different perspective: it changed from an enforced regime to a self-governed one.

GAS - PRIZE OR CURSE

Gas has come of age in the 21st century. In 1984, diesel and kerosene ruled the roost with petrol considered a rich man's fuel. From the early 60s, ONGC had to conceptualize studies on gas utilization in Assam and Gujarat. By mid-1980s, only Gujarat gas utilization was the highest in the country.

But ONGC faced a problem with its gas from Mumbai High fields. In 1976, the Bassein structure was discovered. South Bassein had turned out to be a giant gas field. Yet, it could not be pumped up to Uran because of a typical problem: it was sour gas. Sour gas contained huge amounts of hydrogen sulphide.

H2S not only corroded pipes, it also could kill people. When the concentration of H2S in the air is below 100 parts per million (ppm), it smelt like rotten eggs. Beyond 100 ppm, it is odourless and causes nausea and if inhaled, it can kill instantly.

In 1976, the first well SB #1, was drilled. It gave indications of a large gas pool. Subsequently, seven wells were drilled to delineate the field. It had an aerial extent of 235 square kilometers. But H2S appeared in some areas with concentration levels running into thousands of ppm in the air.

The debate went on about whether all infrastructure should be built to handle H2S. S. Ramanathan had joined Mumbai as GM (Geology). He was convinced about the field being a predominantly H2S prone area. It took some time to persuade everyone. H2S-proof development meant a few million extra dollars. The doubt was turned into a reality when the drilling crew had a narrow escape in consecutive wells. H2S sensors were very few in numbers. One had to rely on the smallest indication, a nose for H2S. The moment it appeared, it was bulldozed back into the formation. It took some time to import H2S handling equipment to test the wells. That delayed the field development.

In 1979, a study was conducted by the reservoir consultants DeGoyler and McNaughton on gas availability and transportation problems of Bassein gas field. They estimated the availability of gas to the tune of 600 million cubic feet per day.

A market had to be established for the gas. The Satish Chandra Committee set up by the government had recommended the usage of gas only for fertilisers and petrochemicals.

Accordingly, the government constituted the Bejawat Committee to look at the gas utilization of Mumbai High. The committee recommended the setting up of six fertilizer units in four states. It envisaged two at Surat (Hazira), one each at

Guna (Madhya Pradesh), Babrala (Uttar Pradesh), Jagdishpur (Uttar Pradesh), Anola (Uttar Pradesh) and Sawai Madhopur (Rajasthan).

The gas from Bassein was to be brought to Hazira in Gujarat. After sweetening the gas, it was to be pumped into a network of pipelines connecting all those places. ONGC formed a team for carrying out the task.

It was a Blitzkrieg on a smaller scale. Asatellite had to be used for route selection, the total length across four states had to be covered, mobile workshops had to be set up for survey teams, local population had to be persuaded to sell the land and pipes had to be procured. The C&M division at Vadodara had developed enough confidence to look after HBJ Pipeline.

The pipeline division had one more task at hand: the offshore gas would land at Hazira landfall point; from that point, a four kilometer-long 36" pipeline had to be laid to the proposed location of the Hazira gas processing plant. It had to cross two rivers, Tapti and Mindola. The job was safely completed except for a scary incident when the pipes came loose from the harness and strayed towards the sea. Those were retrieved.

ONGC had made quite good progress in the construction of the HBJ pipeline. The government formed a new company Gas Authority of India Limited (GAIL) to look after the remaining construction and subsequent marketing of gas.

H.S. Cheema became its first chairman. Many more engineers from ONGC were sent on deputation on higher rank. Two of them, I.L. Buddhiraja and S.R. Prasad later became GAIL chairmen.

Hazira town lies on the banks of River Tapi. Presently, it is the hub of industrialisation in Gujarat. Companies such as ONGC, Reliance, Kribhco, NTPC, L&T and Essar have set up their operations in and around Hazira. This modern industrial complex of today has come a long way since the time when 'the only road from Surat to Hazira was a little stretch between potholes.'

The onshore terminal at Hazira was commissioned in September 1985. After initial treatment of gas on the offshore processing platform, the sour gas and condensate were transported through a 217-km long submarine pipeline of 36 inches diameter to Umbhrat and then through a 14-km long onshore pipeline to Hazira. A specially constructed onshore terminal at Hazira received this sour gas and condensate from South Bassein as well as associated gas from Mumbai High.

Initially, the sweet gas received from Mumbai High was supplied through this terminal to the Kribhco fertiliser plant. Simultaneously, the LPG plant was commissioned in December 1987, to extract LPG out of the sweet gas of Mumbai High.

Later, with the commissioning of the gas sweetening facilities, the sour gas from South Bassein was also received. It was to be the first gas sweetening facility in the country. As gas-based industries increased over the years, the project increased production of gas and also developed additional infrastructure.

The Phase-I of Hazira Project was commissioned in September, 1988, with a capacity to process 10 million cubic meters of gas a day and associated liquid condensate.

As the potential of South Bassein was very high, the Phase-II development was taken up in October, 1990. In January 1996, a second pipeline of 42 inches diameter was commissioned from South Bassein to Hazira covering a distance of 243 kms. This is the largest and the longest subsea pipeline in the country. Later, the project took up the Phase III and III A expansion, commissioned in 1996 and 1997 respectively. In an attempt to maximize the value, a cogeneration plant was set up in Hazira to produce power from the steam generated during the industrial process. It was one of many pioneering gas utilization processes designed by ONGC engineers.

Spread across a sprawling 705 hectares, the Hazira plant was set up at the cost of Rs. 13 billion. The land for construction was acquired from the government of Gujarat in phases. The total gas processing capacity is 41 million cubic meters of gas per day. Today, the product range of the plant includes natural gas, LPG, NGL and kerosene.

The gas supplied by the plant has enriched the industrial activities earning handsome revenues for ONGC.

The excess power produced in the cogeneration plant of the project is transmitted to other assets of ONGC and is also sold to the Gujarat State Electricity Board. If all the spare power can be wheeled, the total revenue generation will be Rs. 980 million annually against the generation cost of Rs. 180 million.

The city of Surat faced a series of natural calamities. In 1994, the western parts of the country witnessed unprecedented rainfall, particularly, in the catchment area of the river Tapi which flows through the city. In order to save Ukai dam which is about 65 kilometers from Surat, a huge quantity of water was released resulting in heavy flooding of Surat and the Hazira Plant.

The surrounding villages like Magdalla, Ichchapore, Bhatpore, Kawas, etc., were submerged in water and the plant was closed for safety reasons. The gas-consuming industries came to a halt. The mammoth task of dewatering, drying, servicing and recommissioning of pumps, motors and electronic equipment was done in shortest possible time. Power from Gujarat Electricity Board became available to the plant on September 19, 1994. In less than 24 hours, one train of gas sweetening unit was put on operation and gas supply to GAIL was resumed.

The project employees had just settled down after massive efforts for recommissioning the plant when the next big calamity confronted them: plague. Nearly half a million residents fled the city. Most of Hazira industries either closed down or drastically reduced their operations. But the Hazira Plant continued uninterrupted and maintained a regular supply to GAIL even as the clouds of fear and death hung ominously.

The memories of death and devastation were still fresh when the floods hit again in 1998. Once again, the floods tested the mettle of management and employees.

Each time, they managed to beat the odds.

BEYOND MUMBAI HIGH

For thousands of years, life in Andhra Pradesh revolved around the two rivers Krishna and Godavari, running parallel through the state.

Everything had some symbiotic relationship with these two river systems: myths, folk songs, sages and people. The alluvium-laden land had attracted many a prospector looking for minerals. The villagers in and around Rajamundry were into agriculture, weaving and fishing.

Myth had it that there were gas shows in Narsapur, Razole, Tatipaka, Yanam and many other places. Arogya Swami of GSI had collected some gas sample from Tatipaka in 1944. It had ended with that attempt. One rice miller, people say, had used the gas for his rice mill.

The Commission entered the K-G basin with financial help from World Bank. The World Bank representatives were involved in choosing the locations. Those locations didn't yield encouraging results. After persuading the Bank to relax the norms, the geologists of the Commission delineated a couple of structures. From the detailed surveys conducted in the Narasapur-Palakollu areas during 1975-76, a well-defined structural closure 'Narasapur Structure' was mapped. The first well, Narsapur #1, was spudded in April 1978, with the first indigenous electrical rig manufactured by BHEL.

The well blew out gas for four days. But it hinted at the presence of hydrocarbons in the K-G basin for the first time. Meanwhile, exploratory drilling in the then defined deep waters (250 m water depth) had begun in 1979. The dynamically positioned, charter-hired drill ship Pelerin had spudded its first well G-1-1. A promising field was on hand.

The first well in shallow waters, GS-16-1 indicated the presence of hydrocarbons but the well had to be abandoned prematurely due to drilling complications. The interesting sands encountered below 1645 meters remained unlogged and unassessed.

The second well Ravva #2 indicated presence of commercial hydrocarbons. The string of successes led to intensification of exploration activities for an early establishment of hydrocarbon reserves and production potential. The field was renamed 'Ravva', meaning diamond in Telugu. After drilling 30 wells, ONGC put the Ravva field on production in February 1993 with an initial production of 1000 tonnes per day.

Kingston, who reassessed the K-G basin in 1995, said that the basin had attained maturity and there would be no significant find. He indicated only 88

MMT of undiscovered oil in place. Soon after his assessment, a month later, Kesanapalli West was discovered which has come up as one of the prime onland oil producers of K-G basin.

Aboard *Anveshak*, geophysicists crisscrossed the Coromandal waters. The entire sedimentary tracts in the land part of Cauvery Basin also bore the pugmarks of the explorers. There was a firm belief in their minds at that time that the structurally highest `Karaikal High' in the basin held the key to good fortune.

On June 9, 1978, just more than two years after the success of Karaikal-10, the offshore rig spudded the well Karaikal High-1 (KH-1). However, fortune did not favour the brave this time! Nonplussed, the geoscientists held on to their view that oil was there in the Basin. Within a couple of years, in 1980, a small gas field PY-1, off Pondicherry coast was discovered.

The discovery of oil in Karaikal and gas in PY-1 shut the cynics up forever. In 1981, a small oil field PH-9 in the Palk Bay area south of Vedaranniyam was found.

After an uncomfortable lull of seven years, the third oil field emerged. In 1988, the second well drilled on PY-3 structure flowed oil. Between 1977 and 1993, 52 offshore wells were drilled.

In the meantime, a dedicated group of geoscientists under geologist Dr R.P. Rao relentlessly pursued the voluminous geophysical and geological data with geochemists, referred to all available literature and latest ideas, arranged and assimilated them and arrived at a reasonable geological model of the Basin. They zeroed in on an area not far away from Pattukottai.

The well Kovilkalappal-1 was spudded in on August 5, 1984. Thus the first commercial oil and gas field in the onland part of Cauvery basin was established on February 11, 1985. Before the excitement died down, the second oil discovery was made at Narimanam just a couple of kilometer south of Karaikal-1. Once the jinx was broken, success came in an avalanche. There was no end to the surprises, but this time around, they were pleasant ones. Delineation efforts in Narimanam field brought to the fore multiple pools of oil.

Having tasted success in Nagapattinam district, the focus shifted towards north, in the area around Chidambaram, where Lord Shiva is said to have held court. Just about five kilometers away, ONGC drilled the well Bhuvanagiri-2 on an independent structure, which again gave oil and gas from tight, calcareous reservoir, albeit after much coaxing. In the area around Kovilkalappal and Narimanam, drilling continued and more new pools discovered. Along with it, there were concerns about the presence of hydrogen sulphide gas in some of the reservoirs. In the nineties, a sour gas Early Production System (EPS) was commissioned at Narimanam.

3D-seismic surveys were introduced on Kovilkalappal field in 1988 and continued in subsequent years on the other discovered fields. In the first week of

June 1991, a minor blowout occurred at Kovilkalappal-9, the first in the basin. This misfortune turned later into a fortune with the discovery of a major oil pool!

Amazed at ONGC's string of successes, Technoexport of USSR entered into a contract in 1985 to carry out seismic surveys and drilling in both Cambay and Cauvery basins. Between 1986 and 1990, it acquired 4003 line kms of 2D seismic data and drilled 18 wells but with marginal success in only one well, Bhuvanagiri-9. On expiry of Phase-I, in December 1994, they relinquished the area.

These hide and seek game continued in the basin. Neyveli, Vadatheru, Attikadai, Tulsapattinam, Kuthalam, etc., kept tantalizing the insatiated. The discovery of Perungulam, Periyapattinam, Ramanavalasai, Kanjirangudi and so many others had ONGC asking for more.

These two basins were upgraded to Category-I reserves. It had taken more than three and half decades to crack the secrets hidden below. In the following years, K-G and Cauvery would become the prospects with a brighter future.

In 1959, Cambay had given hope to a nascent organization. The discovery of oil in the basin had broken a few myths. Within years, it had proved to be a gas field. Next, Ankleshwar gave a lifeline to the infant Commission. Cambay also had not finished throwing up surprises.

Gandhar was a quiet place, near the Gulf of Cambay. For almost 25 years, it had been a silent witness to the goings-on of the oilmen of ONGC who used to go northwards towards the heavy oil belt north of Gujarat while some others went southwards towards the riches of Ankleshwar. Gandhar was located between the high and low water lines near the Dhadhar river estuary. The place used to become an extension of the river during monsoon season.

Sometime in January 1984, the villagers found the oilmen heading towards Gandhar. They came in with a lot of hope. It took them months to prepare the foundation for the rig. Finally, the villagers heard the purring of engines.

In March 1984, without any prior indication, oil surfaced at a well drilled near Gandhar, 80 kilometers south-west of Vadodara town. Overcoming all difficulties, eight more exploratory wells were drilled. There was oil in every single well. The oil discoveries were at a deeper depth between 2,750 to 3,100 meters. It was in sandstone. To everyone's delight, the hydrocarbon reserves were estimated to be 466 million tonnes. The area was spread over 800 square kilometers.

The discovery came just about the time the grand old dame, Ankleswar, was showing signs of a gradual decline. Every oil field, like human beings, follows a similar life cycle.

Buoyed by more oil and more money, employee welfare saw a major makeover. The daily allowance and other amenities were upgraded. Social life in the colonies was made more attractive with community centres and clubs coming up. Interaction with societies around work centres was increased to build a harmonious relationship. The Commission started building schools and other facilities to help the poor and underprivileged. Scholarships to children belonging to weaker sections of society were started.

ONGC encouraged its own employees to take up challenging sports and activities to build a robust organization. The ONGC Himalayan Association (ONGCHA) was established and its members undertook expeditions.

The participation in the Antarctica expedition was a major achievement for the organization. Some of its scientists like Dr Madan Lal, D.K. Pandey and others were part of the path-breaking team of Indian scientists who established a camp in the hostile land of ice.

Shobhna Wahi, wife of Col. Wahi, took initiative to open the Mahila Samiti in all major work centres. A women's polytechnic was opened in Dehra Dun.

ONGC's profits went up from Rs. 0.4 billion in 1981-82 to nearly Rs. 16 billion in 1989-90. The company was considered one of the 11 profit-making companies in the Fortune 500 list when the administrative prices were between one-third and one-sixth of international prices.

Those were the good times when everyone felt contented. On March 19, 1988, the Government of India conferred the coveted Padma Bhushan on Col. Wahi. With humility Wahi said, "This recognition of the Government of India is a tribute to the commitment, hard work and caliber of every employee in ONGC."

HIL REINVENTS ITSELF

The year 1988 was the turning point for Hydrocarbons India Ltd. It was rechristened as ONGC Videsh Limited (OVL).

It started by drilling two wells in Yemen and Egypt. OVL's efforts to insulate India from volatile international crude oil prices remained in the realm of fantasy. In May 1988, OVL signed a contract with Petrovietnam for the exploration and production of hydrocarbons from three blocks in Vietnam offshore.

In February 1989, the newly acquired vessel Sagar Sandhani was deployed for carrying out seismic surveys in Vietnam offshore. The vessel sailed off from Mumbai port and reached Vung Tau port. OVL was to acquire seismic data in South China Sea Basin in Blocks 6, 12 and 19, the first two being far away from coast with some wells producing gas. Base stations were established on Vung Tau coast and in two islands Kega and Conson for sending continuous signals to the ship with 'Maxiran' and 'Argo' equipment for location fixing.

A.V.K. Suryanarayana was the party chief of Sagar Sandhani during Vietnam operations. The data acquisition in offshore Vietnam was a unique experience. The South China Sea is notoriously ferocious with frequent cyclones and hurricanes. It not only adversely affected the survey operations but also was a serious hazard due to the very high degree of pitch and roll of the ship.

The entire survey work of 6400 line kms was successfully covered in seven voyages and MV Sagar Sandhani returned to India in October 1989.

In association with its partners, British Petroleum (BP) and Statoil of Norway, OVL discovered Lan Do and Lan Tay gas fields in Vietnam in 1992. These two gas fields account for more than 51% of the gas reserves in Vietnam.

Later, it got entangled in a prolonged legal battle with BP. OVL was not allowed to develop the field and had to give away 45 per cent of its share to BP and that too at a 'throwaway price'. The upshot was that its initial Rs. 300 million equity was wiped out. OVL also waited for another day to redeem its honour.

The Blitzkrieg was showing signs of fatigue. By the beginning of the nineties, the producing wells of Mumbai High started showing erratic behaviour. The production began a southward move.

PART SEVEN

AFTER SUCCESS BLUES

THE PROBLEMS OF GROWTH

An article titled 'The rise and fall of an oil company' came out in a magazine in 1991. It was written by Hanson. It postulated: "Like all living organisms, oil companies are governed by a life cycle which includes birth, adolescence, maturity, old age and death."

For ONGC, this decade was all about hanging on by a thread. Support came in from unexpected quarters and surprises were aplenty. This was in the emerging era of globalisation.

The 1980s saw ONGC acquire maturity. Within three and half decades, it had learnt to operate in the whole of hydrocarbon exploration and exploitation chain. This was the phase when everything happened: Production, exploration, value addition from hydrocarbons, employee welfare, promotions, growth, knowledge building and massive build-up of assets. In two decades, it had grown into a globally respected E&P company.

Its annual budget exceeded the budget of several smaller states. In 1984-85, ONGC oil production had met 70% of the country's requirements. The demand for oil continued upwards: requirement of oil was 17.1% of the total energy requirement in 1953-54; it rose to 43.4% in 1990-91. The share of coal had reduced from 79% in 1953-54 to 40% in 1990-91. ONGC had produced 32 MMT in 1989-90: offshore production accounted for 20 MMT. As a result, the foreign exchange outgo was Rs. 56.22 billion, almost 20% of the total foreign exchange receipts of the country. That was good news for the nation.

Something strange was happening on the global front. After the 1979 crisis, global oil price saw an upward trend, reaching USD 39 per barrel in 1981. Then, the price went on a downslide. The volatility of oil price could be gauged from the fact that it reached as low as USD 10 per barrel in 1986. A new entity had emerged in the oil markets.

In 1983, the New York Mercantile Exchange (NYMEX) was set up in New York to trade oil as any other commodity. It was supposed to provide stability to the market by introducing futures. All producing countries and companies traded their oil on the floor of NYMEX and one could book future needs at a pre-determined price. It was more or less like a stock market. Though it helped in stabilizing the prices, commodification of a strategic product like oil introduced a new element of speculation. If a sheikh in Saudi Arabia sneezed, NYMEX caught a cold. Any political or regional instability gave it shivers. Just like the stock markets, panic reactions brought in a new element in futures and spot markets.

From 1980 onwards, the government was trying to attract foreign investment in under-explored areas like Kutch-Saurashtra, K-G Basin, Cauvery basin and other Category-II blocks. It had tried everything, including exemption from royalties in 1986. No minimum expenditure commitment was asked for and ONGC was allowed to take a 40% stake in those joint ventures.

The attempts didn't pay off. With the low oil prices, exploration efforts worldwide had slackened. No one wanted to venture into difficult waters; it was prudent to invest the surplus in producing fields.

ONGC's philosophy as a national oil company was different. It had to find and develop the country's national resources. Dry wells added to its cost of operations. It had gone back, time and again, to areas where multinationals had feared to tread. The perseverance had paid off with the discovery of a new oil province in the South. It had adhered to the planned targets of the preceding two five-year plans. The country could invest in importing other necessities because of higher production from Mumbai High. Under the administered price mechanism, it was getting a 15% fixed return on its investments. Gas was not covered in the APM mechanism. The country was yet to realise the importance of gas in the economy. The gas pricing was always mired in controversies.

From 1989, some of the producing wells had a greater influx of gas coming with oil. As per the joint development plan with CFP, water injection had been started. It was a little behind schedule as the platform delivery was delayed by a few months. The first drop in production was in 1990-91. It was a marginal drop. But it opened a Pandora's Box.

EYE OF THE NEEDLE

From the mid-80s, ONGC's performance had earned a new respect in the world money market. The World Bank, ADB and other consortiums of foreign banks had lined up to provide loans for various projects, offshore and onshore. Most of the mega projects were funded with loans.

The world of oil went into spasms once again. The Middle East was in turmoil. Iraq invaded Kuwait. By that time, the Middle East was the last frontier as far as future reserves were concerned. The oil price reacted sharply. From a low of USD 10 per barrel in 1986, it went up to USD 20 in 1990. The world held its breath as the USA prepared to form an allied force to invade Kuwait and drive out Iraq.

