



Elephants, exploration and engineering



Well over a century has passed since a straying herd of logging elephants returned to a railway construction camp in the northeastern province of Assam with their feet covered in oil. This signalled the beginning of India's petroleum industry in Digboi, which was to become a thriving oil city. The first oil field at Digboi is still producing today and supplies the world's oldest operating oil refinery.

Many major discoveries have since contributed to the needs of the world's seventh largest energy consumer. The search goes on, but self-sufficiency is unlikely and the solution will lie in imported natural gas.

Over a century and a half ago, young British army officers and civil administrators touring the northeasternmost part of India by boat, then the only mode of transport in the heavily forested terrain, reported “peculiar gurgling and bubbling sounds” in the river beds. Not until 40 years later, in 1867, during the construction of a railway by Assam Railways & Trading Company (AR&T), did a herd of logging elephants return to camp with their feet covered in oil after a night-time excursion to find food and water. This, coupled with the initiative and enterprise of Mr Goodenough of McKillop Stewart and Co. who completed the first successful, mechanically drilled oil well in Asia at Nahorpung, was the start of the oil industry in India. It was also the beginning of the city of Digboi – it is said that it was Goodenough’s excited urgings to his men to “dig boy, dig” gave this picturesque place its name.

The first taste of commercial success came when a well was struck at Digboi in 1889. AR&T subsequently acquired a 30-square-mile, petroleum-rights concession in the Makum area of Assam, and by 1893 had drilled 10 wells at Digboi producing 200 gal/D. Asia’s first oil refinery went on stream in 1901. Today, Digboi boasts two modern wonders of the world – a hundred-year-old oil field that is still producing and the world’s oldest operating oil refinery, which produces in excess of its capacity. Digboi’s Well No.1 is preserved as a monument to the oil pioneers and their endeavors (see Figure 4.1).

Burmah oil brings benefits of experience

AR & T established the Assam Oil Company to develop the Digboi field, but poor management, and limited and misguided investment resulted in a takeover over in 1921 by the Burmah Oil Company (BOC), already established 300-miles south in the Surma Valley. BOC had already been supplying India with oil products since the 1890s. Using systematic geological mapping, BOC took the guesswork out of the hitherto random siting of wells in the area.

By 1926, Burmah Oil and other indigenous producers were supplying India with 65% of its kerosene needs. In the meantime Shell, also operating in the country, had seen its contribution diminish to a mere 4%, compared with 16% in 1919. This was a precursor to the setting up of a joint Burmah-Shell company in India in September 1927.

Meanwhile, in the Punjab, the independent Attock Oil Company (AOC) had been producing and refining oil since the early 1920s. After a number of unprofitable years, AOC accepted a loan from BOC. In return, BOC acquired a special shareholding in the company in 1934. AOC and Assam Oil together were now producing almost two million barrels and supplying 18% of mainland India’s kerosene and 18% of its motor spirit.

The introduction of electrical logging to India’s oil fields in October 1933 with

the lowering of a simple resistivity tool into Digboi Well No. 269, marked a technological transformation. This, and subsequent surveys, provided the information necessary to trace the reservoir structures, and to map the oil and gas distribution.

BOC abandoned the Badarpur field in the Surma Valley in 1933, but had increased production at Digboi from 350 B/D in 1921 to 4500 B/D in 1937. By this time, the company had recovered its massive investment in the reconstructed refinery at Digboi and was producing at more than 12 times the original figure. In the same year, BOC, BP (then Anglo-Iranian Oil) and Shell began joint geological surveys of all the important plains of India. One seismic survey suggested a concealed structure at Nahorkatiya was worth investigating, but World War II postponed development of this site.



Figure 4.1: Oil well at Digboi in 1905

Wartime precautions

In 1942, refineries and rigs in Burma had to be destroyed to prevent them falling into Japanese hands. One of the most dramatic developments in Digboi’s history occurred when the women and children were evacuated, and the men prepared to defend and, if necessary, destroy the product of their working lives – India’s only oil refinery – to prevent the enemy gaining access to its valuable contents.

Tension mounted as the Japanese invading forces drew closer and came within three days marching distance of Digboi. The news then filtered through that the enemy had retreated and thousands of refugees had crossed Hell’s Gate, connecting India with China, through Myanmar to spill into India. On one occasion, Japanese and allied aircraft clashed close to the oil field. Despite this, and in order to aid the war effort, production was increased to 5500 B/D by drilling new wells under the cover of tarpaulins.

Large finds, but self-sufficiency is elusive

After the war, Burmah-Shell continued to supply most of India’s substantial oil needs. By 1947, Assam Oil, its crude reserves badly depleted by over-production during the war could provide less than 10% of national requirements of kerosene, petrol and fuel oil. Attock Oil’s contribution was less than 1%. The shortfall was made up from imports, largely from Iran. When Indian independence was granted in 1947, Attock Oil, being in the western part of the Punjab, found itself in Pakistan.

