

Hydrocarbon Sector in India : Key Focus Areas for Future Growth

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***Distinguished Guests, Honourable Members,
Geoscientists, Ladies and Gentlemen***

It is a pleasure and a privilege for me to address this August gathering and to share my thoughts with you. At the outset, I would like to thank the organizers of this convention, Madhya Pradesh Council of Science and Technology, for inviting me to this convention and giving me this opportunity to deliver the presidential speech.

Throughout my life, I have been associated with earth science: It is my education, training, passion and profession. Today's involvement with Indian Geological Congress is another great responsibility on me to serve the cause of geoscience, and I believe, working together we can meet the challenges and responsibilities put on us by our country for innovative management of mineral wealth for betterment and prosperity of the country.

The theme of the *symposium "Minerals and Mining in India – the way forward inclusive of cooperative mineral based industries in the SAARC countries"* is well-chosen in the present day context when there is an ever-increasing demand for mineral resources due to growing economy of our Country, as well as the challenges faced by the industry from growing concern over the environmental issues associated with mining and processing industries.

As a geologist associated with hydrocarbon sector of the country, in different capacities, I would like to discuss the background, present status and key focus areas for future growth of Oil & Gas sector in India.

Hydrocarbon as Mineral in India

The fuel minerals of India includes Oil, Gas, Coal – Lignite, and atomic minerals. Amongst them, Oil and Gas are two most important fossil fuel minerals in terms of value and demand. Importance of oil and gas amongst other minerals is much higher in India, as the country is not self sufficient in Oil and Gas and more than 80% of oil and 32% of natural gas requirement is fulfilled through import. The demand for oil gas in India is ever increasing, with 1.3 billion populations with low per capita energy consumption and 6-9% GDP growth rate.

Exploration of Hydrocarbon in India

First reference to hydrocarbons in the country dates back to 1825 when seepages of hydrocarbon were observed along the foothills in Upper Assam. The real story began with the successful drilling of well no 1 in Digboi in upper Assam in 1889 which signalled the birth of Oil Industry in India. These efforts led to the discovery of Digboi field which was later passed on to Burmah Oil Company Ltd (BOC) in 1921 and later on to Oil India Ltd in 1981.

During the pre-independence era, exploration for oil and gas was very minimal. The major part of Indian sedimentary basins was deemed to be unfit for development of oil and gas resources. Exploration of hydrocarbon resources of India was mainly carried out in the NE part of India by private companies. Post independence, a JV company, Oil India Ltd. (a 50% joint venture between Government of India and Burmah Oil Company) was formed for developing two newly discovered fields in Upper Assam (Naharkatiya and Moran).

In 1955, Government of India decided to develop the oil and natural gas resources in various regions of the country

as part of the public sector development. With this objective, an Oil and Natural Gas Directorate was set up in 1955. This directorate later became a commission in 1956 (Oil and Natural Gas Commission). Under initiative of this commission and technical collaboration with erstwhile USSR, exploration was intensified in a number of basins in India during the 2nd Five Year Plan (1956-57 to 1960-61). This resulted in the discovery of the giant oilfield, Bombay High in the Arabian Sea off Mumbai in the early seventies.

Since early nineties, Government of India has undertaken a series of steps to invite private and foreign investment in the oil and gas sector. Initially, 28 small sized fields explored by NOCs were put up for bidding for private participation with a provision of mandatory carryover of NOCs as Licensee and Government nominee. Later, during the pre NELP regime, Government offered the acreages on international competitive bidding with a provision for mandatory participation of NOCs in case of discovery in the blocks. One of the major achievements of this bidding process is the award of Rajasthan block which is producing today about 175,000 BOPD.

Finally, Government opened up upstream hydrocarbon sector for 100% FDI by introducing the New Exploration Licensing Policy (NELP) since 1997. Through NELP, Government of India has provided a level playing field to all the companies including NOCs to compete on equal terms for award of exploration acreage. The result is that from merely two National Oil Companies engaged in oil and gas exploration in the pre-NELP era, we have today more than 80 E & P companies and about 10 CBM companies operating in India. Till date, 9 bidding rounds of NELP and 4 bidding rounds of CBM have been implemented.

The Government of India is gearing up to move to the “Open Acreage Licensing Policy” (OALP) regime as soon as possible. For the OALP to become operational, the establishment of the National Data Repository (NDR) is a pre-requisite. DGH is in the process of setting up the NDR, which will archive all E & P data, under one roof. This data will be available not only to the industry but also to academic and research institutions, thereby promoting interaction and collaboration between various agencies.