Bankers started looking through the eye of the needle at ONGC's performance. P.K. Chandra had taken over as vice-chairman during Wahi's period. After Wahi left on December 9, 1989, he was the acting chairman for six months. On June 14, 1990, a paper landed on his desk. It was the World Bank report on ONGC's performance.

In an incisive reply, he answered each and every query. He said: "The actual terms of reference and source of information for the opinions of World Bank were not known. It appears that some of the experts of World Bank who were associated quite sometime back for development of Mumbai High and K-G basin have contributed in reaching the conclusion whereas we are on record that actual results obtained in these fields are at variance and basically in conformity with the strategy and models pursued by ONGC."

Chandra cited the figures and the joint development plan of CFP and other agencies. He admitted getting some surprises at the heterogeneity of the Mumbai High field. He outlined the future exploration strategy of Mumbai High by adopting high-tech drilling methods like horizontal and in-fill drilling, not forgetting to remind the Bank that ONGC had developed in-house capability in the latest drilling and production techniques.

The world was changing fast. The lenders were afraid of losing the returns on their investment. They stepped up the pressure on the government to intervene. The government set up a committee to look at the reservoir health of Mumbai High.

The Mumbai High Review Committee (BHRC) was headed by Dr A.B. Dasgupta, former Managing Director of OIL. The committee found the field quite complex in nature. It pointed to the delay in the installation of water injection platforms. ONGC replied that it had faced some problems with getting the platforms on time from MDL for the MHS and delays in getting approvals.

The major recommendation of the committee was to conserve and replenish the energy of the reservoir through closure of high GOR (gas-oil-ratio) wells and improve pressure maintenance by water and miscible gas injection. On a question about the reservoir health, the committee had concluded that no irreversible damage was done to the Mumbai High during the production period from 1976 to 1990.

The panel expected the government and ONGC to bear with the temporary closure of problematic wells, which was adhered to.

To add to the Commission's woes, Assam went into a spasm due to law and order problems. It resulted in loss of lives of ONGCians. As a mark of protest, the employees went on a prolonged strike, which brought the company's operations to a standstill. Security for ONGC personnel operating in difficult areas became a major issue. With a lot of persuasion and government assurance on enhanced protection, the operations crawled back to normalcy. But, the problems would not go away.

On June 3, 1990, S.L. Khosla took over as the 10th Chairman of ONGC. He was from the Assam-Meghalaya cadre of IAS. He had served as Chairman of IOC (Indian Oil Corporation) from 1986 to 1990. He knew the background of the oil industry problems in all its facets.

But he had come in at a tough time. Within months of his takeover, the stand-off in the Middle East went beyond posturing. The USA-led forces entered Kuwait to fight the Iraqis in October 1990. It was one year after the Iraqis had invaded Kuwait. During that one year, the world held its breath with tentative posturing on both the sides. The crude price hovered around the USD 21 per barrel. The moment the attack began, the first commodity to react was crude oil; it shot up to USD 33.

India was thrown into a big crisis. The favourable foreign exchange balance was literally wiped out. ONGC had started the closure of the problematic wells in Mumbai High. The production had come down to 19 MMT. To add to the woes of the Commission and the country, the onshore production also came down from 8.81 MMT to 8.69 MMT.

Assam was in turmoil. ONGC lost the lives of two of its employees due to hostile environment. As a remedial measure, R. Srinivasan, ex-Member (Personnel) was asked to study the organizational set-up of ONGC with a mandate to study the strength and weaknesses. He made a number of suggestions which didn't have too many takers. However, the system of having Members with administrative control over different regions was done away with.

The slide continued unabated. By 1992, the production from Mumbai High dropped to 16.47 MMT per annum. The production from land dropped to 7.76 MMT.

FIRE FIGHTING

Panna field was on an extended Early Production System with the installation of Sagar Laxmi (the repaired Sagar Vikas). In 1990-91, three platforms were installed and 23 development wells were drilled. Average daily production reached 10,000 barrels a day.

Mukta field was the next one to be taken up. It was discovered in 1981. ONGC had drilled 30 exploratory wells and eight development wells from the MA platform. Production was started in December 1990.

South Tapti and mid-Tapti fields were discovered in 1978 and 1980 respectively. They were situated 200 kilometers north of Mumbai. ONGC had drilled 15 wells in the south Tapti and eight in mid-Tapti to delineate the field.

On land, Gandhar development had picked up speed. Just at the right time, the South had come to the beleaguered Commission's rescue. After Gujarat, Assam and Mumbai, three southern rivers and their deltas were adding to the geological reserves of the Commission.

ONGC suffered a major setback in Nagaland when the operations had to be called off owing to the unique land ownership rights there. The individual owner of a land also enjoyed the sub-surface rights. With the discovery of oil, the rights became a matter of contention between the individual groups, the state and central governments and ONGC.

Undaunted by setbacks, Khosla, using his contacts in the corridors of power, managed to get proposals worth Rs. 50 billion cleared. But internal revenue generation took a nosedive from a high of Rs. 22.84 billion to Rs. 13.36 billion in 1991-92. Gross revenue fell from Rs. 96.05 billion in 90-91 to Rs. 81.47 billion in 1991-92.

Gas came to the Commission's rescue with Bassein delivering results. But the gas prices were too low to make a substantial impact on the bottom line.

ONGC had created a niche for itself in the people's mind. But some discerning employees noticed a slowdown in the operations. They saw the drilling rigs moving away from exploratory wells to work over (sick well repairs) operations. Otherwise, life went on as usual on the high seas and on land.

Something else was happening in the background. It was fought in the rarefied atmosphere of the board rooms of the multinationals.

To overcome the debilitating debt crisis, India approached the IMF for a bailout. But the IMF and World Bank laid down conditions. Earlier, the policy was quiet persuasion to go for liberalization. Many countries had started defaulting on existing loans given in the 1960s and 1970s.

This time around, they agreed to give the money, provided India opened its doors to investments from outside. The Asian Development Bank agreed to provide a loan under the heading, Hydrocarbon Sector Program Loan. It had 26 conditions (covenants) attached to it.

On January 24, 1992, the government appointed the Kaul Committee to examine all aspects of ONGC. P.K. Kaul was the cabinet secretary to the Government of India. Dr R.K. Pachauri and Dr C.R. Jagannathan were the other members of the committee. Subsequently, Dr Bhagwan Sahay was appointed as the Secretary to the Committee.

One of the salient suggestions of Kaul committee was to turn the Commission into a Corporation to give it more autonomy and access to the funds from the market. The other significant suggestion was the establishment of the Directorate General of Hydrocarbons (DGH) to oversee the operations of the upstream sector.

In another move, ONGC was asked not to buy any more rigs, supply vessels and seismic vessels. Outsourcing rigs and operating crew became the norm. It was not a new phenomenon. During the explosive growth of Mumbai High, it had seen the entry of rigs on contract. In no time, the Arabian Sea was abuzz with almost two dozen chartered rigs.

L.L. Bhandari, Member (Drilling), took over from S.L. Khosla on September 30, 1992 as Chairman-in-charge. Khosla had affected the pay revision of the employees in 1992. It was to be implemented retrospectively from 1987. He had taken the combined beating from every quarter in that troubled period in the Commission's history.

Bhandari, of the 1956 batch, was a complete geologist. He had been sent to Mumbai to be the project manager in 1974. He was one of the few lucky ones to have witnessed the first oil strike on February 19, 1974. He was bestowed with the Shiromani award by the President of India in 1986, "for having risen to one of the highest positions in the Oil and Natural Gas Commission by virtue of hard work, sincerity and dedication, for his matchless contribution in the field of exploration for oil and gas in the country."

Bhandari retired after a stint at the top for four months, handing over charge to S.K. Manglik. As Member (Technical), Manglik had been working tirelessly to bring back Mumbai High, Gandhar and K-G and Cauvery on line. In fact, Manglik was the only serving ONGCian to have risen to the top. Both B.S. Negi and L.L. Bhandari were Chairmen in charge.

He had joined as a drilling assistant in 1958. His incisive engineering mind had helped the Commission in having a self-reliant production department. He was a workaholic who believed in getting things done. He was involved in setting up India's first cryogenic LPG Plant in Uran, the first gas sweetening palnt in Hazira and the sour gas EPS in the south.

CORPORATE IDENTITY

On June 23, 1993, the Oil and Natural Gas Corporation Limited was formed under the Companies Act, 1956. A Parliament Act, titled Oil and Natural Gas Commission (Transfer of Undertaking and Repeal) Act, 1993 was passed on September 4, 1993. S.K. Manglik became the first Chairman and Management Director of the Corporation.

Section 11 (2) of the Oil and Natural Gas Commission Act, 1993 provided that the Corporation shall so far, as may be, comply with the provisions of sections 22 and 23 of the repealed Act for the purpose relating to annual accounts of the Commission. Those two sections were incorporated to enable the Corporation to prepare annual reports, accounts and their audit by the Comptroller and Auditor General of India and the submission of the same to the Central Government for laying before the Houses of Parliament. The government remained the largest shareholder of the Corporation.

Its Mission: To stimulate, continue and accelerate exploratory efforts to develop and maximize the contribution of hydrocarbons to the economy of the country.

Its objectives:

- Optimize production of hydrocarbons.
- Self-reliance in technology.
- Promoting indigenous efforts in oil and gas-related equipment, materials and services.
- Assist in conservation of hydrocarbons, more efficient use of energy and development of alternate sources of energy.
- Environment protection.
- Generate adequate resources for reinvestment.
- Develop scientifically oriented and technically competent human resource through motivation and training.

As a good omen, the year also marked the ONGC's first turnaround after three agonizing years.

The Corporation and its workforce had just about managed to cross the threshold. The net profit had gone down to Rs. 7.88 billion in 1992-93. The year 1994 had seen it inching upward. The price for indigenous crude was increased in a phased manner from Rs. 967.85 per metric ton to Rs. 1741 per metric ton in 1994. That had also helped.

The other redeeming factor was the increase in production. Crude production, including condensate, was 31.64 MMT in 1995-1996. That was the last year of the tenure of S.K. Manglik. In the preceding year, Manglik had raised the output from 24.22 MMT to 29.11 MMT, a jump of nearly 5 MMT. It was an impressive achievement by any standard. That period had seen some hectic activities in the Mumbai Offshore area.

The less prolific L-II development was taken up on a priority basis. The Neelam field development and a new trunk pipeline from ICP platform to Heera were completed. D.P. Bansal, Director (Operations) and later A.S. Soni, and Ishwari Dutt, Director (Technical) took lead in installing five large process platforms, NLP, NLW, NQP, SHG and SHW. An accelerated program for exploration was undertaken to add reserves. It was definitely a turnaround for the Corporation. The government decided to cash in on the positive results. It was decided to disinvest a small portion of the government holding.

ONGC's share capital after its conversion into a corporation was Rs. 150 billion. At a face value of Rs. 10 each, the total number of shares was 15 billion. The government wanted to divest 2% of its share to domestic financial institutions. Accordingly, in October, 1994, the shares were divested at Rs. 1533 per share.

The employees were also hoping for shares in the Corporation. But in some quarters, rumours were floated that this was not possible. The unions and the ASTO were incensed. They threatened a prolonged agitation and lobbied in the political quarters. Things started moving. Another 2% of shares would be given to employees. With bonus share declaration to the tune of 3.08:1, the price was pegged at Rs. 270 per share. Each employee had to arrange almost Rs. 45,000 to buy the shares.

The people who worked in offices went through the process of share allotment but a problem arose vis a vis those who were performing 14 days on and off duty. Manglik sent strict instructions: not a single employee was to be left out.

Mohite, a roustabout, didn't understand what the excitement was all about. His controlling officer called him at home, asked him to come to office for filling up the share form. He didn't come, afraid that the boss was angry. A person was sent to fetch him from his house; he still refused to sign on the dotted line. Mohite then got his educated brother-in-law to convince him to sign on the share allotment form. Persons staying in some remote villages, towns and cities all over India were tracked. Unions and the ASTO arranged for soft loans from banks to buy the shares.

Soon, it was done. Every employee had a small stake in the company: 612 shares each.

THE PLOT THICKENS

Buoyed by the rising crude oil price, the multinationals had renewed interest in India for better returns. The fourth round of bidding in 1990 had introduced a new element: Indian partners could form joint ventures with multinational to bid for blocks.

Consumer durables giant Videocon and textiles giant Reliance had tied up with multinationals to enter the oil business. For manpower, they didn't have to look far. ONGC had spent millions of rupees to train its manpower from scratch. Some of them had retired. They had the domain knowledge about potentialities of the fields. The new players simply lapped them up.

But exploration in difficult areas got a setback when the oil price dropped as fast as it had risen. The war in Kuwait was over in a matter of weeks. Oil prices came down.

The small and marginal fields became uneconomical. Tthe inexorable pressure from donor banks to give participatory interest in producing fields was too much to withstand. With a greater enticement, it was thought that the companies might bring in the vital foreign exchange to explore in difficult areas like deep waters and Himalayan foreland basins.

ONGC, with the retention concept of profit, was able to give full attention to one region at a time. In the 1960s, it was Gujarat and Assam; the whole of 1970s and 80s saw Mumbai High development.

Another factor was the presence of over 60% of the prognosticated reserves in deeper waters. By 1990, India had a prognosticated reserve of 21.3 billion tonnes of O + OEG, 40% in on-land sedimentary basins. Only 5.32 billion had been turned to geological reserves. Prognosticated reserves were like the intangible capital; geological reserves were like hard cash.

In an unexpected move, five medium-sized fields were awarded to the multinational combine for exploitation rights in August 1992.

Five producing fields, Panna, Mukta, South Tapti, Mid Tapti, were awarded to a consortium of Enron and Reliance. A Production Sharing Contract was signed on December 22, 1994. ONGC had a 40% participating interest in the joint venture.

Many ONGC employees packed up their bags and left. Some of the key personnel were offered sky high packages and recruited in Enron and Reliance. ONGC couldn't stop the poaching. It had to abide by Bureau of Public Enterprises guideline as far as personnel remuneration was concerned.

Ravva was discovered in 1988. ONGC had drilled thirty wells to delineate the structure. It was in very shallow waters, almost adjoining the coast. P.K. Chandra, as Vice-Chairman, advised to locate the process platform stand on the coast, to reduce the cost. The unmanned platforms were in the sea. The wells were producing 1,000 tonnes per day. Command Petroleum and Videocon combine were awarded the field in 1994. ONGC was again left with 40% as sleeping partner.

In the annual report of 1994-95, the liabilities were enumerated: 'As per the terms of production sharing contracts, the Company's right to reserves in these fields has been reduced to 40 percent and remaining 60 percent vests with the joint venture partners. The Company has not been fully compensated for the past costs incurred on these fields.' The cost incurred was a whopping Rs. 66.31 billion. Moreover, the control and possession of those assets were no longer with the Company for the next 25 years.

The discovery of Mumbai High field had restored to ONGC its sense of direction and purpose. The largest oilfield dominated the oil map of India and at its peak produced 400,000 barrels per day. About 60% of oil production in the country was from this single field. The production came down gradually to 2,30,000 barrels per day in 1993 as a number of wells were shut down for repair and maintenance. The reduction in production had considerably pushed the import bill.

Many multinational companies and the World Bank thought that this was the perfect opportunity to break ONGC's swagger. There was unwarranted advice from all quarters. One multinational company Occidental (Oxy) took its enthusiasm too far. The government received an unsolicited offer from this company which claimed that it would obtain an additional production of about 500 million barrels of oil over and above what had been projected by ONGC by the year 2023. The company proposed to achieve that by an additional investment of about USD 2.5 billion.

The fallout of the unsolicited offer was that letters of invitation were sent to 31 shortlisted international oil companies from July to October 1993. Petroconsultant- MAI Ltd, Geneva, was engaged to prepare a broad guideline for the participants, which included criteria for evaluation of various bids. Of the 31 companies invited, only five companies, Occidental, Chevron, AMOCO, ARCO and TOTAL submitted their preliminary proposals. The proposals were evaluated by a multi-disciplinary team from ONGC. The government appointed Dr A.B. Dasgupta (December 1994) and other eminent personalities to review the proposals and give their considered opinion.

S. Ramanathan questioned Oxy's claim of an additional recovery of 500 million barrels with reference to the base case profile indicated by ONGC. "It is not clear how any production profile for next twenty years could be indicated without the latest simulation study." He recalled a similar situation that had existed in the 1980s when CFP, the consulting company for the development of Mumbai High, came up with a suggestion to assist ONGC in the management of the field and share the profit of incremental oil. At that time ONGC categorically refused the offer. "Unfortunately, though the situation is similar today, the handling has been different. In fact there is helplessness all round," he wrote in *The Times of India.*

Dr Hari Narain, too, joined the public campaign to pooh-pooh the suggestion that overproduction from the Mumbai High fields resulted in a number of sick wells and permanent damage to the reservoir: "Overproduction temporarily from some of the fields or wells to meet production commitments is an accepted industrial practice."

Dr K. Narayanan wrote to A.B. Dasgupta: "The government, in any case, must seriously evaluate whether India should buy back her own oil, now available at cost of production, at an inflated price (which is currently USD 17/ bbl). Because that would be the sole consequence of any joint venture in the case of highly profitable fields like Mumbai High... On general principles, it does not make any economic sense to bring in any new partners once a major oil field has been profitably fully developed."

The Mumbai High field was about to be handed on a silver platter to one of the multinationals, when the concerned file reached the desk of B.L. Ahuja, Director (Finance). In a strongly worded five-page note, he registered his opposition: "I am unable to decipher for whose interest the committee has recommended that Mumbai High should go to someone else. If it was neither in the interest of ONGC nor in the interest of the country, then this is done in whose interest?"

Although he knew he was sailing too near the wind, Ahuja informed the Association of Scientific and Technical Officers (ASTO) and waited with bated breath: "At that time, I genuinely thought that it was the only way Mumbai High could be saved." As expected, the ASTO, unions and others raised a furore over the proposed sell-off. Mumbai High stayed on with ONGC.

The people who had toiled all their lives in these oil fields didn't give up so easily. ONGC managed to avert another identity crisis.

PART EIGHT

SLOGGING MILES

KALEIDOSCOPIC VIEW

Manglik retired at the end of March 1995. He had steered the company through troubled times with patience and perseverance.

Till the last minute, Manglik didn't know who his successor was. And K.K. Kapur, the C&MD of GAIL, also didn't have any inkling of the offer coming his way. In a surprise move, Kapur was asked to take over from Manglik, in addition to his assignment at GAIL. Kapur also held the additional responsibility of finance at GAIL.

Kapur was associated with the public sector from a very early stage. He had joined as a management trainee in Steel Authority Of India, Ltd (SAIL) in 1960. In 1984, after GAIL was formed, he joined as Director (Finance). With the passage of time, he had risen to the rank of C&MD of GAIL.

With three high-profile responsibilities, he used to divide his working time between GAIL and ONGC. He spent his time in ONGC studying the organizational structure and tried to work out a solution. He didn't like many facets of the organization but he admired ONGC for having set up exceptionally good R&D institutes, which very few oil companies did.

He was surprised at the responsibilities of the C&MD who had to spend a major portion of his time clearing files of those going abroad or attending to vigilance cases.

In fact, vigilance cases were building up into huge hurdles. The most satisfying moment of Kapur's stay in ONGC was the case of a junior officer who was found to have been falsely implicated in a vigilance case. It concerned the non-utilisation of a platform in Mumbai High. The case had been dragging on for years. Kapur had a gut feeling that a junior officer couldn't have had the powers to subvert the system. After weighing all the pros and cons, he decided to close the case for ever.

Kapur requested the then Petroleum Secretary, Dr Vijay L. Kelkar, to help in restructuring the organization. Both felt that an organization with 40,000 employees could not operate as a monolithic entity. Dr Kelkar, an economist by profession and widely respected for his pragmatic views, gave the go-ahead.

Kapur, in his short stint, asked each unit to prepare its own profit and loss account. Each unit would be judged, rewarded and punished by its performance. He wanted the drilling services to be delinked from the organization. With one fourth of the organization involved in drilling services, its performance had to be judged from its efficiency, Kapur reasoned. The drilling service was also envisaged to go abroad and provide services in other countries as well.

Coming from a gas marketing organization, he was surprised at the functioning of the steering committee to decide the purchases of the company. At that time, a steering committee existed with government appointed nominees on its board. He strongly protested the lack of faith in the company to make its own purchases. He felt very strongly about the structure of the committee because GAIL never had any such procedure. He had insisted on ONGC having its own powers to make purchases without the intervention of government nominees.

He had very little time left to roll out the proposed restructuring. Exactly after 116 days at the helm, he handed over charge to B.C. Bora, the new C&MD. He pleaded with Bora to undertake restructuring at the earliest date possible.

Bora had come in at a very critical juncture in the company's history. He fought off each threat with resilience, never letting the ordinary worker feel threatened.

TURBULENT TIMES

With a gentle face, Bora had an excellent track record as the C&MD of OIL. He used to bring a serene atmosphere to the board room. Whenever anyone interacted with him, the person went back with a sense of gratitude. He could overwhelm the toughest opponent with reasoning and patience. Like B.S. Negi, he could wear down the opposition with measured answers and strategic moves.

ONGC would need all these qualities to survive one of the most turbulent times in history. In one of his New Year messages, he urged the employees to bring in "synergy" in every form of activity. But the worries surfaced again.