The dollar shortage in India made it worthwhile to import crude and gain the value added by the refining stage. India’s need for refineries was all the greater because of its poor balance-of-payments situation, and Burmah-Shell and other oil companies were asked to assess the economic case for constructing refineries in the country. At first, this issue became deadlocked, the Indian Government refusing to accept that refineries could only be built if products were sold at 10% above the Gulf parity price. However, other events, not least the nationalization by Iran of Anglo-Iranian’s operations there, led to an



Figure 4.2: Natural resources – an elephant helps to load a storage tank onto a lorry

agreement between the Board of Directors of Burmah Oil and the Indian Government to share the cost of building a refinery. This 12.5-MMbbl refinery at Trombay Island, near Bombay, came onstream in 1955 and soon afterwards was supplying 45% of India’s total requirements of oil products. Stanvac also built a refinery at Trombay in 1954 and Caltex built one at Vizagapatam in 1957 (see Figure 4.2).

BOC resumed exploration and deep drilling in the Bramaputra Valley. In 1953, a rig at Nahorkatiya hit oil at five intervals between 9000–11,000 ft and came in at 3000–4000 B/D. Today this is a 500-MMbbl field. This exciting discovery, after a long list of failures in Upper Assam, paved the way for exploration in other parts of India. In 1956, the government decided on a more coordinated control over the development of the nation’s oil resources and created the Oil and Natural Gas Commission (ONGC), which became a statutory body in 1959. The same year, Oil India Private Limited (OIL), a Rupee Company, was created to take over BOC’s affairs in Assam, giving BOC two-thirds and Geological Survey of India (GOI) one third. In 1961, they became equal partners.

Within a year of being formed, ONGC discovered oil at Cambay, then the giant Ankleshwar field in the State of Gujarat

in 1960. It made major finds at Assam (Rudrasagar) in 1960, Lakwa in 1964 and Geleki in 1968. OIL continued pioneering work and also developing established fields, carrying out the first dual completion, drilling the first deviated well, and introducing gas injection.

After much financial and technical wrangling, a 720-mile pipeline linking the sites of the new refineries was completed in 1963 (see Figure 4.3). One of the longest in the eastern hemisphere, it was notable for its technical sophistication in controlling crude conditions before piping in order to prevent solidification at low temperatures. It was also buried to minimize low-temperature effects.

Offshore oil strike

In 1974, ONGC struck oil offshore at Bombay High (the largest field in India) producing 250,000 B/D and with reserves of 1.9 billion barrels. In the period 1984–5 oil was found at Godavari offshore and at Changmaigam in Assam. Gas was struck in the Eastern Onshore region at Baramura (Tripura) and there followed many new hydrocarbon strikes spread over Cambay, Krishna-Godavari, Assam-Arakan, Western Offshore and Cauvery basins.



Figure 4.3: Construction of the Oil India Ltd pipeline in 1963

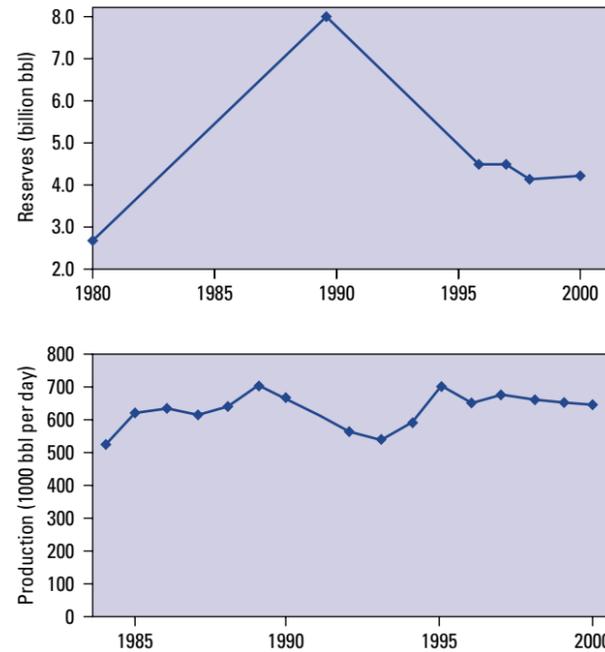


Figure 4.4: Production and reserves for India

During the 1980s, aware that production was meeting only about 60% of home demands, ONGC made a concerted effort to increase production from existing areas and also many new areas. In 1989, India's hydrocarbon reserves (see Figure 4.4) were put at 479.2 MMt, oil production at 29.6 MMt compared to 27.9 MMt in the previous year, and gas production was up by nearly 19% to 6969 MMm³.

In April 2000, ONGC struck oil in a new well in the Krishna-Godavari basin, in the southern region of the country. The production rate of the two wells is close to 470 B/D. The company recorded crude oil output of 146,000 t from the basin, higher than the target of 80,000 t.