PRESENT OIL & GAS SCENARIO IN INDIA

India has an estimated sedimentary area of 3.14 million square kilometres, comprising 26 sedimentary basins. As mentioned earlier, exploration for oil and gas got momentum after implementation of New Exploration Licensing Policy (NELP). Under NELP, Government of India has awarded

254 exploration blocks covering an area of 15,00,957 sq. km in Indian sedimentary basins to E&P companies. So far, 117 oil and gas discoveries have been made in 39 NELP blocks. As a result, about 737 million metric tonnes of oil equivalent hydrocarbon in-place volume have been added to the country's oil and gas portfolio (as on 01.04.2012). Investment made as on 01.04.2012 by Indian and foreign companies in NELP blocks was of the order of US \$ 20 billion, out of which, US \$12 billion was on hydrocarbon exploration and US\$ 8 billion on development of discoveries.

The domestic crude oil production in the year 2011-12 was 38.086 MMT and the projected crude oil production in 2012-13 was about 39.517 million metric tonne (MMT). Domestic natural gas production in the financial year 2011-12 was 47.56 billion cubic metre, a downfall was expected in 2012-13 due to less gas production in KG deepwater block. The reconciled production data till end of financial year 2012-13 are yet to come.

The total prognosticated resources of the country have been estimated at about 28 billion tonnes. As on 01.04.2011, balance recoverable crude oil and natural gas reserves in the country are 757.395 million metric tonne (MMT) and 1284.41 billion cubic metre (BCM) respectively.

In the downstream sector, the present Indian refinery capacity is 213.2 MMTPA. Refinery production (crude throughput) during 2011-12 was 203.8 MMT.

PRIMARY ENERGY VIS-A-VIS OIL AND GAS DEMAND SUPPLY SCENARIO : GLOBAL AND INDIA

Looking at the global Oil and Gas scenario, we see that world daily production of oil is about 84 MM bbls. Average daily production of India is less than 1% of this value. If we look at the projected energy demand scenario, we see that worldwide demand for primary energy increases by 36% between 2008 and 2035, or 1.2% per year on average. Global demand for each fuel source show increasing trend, with fossil fuels – coal, oil and gas accounting for over 50% of the increase in total primary energy demand. All this rise in demand is attributed to developing countries, led by China, India, Brazil etc. India's energy demand is expected to increase by 3.6% per year on average. It is expected that oil will remain primary fuel in primary energy mix till 2035. World's demand for oil is expected to grow continuously to reach 99 MM bbls/d in 2035. A significant increase in renewable / alternative energy source is also expected during the coming years. Natural gas is set to play a central role in meeting the world's energy needs for

at least the next two-and-a-half decades. Global natural gas demand, increases by 44% between 2008 and 2035 – an average rate of increase of 1.4% per year. Besides, unconventional oil is set to play an increasingly important role in world oil supply through to 2035.

In India, though oil and gas sector is ahead of other minerals in terms of value of annual production, our domestic production of oil & gas is insufficient to meet the demand of the country. In India, share of crude Oil and Gas in primary energy source is about 40%, which is second to coal, which contribute about 53% of the total primary energy. India is 4th largest oil and gas consumer in the world after USA, China and Japan.

Despite continuous effort to increase indigenous oil and gas production through various policy and incentives by government, it has not been able to meet the ever increasing demand and the gap between demand and supply is widening day by day. The demand forecast for petroleum products during 12th Five Year Plan is estimated to enhance from 148.3 MMT in 2011-12 to 189 MMT in 2016-17. This will result in increased dependency on imports from 81.8 % in 2012-13 to 86.7 % in 2016-17. India is in urgent need to explore/produce more oil & gas.

EXPLORATION OF DOMESTIC OIL AND GAS: FUTURE THRUST AREAS

As of now, out of the total 3.14 million sq.kms sedimentary basin area about 2.15 million sq.kms has already been offered for exploration. Further, out of the total prognosticated resources of 206 billion barrels of oil and oil equivalent of gas, 77 billion barrels have been established as in-place reserves. It is my firm belief that there is much more potential in our sedimentary basins, which can be found by accelerating the pace of exploration in the country and by offering new acreages expeditiously.

The future key focus area for hydrocarbon exploration and production enhancement are :

1. Deepwater basins
2. Increase of recovery from existing fields
3. Unconventional hydrocarbon resources like shale oil/gas, gas hydrate, CBM
4. Category III & IV Basins & frontier areas

Exploration for Deepwater Sedimentary Basins :
During last century, due to limitation of technology or due to

existing policies, explorations for deepwater prospects in India were sparse. The total areal extent of sedimentary basin that falls under deepwater category (>400m isobaths) is 1.35 Million Sq km which is 42 % of total sedimentary basin area of India. The good news is that 52% of the total deepwater sedimentary basin area is covered by PEL area under operation. This will definitely generate voluminous information on hydrocarbon prospect in deepwater basins. Success has already come in Mahanadi deepwater and KG deepwater basin exploration by ONGC and RIL. With almost 50% of the area yet to be explored in detail, there is enormous scope for exploration and prospect generation from deepwater sedimentary basin.