Production levels were again showing signs of a fatigue. The biggest setback was in case of the Neelam field. It was producing a healthy 90,000 barrels a day up to 1994. Then, the reservoir started behaving erratically. The downslide began in 1995, and kept on going down. To add to the worries, production from on-land wells showed increasing signs of sickness. As a result, the production fell down from 30 MMT in 1995 to 28 MMT in 1996.

The government appointed a committee headed by Dr K. Narayanan to look at the reservoir health of Mumbai High. Dr Narayanan had grown up with the organization. He had joined as an apprentice geologist in 1956. He had grown in stature as an eminent petroleum geologist too and was on the Oil Advisory Body. The broad recommendations of the expert committee were adopted by ONGC.

ONGC hired Gaffeine Cline and Associates, USA for reservoir description and modeling. Dr Robert Lane, a world renowned polymer gel specialist, was hired for the application of polymer gel technology. Narayanan advised that drilling be skipped in certain areas and immediate closure of 25 wells. In addition, ONGC was asked not to commit any more gas to its customers.

The committee had asked for computerization of data with adequate back-up hardware and software. ONGC started taking steps to bring all the exploration and production data under one platform. That was the genesis of EPINET (Exploration and Production Information Network).

In 1999, ONGC-GCA launched the first field experiment by installing a 16-slot and fit-for-purpose ZA platform. It involved drilling of high technology horizontal and extended reach drilling. The successful experiment pointed towards the future course of action as a benchmark in cost reduction and high well oil production.

An Accelerated Exploration program was launched. Deep water exploration became the focus of the company. A team led by the Director (Drilling), S.M. Malhotra, went on a tour of major oil business centres to scout for deep water drilling rigs. At that time, the oil industry had woken up to the potential of deep sea reserves. There was a tremendous demand for deep water drilling rigs. Meanwhile, one of the strongest storms hit Mumbai High.

For people working on hundreds of platforms and rigs in Mumbai High, those three days were the worst experience of a lifetime. Even the storm calculations done for a 100-year period, in 1974, had not anticipated the storm that lashed Mumbai High in June, 1996. Platforms were damaged, people were left stranded on un-manned platforms without food and water, and jack-up drilling units suffered from burst tanks and tilted legs.

The floating drilling rig, Sagar Vijay, was extensively damaged. The ONGC board took a major decision in the aftermath of the storm. It decided to upgrade Vijay for deeper water drilling. Vijay at that time had a capability of operation up to 300 metres water depth. After the storm, it was towed to Mumbai harbour. It was up-graded to 900 metres water depth capability at the Cochin Shipyard Limited. The first deep water well CDW-1A, with a water depth of 771 meters, was drilled in the PY structure of Cauvery basin in 1998.

Dr Vijay L. Kelkar knew the problems facing the oil industry. In the Loveraj Kumar memorial lecture given in 1996, he outlined the basic changes needed to guide India's oil policy for the next century. He was for complete de-regulation of the petroleum sector: upstream and downstream. He suggested the abolition of the Administered Price Mechanism as it had led to the 'dieselisation' of the economy. The subsidized diesel prices had made useful and environment-friendly fuel like gas less attractive. He firmly believed that the 21st century would belong to gas.

Earlier, the government had appointed a Group of Ministers (GoM) to study the possibilities of restructuring the oil sector. Known as the R committee, it was headed by Dr Kelkar.

The R committee based its findings on the Sundararajan Committee set up earlier to conduct a study on the Market Determined Price Mechanism (MDPM).

U. Sundararajan was the C&MD of Bharat Petroleum Corporation Limited. He gave a complete report on the lacunae facing the oil industry in India and the urgent need for reforms, which was called 'Hydrocarbon Vision-2010, Meeting the Challenges'.

Some of the key observations of the Sundararajan committee were very comprehensive. The report gave a broad outline of the MDPM and the ways to go about it. Apart from the pricing structure, it suggested a major restructuring of ONGC and OIL, empowering them to take independent decisions.

Sundararajan wrote: "Since both ONGC and OIL are in the public sector, there is conflict between autonomy required for efficient operations vis-à-vis the control requirements given the accountability to the Parliament. If ONGC and OIL are to play a major role in this high tech field towards meeting the demands of the country, they need to have more autonomy and flexibility to operate on commercial lines; privatization of these companies is an option that may be considered for achieving this.

"Another option could be for the Government to retain 40% of the equity in these companies and disinvest 11% to Indian Financial Institutions. With this arrangement, the Government and its bodies will hold 51% equity thereby retaining control over the PSUs. The balance could be disinvested to the public...

"However, as per the covenant to one of the Yen loans availed by ONGC, the government shareholding should not fall below 80%. This matter needs to be taken up with the concerned financial institution for alteration of the covenant. In the event that the deletion of the covenant is not acceptable, the Government may consider utilizing the huge foreign exchange reserves to repay the loan, more so, due to the appreciating value of the Yen.

"In the transition time, it is recommended that the Board may be delegated full powers to decide on all investment decisions without any cap on the expenditure, subject to the conditions that the companies will not seek any budgetary support and that the project has been evaluated by a merchant banker.

"In addition to the core E&P activities, ONGC and OIL also perform, for historical reasons, several non-core activities like geophysical data acquisitions, data processing, drilling, mud services, logging services, cementing, work-over operations, logistics, well simulations and wireline services. As per international practice, these non core activities can be more efficiently carried out through third party contracts, thereby not only saving time and money, but also facilitating greater focus on core-competence areas.

"The various departments in ONGC/ OIL currently engaged in non core activities can be organized into separate subsidiary/ joint venture service companies. These companies can take contracts not only from ONGC and OIL but also from private parties within the country and abroad. This arrangement will not involve any retrenchment of the existing manpower of these organizations."

Acting on the Sundararajan committee report, the R panel suggested major changes like dismantling of APM and price reforms. It also strongly advocated the empowerment of Oil PSUs to give them more flexibility, including permission to get into downstream business.

The government brought out a notification in November 1997. It announced the phased dismantling of APM from 1998. Gradual parity with international oil price was to be achieved and ONGC and OIL paid accordingly. To protect the consumers from initial shocks, the reforms were to be spread out over four years.

To help the public sector compete with the best, a 'Navaratna (Nine jewels)' package was announced. In 1997, ONGC was one of the nine premier public sector entities to get enhanced powers and authority to make decisions for its growth. The limit on CAPEX (Capital Expenditure) was removed. But it would still need government permission for any new business.

Nevertheless, it was a big boost and a bigger responsibility for the ONGC board to take the company forward.

To attract foreign investors into oil exploration, the government announced New Exploration Licensing Policy (NELP) in 1997-98. It was aimed at providing a level playing field to all players in the exploration business.

For ONGC, NELP offered a mixed bag of opportunities. For any new oil find under NELP, the operator was promised total parity with international price. There would be no cess on crude oil production. Royalty rates were lowered. There was a seven-year tax holiday from the commencement of production. The DGH was appointed as the regulating authority to auction the blocks. NELP was formally launched in January 1999.

Petroleum Minister Ram Naik went on road shows across the world to attract foreign players into the exploration business. But domestic reserve accretion was falling beyond expectations. The ninth plan (1997-2002) had a target of reserve accretion to the tune of 862 MMT. But the first three years of the plan saw a meagre addition of 139.83 MMT. The government was obviously worried. It needed an intervention from the top.

Prime Minister Atal Behari Vajpayee appointed a GoM to draw up a specific framework for developing the hydrocarbon sector over the next 25 years. The hydrocarbon Vision-2025 was announced in March, 2000. It envisaged intensive exploration in frontier basins, more equity oil from abroad and deep water thrust among other energy security issues. The PSUs were proposed to be strengthened through internal restructuring, mergers and alliances and a phased program of disinvestment.

The rules were very liberal if one could find new oil. ONGC had to compete with other players to bid for blocks.

INTROSPECTION

With so many policy changes, Bora knew the company needed a reorganization to compete with the best in the business. ONGC appointed the international consultancy firm, McKinsey, to undertake a major revamp of the systems and procedures. McKinsey undertook the study with a team of officers from ONGC. It was called Organization Transformation Project (OTP).

Bora enunciated the purpose of the study: "To develop a shared vision and to provide strategic direction for sustained growth to bring in cultural change for commercial awareness and approach to redesign key processes for improving overall effectiveness and efficiency and to make them flexible for adopting ever-changing environment to develop competitive edge in the core areas for becoming a global player."

The principal goals of the organization in the new era were identified as Corporate Mission, Business Strategies, Business Processes, Learning Processes and Organisational Culture.

McKinsey suggested the OTP exercise to be developed in four phases:

- Phase-I: Diagnostic assessment and setting strategic direction.
- Phase-II: Redesigning the organization structure and key business processes and setting up pilots.
- Phase-III: Implementing the changes at pilot stage and fine-tune recommendations.
- Phase-IV: Roll out implementation across the organization.

The teams were formed and Phase-I was launched.

But the company was again in the eye of a storm. Oil production kept decreasing from 30 MMT in 1995 to 26.11 MMT in 1997. To make matters worse, some of the major secondary recovery projects were awaiting government approval.

The manpower scenario had entered a blind alley too. Director (Personnel) Jauhari Lal admitted to a serious flaw in R&P policies. The policies, formulated by T.N. Seshan in 1980, had undergone several changes over two decades. A few court cases had set off a chain of anomalies, one of which had resulted in a carpenter becoming a senior engineer. It had left some of the best technicians in the lurch; they didn't know where they belonged. The middle management had grown beyond permissible limits.

Despite the anomalies, the pay revision due from 1992 was carried out. This time, there was a policy shift. The duration of the pay revision period was increased from five to ten years. The management decided to go for a comprehensive overhaul of the existing R&P policies. In spite of the remedial measures, the pressure on the organization was increasing by the day.

Bora fought a heroic battle to keep his flock together. With falling production, the enhancement of price for domestic crude came as a welcome and timely breather. ONGC retained its position as No.1 public sector Company in the country. A major revamp of systems was launched. OVL started scouting for new business in foreign countries.

NEW EXPERIENCES

ONGC, after Iraq and Tanzania, went on to undertake drilling in foreign countries. A major confidence boost came in the form of drilling contracts in Bangladesh and Oman. The ONGC crew did exceedingly well. The second drill ship, Sagar Bhushan, drilled for Vaalco Energy in the PY field in south. The experience as a contractor was an eye-opener. Sagar Bhushan learnt important lessons in safety management from the international major.

Meanwhile, there were major blow-outs in the gas fields of the Krishna-Godavari basin in Andhra Pradesh and in Mumbai Offshore.

On January 8, 1995, the evening sky turned orange as a result of a blow-out in well # Pasarlapudi-19, part of the biggest onland discovery of the K-G Basin. The escaping gas caught fire. It took almost 65 days of concerted effort, again by the Red Adair fire-fighting company, to douse the fire. The rig was lost. It was a crucial lesson for the Crisis Management Team of ONGC. Bora, with his board of directors, virtually camped at the site to take charge of the operations.

The blow-out at Pasarlapudi was termed as the seventh biggest blowout in the world. The gas wrought havoc in the nearby villages and was a major environmental threat. Artificial clouds formed; human beings and livestock were affected.

There were more mishaps in store. Two other major blowouts took place, one in Mandapeta in K-G Basin and the other in B-121 Platform in Mumbai Offshore.

The well control school came up at IDT. S.M. Malhotra asked V.P. Mahawar, a drilling engineer of the crisis management team, to organize the school. Tying up with International Well Control Forum (IWCF), the Institute, in no time, became a hallmark of excellence. No ONGC driller was allowed to enter a drilling rig unless he passed the stringent tests at the school.

Quality, Health, Safety and Environment (QHSE) became real-time issues. Projects were launched to increase awareness and devise new systems to treat effluents and gases.

REMEDIAL MEASURES

As per the recommendation of McKinsey, two pilot projects were launched: one in the Neelam field of Mumbai Offshore in January, 1998 and the other in the western onshore oil fields in April 1999. Kharak Singh was made the Chief General Manager of the Neelam Pilot project under OTP. Nathu Lal was the Implementation Manager for the western onshore fields.

The initial results from the pilot projects were encouraging. The declining trend of the Neelam field was arrested and a constant production level could be maintained.

In the renamed Western Onshore Business Unit (WOBU), the exercise was a very tough one. Bora had to conduct scores of meeting to allay the fears in the minds of people. There were marked improvements in certain areas. A new field, Akholjuni, was discovered in the Cambay Basin. It infused a new life into the otherwise ageing Basin.

But certain problems cropped up. The duality in the organizational structure created a lot of confusion. People identified themselves with the old structure more readily because the BDP, HR and CDA rules were unchanged. The limited financial empowerment was a major handicap, too.

Bora answered the critics by formulating a blueprint for re-development of Mumbai High. A comprehensive 3-D seismic survey was launched. It was one of the biggest data Acquisition, Processing and Interpretation (API) exercises. A new establishment, Seismic Processing and Interpretation Centre (SPIC), was set up at Panvel for seismic data interpretation. In those difficult times, S. Srinivasan, T.K.N. Gopalaswamy and Y.B. Sinha, all Directors (Exploration) at different times, led the exploration drive.

The Mumbai High North redevelopment was approved in December 2000. It was launched on January 12, 2001. It envisaged drilling of 73 in-fill development wells over a period of five years from four new well platforms, 15 clamp-on structures with an estimated capital investment of Rs. 29.29 billion. On successful implementation, Mumbai High North field is expected to yield additional 24.8 MMT oil and 5.24 BCM gas by 2030.

In Gujarat, the pioneering work by IRS in the Enhanced Oil Recovery (EOR) and Improved Oil Recovery (IOR) techniques to get heavy oil from the north oil fields had reached a critical state. The pilot projects, involving in-situ combustion and polymer flooding, were started in the mid-80s. It had proved to be successful, making ONGC one of the few companies in the world to have an in-house capability. But the projects needed huge investments requiring government permission. It had to wait for some more time.

At deeper levels, methane gas is formed and stored inside the coal seams. Methane was treated as a nuisance and safety hazard in the earlier days. Col. Wahi had initiated a conceptualization study in 1987-88. Coal Bed Methane (CBM) got a re-look as an alternate measure. A rig, in disuse, was mobilized from Assam to do preliminary drilling.

In the early 1990s, the changed circumstances led scientists to reject the methane option. But the Hydrocarbon Vision-2025 had chosen CBM as an alternate source of energy. ONGC chose to have another go with the available resources as the policy for CBM evolved.

Between 1995 and 1997, two wells were drilled in the Durgapur area of West Bengal. The results were not encouraging. In 1997, the first breakthrough was achieved when the first well in Jharia, Bihar, flowed methane. India was on the CBM map of the world. Subsequently, KDMIPE was chosen as the nodal agency for data generation and analysis.

In 1999, Dr A.K. Balyan, General Manager, was asked to initiate the drilling of three R&D wells in the Parbatpur sector of the Jharia coalfields. Methane didn't flow on its own. It needed an artificial lift mechanism to bring it to the surface. It was a tough exercise to mobilize the wherewithal from all work centres of ONGC. But it was done with enterprise and innovation. The discovery underlined the urgency in firming up a policy framework for CBM.

Then, the company turned its eyes towards business process integration. It engaged PricewaterhouseCoopers to design a financial system on the SAP R3 platform. It was named UFSO (Up-gradation of Financial Systems Organisation). On the HR front, a similar SAP based system was designed by SISL, an IT solution provider. It was named SHRAMIK (System of Human Resource Automated Management Information for Kaizen). On the materials management front, Project IMMS (Integrated Material Management Systems) was launched. In a matter of two decades, from 1980 onwards, successive members of finance, V. Ramanujachari, S.B. Kabra, G.C. Raghubir, M.C. Nawalakha, B.L. Ahuja, I.N. Chaterjee and R.S. Sharma, made significant contributions in fiscal management. During Chaterjee's tenure, ONGC changed from a Commission to a Company, and had to compete with private companies from India and abroad. Commercial considerations became important. Keeping this in mind, Chaterjee took a decision to induct finance professionals at all levels of the organization to encourage professional decision making.

As the slew of measures got off the conceptualization stage, it was time for the battle-hardened Bora to hand over the baton to a new chairman.

Bora had ensured that the Corporation had emerged from the morass it found itself in. In fact, as early as 1998, he had written to all sections to wake up to new realities.

While addressing a national seminar on 'Energy Sources, Production, Demand, Consumption and Projection for 2050 AD', Bora quoted from an article published in Time magazine titled "Next 500 years" which had some mind-boggling predictions: "In 2005, active contact lens linked to the internet will enable the wearer to surf without even opening the eyes; in 2015, genetic roots of all diseases would be identified; in 2500 AD, the average life of a human being will go up from 78 to 140 years."

He urged everyone to wake up to the new reality of liberalistaion, technology and innovative breakthroughs.

PART NINE

THE SURGE FORWARD

NEW BRAND EQUITY

On May 25, 2001, Bora handed over the baton to Subir Raha. They were not unknown to each other. Just a year earlier, Raha had joined ONGC board as IOC's nominee.

Raha epitomized the spirit of adventure, innovation and camaraderie that has been the hallmark of ONGCians since the beginning. Once, as part-time director, he had wanted to visit an offshore installation in Mumbai High. It was probably the best way for him to guage the company, by being close to the people who took out that crucial barrel of oil from miles below.

In IOC, Raha's responsibilities included human resources, business development, information systems and corporate communications. At one point of time, he was also Director (Marketing). Raha was also instrumental in formulating the Corporate Vision and the changed mission of IOC.

He had designed the country's first computerized and automated product terminals in IOC's northern region. He had also won the fight of his life to convince people about a proposed change in LPG bottle design. The stint at Oil Coordination Committee (OCC) had armed Raha with knowledge about the intricacies of oil pricing structure.

When he took over the reins of ONGC, the organization was not exactly in the pink of health. The days of easy oil were long gone and the company had on its hands a clutch of ageing oil fields and worn-out equipment. Private players, Indian and foreign, had already entered the fray in a very aggressive way with newer technologies. Competition was the buzzword. ONGC had established geological reserves of six billion tonnes. Intensive deepwater exploration had become a reality and the challenge was to go deeper.

In 2000-2001, the combined oil production from onshore and offshore fields was 25.06 MMT, and gas production was around 24 BCM. International crude price had shot up to USD 22 in April 1996 and remained within the USD 22-23 price range in 1996-97. Oil import bill was growing bigger by the day, and the pressure to increase production was building up. The image of the company had taken a beating. It was the No.1 public sector undertaking in the country. But its market capitalization was nowhere near its real potential. A decade of uncertainty had a demoralizing effect on the work force. The middle age syndrome had perhaps caught up with it. ONGC needed rejuvenation and a brand new makeover.

Raha's plan was simple: direct action.

THE LONG HAUL

In a series of strategic meetings and conclaves involving early pioneers, policy makers, current leadership at the top and middle management level, the vision, the objectives and the strategies were clearly formulated.

Armed with the knowledge of the intricacies, strengths and weaknesses of the organization, Raha called for a strategic meeting to decide on the future. He realized that it was time for consolidation and clarity of vision before ONGC entered the global oil scenario in a big way. For the long haul, a strategic vision was chalked out. Consolidation of systems was taken up and the redevelopment of Mumbai High was given the highest priority.

On July 7, 2001, plans were made to achieve certain targets. The imposing Jaypee Manor hotel in Barlowganj in Mussoorie saw a stream of oilmen getting out of their cars, and getting into a huddle. They were there to chalk out the future of ONGC. It was a question of survival. V.N. Kaul, Secretary, Ministry of Petroleum and Natural Gas was there. So was Joint Secretary Jayant Mauskar and Dr Avinash Chandra, Director DGH. M.S. Ramachandran, Director (Planning and Business Development) IOC were also invited.

There was an intense debate. They knew the oil business. It took some time to reach a common objective. Four issues emerged: exploration strategy, organisational transformation project, empowerment and ONGC Videsh Limited.

The usual process was reversed. Everything was worked out to the minute details. First, the goals were established. Next, the ways to achieve the goal were quantified. A time frame was fixed. The Navaratna status had given extra powers to the Company. Power had to be delegated down to the last man in the chain of hierarchy. The OTP would be rolled out in one go across the organisation. The delegation of power and authority was the key turning point. That was the quintessence of the re-christened Corporate Rejuvenation Campaign (CRC).

Exploration strategy was devised to get new oil. It had taken forty years to establish six billion tonnes of reserves. The next six billion tonnes had to be accreted in 20 years, cutting the time frame by half. Exploration strategy was laid out to get new oil and gas from domestic and overseas ventures and enhance recovery factor.

The three goals were clearly enumerated:

- To double accretion of initial in-place hydrocarbons from 6 billion tonnes to 12 billion tonnes by 2020.

- Improve global recovery factor from 28% to 40 % by 2020.
- Generate 20 MMT per annum equity oil and oil equivalent of gas from overseas by 2020 through OVL.

That was the Corporate Vision-2020 with three priorities: benchmark systems and processes to global standards; focus on the core business of oil exploration and production; risk mitigation, long-term priority.

The next few years saw a slew of Mergers (mind, business process, data acquisition, technology) and Acquisitions (new business through assetization of money, incremental value from old properties by monetising assets) to start a real rejuvenation campaign.

One hundred and ten officers from the 1975-76 batches of graduate trainees planned a re-union. They were the next generation of leaders of the company from middle to senior level executives. Most of them were not aware that the Chairman and Directors would also join them. After the formal greetings, Raha prodded them to carry out a LENS exercise. LENS, as the name suggested, was to look at oneself objectively. They were asked to identify three things if they were to be the CEO of the company. The next poser was tricky. What would be the one thing they would stop?