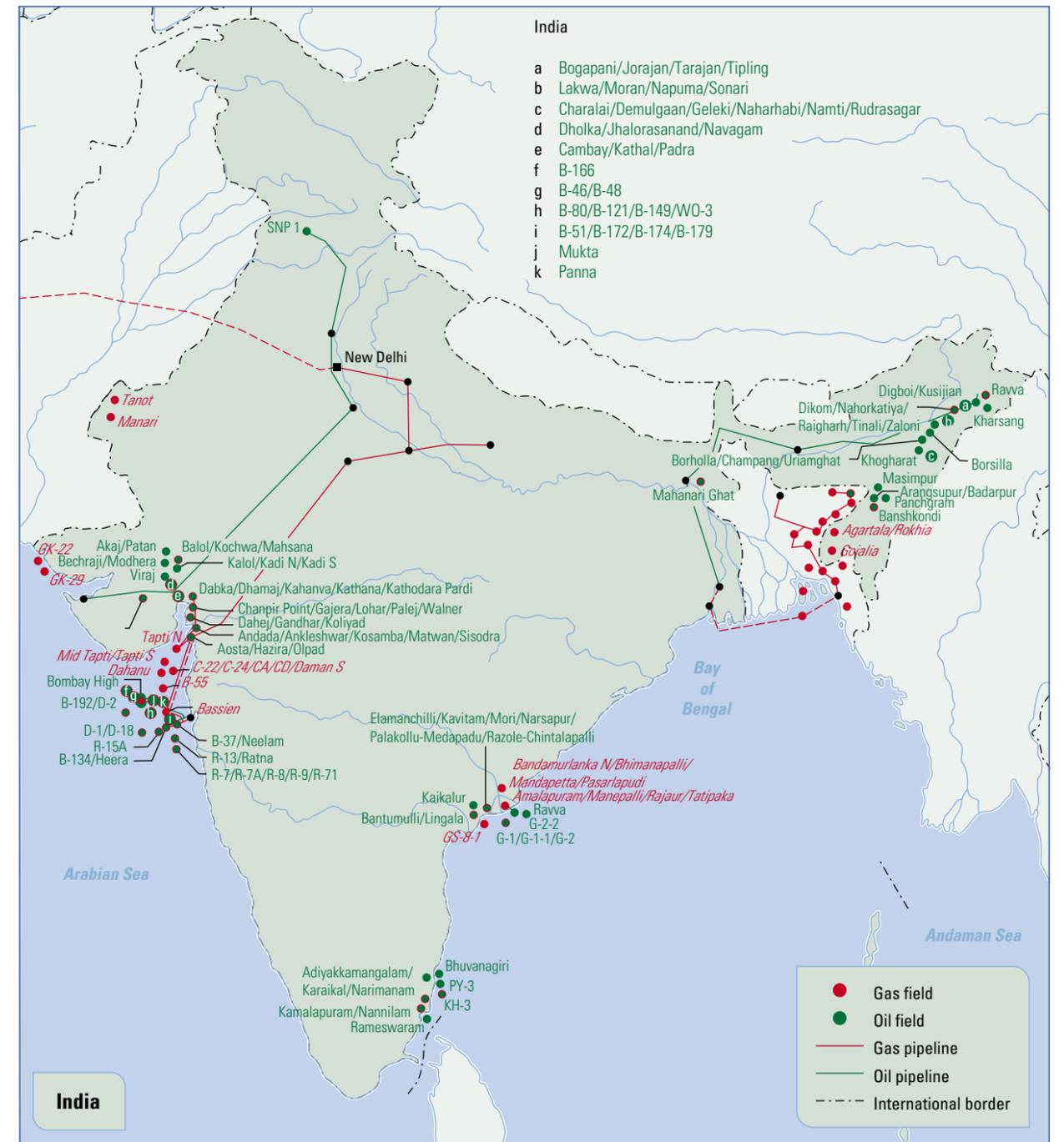
Natural gas

India's gas reserves are estimated at 24.91 Tcf. Almost 70% of these are found in the Bombay High basin and the State of Gujarat. To the east, the Krishna-Godavari basin produced 1363 MMm³ of natural gas in the fiscal year 1999–2000. Current projects include enhancing gas production at the Tapti fields, and recovering gas that would have been flared previously at the Bombay High oil field.

Energy supplies for the future

There have been no major finds in recent years, and oil and gas imports are expected to rise rapidly. It is planned to increase the use of gas in India, the world's seventh largest energy consumer, mainly for power generation, from 1.2 Tcf in 2000 to 1.9 Tcf by 2005. To prepare for this, there has been heavy investment to provide the infrastructure required to support increased use of natural gas by building LNG import terminals and pipelines. Natural gas sources include Yemen, Oman, Abu Dhabi and Qatar. There is currently a proposal under examination for a subsea pipeline from Iran.

The largest projects will be conducted by Petronet, a joint venture between ONGC, IOC, the Gas Authority of India Ltd (GAIL), Bharat Petroleum, and the National Thermal Power Corporation (NTPC). Under the current plan, each of the state firms would own a 10% stake, with the remaining 50% offered



The oil and gas fields of India

to financial institutions and private shareholders, though questions about the equity structure and financing for the project have delayed implementation. Petronet plans two import terminals, one at Dahej and the other at Cochin. Qatar's RasGas has signed an agreement for LNG supplies beginning in mid-2003.