Increase recovery from old fields : There are about 400 big, medium and small Oil and Gas fields in India. The average oil recovery factor of these fields is less than 25% whereas in several countries like Norway, the recovery is as high as 60%. Some of the major producing fields in the mature basins like Assam Arakan, Cambay and Bombay have been producing for more than three decades and have already started declining. There is scope for production enhancement of such declining fields by implementation of enhanced oil recovery techniques like pressure maintenance, water/CO₂/flooding etc and IOR techniques such as drilling of infill wells, drain-holes etc. With the development of software technology for geo-cellular modelling of the reservoir, dynamic simulation can be carried out is more precisely. This helps to simulate ultimate recovery under different with IOR/EOR methods and in-fill drilling programs. New drilling technology like short radius horizontals, multilateral from single well can maximize the reservoir contact and drain the by passed oil. Advanced cased-hole measurement like cased-hole resistivity is now playing an important role in identification of left out hydrocarbon in drained reservoir.

Unconventional Hydrocarbon Resources : A major part of the world hydrocarbon resources are entrapped in “unconventional reservoirs” which are difficult to develop economically but large in volume. The most commonly discussed unconventional hydrocarbon resources are Shale Gas, Shale Oil Coal-Bed Methane, tight gas, bitumen sand, heavy oil and Gas Hydrates. Among these, maximum attention has been drawn by “shale gas” and “shale Oil” reservoir in the recent times.

Shale Gas/Oil : Shale gas and shale oil have been identified

much earlier over a century back, but was difficult to develop due to lack of technology and production was commercially not viable. Improved gas price in US market, low cost horizontal drilling technique and multistage hydraulic fracturing gave momentum to shale gas production. Present shale gas production in United States is about 6 BCF/day which is higher than the daily gas production of India from conventional gas reservoirs. Worldwide, the estimated gas in-place volume in shale reservoir is 16,000 TCF which is even higher than the gas in place of conventional reservoir (12,000 TCF).

In India, exploration for shale gas / shale oil has already been started. ONGC carried out studies on the sedimentary basin and prioritized Damodar basin and Cambay basin as the two prospective basins for shale gas exploration. In a well drilled in Damodar basin by ONGC, presence of shale gas has been established. DGH is collecting data from various basins to identify prospective areas for shale gas exploration. Oil India Limited has also carried out study to evaluate shale gas prospect in Assam Arakan Basin and Rajasthan (Jaisalmer & Bikaner Nagaur Basin). Since about 60% of total sedimentary rock is made up of shale there is ample opportunity for exploration of shale gas in India.

Coal Bed Methane (CBM) : Another proven source for unconventional hydrocarbon (gas) is Coal Bed Methane (CBM). Here also US is ahead of all other countries in CBM production. India having one of the largest coal reserves in the world, coal bed methane is one of the prime targets for exploration in future. For systematic exploration of CBM in India, GOI formulated a CBM policy in 1997 and awarded 33 CBM blocks through international competitive bidding till now. This has initiated exploration in about 52% of the area and about 280 CBM wells have been drilled. Good news is that out of prognosticated resource of 52 TCF CBM in India, 8.39 TCF has been established as in place volume. Presently commercial CBM production is going on in a block in Raniganj.

Gas Hydrate : Gas hydrate is another source of unconventional hydrocarbon for future. R&D activity is going on for commercial extraction of gas from gas hydrates. India has launched a National Gas Hydrate Program under the leadership of DGH with consortium of national oil companies (OIL, ONGC, GAIL) along with National Research Institutions like National Institute of Oceanography, National Geophysical Research Institute and National Institute of Ocean Technology. India has already

established the physical presence of marine Methane hydrates in the offshore deepwater of Krishna-Godavari, Mahanadi & Andaman areas. In order to study the distribution and nature of gas hydrate in marine sediments in Indian Territory certain areas has been earmarked based on analysis of geological and geophysical data. The short listed areas are: the Kerala-Konkan Basin, Krishna-Godavari Basin, Mahanadi Basin and the previously unexplored Andaman Islands.

Exploration in Category III & IV Basins & frontier areas : Category III & Category IV basins are termed as prospective basins and potentially prospective basins respectively based on broad geological information. The total sedimentary area in Category III basin is 6,41,000 sq km which includes Himalayan Foreland, Ganga, Bindhan (onshore only), Bengal, Saurashtra (both onshore and offshore) and Kerala – Konkan – Lakshadweep (offshore) basins. Total sedimentary area of Category-IV basin is 4,61,200 sq km and includes intra-cratonic basins like Cuddapah, Deccan Syncline, Pranhita-Godavari etc.