For the first poser, suggestions came thick and fast. After consensus, certain critical observations were short-listed: enhance the reserves; build pride in ONGC; replace old equipment; decide on OTP; cut delays in decision-making; promote only against vacancies; inculcate accountability; improve internal communications; improve discipline; rationalize systems and procedures; create technology advantage; change organizational culture; make strategic plans; go for wildcat drilling; reduce retirement age; introduce VRS; reduce costs; check quality of exploration; delegate authority; globalize the business; step up production; check corruption; review all HRD processes; and so on.

Everyone then closed in on the three most important issues: focus on core business - Exploration & Production; rework HRM in all dimensions; rejuvenate Structure and Culture.

For the second poser, the issues raised were revealing: indiscipline, lack of accountability, corruption, infructuous expenditure, recruitment, compartmentalization, appeasement of collectives and undeserved promotions. It took a while to reach a consensus and three key issues emerged: check corruption, infructuous expenditure and indiscipline.

From the same brainstorming sessions, the Own Oil Recovery (OOR) concept emerged. For instance, if someone walked past a leaking diesel hose, the first action was to stop that leakage or be there till a responsible person came around. EOR/ IOR projects needed permission from the board but OOR did not.

Raha then invited the field superintendents for an open discussion. All the issues raised above were there but a critical issue that emerged was non-delegation and lack of empowerment.

Before embarking on the long journey ahead, a simple message was sent across the organisation: "You give me trust, I will give you hope."

CONSOLIDATION

The board moved to the fields. The Navaratna status had given enhanced powers to ONGC board. Raha was convinced that the empowerment had to percolate down to the field personnel. At that time, only two regions, WOBU and Neelam, were put under the OTP experiment while the rest followed the old system. Change always has its problems. If change had to be effected, he decided, it had to be in one go throughout the organisation.

The Corporation Rejuvenation Campaign (CRC) was thus rolled out on August 20, 2001. The ONGC board structure and functional responsibilities were changed. There would be six areas:

- Director (Exploration)
- Director (Finance)
- Director (Onshore)
- Director (Offshore)
- Director (Human Resources)
- Director (Technology and Field Services)

ONGC was divided into Basins, Assets and Services. Assets would focus on producing properties and maximise returns; Basins would create assets; Services, in collaboration with Institutes would provide services and state-of-art technologies to assets and basins; support services would be provided by HR, MM and Finance.

Key executives were identified to lead the work centres. The Book of Delegated Powers (BDP), HR Manual and other statutory rules were revised to meet the new thinking, where key executives were empowered depending on the assignments they were to carry out. Each key executive had to form his own virtual corporate in line with the Executive Committee (EC). The concept of Performance Contract (PC) between key executives and concerned directors and Service Level Agreement (SLA) between key executives was introduced.

The Company's focus shifted from process to result; at an individual level, the focus shifted from performance to contribution. The effectiveness of CRC rested on changing the mindset and consolidating the systems.

One of the biggest information consolidation processes was launched to keep up with the new times. Project PROMISE (Professional Review of Major Infocom Systems & Equipment) was designed to integrate the total gamut of InfoTech resources and communication systems, so that acquisition, collation, dissemination and storage data are done with maximum efficiency, security and cost-effectiveness throughout the company.

Simultaneously, Project ICE (Information Consolidation for Efficiency) was initiated to create an integrated, company-wide Enterprise Resource Planning (ERP) -based Management Information System. The project, apart from being the largest ERP under SAP in Asia, went by one maxim given by management guru, Stephen Covey: "To achieve goals you have never achieved before, you need to start doing things you have never done before."

In fact, ONGC was the first E&P Company to adopt ERP for its business processes. The premise was to have all the business processes under one platform. If the strategic goals were to be pursued vigorously, instantaneous decision making, the hallmark of any nimble footed MNC, was the most urgent need of the hour.

From the beginning, ONGC made attempts to create an information network for its operations. Johnson had ushered in a new era with the Control Room. In the mid-80s, with the growing offshore activities, Telnet and SCADA were established to communicate with platforms from the shore. The launching of IMMS and UFSO, in the late nineties, had brought about considerable integration.

On day one, A. Kaviraj moved with his team to the 15th floor of SCOPE Minar in Delhi. It was a mammoth task: 1.42 million material codes were reduced to 290,000. The job of mapping more than 200,000 of ONGC equipment with its maintenance plans was back-breaking. The entire business process was mapped minutely. It was one of the most comprehensive knowledge management exercises ever taken up. Massive computerisation drive was on with billions of bytes of data and networking across all work centres. The PC to employee ratio increased from 1: 7.37 to 1: 1.4.

The corporate rollout of ICE was done in December 2004. ICE also became a case study for the effectiveness of the empowerment given by CRC - not more than a couple of files came to ONGC board for approval.

The integration didn't stop there. The road ahead is to have a fully operational SCADA and a Geographical Information System (GIS) system. SCADA, integrated on the ICE platform, would provide instant access to varying parameters of each well, onshore and offshore. The GIS will be a smart and intelligent map, which will show the pipeline network and assets. It will show real time monitoring of movement of supply vessels and cargo.

The Exploration and Production Information Network (EPINET) launched during Bora's time, made rapid progress. It is an effort to provide the organisation wide access to a single world class validated E&P data base. EPINET has the potential to minimise non-productive time in collating data and ensure that every interpreter in ONGC, uses the same data.

CHASE EVERY MOLECULE

Raha gave a big thrust to monetising assets and assetising money. The Corporation was sitting on a huge pile of cash which was earning hardly 5% interest in banks. It was bad economics. He was of the opinion that the future generation would be left with ageing assets and lesser returns. Time was ripe for assetising the money. R.S. Sharma, Director (Finance) carried out a sweeping drive by taking some key decisions relating to tax planning, efficient treasury management, highest ever utilisation of Capital Expenditure budget and various other accounting initiatives. It resulted in ONGC obtaining a 'Nil' report from the government audit for consecutive years, 2002-03 and 2003-04. It was a big boost to ONGC's accounting policies and auditing processes.

The way out was to get the money out of banks and turn it into tangible assets. That apart, with the bottom-line looking pink, all loans from ADB, World Bank and other financial institutions were paid off and the Corporation virtually became debt-free. The strategic goal of increasing the recovery factor was vigorously pursued. Investments were turned towards monetising assets and assetising money.

Monetising assets was taken up on a priority basis. There were huge projects going on at the same time. The Mumbai High North redevelopment was in full swing. The Mumbai High South redevelopment project was sanctioned at an estimated capital outlay of Rs. 52.56 billion: it envisaged drilling of 140 in-fill development wells over a period of six years from 17 well-platforms. On completion, the field would yield an additional 35.95 MMT of oil and 9.63 BCM of gas.

The redevelopment of Mumbai High envisaged drilling hi-tech horizontal wells, multilaterals, Extended Reach Drilling (ERD) and side-tracks with non-damaging drilling fluids and low-toxicity synthetic oil based mud. One could drill and electrolog at one go (LWD); one could also drill and case the hole at the same time (Casing While Drilling). Technology had expanded in a mind-boggling way. It needed real time monitoring, minute by minute, metre by metre. These wells could cost up to Rs. 500 million. Kharak Singh, the Asset manager, termed it as one of the most ambitious programs in recent years to improve recovery.

The massive amounts deployed in the redevelopment plans of Mumbai High oil fields started showing results. It started inching upwards; in 2005, it could reach 2,70,000 barrels per day.

New experiences and realisations gave birth to a new concept. It was to be adopted in all future field development. It was called the lifecycle concept of oil fields.

A classic study was that of the oilfields of Norway which have the highest recovery rates in the world, averaging 55% in all oil wells. The reason was a prudent thought process: the optimum output is calculated beforehand; accordingly, inputs are determined and followed in principle. ONGC decided to follow that method in all new fields being brought under production.

The EOR/IOR projects were taken up on priority. They were rolled out in 15 major fields, Kalol, North Kadi, Sobhasan, Rudrasagar, Geleki, Lakwa, Heera and others with an outlay of Rs. 120 billion.

The Mehsana project, where some of the innovative methods were applied, was one of the first to show results. In the 1960s and 1970s, the Mehsana asset had won several trophies as the best-producing field but recent times had seen a downward slide. Finally in 2005, after a gap of 11 years, the 35-year-old oilfield was coaxed into reaching the target of 47,450 bopd. Soon, Ahmedabad followed with enhanced production of 35,000 bopd from its 38-year-old fields. The Ankleswar field, almost 45 years old, achieved a rate of 43,000 bopd.

Whenever crude prices go up, marginal fields become attractive. ONGC took up marginal fields like D-1 in Mumbai Offshore for development. It decided to invest up to Rs. 127 billion for marginal field development. Massive 3D seismic shooting in all the basins were launched to locate isolated pools of oil for exploitation. To put to use the enhanced knowledge base, it also took up the development of deepwater field G-1 and shallow GS-15 structure in the K-G Basin.

These two are now being developed through an 'intelligent well completion' method. D.K. Pande, Director (Exploration), terms the induction of new technologies as a vital imperative: "We have gone in for aggressive technology induction for risk mitigation. Globally proven technology has been inducted and some are under absorption while the emerging technologies are being pilot tested for induction. This is a continuous process and will continue."

There are isolated oil pools where techno-economics don't allow installation of production and process platforms. In the mid-60s, ONGC had tried to experiment with mobile production units. Now, in these difficult times, it planned to reintroduce such mobile production units, both offshore and onshore.

Monetization of assets concept was adopted in isolated gas pockets. Tripura was a classic example of gas which remained idle because of transportation and utilisation problems. Discovered in 1972, the Tripura oil wells had to be capped as there were no customers for the gas. In pursuance of its policy to chase each molecule, the gas-to-wire program was launched in Tripura. As a part of the program, the power generation was given a big push when ONGC entered into an agreement with Tripura Power Corporation for optimal use of locked-up gas. ONGC Tripura Power Corporation (OTPC) was launched to set up a 740 MW power plant using idle gas as feedstock. In addition, mobile power generators are in the offing to move to isolated gas wells for value addition.

Assetising the money was taken up simultaneously. Fifteen years before, the world had taken to deep water drilling (beyond 400 metres) in a big way. That was where the future goldmine lay. The industry had invested billions of dollars in research and development of deep water exploration equipment.

Brazil and the Gulf of Mexico had seen the maximum activity in this area. In India, 40% of undiscovered reserves lay in deeper waters. Now, ONGC was to have its own deep water campaign. It was named Sagar Samriddhi - prosperity from ocean. The project had the vision of drilling 47 deepwater wells, on the east and west coast, involving a daily expenditure of USD 0.75 million. In another innovation, the project adopted an integrated services contract: the lead contractor would be responsible for all the services.

Two rigs were hired. Transocean Sedco Forex, the leaders in deepwater drilling, came with their rig Discoverer Seven Seas. Another rig, Bedford Dolphin was hired from Dolphin Drilling Limited. The third one to join Sammriddhi was the in-house rig, Sagar Vijay, which had already made a series of discoveries on the east coast.

In the largest deep water campaign by any single operator, ONGC launched its program on November 30, 2003. The well, GKDW-A-A, was situated in the Kutch Offshore. The water depth was 1,862 metres. That marked the beginning of the journey beyond horizons. The campaign has resulted in four discoveries including the big one, Vasishtha, named after the river in Andhra Pradesh.

In July 2004, deep water drilling in India reached a high when Bedford Dolphin spudded a well in 3008 metre water depth. It became the second company in the world to drill in such great depth. U.N. Bose, Director (T&FS) termed it crossing the threshold.

Earlier, deep water drilling witnessed another dramatic moment. A.K. Mitra, who calls himself the oldest roughneck in India, checked all the systems on Discoverer Seven Seas before spudding a deep water well in the West coast. From the venerable Nat-45 to Discoverer Seven Seas drilling had come of age.

As the company got into deeper water and hi-tech wells, real time monitoring became a necessity. Worldwide, very few companies had taken to geosteering (it was like sitting in a cockpit and commanding the course that the plane or drill bit was taking). Two virtual reality centres came up: in Vasudhara Bhavan and Panvel in Mumbai. They were named the Third Eye. A.G. Pramanik, the retired chief of geophysics, put it in an easily understandable language: "The ability of professionals to walk into a data set and experience the full data in three dimensions." When S. Satyamoorthy, Deputy Comptroller and Auditor General, visited the Third Eye centre, he wrote in the visitor's book: "My third eye was opened."

On land, the promising Assam field is on the verge of having fresh capital infused, to the tune of Rs.33 billion, to increase production to 3 MMTPA. A.K. Hazarika, Director (Onshore) thinks that one has to walk that extra mile: "Recognising the challenges, it is imperative for each individual employee of this organisation to put his thinking cap on and come out with new ideas to do things differently not only in terms of adopting new technology but also to reduce the cost of operation."

To have the best-in-class systems in place, massive refurbishment and replacement of aging equipment was launched with an investment of Rs.18 billion. BHEL, which had supplied electrical drilling rigs and other components for ONGC earlier, started the refurbishment process in a phased manner. In every work centre, attention was turned to replace/repair leaking pipes, corroding equipment and other bottlenecks.

The existing tendering process was a major hindrance for projects of this magnitude. The Cost Reduction in the New Era (CRINE) concept, developed for the North Sea operations, was adopted in the tendering process. Pre-bid conferences were started with prospective vendors. In a free atmosphere, the scope of work and the specifications were discussed. After the discussions, tenders were issued leaving no room for doubts and subsequent time consuming clarifications.

As the consolidation on the home front gathered momentum, ONGC turned its eyes towards equity oil.

Equity Oil

ONGC Videsh Limited (OVL) had been struggling for the last 25 years. Started as HCI in 1965, it was Malaviya's brainchild to give India succour by getting equity oil from abroad. Acquired in the eighties, Vietnam became the first producing asset with oil and gas from the Lan Tay and Lan Do fields in 2002.

Sudan was one of the new success stories in the world of oil. The deserts of Africa and Middle East seemed to have an endless supply of oil. There was a petroleum consortium operating in Sudan. One of the operators, Talisman Energy of Canada, wanted to opt out. OVL got scent of it. And before other competitors could make the first move, OVL went into negotiations. With the government chipping in on the diplomatic front, OVL clinched the deal at USD 670 million for 25% equity.

The property with a 3 MMTA potential was acquired on March 12, 2003. The parent company Greater Nile Petroleum Operating Company (GNPOC) was a conglomeration of different nations and their oil companies. The China National Petroleum Corporation (CNPC) held 40%; Petronas of Malaysia controlled 30%; Sudan national oil agency controlled 5%; OVL got the remaining 25%. OVL formed a 100% subsidiary, ONGC Nile Ganga BV, to look after the Sudan oil operations.

ONGC took its pipeline building expertise to Sudan where its engineers completed the Sudan Pipeline Project. It connected Khartoum refinery to Port Sudan with a 741 Kilometre long 12" diameter pipeline. The project was completed in August 2005, two months ahead of schedule.

In four years, it has left footprints in 13 countries with 21 projects including Syria, Libya, Sudan, Angola, Myanmar, Vietnam and Sakhalin. In Sakhalin, Russia, OVL has made an investment of USD 1.7 billion. In 2005, it became the third producing asset of OVL and Syria became the fourth with 0.957 MMTPA of equity oil. It paid back part of its debt to the nation when it declared a maiden dividend of 35% in 2004-05. In no time, OVL evolved into the second biggest E&P Company in India next to ONGC. With an investment of Rs. 16.5 billion, it is bringing in almost 6.34 MMTPA of equity oil every year.

In further quest for equity oil, ONGC roped in the formidable Laxmi Mittal of Mittal steel fame to form a consortium, ONGC Mittal Energy Limited (OMEL). It is a joint venture between OVL (49.98%), Mittal Investments Sarl (48.02%) and State Bank of India (SBI) with the remaining 2% stake. The joint venture tasted its first success with the signing of an MOU with the Government of Nigeria, a major oil producing country, in 2005. OMEL has drawn out plans to develop infrastructure of Nigeria in the areas of Refining, Power, Railways and other capacity-building exercises.

To transport and market the crude sourced by OMEL, another joint venture, ONGC Mittal Energy Services Limited (OMESL) has been formed.

Across the Value Chain

Mangalore Refineries and Petrochemicals Limited (MRPL) had been a good business model. Situated in the busy port city of Mangalore in Karnataka, it had all the advantages of a coastal refinery. It had very reputed promoters: Aditya Birla group and HPCL.

Conceived in the 1980s, the refinery was launched in two phases. It had an initial capacity of 3.6 MMTPA and it was built with state-of-the-art machinery. It was doing well till the sector was de-licensed following the liberalisation process in the early 1990s. MRPL was soon swamped by bigger players like IOC and Reliance.

Slowly it began losing its market, its small size no longer viable in the changed market scenario. It began taking loans to sustain itself, but that proved to be counter-productive and its net worth started shrinking. One day, it fell below 50%. In no time, the company stood at the doors of BIFR.

When it was put on sale, no one would touch MRPL. In fact, the original promoters wanted to wash their hands off the project. But when the Administrative Ministry asked ONGC if it wanted to take over, Raha jumped at the idea.

People wondered at the decision. The share price of MRPL was less than Rs. five in an otherwise booming market. But when rumours floated that ONGC might be interested in the refinery, its stocks started rising.

ONGC meanwhile, was already laying the groundwork in the backroom. Vedika Bhandarkar of JP Morgan Stanley was its negotiator working on the finance part. There were 22 lenders, which included majors like ICICI and IDBI.

Vedika was awarded the IFR Asia's Debt Restructuring Advisor of the year award. And ONGC had a full fledged refinery on its hands, a dream come true after almost 50 years.

To start a greenfield refinery, one needed to pump in Rs. 10 billion for every one MMT of capacity building. A 9.69 MMT refinery would have cost Rs. 100 billion. ONGC had acquired its own refinery for just Rs. 1.4 billion.

Fresh capital was infused. The debt was restructured. ONGC pumped in Rs. 8 billion to revive the refinery. Part of its Mumbai High crude was diverted to the refinery along with its overseas crude from Sudan. Its capacity utilisation increased to almost 109% in no time.

On May 15, 2003, MRPL received the first batch of equity oil from Sudan. It was a defining moment when Deputy Prime Minister L.K. Advani, came over to witness the historic event. It was a proud moment to become the first company in India to process its own crude in its own refinery.

The green initiative of the company received a boost when it started producing HSD and MS conforming to Euro-III standards. MRPL is on a roll with a 55% Compounded Annual Growth Rate (CAGR). With a capital investment of Rs. 80 billion, MRPL is to be upgraded to a 15 MMTPA refinery with an integrated Aromatics and Olefin complex.

MRPL has set in motion plans for large petroleum and petrochemical-based projects at the Mangalore Special Economic Zone (Mangalore SEZ). It will be a Special Purpose Vehicle (SPV) with equity participation of 49% from Karnataka Industrial Areas Development Board (KIADB), Karnataka Chambers of Commerce and Industry (KCCI) and ONGC (26%) and IL&FS (51%). The projects to come up are a 10 MMT LNG terminal, C2 and C3 extraction plant, Naptha Cracker plant and a petrochemical complex. To bring in more synergy, ONGC acquired a 23% stake in the newly formed company Petronet Mangalore- Hassan- Bangalore Limited (PMHBL) pipeline project linking MRPL to Bangalore.

Soon, the acquisition and turnaround story of MRPL became a case study in management schools. With the commissioning of the Tatipaka Refinery in 2001, the Corporation cornered almost 10% of the refinery market. Tatipaka was a necessity of the times. The K-G basin was having its own problems with transportation of crude and other value added products. It used to send the crude from its marginal fields by tankers to the HPCL refinery in Visakhapatnam. One day, there was a major fire inside the complex during LPG loading. After that, HPCL refused to accept ONGC crude transported in road tankers due to safety reasons. The coastal route was not a viable solution. That was when N.K. Bose, head of Operations Business Group, Southern Region, asked P.K. Ghosh to form a multi-disciplinary team to get a mobile refinery commissioned.

A crack team was formed to get the mini-refinery-on-wheels going. Dr Ramashish Rai and his team from IOGPT, Mumbai, were roped in to help in the engineering part. They took the help of IEOT in the designing of the refinery. All this happened towards the end of the 1990s.

The refinery was commissioned in 2003 with a modest capacity of 1,500 barrels a day. The High Speed Diesel (HSD) produced was used for internal power generation for drilling and production operations. The other value added products were sold to the HPCL/ BPCL combine.

ONGC has embarked upon some of the biggest initiatives in the emerging business of gas. Gas is available all over the world. It is not concentrated like oil in the Middle East. Scientists have also developed technologically advanced ships which can carry Liquefied Natural Gas LNG (stored at minus 370 degree centigrade). When it reaches the terminal, the liquid is turned into gas again.

The joint venture company Petronet-LNG will help ONGC leap forward in this sector. Using its domain knowledge in the fractioning of gas, it is setting up an LNG plant at Dahej in Gujarat. ONGC is helping the Gujarat government launch an Exclusive Economic Zone (EEZ) with a view to setting up industries for gas utilization. LNG has all the potential of being the most versatile fuel of the 21st century.

Apart from the LNG business, ONGC is actively producing shallow gas resources. It has already started exploring the Cambay and K-G basins for tapping shallow gas. It got a major thrust with the successful testing of the well, Olpad # 26, in Cambay basin.

The other new business is clean coal technology. ONGC in the last three decades has experimented with Coal Bed Methane (CBM) and Underground Coal Gasification (UCG) and Surface Coal Gasification (SCG) and Gas Hydrates.

ONGC had drilled one well for CBM with an assembled rig in the mid-80s. In the mid-90s, the engineers experimented by drilling three R&D wells in the Parbatpur sector of Jharia coal fields in Bihar. The CBM policy was announced and ONGC bagged some prospective areas in West Bengal, Bihar and Madhya Pradesh. For risk mitigation, in some of the blocks, it tied up with IOC and CIL. Commercial production is slated to commence from 2007.

Surface Coal Gasification (SCG) is already going ahead with collaboration with Shell. At deeper horizons, UCG remains the most viable option. ONGC started UCG experiment in the coal belt of Mehsana in mid-1980s. With the findings, the scientists have honed the technique and ONGC has tied up with some of the world leaders in coal technology, USA, and the Skochinsky Institute of Mining (SIM) Russia, to exploit this vast source of energy and start the commercial production from 2008.

ONGC, with its knowledge in exploration data management, has taken the lead in gas hydrate exploration along with other agencies. It has also initiated research into extracting Helium from gas in its Kuthalam GGS in Tamil Nadu. It is an emerging technology involving gas which is very expensive and has usage in nuclear sciences and super conductivity. All these activities need knowledge to look beyond. At a depth of thousands of metres, it is the knowledge, science and technology which will make the difference.

With Administrative Ministry's permission, ONGC went full steam to set up a modern retail station on the outskirts of Mangalore.

OVaL - ONGC Values - ushered in a new era in ONGC. It was launched on March 19, 2005 at Mangalore. The retail outlet was named Relax Top. Two of the most successful chairmen of the company, Col. S.P. Wahi and Subir Raha, filled up the tank of a humble Maruti-800 belonging to the oldest employee of MRPL.

In the Golden Jubilee year, ONGC achieved total integration across the hydrocarbon value chain- Drilling to Dispensing.

CORPORATE GOVERNANCE PAYS

In today's business environment, transparency and ethics occupy a prominent place. The Corporation decided to go for independent reserves estimation on a regular basis. It appointed the international firm DeGoyler and MacNaughton to have a look at the reserves. To add more confidence, it promised the government and share-holders estimates at regular intervals. Apart from statutory disclosures, it gave out all the relevant information voluntarily. It also called the vendors to know their problems and launched a website for its tenders. It was a major departure for an oil company.

ONGC became the first corporate in India to adopt an Integrity Pact (IP) which aimed at best-in-class business ethics for customer and vendor satisfaction. IP was introduced by Transparency International (TI), an institution sponsored by the United Nations (UN). Annual vendors meets were organised so that business relationships grew and both sides come to a common ground for a common objective. The stock market responded to the new business ethics by lapping up the Corporation's 10% disinvestment of government share in 11 seconds. The biggest ever public issue amounting to Rs. 104.36 billion saw Foreign Institutional Investors (FIIs) queuing up.

In a matter of a few years, the market capitalisation has crossed the one trillion rupees mark. ONGC is a heavyweight in the Mumbai Stock Exchange (BSE) with 5% weightage. It constitutes 10% of the total SENSEX capitalisation. The credibility reached an all time high when ONGC received the highest ever credit rating assigned by Moody's to any Indian Corporate.

The process of risk mitigation has several components: new business, more oil and gas and reserve accretion. But, the biggest risk was perceived in the deteriorating condition of old equipment and standards. After thirty years of service, a majority of the equipment, platforms and rigs, had developed a lot of problems which was affecting the safety of operations.

In 2001, the BHN platform had developed some safety problems. ONGC appointed Lloyd's to carry out a safety audit. Taking a serious view of the matter, the EC (Executive Council) of the company in its 199th meeting, decided to carry out a comprehensive audit of all its facilities. 24 different teams were formed. They fanned out across the length and breadth of the country to have a look at existing facilities. Safety standards had huge gaping holes.

In 2002, the Mumbai-Uran trunk pipeline, built in 1976, developed a major leak. There was oil spillage in the sea and loss of production. The disaster was controlled through immediate measures. As a remedial action, the Mumbai-Uran gas trunk pipeline (MUT) renewal project was started. It was commissioned on August 15, 2005.

An organisation-wide quality consciousness drive as launched. The target for all assets to achieve safety accreditation was set as March 2005. International Safety Management (ISM) system was made mandatory for all floating platforms and rigs. The Indian Standards Organisation (ISO) certification had to be obtained for carrying out operations after the expiry of the stipulated time frame. In one of the most comprehensive exercises, all the installations acquired the ISM certification on time.

Right from the 60s, Effluent Treatment Plants (ETPs) were a necessity, considering the huge volumes of drilled cuttings and other chemicals used in the drilling and production process. But in the course of time, a lot of them had developed problems. They had to be replaced or repaired. The refurbishment was taken up on a war footing.

Every employee was required to undergo a series of trainings like personal survival, fire fighting, first aid, and professionals like drillers and production engineers were required to acquire International Well Control Certification.

All the research institutes also went through the process of quality accreditation. There was no point in attritional war in the spheres of emerging technologies. The institutes entered into MOUs with some of the best names in the business for technology upgradation. Halliburton, Schlumberger, Baker Hughes, IPR were now partners in technology upgradation and in taking up challenging E & P problems. Similarly domain specialists were hired for specific jobs. Field maintenance practices needed attention to reduce downtime. That led to the establishment of School of Maintenance Practices (SMP) at Vadodara to provide specialised training and certified courses in maintenance of oilfield equipment. Project Implementing Maintenance & Procurement Efforts through Upgraded Systems (IMPETUS) was launched in 1999 for improving operational efficiency and optimum asset utilisation. It was vigorously pursued by integrating with ICE system. On completion, it would provide a consistent set of guidelines to achieve superior operational effectiveness in terms of system availability and safety of equipment.

In March 2005, the target of 100% quality certification was achieved.

One more target was set: Zero gas flaring. From the early 90s, ONGC had been trying to reduce gas flaring. The dawning of the 21st century had brought gas to the forefront. ONGC's engineers, through years of research, had come out with workable solutions to re-use the gas through compression and other emerging technologies like cogeneration. Heera Process platform was the first installation to achieve the milestone. By December 31, 2004, gas flaring had been reduced almost to zero.

As a result of these initiatives, the insurance premia came down, from USD 36 million in 2003-04 to USD 19 million in 2005-06. The award for the Greenest Company has come as a reminder to every employee. They have to think, live and work with safety if the company has to prosper. In fact, ONGC became the first Public enterprise to receive the approval from the Government for Clean Development Mechanism (CDM) initiatives under the Kyoto Protocol.

The biggest strength of ONGC is its manpower. In fifty years, it has built up a large pool of domain specialists in every area of oil exploration and production. The economic value of its manpower runs into billions. From the humble Naaz building in 1957, it had made wise investments in proper training and development of its manpower. It had created eleven institutes and numerous regional laboratories, all state-of-the-art centres of excellence. But cracks had developed unobtrusively in the system, affecting morale. There were wide-spread undercurrents of dissatisfaction. It needed a vent.

Raha, in his first address to ONGCians, opened a C&MD's forum on May 25, 2001. People could write or e-mail him on any subject they thought was important and critical to the company. Thousands of letters poured in. He went through each one of them, replying to deserving ones. There was so much the employees had to share with the top management that Raha launched an electronic newsletter, ONGCReports.net, on August 14, 2001, to provide an open and fair platform for each and every employee. It was an eye-opener for everyone. In yet another move, the Chairman and the board went to every work centre, and conducted an Open House with the employees. A trend emerged and that was the link to every other problem.

Manpower had grown in a skewed manner. In the preceding three decades, the envisaged expansion of operations couldn't take off as planned. That had resulted in too many people chasing too few posts. As disputes grew, promotions were being obtained by court orders.

On review, it was decided to do away with the time-bound promotion policy of the Corporation. Promotions would henceforth, be vacancy-based. Dr A.K. Balyan, Director (HR) was in the hot seat. On taking over in 2003, he shared his feelings: "The challenge before HR in my view is to invest in creating the right environment and to equip our professionals with new learning and technology, so that they grow to their potential and meet the challenges ahead. While we have moved ahead in the past, we still have many miles to go. Putting HR systems in harmony with the changes taking place around us, introducing greater transparency, objectivity and provide ample opportunity for self-actualization, remain the cardinal tasks, in my opinion."

The last time the promotion orders were out, there was a barrage of complaints on OR.net. Dr Balyan assuaged hurt feelings by asking the employees to rise beyond meaningless promotions. The way ahead is much more exciting, he said. Get trained, get re-trained, get empowered with new knowledge, he urged. Raha set the tone when he announced the empowerment of the mind scheme. It was a new scheme in the corporate world.

Unnati Prayas, quest for improvement, was launched on June 2, 2003. It was to provide an opportunity for the meritorious to acquire graduate level engineering degree and skill. Technology was evolving very fast. As Raha put it: "Today's technology cannot be handled with yesterday's knowledge and skills. It is traditionally held that a Manager's task is to utilize four resources, men, money, materials and time, to achieve the desired outputs of goods and services. A fifth resource is now recognized: knowledge. The company is not in the knowledge business but the business of the company is knowledge. With knowledge, we find oil and gas. With knowledge, we generate wealth. With knowledge, we create satisfaction."

ONGC Academy tied up with Punjab Technical University to impart graduate level engineering skills to employees who had done diploma courses 10 to 15 years ago. A written test was conducted at all work centres; only the top ten percent of candidates were taken in.

Then came the hard part. The executives left behind their families and moved to the hostel in Dehra Dun. It was a difficult decision for the candidates as all of them had grown-up children. It was an uphill task to ensure that middle-aged executives who were removed from their secure world went back to engineering books. Holding them together for the first semester was a challenge for Gautam Sen, Head, ONGC Academy, and his team. The Unnati Prayas students, overcoming the initial fear, took to the books and completed the course. It was crossing a major milestone for the 120 engineers who passed out in 2005. The families, who had sacrificed so much, had their moment of redemption when they saw their husband/ father receive the coveted degree at the convocation held on August 14, 2005.

With ONGC's rapid forays into new businesses and overseas acquisitions, there was a need to build up a pool of business managers. They were to be conversant with the latest managerial techniques for the new era. They were to be like predators, ready to move to any place on the globe to sieze any business opportunity.

With this thought process, Super Unnati Prayas (SUP) was launched in 2003. ONGC tied up with Indian Institute of Foreign Trade (IIFT), Delhi, and Management Development Institute (MDI), Gurgaon, to launch a specialised MBA course for 40 of its executives.

The written test was as tough as it could get. The age limit was 45. People suddenly saw a good opportunity. It was back to brushing up numerical and analytical mathematics, brushing up word power. Some even joined coaching classes after office hours! Only, 40 out of 800 applicants got through. They also underwent the same experience as the Unnati Prayas students as they left their families behind. The course was tailor-made for ONGC's business requirements for the future. As a student admitted, it was one of the most gruelling times they had ever faced.

The first batch passed out and joined new businesses of ONGC to use the new knowledge. They are supported by a team of very senior executives who underwent another type of course at International School of Business (ISB) at Hyderabad. The course was named 'Sangsaptak - do or die'. The christening of the course was decided by Raha and M.S. Srinivasan as they were flying together to Hyderabad for declaring the course open. During the course, participants drew out a roadmap for the company's future.

Other initiatives taken to strengthen the fabric of the organisation were an assessment development centre to map the attributes and development needs of the senior officers aspiring to be key executives and project ARCUBE (R^3) to map the role, roster and responsibility of each CRC position.

Debt and Equity

In 1959, the few hundred people working in the Commission were too busy to think about the basic necessities of life. On October 15, 1959, the Commission was turned into a statutory body. The old age pension scheme was replaced by a Contributory Provident Fund. They had played a big part in establishing the company in the oil business. On retirement they found that times had changed. The small amount from their provident fund was spent in educating children and marrying off daughters. The gratuity was hardly Rs. 150,000. Wages were very low.

T.N. Seshan was requested to head a team to look into the matter. Seshan was joined by Dr S. Ramanathan who had helped him in formulating the R&P rules in the late 70s.The scheme, *Aggrani Samman*, emerged. All elders, now in their 70s, would be paid amounts ranging from Rs. 1,500 to Rs. 6,000 per month. The smiles were back.

ONGCians have faced disasters from early days with equanimity. In the course of fifty years, 136 people have laid down their lives while performing their duty. In 2003, twenty-nine precious lives were lost when a helicopter crashed into the sea. It shocked the company and the nation. Later, on July 27, 2005, the day after Mumbai had come to a standstill with unprecedented rainfall, a massive fire occurred on BHN and the platform was lost. There were 383 people on the platform and they had to be rescued. Raha and the Directors dashed off to Mumbai to oversee the rescue operations. The rescue teams saved 361 lives but 11 people perished while 11 others were missing in the accident.

The effort at reducing the losses was lauded in the Parliament. In both the cases, ONGC took unprecedented steps to look after the bereaved families. One member of each family was given a job in the company. Financial consultants were engaged to guide the families for secure investments. N.K. Mitra, Director (Offshore), camped with a group of senior officers at Mumbai to take care of the families and at the same time, bring back Mumbai High production close to its earlier level.

One worrying feature involving contractual workers surfaced. These contract labourers worked with ONGCians, shoulder to shoulder, in the harshest of the environment. Considering the inevitable risks attached with an oil field job, they also had accidents which sometimes proved fatal. Raha urged the collective to do some soul searching.. With a Rs. 100 million contribution from the Company, a Sahayoga (Cooperation) trust was set up. It was meant to help the families of contract workers when they died or were disabled in the course of duty at any ONGC premises.

ONGC was built with the hard-earned money of every Indian. Raha called it the people's equity and ONGC would carry the debt forever. ONGC's operations involve people around the country and in some of the remotest corners of the world. Corporate Social Responsibility (CSR) has been an on-going process for the company from its inception. One geologist of the 1956 batch remembers the happy faces of villagers when a couple of them went to one of the inaccessible places in Assam.

Disaster management is one of the cornerstones of its CSR policy. It has always come forward to help in the times of crises like the devastating earthquake in Gujarat or the super cyclone in Orissa or the tsunami. When the war in the forbidding heights of Kargil left scores of our brave soldiers dead or disabled, ONGC set off a process to recruit some of the disabled persons on its rolls.

Now it has decided to earmark 0.75 percent of its net profit for the betterment of society. Even as the policy was evolving, the President of India gave a call to corporates to come forward to mitigate the imbalances in the society.

A simple conversation by President of India, Dr A.P.J. Abdul Kalam with a five year old boy from Nagaland set off the chain of events. The boy had asked the President: "I would like to live in a happy, prosperous, peaceful and safe India. Tell me, what will you do, Mr. President? Also tell me what I should do for that?"

The President, addressing a group of people in a conclave, cited this conversation as an eye-opener. His overall vision for a happy and prosperous India included a vital component, Providing Urban amenity in Rural Areas (PURA).

PURA envisaged bridging the rural-urban gap and to achieve a balanced socio-economic development. It involved the identification of rural clusters with growth potential to create connectivity: Physical Connectivity in the form of road, transportation and power; Electronic Connectivity in the form of reliable telecom, Internet and IT services; Knowledge Connectivity in the form of good educational and training institutions; Economic Connectivity to enable farmers and others to get the best price for their produce.

ONGC was the first corporate to embrace it immediately. It set up an ONGC PURA trust with a capital of Rs. 100 million. The basic aim was to roll out PURA in isolated oil and gas pockets. The nearby villages were to be sustained from the incremental value from hydrocarbons by generation of electricity and other by-products.

Two of the finest institutions in the country, National Bank for Agriculture and Rural Development (NABARD) and Tata Energy Research Institute (TERI) became partners in this enterprise.

The first PURA project was launched in Tripura's Maichara village on April 18,

2005. President Kalam, much before the launching of PURA, had promised the state Chief Minister, Manik Sarkar, help to set up PURA in sixty of the most under-developed regions of the state.

In Maichara, ONGC used the gas from a nearby well to go for electrification. The four centres now coming up there are Bijlee Ghar (Electricity Generation Room), Randhan Sewa (Community Kitchen), Samaj Shibir (Community centre) and Gyan Kendra (Information Centre).

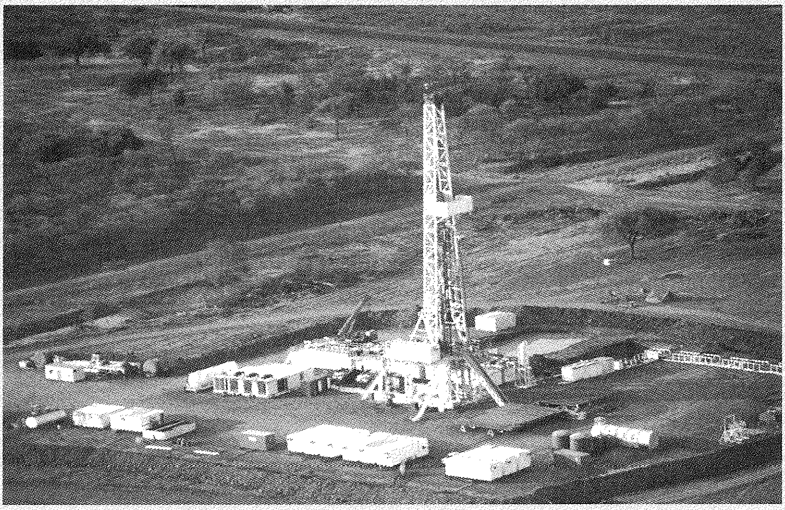
ONGC has a clearly defined policy for the weaker societies of society. ONGC has on its rolls 1962 female employees who make up 5% of the work force. It conducts regular workshops in every work centre for gender sensitisation. Scheduled Caste and Scheduled Tribe employees constitute 23.6% of the total manpower strength.

Sustainable solution to ground water resource management has added another dimension to ONGC's commitment to environment and society. To consolidate its CSR efforts, which were hitherto spread thin across several small projects, Raha identified the search and development of deeper ground water resources in drought prone areas of the country as a major initiative, and named it ONGC Project Saraswati in the Thar Desert of western Rajasthan.

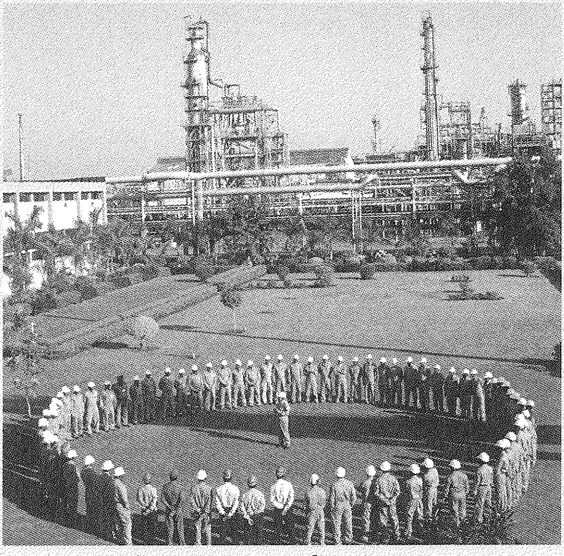
Inspired by the great man-made river project in the Sahar desert by Libya, which found huge quantities of fresh water in deep subsurface formations, search for similar conditions and deep aquifers was taken up. Geophysical investigations and drilling are underway. M. Rajagopala Rao, Project coordinator, remembers the impassioned pleas by a poor villager who had waited outside the meeting hall to plead with them to find water in his village - he had walked over 150 kilometres. Rao says that his efforts will be fully rewarded the day water gushes out and there is a smile on that villager's face.

Sports in ONGC had an old history. When laboratories were being set up in 1957, the early pioneers had encouraged the promotion of sports. The Naaz building was a hub of activities as A.M.N. Ghosh and M.B.R. Rao joined the crowd to watch badminton matches between technicians and scientists. Volleyball was the only past-time for field parties in the wilderness. In the eighties, Col. Wahi had given a big thrust to adventure sports. In 1996, ONGC had an official sports policy.