Out of 19 on land non producing basins, 17 are categorized as frontier basins with prognosticated resource of 3.4 billion tons as per DGH estimate. Most of these basins are in initial stage of exploration. Some of the basins like those in Himalayan foothills and Deccan syncline pose seismic imaging problems due to complex structural setting.

Areas of concern in oil and gas sector : Despite the above opportunity, the future growth of hydrocarbon sector, both in conventional and unconventional will be decided by a number of country specific parameters. I am going to discuss few of them, which requires immediate attention by regulatory authorities as well as members of oil and gas fraternity to make a breakthrough.

- i) As discussed earlier, there are about 1 million Sq. Km of category III & IV basin yet to be explored. But exploration in these areas are hampered due to non-existence of preliminary G&G data to attract investors. Further, Country yet to implement an effective policy for data acquisition of the unexplored area and to start national data repository. Recently action is taken for a national data repository by DGH but model for data acquisition in those challenging area is yet uncertain.
- ii) Lack of clarity of policy, delays in getting statutory

clearance is another issue that distracts foreign investors. Before NELP, DGH used to get clearance from all ministry for the exploration blocks. Now it has been seen that a large number of NELP blocks are entangled due to permission from MOD, DRDO, DOS & MOE&F etc. This gives a wrong message to the global E&P players and interest to invest in India is reducing.

- iii) Country has inadequate upstream infrastructure as well as oilfield services. The committed work programme for NELP includes 54,000 LKM 2D, 42,000 Sq km 3D and 520 wells. In next five years, 50% of these work to be carried out in deepwater. Against this challenging job volume, as on date, country does not have a single deep water rig for hire.
- iv) Government policies have not provided enough encouragement to entrepreneurs to start oilfield service industry. For example, for services and consumables imported for use in NELP are entitled to custom duty waiver. At the same time, is a domestic entrepreneur want to buy a drilling rig or oilfield service equipment or intend to manufacture consumables within the country, neither get custom duty waiver, nor get any financial incentive form the government to so. For the monetization of 157 of balance discoveries, there will be a lot of demand for rigs, oil and gas production equipments, pipelines and numerous surface facilities in the coming years. The country is not equipped with to provide this oil and gas services. As a result, there are time and cost overruns and penalties are being imposed on operators for non completion of work in stipulated time.
- v) Though much has been talked about shale gas/oil prospect in India, there are a lot of issues to be addressed for exploitation of the same in India. Shale gas/oil exploitation require land for close space drilling, technology for horizontal drilling and fracturing, huge volume of water for fracturing. Unlike US, where these resources are abundant, India is thickly populated, land and water are precious and not even enough for livelihood. In areas where both shale gas

as well as conventional oil & gas exists, formulation of exploration and exploitation policy is challenging because of technological and economical differences between the resources. As per EIA, technologically recoverable shale gas resource of India is about 63 TCF, but systematic database on shale gas resources of the country is yet to be generated.

- vi) Similar to shale gas/oil, exploration and exploitation of coal bed methane also facing similar issue. Most of the coal bed methane prospective areas are obviously in existing coal mine areas. Due to coexistence of these two diverse type of resource, there are issues regarding lease ownership as well as surface operations. Also most of the coal mine areas are tribal land areas, where land acquisition is restricted. Further, land acquisition, environmental clearance etc. more difficult and time consuming when leases cut across the state boundaries with different rules.
- vii) Lack of industry to buy shale gas or coal bed methane locally is another challenge, especially if the production is not big enough to set up long distance transport facility.
- viii) There is an increase in Law and order problem in the coal and forest rich areas of India in terms of extremist activities. Illegal mining, lack of development in and around mining area, deprivation or inadequate compensation to the effected people are fuelling the situation.
- ix) Growing environmental concern and upcoming stringent environmental norms is a major challenge in mining of all kinds of minerals in India. To ensure a greener and cleaner earth to the future generation, we have to welcome rules to safeguard environment, but such rules need to be transparent enough for the investors so that they have a clear idea about the future of their investment before pumping money into it.

In conclusion, I would like to emphasize that vast resource of oil and gas are still hiding beneath Indian Territory, in the form of conventional or in the form of unconventional resources. To tap this hydrocarbon potential, we require to grow in two key areas. Firstly,

we have to bring in innovations and fit for purpose technology to exploit the difficult oil. In this regard, I would like to mention that, in the recent past, somehow the Geosciences, as a subject, failed to attract talent compared to subjects like management and engineering. Second, and most importantly, we need to develop congenial geo-political environment and attractive

hydrocarbon regulations, to invite global E&P majors to invest in India.

Thank you very much for your kind and patient hearing.

Jai Hind