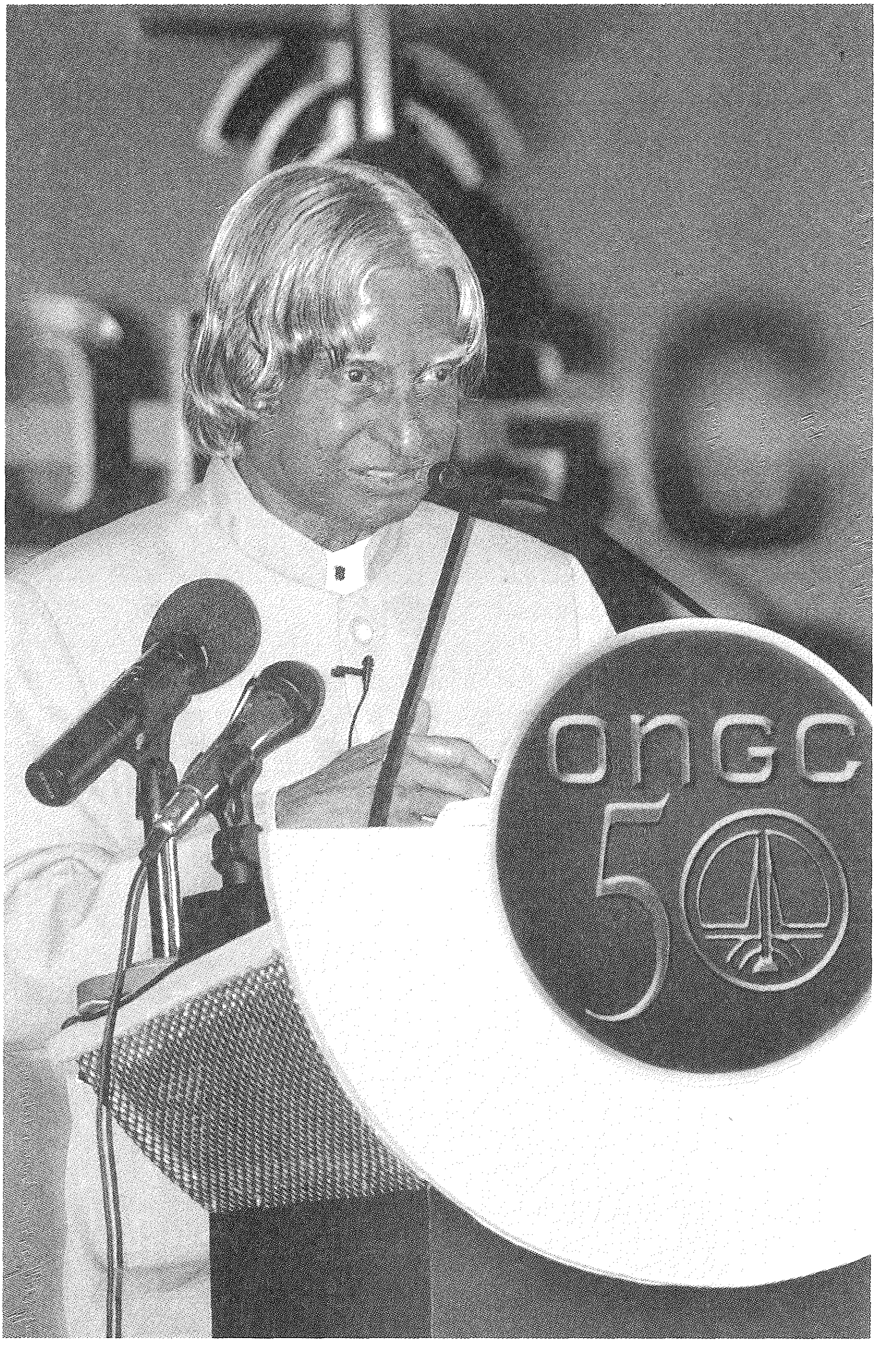
It has 153 sports persons on its pay rolls with 89 playing at international level. ONGC has some of the best names and Arjuna Awardees on its rolls: Virender Sehwag and Mohammad Kaif in Cricket, Shashikaran in Chess, Alok Kumar in Snooker, Anil Kumar in Discus throw, Pankaj Advani in Billiards and Sandip Dhillon in Badminton. It spends the largest amount on sports by any single corporate in the country. It has sponsored the National Football League (NFL), giving big corporate support to Football. ONGC recently was honoured as the Best Sports promoter among all PSUs by All India Public Sector Sports Promotion Board.



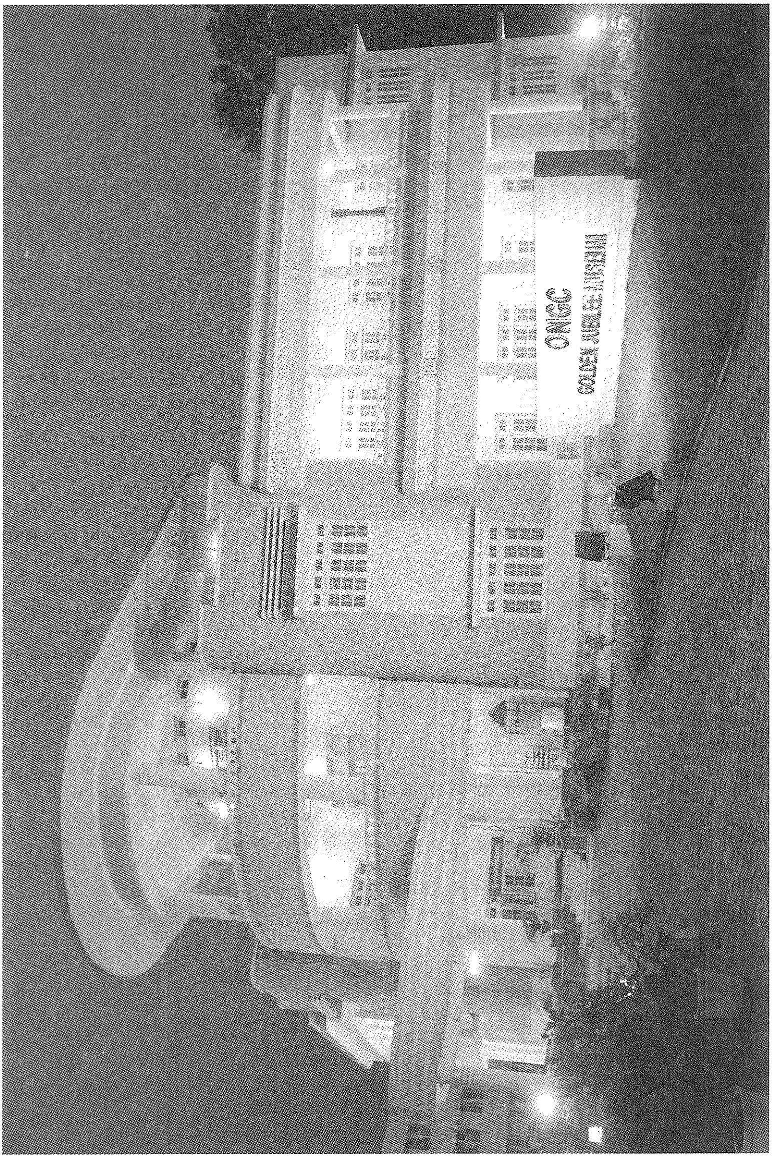
ONGC in Sudan



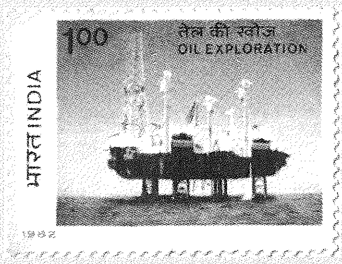
India's Greenest Refinery - MRPL



Giving a new vision to ONGC
President Kalam at ONGC Golden Jubilee



ONGC Golden Jubilee Museum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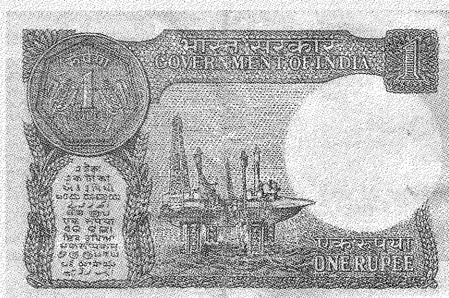
तेल की खोज
OIL EXPLORATION
भारत INDIA
1982


भारत सरकार
GOVERNMENT OF INDIA
1
एक रुपया
ONE RUPEE


1000
भारतीय रिज़र्व बैंक
1000
1000 एक हजार रुपये
ONE THOUSAND RUPEES

Logos

1957

1960-1965

1965-1975

1975-1985

1985-1987

1988-2004

2004

Soldiers of energy

Road Ahead

As ONGC enters the new era with new dreams, customer satisfaction and creating wealth for the stake holders would be the focus of the company. RS Sharma, C&MD, who took over from Raha on May 25, 2006, had a message for ONGCians: "Being the country's highest market cap company, we also have a major responsibility of effectively managing relations with a large number of domestic and international institutional investors."

The road ahead is much more difficult. It will mark the final war, consisting of many more battles over attitudes, resources and external factors.

ONGCians ask: "Where do we go from here?"

On all such occasions when ONGC stood at the crossroads, words of visionaries shone as beacons to guide it into unknown territories in search of new glory in the service of India. At this momentous juncture words of Dr. APJ Abdul Kalam, the greatest visionary of India today, infused vigor and enthusiasm in the organization. He gave a new vision of leading in providing energy security for the country through aggressive participation in the entire gamut of energy resources

The Company, in the coming few years, has plans to be in every sphere where energy is concerned. Energy from oil, gas in traditional exploration areas, frontier locales, deep waters, unconventional hydrocarbons, coal, sun, wind, water, bio-mass and hydrogen will be its focus. An Energy Centre trust for promoting R&D in all concerned areas of energy with a theme 'Mind to Market' is coming up in New Delhi. It will focus on development of marketable applications.

Fundamental and applied research elsewhere in the world has taken the oil business into hitherto unheard of places. ONGC, with its unique knowledge base built over fifty years has to strive very hard to get that elusive extra barrel of oil. Dr Manmohan Singh, Prime Minister of India, expressed the same sentiments during his inaugural speech at Petrotech-2005:

"Technology is an area that requires special attention and technology today is driving the business in the Hydrocarbon sector. Technology has transformed the oil Industry from a commodity business to high-tech industry."

ONGC looks at the future with anticipation: from CBM to Coal Gasification to Gas hydrates to hydrogen to helium. In fifty years, the company's biggest strengths are its people and the vast knowledge base of sedimentary basins of India.

When it started there were severe limitations in terms of resources, opportunities and above all confidence of those who matter in its capabilities. Today the colossus commands an enviable respect from its supporters and detractors alike.

Hydrocarbons are likely to rule the roost on the energy landscape for quite some time into the future. However, the energy mix, particularly for developing economies, is likely to undergo substantial change. Fifty years ago, when India was taking its faltering steps towards self reliance in the sphere of hydrocarbons, there were helping hands supporting its forays into the technological domains. Now, ONGC has built up capabilities to pay back the debt through leadership for other emerging economies.

It all started with a dream. As it hits the road, it needs to dream big, once again.

As Wallace Everett Pratt, world-famous geologist wrote: "Unless men can believe that there is more oil to be discovered, they will not drill for oil...where oil is first found, in the final analysis, is in the minds of men. The undiscovered oil fields exist only as an idea in the minds of some oil finders. When no man any longer believes more oil is left to be found, no more oil will be discovered; but, so long as a single oil finder remains with a mental vision of new oil fields to cherish, just so long new oil fields may continue to be discovered."

In a way, that exactly is what ONGC is all about: courage to explore; knowledge to exceed; technology to excel.

APPENDIX-I
ABBREVIATIONS

ABGL	Ankleshwar-Baroda Gas line
ADB	Asian Development Bank
AEC	Atomic Energy Commission
AIOC	Anglo Iranian Oil Company
AIR	All India Radio
AKCL	Ankleshwar- Koyali Crude line
AOC	Assam Oil Company
APEX	Accelerated Programme of Exploration
API	Acquisition, Processing and Interpretation
API	American Petroleum Institute
APM	Administered Pricing Mechanism
APP	Accelerated Production Programme
ASTO	Association of Scientific and Technical Officers
AUGL	Ankleshwar- Uttran Gas line
BARC	Bhabha Atomic Research Centre
BCM	Billion Cubic Metres
BDP	Book of Delegated Powers
BHEL	Bharat Heavy Electricals Limited
BHN	Bombay High North field
BHRC	Bombay High Review Committee
BHS	Bombay High South field
BHU	Benaras Hindu University
BIFR	Bureau of Industrial and Financial Reconstruction
BOC	Burmah Oil Company
BOP	Blow Out Preventer
BOP	Bombay Offshore Project
BP	British Petroleum
BPCL	Bharat Petroleum Corporation Limited
BPE	Bureau of Public Enterprises
BSE	Bombay Stock Exchange
C&M	Construction and Maintenance
C2	Ethane
C3	Propane
CAGR	Compounded Annual Growth Rate
CBM	Coal Bed Methane

CDA	Conduct, Discipline and Appeals rules
CDGL	Cambay- Dhuvaran Gas line
CDM	Clean Development Mechanism
CDP	Common Depth Point
CFP	Companie Francais du Petrole
CGG	Campagnie Generale De Geophysique
CIL	Coal India Limited
CNPC	China National Petroleum Corporation
CPM	Critical Path Method
CPWD	Central Public Works Department
CRC	Corporate Rejuvenation Campaign
CRINE	Cost Reduction in the New Era
CSIR	Council of Scientific and Industrial Research
CSR	Corporate Social Responsibility
CTF	Central Tank Farm
DA	Dearness Allowance
DGH	Directorate General of Hydrocarbons
DGMS	Directorate General of Mines Safety
DJP	Dikhu Junction Point
DMU	Design and Manufacturing Unit
DST	Drill-Stem Testing
E&P	Exploration and Production
EB	Efficiency Bar
EC	Executive Committee
ECAFE	Economic Conference of Asia and Far-East
EEZ	Exclusive Economic Zone
EIA	Environment Impact Assessment
EIL	Engineers India Limited
ENI	Ente Nazionale Idrocarburi
EOR	Enhanced Oil Recovery
EPA	Environmental Protection Act
EPINET	Exploration and Production Information Network
EPS	Early Production System
ERD	Extended Reach Drilling
ERP	Enterprise Resource Planning
ETP	Effluent Treatment Plant
FII	Foreign Institutional Investor
FRI	Forest Research Institute
GAIL	Gas Authority of India Limited

GATT .... General Agreement on Trade and Tariff
GCA .... Gaffeine Cline and Associates
GDP .... Gross Domestic Product
GE .... General Electric
GEOPIC .... Geodata Processing and Interpretation Centre
GGS .... Group Gathering Station
GIS .... Geographical Information System
GNPOC .... Greater Nile Petroleum Operating Company Ltd.
GOR .... Gas-Oil-Ratio
GP .... Geophysical Party
GSI .... Geological Survey of India
H2S .... Hydrogen Sulphide
HBJ .... Hazira- Bijapur- Jagdishpur pipeline
HCI .... Helicopter India Limited
HEC .... Heavy Engineering Corporation, Ranchi
HIL .... Hydrocarbons India Limited
HODI .... Hind Oil Design Institute
HPCL .... Hindustan Petroleum Corporation Limited
HR .... Human Resources
HRD .... Human Resource Development
HRM .... Human Resource Management
HSD .... High Speed Diesel
HSL .... Hindustan Shipyards Limited
IAF .... Indian Air Force
IAS .... Indian Administrative Service
IBRD .... International Bank for Reconstruction and Development
ICE .... Information Consolidation for Efficiency
ICI .... Imperial Chemical Industries
ICICI .... Industrial Credit and Investment Corporation of India
ICS .... Indian Civil Service
IDBI .... Industrial Development Bank of India
IDT .... Institute of Drilling Technology
IEOT .... Institute of Engineering and Ocean Technology
IFP .... Institut Francais du Petrole
IIFT .... Indian Institute of Foreign Trade
IIP .... Indian Institute of Petroleum
IIT .... Indian Institute of Technology

IL&FS	Industrial Leasing and Financial Services
IMA	Indian Military Academy
IMD	Institute of Management Development
IMF	International Monetary Fund
IMINCO	Iranian Marine International Company
IMMS	Integrated Material Management Systems
IMPETUS	Implementing Maintenance & Procurement Efforts through Upgraded Systems
IMR	Inspection, Maintenance and Repair
INBIGS	Institute of Bio-technology and Geotectonic Studies
IOC	Indian Oil Corporation
IOGPT	Institute of Oil and Gas Production Technology
IOR	Improved Oil Recovery
IP	Integrity Pact
IPC	Iraq Petroleum Company
IPCL	Indian Petrochemicals Company Limited
IPE	Institute of Petroleum Exploration
IPSEM	Institute of Petroleum Safety and Environment Management
IPSHEM	Institute of Petroleum Safety, Health and Environment Management
IRS	Institute of Reservoir Studies
ISB	International School of Business
ISM	Indian School of Mines
ISM	International Safety Management
IT	Information Technology
IWCF	International Well Control Forum
KAPL	Koyali- Sabarmati (Ahmedabad) Product Line
KCCI	Karnataka Chambers of Commerce and Industry
KDMIPE	Keshava Dev Malaviya Institute of Petroleum Exploration
K-G	Krishna-Godavari
KIADB	Karnataka Industrial Areas Development Board
Kribhco	Krishak Bharati Cooperative Limited
L&T	Larsen & Toubro
LIC	Life Insurance Corporation
LNG	Liquefied Natural Gas

Mangalore SEZ	Mangalore Special Economic Zone
MDI	Management Development Institute
MDL	Mazagaon Dock Limited
MDPM	Market Determined Pricing Mechanism
MEOR	Microbial Enhanced Oil Recovery
MHN	Mumbai High North
MHS	Mumbai High South
MIS	Management Information System
ML	Mining Lease
MMT	Million Metric Tonnes
MMTPA	Million Metric Tonnes Per Annum
MNC	Multi - National Company
MOU	Memorandum Of Understanding
MRPL	Mangalore Refineries and Petrochemical Limited
MSV	Multi-Support Vessel
NABARD	National Bank for Agriculture and Rural Development
NELP	New Exploration Licensing Policy
NFL	National Football League
NGL	Natural Gas Liquid
NIOC	National Iranian Oil Company
NML	National Metallurgy Laboratory
NOC	National Oil Company
NR&SR	Natural Resources and Scientific Research
NTPC	National Thermal Power Corporation
NYMEX	New York Mercantile Exchange
O + OEG	Oil plus Oil Equivalent of Gas
OCC	Oil Coordination Committee
OIDB	Oil Industry Development Board
OIL	Oil India Limited
OISA	Offshore International S.A
OMEL	ONGC Mittal Energy Limited
OMESL	ONGC Mittal Energy Services Limited
OMR	Oil Mines Regulations
ONGCHA	ONGC Himalayan Association
OOR	Own Oil Recovery
OPEC	Organisation of Petroleum Exporting Countries
OTP	Organization Transformation Project
OTPC	ONGC Tripura Power Corporation

OVL	ONGC Videsh Limited
P&DG	Production and Development Group
PAT	Profit after Tax
PC	Performance Contract
PC	Personal Computer
PIB	Public Investment Board
PMHBL	Petronet Mangalore- Hassan- Bangalore Limited
PPM	Parts per Million
PROMISE	Professional Review of Major Info-com Systems & Equipment
PSI	Pounds per Square Inch
PSU	Public Sector Unit
PURA	Providing Urban amenities in Rural Areas
PWD	Public Works Department
QHSE	Quality, Health, Safety and Environment
R&D	Research and Development
R&P	Recruitment and Promotion policy
R&TI	Research and Training Institute
RCL	Regional Chemistry Laboratory
RCP	Recommended Code of Practices
SAIL	Steel Authority Of India, Ltd.
SBI	State Bank of India
SBM	Single Buoy Mooring system
SCADA	Supervisory Control and Data Acquisition
SCG	Surface Coal Gassification
SCI	Shipping Corporation of India
SEISA	Seismic Engineering International SA
SEM	Safety and Environment Management
SEM- EPMA	Scanning Electron Microscope cum Electron Probe Micro-analyzer
SENSEX	Sensitivity Index
SHRAMIK	System of Human Resource Automated Management Information for Kaizen
SIM	Skochinsky Institute of Mining
SKO	Superior Kerosene Oil
SLA	Service Level Agreement
SMP	School of Maintenance Practice
SPIC	Seismic Processing and Interpretation Centre
SPV	Special Purpose Vehicle

SUP ....Super Unnati Prayas
SWOT .... Strengths, Weaknesses Opportunities and Threats
TERI ....Tata Energy Research Institute
TI ....Transparency International
TIOPS .... Texas Instruments Office Processing System
TPDC .... Tanzania Petroleum Development Corporation
UCG ....Underground Coal Gasification
UFSO ....Upgradation of Financial System of ONGC
UN ....United Nations
UNDP .... United Nations Development Project
UNSF ....United Nations Special Fund
UP ....Uttar Pradesh
UPSC .... Union Public Service Commission
UPSEB ....Uttar Pradesh State Electricity Board
USA .... United States of America
USSR .... Union of Soviet Socialist Republics
VAP ....Value-Added Products
VRS ....Voluntary Retirement Scheme
WIN .... Water Injection
WOBU .... Western Onshore Business Unit
XRD .... X-ray Diffractometre

APPENDIX-II

GLOSSARY OF COMMONLY USED OILFIELD TERMS

Alluvium	:	Deposit of earth, sand etc. left by flood especially in river valley or delta.
Anomalies	:	In geophysical parlance these are measurable variations or changes in the physical properties of subsurface rocks. In gravity surveys, changes in rock density are determined; while in magnetic surveys, changes in the magnetic character of the rock are determined. These observed changes can, after correction for non-geological effects, be presented as two-dimensional maps of "anomalies" over the earth's surface and then interpreted in terms of three-dimensional subsurface variations of rock properties. These in turn must relate to what is termed as the "geology" of the subsurface.
Anticline	:	A fold in sedimentary rock strata that is convex upward. The anticlinal theory of oil accumulation was propounded by Andrews in 1863, revived by White in 1885 and conclusively established by the Mannington Field discovery in 1889.
Associated GasAPI Gravity	:	The gas that occurs with oil, either overlying it as free gas or in solution. An arbitrary scale adopted by the American Petroleum Institute for expressing the specific gravity of oil. Its relation to specific gravity is as follows:- $\text{deg. API} = \dfrac{141.5}{\text{Sp.gr.at60deg.F}} - 131.5$
Barrel	:	A common unit of measurement of liquids in the petroleum industry. It equals 42 US standard gallons or 35 imperial gallons.
Basin	:	A depression in the earth's crust where sedimentary materials have accumulated.
Blow-out	:	A condition resulting form high pressure fluids blowing all the drilling mud out of the well and flowing out of control.

Blow-out preventer(BOP)	:	A heavy fitting at the well-head with valves which can be closed to maintain control of a drilling well that threatens to blow wild.
Cable-tool drilling	:	In this now-obsolete system, the rock was penetrated by hammering or percussion: of a bit on bottom. The bit was suspended on a wire-line and the necessary motion imparted by a beam pivoted at the centre, the walking beam.
Cap-rock	:	An impervious layer e.g. clay, which overlies a reservoir rock and prevents leakage of petroleum to the surface.
Casing	:	Pipe cemented in a well bore to support the walls of the hole, isolate potential producing zones and protect fresh water sands from contamination. Typically, several strings of casing are set during the drilling of a well.
Christmas Tree	:	An elaborate system of pipes and valves installed at a well-head to control the flow of gas or oil.
Circulation	:	The journey cycle of the mud from surface tanks through the Kelly and drill-pipe and bit to the subsurface and then back again to the surface through the annular space between the drill-pipe and wall of the drilled hole.
Completion	:	A well is completed in one or more reservoirs after drilling and casing the hole with a view to producing hydrocarbons from it.
Clastics	:	Sedimentary rocks made up predominantly of mineral or other rock fragments.
Compaction	:	The squeezing closer together of grains within sedimentary rocks because of the weight of overlying strata.
Condensate	:	Liquid hydrocarbons separated from natural gas, usually by cooling.
Core	:	Cylindrical sample of rock, normally several tens of feet long, cut by a special drilling device at specific intervals in a well. Core analysis provides indispensable data on porosity, permeability, water saturation, structure trends etc.
Cuttings	:	Chips or slivers of rock produced by the drill-bit as it penetrate downward, which are examined at the surface to identify the rocks being drilled through.

Development Well	: A well drilled in an already discovered oil or gas field.
Dog-leg	: A sharp or sudden change of direction in a bore-hole. This could have a geological significance e.g. proximity of an unconformity, or merely be a drilling lapse.
Dome	: A more or less circular anticline
Down-time	: Time lost in drilling due to repairs on machinery, waiting on equipment or bad weather.
Draw-works	: That part of a drilling rig that supplies power to raise and lower the drill pipe and to turn the rotary table.
Derrick (drilling)	: A steel pylon-like structure usually of sufficient height to permit the withdrawal of at least three 30 ft. lengths of drill-pipe and capable of supporting the maximum load likely to be experienced during the drilling of the well.
Drilling mud	: A carefully concocted mixture of clays and other minerals, usually in water, pumped down the drill-pipe to lubricate and cool the bit, flush out cuttings, provide a wall to the open-hole and balance formation pressures.
Drill-pipe	: The steel pipe used for carrying and rotating the drilling tools and for permitting the circulation of the drilling mud.
Drill-stem testing (DST)	: A controlled blow-out in which a limited amount of reservoir fluid is produced into the drill-pipe through a special tool. It is generally run in open-hole for a tentative test of the fluid content and caliber of the reservoir prior to undertaking a full-scale production test.
Dual completion	: Completing a well such that it can produce from two or more separate formations.
Electrical Log	: A continuous strip graph displaying various electrical responses of rocks penetrated by a well-bore as measured by electrodes lowered into the hold. An entire suite of logs based on electrical, acoustic, radioactive principles is now available to the industry for deciphering the lithology and fluid content of the subsurface.

Enhanced Oil Recovery (EOR) : A means of recovering a tertiary or third "Crop" of oil after primary and secondary methods have been used. These latter methods still leave about 70% of the original oil-in place in the reservoirs. EOR processes such as miscible and thermal flooding are designed to help recover as much as possible of the left-over oil. These processes are implemented even during the primary and secondary stages of oil recovery.

Erosion : The aggregate of all processes by which rock material is dissolved, loosened and removed from any part of the earth's surface.

Exploration : In the oil business, all the processes leading to the discovery of previously undiscovered accumulations of oil or gas.

Fault : A fracture within the earth's crust along which rocks have been displaced.

Field : A geographic area containing one or more hydrocarbon reservoirs all related to the same geological structure.

Fish, fishing : When trying to recover equipment accidentally left in a bore-hole such as part of a drilling string, one is said to be fishing. The equipment thus left is, of course, the fish.

Flaring : The burning of gas vented through a pipe.

Foraminifera(Forams) : A group of single-celled shell-building animals, mostly marine, mostly microscopic, whose fossil shells are of great value in determining the age of the rocks containing them.

Fossils : Naturally occurring remains or traces of plants or animals preserved in rocks of the earth's crust.

Gas-oil Ration (GOR) : The quantity of gas produced with the oil, usually expressed as cubic feet per barrel or as volumes of gas per volume of oil.

Geology : The study of the earth, the rocks of which it is composed and the changes that it has undergone.

Geophones : Sensitive sonic receivers used in arrays during reflection seismic surveys to detect shock waves reflected from subsurface rock interfaces.

Geophysics : The study of variations in physical properties of

		the earth such as the pull of gravity, intensity of the magnetic field, susceptibility of rocks to electrical currents and the speed of acoustic waves within the crust.
Geothermal gradient	:	A measure of the rise of rock temperature with depth below the surface.
Hydrocarbons	:	Organic chemical compounds made up predominantly of carbon and hydrogen, but sometimes with suplhur, oxygen or nitrogen, typically forming chain-like molecules. Those having up to 4 carbon atoms are gaseous; those with 20 or more are solid; and those in between are liquid.
Igneous Rock	:	Rock crystallized or solidified from molten material at the surface or within the crust.
Inclinometer	:	An instrument to determine the magnitude and direction of deviations in a bore-hole during the drilling phase so that corrective measures could be taken if required.
Infill Well	:	Well drilled between established producing wells to increase production.
Kelly	:	A square or hexagonal hollow shaft which engages in the rotary table imparting rotation to the drill-pipe.
Killing a well	:	Reversing and halting the tendency of a well to flow by pumping into the well-bore a fluid of suitable specific gravity, usually mud.
Limestone	:	A sedimentary rock made up predominantly of calcium carbonate; typically, consolidated lime mud, calcareous sand or shell fragments; where calcium-magnesium is the predominant mineral, the rock is a dolomite.
Lost circulation	:	Partial or total disappearance of bore-hole circulation mud, often accomplished swiftly, into cracks, crevices or abnormally low pressure zones during the drilling phase. Combated by a variety of lost circulation material before resumption of drilling.
Material-balance equation	:	This states that since the volume of the reservoir

		is constant, the algebraic sum of the volume changes of the oil, the free gas and the water must be zero. The equation gives an inventory of reservoir fluids, the behaviour of reservoir pressure, the impact of encroaching water and, finally, the initial oil and gas content of the reservoir.
Maturity	:	The condition reached by a source bed through prolonged existence at high temperature whereby organic matter is converted into petroleum.
Metamorphic rock	:	Rock altered from pre-existing rocks by heat, pressure or chemical reactions within the earth's crust.
Methane	:	Chief constituent of natural gas; a light; odourless; flammable gas, CH_4. Also produced by partial decay of plants in swamps.
Microfossils	:	Any of several varieties of extremely small fossil plant and animal remains (spores, pollen, foraminifera etc.) that can only be studied under a microscope.
Migration of oil	:	The journey which oil (or gas) makes from the source to the reservoir rock in response to the action of multiple forces. The exact mechanisms and pathways are still uncertain.
Natural gas	:	Gas issuing from the earth under pressure and often produced in association with crude oil, when it acts as an important factor in the recovery of the latter. Referred to as casing-head gas if it is from an oil-well.
Oil-shale	:	An immature, highly organic, fine-grained sedimentary rock from which hydrocarbons can be artificially liberated.
OPEC	:	The Organization of Petroleum Exporting Countries. Members are : Algeria, Ecuador, Gabon, Indonesia, Iran, Iraq, Kuwait, Libya, Nigeria, Qatar, Saudi Arabia, United Arab Emirates and Venezuela.
Outcrop	:	Any exposure of rock at the surface which is in-situ and not traveled down from elsewhere.

Outstep	:	A bore-hole drilled during the development phase outside the area already drilled but still on the same structure or to the same trap.
Palaeontology	:	The study of fossils.
Perforation	:	A method of making holes through the casing opposite the producing formation to allow the oil or gas to flow into the well and eventually to the surface.
Permeability	:	A measure of the relative ability of a rock to permit the flow of fluids through its pores.
Petroleum	:	Naturally occurring mixtures of organic chemical compounds, including oil and natural gas.
Photogeology	:	The interpretation of the surface geology of an area from aerial photographs.
Pore	:	The space between adjacent grains within a rock, normally liquid or gas-filled.
Porosity	:	A measure of how much pore space exists in as a percentage of the total volume.
Pour point	:	The lowest temperature at which the oil will pour or flow when it is chilled without disturbance under prescribed conditions.
Primary recovery	:	Oil recovered from the subsurface through the recovery action of natural energies and forces operating in the reservoir rock. When these energies weaken, the pressures are maintained by injecting gas or water or both near the oil reservoir.
Reaming	:	Hole enlargement by rotating suitable tools in the section of the hole to be enlarged.
Reflection	:	A sophisticated electronic system that seismograph detects and records the intensity and character waves generated at the surface and reflected back from rock interfaces within the earth's crust.
Reserves	:	A somewhat hazy concept but generally accepted as the quantity of oil and gas yet unproduced but commercially recoverable with present day techniques. Sub-classifications recommended by a study group of the Eleventh World Petroleum Conference include Proved Reserves (subdivided

		into Proved Developed and Proved Undeveloped) and unproved reserves (subdivided into Probable and Possible).
Reservoir Rock	:	A rock unit, usually sedimentary, which is sufficiently extensive, porous and permeable to contain and to yield significant volumes of petroleum.
Rotary	:	In this system the rock formation is drilling penetrated by a rotating bit connected to a hollow drill-pipe through which fluid is pumped to convey the rock-cuttings to surface.
Rotary Table	:	A circular platform on a drilling-rig floor through which the drill-pipe passes; the table turns to rotate the drill-pipe during drilling.
Round Trip	:	A drilling procedure consisting of raising the drill-pipe and unscrewing it into suitable lengths for stacking in the derrick until it is all out of the hole so that a worn bit can be replaced (or well logs run), then reversing the process until the pipe is all back in the hole again.
Salt Dome	:	A structure (anticline) formed around and above a cylindrical or ridge-like intrusive core of rock-salt which may be several miles in diameter and several thousand feet high.
Sandstone	:	A sedimentary rock compressed predominantly or more-or-less compacted or cemented sand-grains.
Saturation	:	The saturation of a rock with respect to a fluid is the proportion of its pore-space filled with that fluid.
Secondary Recovery	:	Any of several procedures used to revitalize depleted outfields through injecting water, gas etc. into the reservoir to flush out oil remaining in the pore space.
Sedimentary Rock	:	Rock made up of mineral grains or rock fragments usually deposited from some transporting medium such as running water, ice or wind.
Seepage	:	Oil or gas trickle flow from an underground accumulation, now observable at the surface; this leakage may have been going on for centuries and

		could be attributed to prolonged erosion, fault-lines or lack of permeability barriers. Near-surface paraffination could create a cap-rock effect thus converting the seepage into a potential accumulation.
Separator	:	A pressure vessel used to separate well fluids into gases and liquids.
Shale	:	A clastic rock composed primarily of compacted clay particles; often finely stratified.
Side-track	:	As this part is plugged off and drilling resumes long a new course deviating somewhat from the previous one.
Silt	:	Rock fragments finer than sand, but still gritty and not so fine as clay.
Source-rock	:	A fine-grained sedimentary rock, rich in organic material, which has undergone a long enough period at sufficiently high temperatures to convert the organic matter to petroleum.
Spudding-in	:	A term borrowed from cable-tool drilling days to denote the commencement of a well.
Strata	:	Layers of sedimentary rock, each of which is more or less uniform in character. The study of strata sequences in respect of history and correlation is stratigraphy.
Structure	:	Manner of rock disposition in space; any deformation bending, warping, dislocation of rocks which in oil exploration could provide a habitat for oil.
Subsidence	:	The sinking of a large area of the earth's crust, sometimes resulting in an encroachment of the sea over former land areas and commonly resulting in thick sedimentation.
Swabbing	:	A lifting device to bring well-fluids to the surface to induce a well to flow naturally; if it does not, some permanent device such as gas-lift or rod-pump is installed.
Syncline	:	A fold in sedimentary rock strata that is concave upward.
Torsion Balance	:	In gravity surveys, an instrument that measures the distortion or warping of the gravitational field

		rather than the intensity of the field. Now outdated.
Trap	:	A barrier formed within a reservoir rock by lateral termination of such rock beyond which petroleum cannot readily migrate.
Tubing	:	The pipe or pipes through which gas and/or oil released from their subsurface reservoir by perforation flow to the surface.
Ullage	:	The empty space above the liquid petroleum (or product) in a tank or similar container.
Ultimate recovery	:	The sum of reserves and cumulative production of oil and gas.
Unconformity	:	A surface or interface between rock layers of different ages representing a gap in the rock record because of an interval of erosion or non-deposition.
Weathering	:	The physical disintegration and chemical decomposition of rocks due to natural causes through the passage of time.
Wildcat	:	An exploratory well drilled in untried territory.
Wire Line	:	Any of several sophisticated electronic device tools lowered into a well-bore on a cable to record the physical properties of the rocks penetrated (e.g. electrical logs).
Workover	:	A term applied to any operation performed on a well subsequent to completing it e.g. cleaning casing, reperforation, plugging back etc.

APPENDIX-III

PRODUCTION FIGURES OF ONGC

OIL PRODUCTION IN MILLION METRIC TONNES (MMT)

YEAR	ONSHORE	OFFSHORE	TOTAL
1961-62	0.04		0.04
1962-63	0.46		0.46
1963-64	0.72		0.72
1964-65	0.77		0.77
1965-66	1.45		1.45
1966-67	2.56		2.56
1967-68	2.83		2.83
1968-69	3.10		3.10
1969-70	3.65		3.65
1970-71	3.65		3.65
1971-72	4.02		4.02
1972-73	4.09		4.09
1973-74	4.05		4.05
1974-75	4.54		4.54
1975-76	5.27		5.27
1976-77	5.36	0.41	5.77
1977-78	5.53	2.07	7.60
1978-79	5.61	3.31	8.92
1979-80	5.10	4.42	9.52
1980-81	4.23	4.99	9.22
1981-82	5.21	7.98	13.18
1982-83	5.37	12.88	18.25
1983-84	5.77	17.39	23.17
1984-85	6.14	20.14	26.28
1985-86	6.71	20.82	27.54
1986-87	7.24	20.62	27.86
1987-88	7.75	20.16	27.91
1988-89	8.52	21.11	29.64
1989-90	9.67	22.32	31.99
1990-91	9.14	21.21	30.35
1991-92	8.85	18.96	27.81
1992-93	8.68	15.75	24.43
1993-94	8.84	15.37	24.21
1994-95	9.02	20.09	29.11
1995-96	8.97	22.66	31.63
1996-97	8.50	20.18	28.69
1997-98	8.39	19.86	28.25
1998-99	8.10	18.29	26.39
1999-00	7.92	16.73	24.65
2000-01	8.43	16.63	25.06
2001 -02	8.64	16.07	24.71
2002 -03	8.45	17.56	26.01
2003-04	8.38	17.68	26.06
2004-05	8.32	18.17	26.49
2005-06	8.09	16.31	24.40
TOTAL	**266.13**	**470.14**	**736.27**

GAS PRODUCTION IN BILLION CUBIC METRE (BCM)

YEAR	ONSHORE	OFFSHORE	TOTAL
1961-62	0.005	0.000	0.005
1962-63	0.051	0.000	0.051
1963-64	0.078	0.000	0.078
1964-65	0.100	0.000	0.100
1965-66	0.272	0.000	0.272
1966-67	0.329	0.000	0.329
1967-68	0.363	0.000	0.363
1968-69	0.465	0.000	0.465
1969-70	0.501	0.000	0.501
1970-71	0.477	0.000	0.477
1971-72	0.543	0.000	0.543
1972-73	0.558	0.000	0.558
1973-74	0.546	0.000	0.546
1974-75	0.704	0.000	0.704
1975-76	0.930	0.000	0.930
1976-77	0.980	0.048	1.028
1977-78	1.099	0.229	1.328
1978-79	1.125	0.386	1.511
1979-80	1.116	0.542	1.658
1980-81	0.937	0.673	1.610
1981-82	1.087	1.345	2.432
1982-83	1.113	2.357	3.470
1983-84	1.104	3.259	4.363
1984-85	1.191	4.408	5.599
1985-86	1.401	5.180	6.581
1986-87	1.457	6.706	8.163
1987-88	1.635	8.229	9.864
1988-89	1.972	9.731	11.703
1989-90	2.389	13.088	15.477
1990-91	2.398	14.082	16.480
1991-92	2.735	14.393	17.128
1992-93	3.134	13.352	16.486
1993-94	3.459	13.356	16.815
1994-95	3.756	14.190	17.946
1995-96	4.296	16.579	20.875
1996-97	4.484	16.794	21.278
1997-98	4.947	18.102	23.049
1998-99	5.326	17.514	22.840
1999-00	5.478	17.775	23.253
2000-01	5.555	18.465	24.020
2001-02	5.615	18.427	24.042
2002-03	5.871	18.373	24.244
2003-04	5.778	17.806	23.584
2004-05	5.528	17.442	22.970
2005-06	5.631	16.943	22.574
TOTAL	**98.519**	**319.774**	**418.293**

APPENDIX-IV

UNITS OF ONGC

ASSETS:

- Mumbai High Asset, Mumbai
- Neelam & Heera Asset, Mumbai
- Bassein & Satellite Asset, Mumbai
- Ahmedabad Asset, Ahmedabad
- Ankleshwar Asset, Ankleshwar
- Mehsana Asset, Mehsana
- K-G Asset, Rajamundry
- Cauvery Asset, Karaikal
- Assam Asset, Nazira
- Tripura Asset, Agartala

BASINS

- Western Offshore Basin, Mumbai
- Western Onshore Basin, Vadodara
- K-G Basin, Rajamundry
- Cauvery Basin, Chennai
- Assam and Assam-Arakan Basin, Jorhat
- CBM - BPM Basin, Kolkata
- Frontier Basin, Dehra Dun

PLANTS

- Uran processing complex, Uran
- Hazira gas processing complex, Hazira.
- Mini-refinery, Tatipaka

INSTITUTES

- Keshava Deva Malaviya Institute of Petroleum Exploration (KDMIPE), Dehra Dun.
- Institute of Drilling Technology (IDT), Dehra Dun.
- Institute of Reservoir Studies (IRS), Ahmedabad.
- Geodata Processing & Interpretation Centre (GEOPIC), Dehra Dun.
- ONGC Academy, Dehra Dun
- Institute of Oil & Gas Production Technology (IOGPT), Navi Mumbai
- Institute of Engineering & Offshore Technology (IEOT), Navi Mumbai
- Institute of Biotechnology & Geotectonic Studies (INBIGS), Jorhat.
- Institute of Petroleum Safety, Health & Environment Management (IPSHEM), Goa
- School of Maintenance Practices (SMP), Vadodara.
- Energy Centre, Vasant Kunj, New Delhi (under construction).

REGIONAL COMPUTER CENTRES

- SPIC, Mumbai
- RCC, Vadodara
- RCC, Chennai
- RCC, Kolkata
- RCC, Jorhat

REGIONAL TRAINING INSTITUTES (RTI)

- Regional Training Institute, Panvel
- Regional Training Institute, Vadodara
- Regional Training Institute, Sivasagar
- Regional Training Institute, Chennai

REGIONAL LABORATORIES

- Regional Laboratories, Vadodara
- Regional Laboratories, Sivasagar
- Regional Laboratories, Chennai
- Regional Laboratories, Kolkata
- Regional Laboratories, Panvel

CENTRAL WORKSHOPS

- Central Workshop, Sivasagar
- Central Workshop, Vadodara

APPENDIX-V

LIST OF ONGC BOARD MEMBERS / DIRECTORS DURING THE TENURE OF DIFFERENT CHAIRMANS / CHAIRMAN CUM MANAGING DIRECTORS OF ONGC SINCE INCEPTION

S.No.	Designation	Name(S/Shri) W.E.F.	Dates Upto	Remarks
1. CHAIRMAN	**K.D. MALAVIYA**	**14.08.1956**	**23.06.1963**	
2. Member (Technical)	1. A.M.N. Ghosh	14.08.1956	02.01.1961	
	2. M.B.R. Rao	03.01.1961	05.08.1961	
	3. L.P. Mathur	21.02.1962	03.04.1964	
3. Member (Exploration)	M.B.R. Rao	24.11.1959	02.01.1961	
4. Member (Finance)	1. P.C. Bhattacharya	15.10.1959	31.05.1960	
	2. J. Dayal	01.06.1960	13.06.1963	
	3. A. Zaman	13.06.1963	31.05.1965	
5. Member (Production)	R.D. Verma	05.05.1961	01.04.1964	
6. Member (Refineries) - Part Time	P. R. Nayak	15.10.1962	14.08.1967	
7. Part Time Member	K.N. Kaul			
1. CHAIRMAN	**S.S. KHERA**	**25.06.1963**	**31.08.1964**	
2. Vice Chairman	P.R. Nayak	30.06.1963	01.09.1964	
3. Member (Technical)	L.P. Mathur	21.02.1962	03.04.1964	Re-designated as Member (E&D).
4. Member (Production)	R.D. Verma	05.05.1961	01.04.1964	Re-designated as Member (P&E) in 1962-63
5. Member (Finance)	A. Zaman	14.06.1963	31.05.1965	
6. Part Time Member	N. N. Kashyap	15.05.1964	15.04.1965	
1. CHAIRMAN	**P.R. NAYAK**	**01.09.1964**	**31.05.1965**	
2. Member (Finance)	1. A. Zaman	14.06.1963	08.04.1965	
	2. T.H. Veeraiah	09.04.1965	30.04.1965	
	3. A.P.B. Nayar	14.05.1965	06.06.1960	
3. Member (Exploration)	B.S. Negi	18.12.1964	06.09.1970	
4. Part Time Members	1. N.N. Kashyap	15.05.1964	15.04.1965	
	2. Dr. D.N. Wadia	19.09.1964	21.06.1965	
	3. B.C. Roy	10.11.1964	14.05.1965	
	4. S.K. Guha	05.02.1965	05.07.1966	

S.No.	Designation	Name(S/Shri)	Dates W.E.F.	Upto	Remarks
1.	**CHAIRMAN**	**A. ZAMAN**	**01.06.1965**	**06.05.1966**	
2.	Member (Finance)	A.P.B. Nayar	14.05.1965	06.06.1968	
3.	Member (Exploration)	B.S. Negi	18.12.1964	06.09.1970	
4.	Member (Engineering & Production)	L.T. Madnani	21.06.1965	15.07.1967	
5.	Part Time Members	1. Dr. D.N. Wadia	19.09.1964	21.06.1965	
		2. S.K. Guha	05.02.1965	05.07.1966	
1.	**CHAIRMAN**	**L.J. JOHNSON**	**07.05.1966**	**07.09.1970**	
2.	Member (Exploration)	B.S. Negi	18.12.1964	06.09.1970	
3.	Member (Finance)	1. A.P.B. Nayar	14.05.1965	06.06.1968	
		2. N.R. Bansod	06.08.1968	28.12.1970	
4.	Member (Engineering)	1. L.T. Madnani	21.06.1965	15.07.1967	Designated as Member (P&E)
		2. S. S. Raina	12.12.1967	21.03.1975	
5.	Member (Production)	I.N. Dhar	31.10.1967	30.04.1972	
6.	Member (Stores)	B.R. Kinra	15.06.1970	14.09.1971	
7.	Part Time Members	1. S.K. Guha	05.02.1965	05.07.1966	
		2. P.K.J. Menon	06.10.1966	23.11.1966	
		3. M.V. Rajwade	27.01.1967	17.08.1971	
		4. W.B. Metre	18.11.1967	22.10.1969	

List Of ONGC Board Members / Directors & Chairman Cum Managing directors

S.No.	Designation	Name(S/Shri) W.E.F.	Dates Upto	Remarks
1. CHAIRMAN	**B.S. NEGI**	**07.09.1970**	**09.04.1974**	Holding original charge of Member (Exploration) also
2. Member (Engineering)	S. S. Raina	12.12.1967	21.03.1975	
3. Member (Production)	1. I.N. Dhar	31.10.1967	30.04.1972	
1974-75 onwards Member (Onshore)	2. A.K. Ghosh	01.05.1972	21.03.1977	
4. Member (Finance)	1. N.R. Bansod	06.08.1968	2912.1970	
	2. P.T. Venugopal	15.02.1971	21.08.1978	
5. Member (Offshore)	Dr. G. Ramaswamy	16.08.1971	26.04.1979	Re-designated as (Exploration) in 1976-77
6. Member (Stores)	1. B.R. Kinra	15.06.1970	14.09.1971	Re-designated Member (Materials) in 1974-75
	2. P.K. Lahiri	15.09.1971	18.02.1980	
7. Part Time Members	1. M.V.. Rajwade	27.01.1967	17.08.1971	
	2. Dr. A. K. Dey	23.06.1970	05.06.1971	
	3. Dr. A.B. Dasgupta	05.08.1970	27.09.1976	
	4. M.G. Kaul	30.04.1973	25.10.1976	
	5. P.K. Dave	30.04.1973	29.12.1975	

S.No.	Designation	Name (S/Shri) W.E.F.	Dates Upto	Remarks
1. CHAIRMAN	**N.B. PRASAD**	**10.04.1974**	**22.08.1978**	
2. Member (Finance)	P.T. Venugopal	15.02.1971	21.08.1978	
3. Member (Offshore / Exploration)	Dr. G. Ramaswamy	16.08.1971	26.04.1979	Re-designated as Member (E) in 1976-77
4. Member (Production / Onshore)	A.K. Ghosh	01.05.1972	21.03.1977	Re-designated as Member (Onshore) in 1974-75 after restructuring
5. Member (Materials)	P.K. Lahiri	15.09.1971	18.02.1980	
6. Part Time Members	1. Dr. A.B. Dasgupta	05.08.1970	27.09.1976	
	2. M.G. Kaul	30.04.1973	25.10.1976	
	3. P.D. Dave	30.04.1973	29.12.1975	
	4. B.B. Vohra	08.04.1976	23.08.1977	
	5. Dr. Manmohan Singh	03.01.1977	03.12.1977	
	6. S. Krishnaswamy	21.11.1977	03.12.1977	
	7. C.R. Vaidyanathan	25.01.1978	08.06.1978	
	8. T.R. Satish Chandran	25.01.1978	29.04.1981	
	9. R.N. Malhotra	05.04.1978	03.03.1980	
	10. R.K. Bhargava	03.08.1978	05.05.1980	

LIST OF ONGC BOARD MEMBERS / DIRECTORS & CHAIRMAN CUM MANAGING DIRECTORS

S.No.	Designation	Name(S/Shri) W.E.F.	Dates Upto	Remarks
1. CHAIRMAN	**P.T. VENUGOPAL**	**22.08.1978**	**30.09.1981**	
2. Member (Materials)	1. P.K. Lahiri	15.09.1971	18.02.1980	
	2. P.N. Jha	01.12.1980	09.03.1983	
4. Member (Offshore / Operation)	Dr. A.K. Malhotra	05.05.1980	09.12.1985	Re-designated as Member (Operations) in 1983-84
5. Member (Onshore)	H.G.T. Woodward	20.03.1980	31.07.1983	
6. Member (Personnel)	T.N. Seshan	25.12.1978	25.05.1980	
7. Member (Finance)	1. B.K. Banerjee	10.09.1979	29.09.1981	
	2. V. Ramanujchari	29.04.1981	11.11.1983	
8. Officer on Special Duty	Col. S.P. Wahi	01.03.1981	30.09.1981	
9. Part Time Members	1.T.R.Satish Chandran	25.01.1978	29.04.1981	
	2. R.N. Malhotra	05.04.1978	03.03.1980	
	3. R.K. Bhargava	03.08.1978	05.05.1980	
	4. P.P. Khanna	07.07.1980	17.11.1983	
	5. S.V..S. Juneja	25.11.1980	16.05.1983	

S.No.	Designation	Name(S/Shri) W.E.F.	Dates Upto	Remarks
1. CHAIRMAN	**COL. S.P. WAHI**	**01.10.1981**	**14.12.1989**	
2. Member (Offshore / Operation)	Dr. A.K. Malhotra	05.05.1980	09.12.1985	Re-designated as Member (Operations) in 1983-84
3. Member (Onshore)	1. H.G.T. Woodword	20.03.1980	31.07.1983	
	2. H.S. Cheema	09.09.1983	11.07.1984	
4. Member (Exploration)	1. S.N. Talukdar	18.12.1981	02.12.1986	
	2. P.K. Chandra	02.12.1986	18.12.1989	Elevated to vice Chairman on 29.11.1988
5. Member (Materials)	P.N. Jha	01.12.1980	09.03.1983	
6. Member (Personnel)	1. R. Srinivasan	05.03.1982	30.04.1986	
	2. Dr. S. Ramanathan	06.08.1986	15.08.1989	
	3. D.N. Avasthi	19.09.1989	30.04.1992	
7. Member (Finance)	1. V. Ramanujchari	24.04.1980	23.11.1983	
	2. S.B. Kabra	18.01.1984	30.09.1985	
	3. G.C. Raghubir	05.10.1985	07.02.1987	
	4. M.C. Nawalakha	08.11.1988	12.11.1992	
8. Member (Technical)	1. B.R. Choudhary	31.03.1984	21.07.1987	
	2. S.K. Manglik	21.07.1987	31.01.1993	
9. Member (Drilling)	L.L. Bhandari	31.10.1984	30.09.1992	
10. Member (Natural Gas / Operations)	1. H.S. Cheema	07.10.1986	01.05.1989	Re-designated as Member (Operations) in 1988-89
	2. S. S. Paintal	30.04.1989	31.03.1995	
11. Part Time Members	1. P.P. Khanna	07.07.1980	17.11.1983	
	2. S.V.S. Juneja	25.11.1980	16.05.1983	
	3. J.S. Baijal	06.07.1983	29.01.1985	
	4. L.M. Goyal	18.04.1984	27.09.1985	
	5. Ms. Otima Bordia	29.03.1985	27.09.1985	
	6. K.P. Geetha Krishnan	30.01.1986	10.05.1988	
	7. B.S. Lamba	31.03.1986	27.06.1988	
	8. N.R. Ranganathan	20.07.1988		
	9. P. Sengupta	20.07.1988	30.05.1990	
	10. S. Kanungo	29.11.1988	08.02.1991	

List Of ONGC Board Members / Directors & Chairman Cum Managing directors

S.No.	Designation	Name(S/Shri)	Dates	Remarks
		W.E.F.	Upto	
1. CHAIRMAN	P.K. CHANDRA	19.12.1989	02.06.1990	Additional
2. Member (Drilling)	L.L. Bhandari	31.10.1984	30.09.1992	Charge of
3. Member (Technical)	S.K. Manglik	21.07.1987	31.01.1993	Member
4. Member (Finance)	M.C. Nawalakha	08.11.1988	12.11.1992	(Exploration)
5. Member (Operations)	S.S. Paintal	30.09.1989	31.03.1995	
6. Member (Personnel)	1. D.N. Avasthi	19.09.1989	30.04.1992	
	2. Dr. Jauhari Lal	23.06.1992	30.04.2003	
7. Part Time Members	1. P. Sengupta	20.07.1988	30.05.1990	
	2. S. Kanungo	29.11.1988	08.02.1991	

S.No.	Designation	Name(S/Shri)	Dates
		W.E.F.	Upto
1. CHAIRMAN	S.L. KHOSLA	03.06.1990	30.09.1992
2. Member (Drilling)	L.L. Bhandari	31.10.1984	30.09.1992
3. Member (Technical)	S.K. Manglik	21.07.1987	31.01.1993
4. Member (Finance)	M.C. Nawalakha	08.11.1988	12.11.1992
5. Member (Operations)	S.S. Paintal	30.09.1989	31.03.1995
6. Member (Personnel)	1. D.N. Avasthi	19.09.1989	30.04.1992
	2. Dr. Jauhari Lal	23.06.1992	30.04.2003
7. Member (Exploration)	R.B. Mehrotra	04.06.1992	31.12.1993
8. Part Time Members	1. S. Kanungo	29.11.1988	08.02.1991
	2. Naresh Dayal	31.07.1990	20.07.1993
	3. B.P. Verma	06.03.1991	20.05.1993
1. CHAIRMAN	L.L. BHANDARI	01.10.1992	31.01.1993
2. Member (Technical)	S.K. Manglik	21.07.1987	31.01.1993
3. Member (Finance)	1. M.C. Nawalakha	08.11.1988	12.11.1992
	2. B. L. Ahuja	08.12.1992	31.05.1994
4. Member (Drilling / Operation)	S.S. Paintal	30.06.1989	31.05.1995
5. Member (Exploration)	R.B. Mehrotra	04.06.1992	31.12.1993
6. Member (Personnel)	Dr. Jauhari Lal	23.06.1992	30.04.2003
7. Part Time Members	1. Naresh Dayal	31.07.1990	20.07.1993
	2 B.P. Verma	06.03.1991	20.05.1993

S.No.	Designation	Name(S/Shri)	Dates W.E.F.	Upto	Remarks
1.	**CHAIRMAN**	**S.K. MANGLIK**	**01.02.1993**	**31.01.1994**	
	CHAIRMAN	**S.K. MANGLIK**	**01.02.1994**	**30.04.1995**	
	& MANAGING DIRECTOR	**K.K. KAPUR**	**30.04.1995**	**23.08.1995**	
2.	Member / Director (Drilling)	1. S.S. Raina	30.06.1989	31.03.1995	
		2. S.M. Malhotra	05.05.1995	30.09.2000	
3.	Member / Exploration (Exploration)	1. Dr. S. Srinivasan	16.12.1994	31.05.1996	
4.	Member / Director (Personnel)	Dr. Jauhari Lal	28.06.1992	30.04.2003	
5.	Member / Director (Finance)	1. B.L. Ahuja	08.12.1992	31.05.1994	
		2. I.N. Chatterjee	11.10.1994	16.07.2001	
6.	Director (Operation)	1. D.P. Bansal	01.02.1994	31.01.1995	
		2. A.S. Soni	29.03.1995	31.07.2000	
7.	Director (Technical)	Ishwari Dutt	01.02.1994	30.09.1995	
8.	Part Time Members/ Directors	1. Naresh Dayal	31.07.1990	20.07.1993	
		2. B.P. Verma	06.03.1991	20.05.1993	
		3. N.K. Singh	02.09.1993	31.01.1994	
			24.03.1994	07.08.1995	
		4. A.N. Saksena	23.06.1993	04.05.1996	
		5. Najeeb Jung	02.02.1994	07.07.1995	

List Of ONGC Board Members / Directors & Chairman Cum Managing directors

S.No.	Designation	Name(S/Shri) W.E.F.	Dates Upto
1. **CHAIRMAN AND MANAGING DIRECTOR**	**B.C. BORA**	**23.08.1995**	**30.04.2001**
	NARESH NARAD	**01.05.2001**	**24.05.2001**
2. Director (Personnel)	Dr. Jauhari Lal	23.06.1992	30.04.2003
3. Director (Finance)	I.N. Chatterjee	11.10.1994	16.07.2001
4. Director (Operation)	A.S. Soni	29.03.1995	31.07.2000
5. Director (Technical)	Ishwari Datt	01.02.1994	30.09.1995
6. Director (Drilling)	S.M. Malhotra	05.05.1995	30.09.2000
7. Director (Onshore)	R.C. Gourh	16.11.1995	31.12.2003
8. Director (Exploration)	1. Dr. S. Srinivasan	16.12.1994	31.05.1996
	2. Dr. T.K.N. Gopalaswamy	18.03.1997	27.08.1999
	3. Y.B. Sinha	05.05.2000	05.05.2005
7. Director (Offshore)	V.K. Sharma	19.02.2001	28.05.2004
8. Director(Technology & Field Services)	Nathu Lal	12.03.2001	30.05.2005
9. Part Time Directors	1. A.N. Saksena	23.06.1993	04.05.1996
	2. Sanjiv Mishra	30.10.1995	05.11.1997
	3. Atul Chandra	27.02.1996	30.04.2004
	4. Inderjit Khanna	03.09.1996	20.11.1998
	5. Ravi Saxena	06.03.1997	26.10.1998
	6. Shivraj Singh	24.11.1997	14.05.1999
	7. A.R. Sihag	20.11.1998	16.06.1999
	8. J. Jayaraman	29.04.1999	11.09.2003
	9. N.K. Sengupta	29.04.1999	10.03.2000
	10. Ms. R.D. Barkataki	29.04.1999	11.09.2003
	11. J.M. Mauskar	14.05.1999	22.04.2004
	12. Subir Raha	29.08.2000	24.05.2001

S.No.	Designation	Name (S/Shri) W.E.F.	Dates Upto
1. CHAIRMAN AND MANAGING DIRECTOR	**SUBIR RAHA**	**25.05.2001**	**24.05.2006**
2. Director (Finance)	R.S. Sharma	01.03.2002	Till date
3. Director (HR)	1. Dr. Jauhari Lal	23.06.1992	30.05.2003
	2. Dr. A.K. Balyan	23.08.2003	Till date
4. Director (Onshore)	1. R.C. Gourh	16.11.1995	31.12.2003
	2. A.K. Hazarika	09.09.2004	Till date
5. Director (Exploration)	1. Y.B. Sinha	05.05.2000	04.05.2005
	2. D.K. Pande	23.09.2005	Till date
6. Director (Offshore)	1. V.K. Sharma	19.02.2001	28.05.2004
	2. N.K. Mitra	09.09.2004	Till date
7. Director (Technology & Field Services)	1. Nathu Lal	12.03.2001	30.04..2005
	2. U.N. Bose	27.09.2005	Till date
8. Part Time Directors	1. M.S. Ramachandran	25.06.2001	01.04.2002
	2. P. Sugavanan	16.04.2002	12.03.2003
	3. Dr. Surajit Mitra	09.05.2002	26.07.2003
	4. N.K. Nayyar	12.03.2003	05.12.2005
	5. G.S. Dutt	25.05.1999	10.06.2003
	6. P.K. Deb	16.07.2003	01.12.2006
	7. B.K. Das	02.09.2003	30.06.2004
	8. U. Sundararajan	11.09.2003	Till date
	9. Rajesh V. Shah	09.04.2003	Till date
	10. M.M. Chitale	11.09.2003	Till date
	11. Sunjoy Joshi	28.05.2004	05.12.2005
	12. P.K. Sinha	24.12.2004	03.03.2006
	13. Atul Chandra	27.02.1996	30.04.2004
	14. J.M. Mauskar	14.05.1999	22.04.2004
	15. Ms.R.D. Barkataki	29.04.1999	11.09.2003
	16. J. Jayaraman	29.04.1999	11.09.2003
	17. Dr.K.R.S. Murthy	29.04.1999	11.09.2003
	18. Jawahar Vadivelu	29.04.1999	11.09.2003
	19. Ravi Saxena	01.06.1999	21.02.2002
	20. M.S. Srinivasan	21.11.2005	02.01.2006

LIST OF ONGC BOARD MEMBERS / DIRECTORS & CHAIRMAN CUM MANAGING DIRECTORS

S.No.	Designation	Name (S/Shri)	Dates W.E.F.	Upto
1.	**CHAIRMAN AND MANAGING DIRECTOR**	**R.S. SHARMA**	**25.05.2006**	**Till date**
2.	Director (Finance)	R.S. Sharma	01.03.2002	Till Date
3.	Director (HR)	Dr. A.K. Balyan	23.08.2003	Till date
4.	Director (Onshore)	A.K. Hazarika	09.09.2004	Till date
5.	Director (Exploration)	D.K. Pande	23.09.2005	Till date
6.	Director (Offshore)	N.K. Mitra	09.09.2004	Till date
7.	Director (Technology & Field Services)	U.N. Bose	27.09.2005	Till date
8.	Part Time Directors	1. Rajesh V. Shah	09.04.2003	Till date
		2. U. Sundararajan	11.09.2003	Till date
		3. M.M. Chitale	11.09.2003	Till date
		4. Anil Razdan	20.02.2006	Till date
		5. Ashok Chawla	05.12.2005	Till date
		6. A.M. Uplenchwar	23.12.2005	Till date
		7. P.K. Choudhury	26.06.2006	Till date
		8. V.P. Singh	26.06.2006	Till date
		9. Dr. R.K. Pachauri	26.06.2006	Till date
		10. Dr. Bakul H. Dholakia	26.06.2006	Till date

APPENDIX-VI

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- N.K. Bose, GGM(P) Retd. On Production
- P.P. Gupta, DGM(GP) Retd. On Geophysical Services
- R.C. Garg, GGM(GP) Retd. On Electrologging Services
- S.K. Singh, Addl.ED Retd.on Engg. Services
- S.N. Shukla, GM Retd. On Geology, Geophysics, Production & Electrologging
- B.L. Ahuja, Ex Member (F) on Finance Discipline
- Ashok Malaviya, GM, on Drilling & Production
- Lakshman Singh, Director, IRS, (Retd.) on IRS
- S.H.A. Jafri, GM (SEM), on Drilling, Safety & Engg.
- K.L. Goyal, GM (R&P), on Miscellaneous subjects
- D.L. Vohra, Addl. Director (E&S) Miscellaneous subjects
- Sujit Sen, GGM (HR) Retd. On H.R

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MEMOIRS:

- M.B.R. Rao
- L.J. Johnson
- Dr. Hari Narain
- T.S. Balakrishnan
- K.N. Bhave
- H.S. Cheema
- D.N. Awasthi
- A.M. Awasthi
- H.S. Cheema
- A.K. Gupta
- P.N. Rajaram
- S.C. RoyChoudhury
- Dr. S. Ramanathan
- Amitava Mukherjea

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SECTIO

THE OIL & NATURAL GAS

(No. 43 o

An Act to provide for the establishmen
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been captured in these chapters. You will meet the daring pioneers, the world-class experts and above all the dreamers who guided this company in this journey. The book captures the struggle and the ultimate triumph of ONGCians against all odds.

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