Diamonds in the rough

SCHLUMBERGER CELEBRATES ITS DIAMOND ANNIVERSARY IN TRINIDAD, THE SITE OF MUCH PIONEERING WORK IN THE EARLY DAYS OF THE OIL INDUSTRY

The story of Schlumberger in Trinidad & Tobago has been one of mutual benefit. Although the first oil well in the country was drilled in 1857, two years before the famous Drake discovery in the United States, it was only after several years of deliberation and negotiation that the Schlumberger brothers were permitted to try their 'Boîte magique' to help ease the task of finding and quantifying potential reservoirs. From the very beginning, Trinidad operators realised that geological formations there were exceedingly complex, requiring lengthy and costly coring operations to acquire the information necessary to characterise the lenticular reservoirs.

A brief history

Trinidad's characteristic geological complexity played a significant role in the establishment of well-logging operations in Trinidad, the official debut of which was made on 19th July 1932 in the Palo Seco No. 126 well for British Controlled Oilfields, who had witnessed the benefits of well logging through its involvement in Venezuela. In fact, the first Schlumberger logging engineers, Pierre Bayle, Roger Piotte and Louis Bordat, shuttled back and forth between Venezuela and Trinidad to attend to jobs for a year before the first permanent base was established in San Fernando, the island's southern city. But once the company formally set up shop in Trinidad it was there to stay. By 1935, five engineers were active in the country.

Interestingly, although at the time, Schlumberger was best known for its ability to record continuous resistivity logs, an indication of the possible presence of hydrocarbon-bearing strata, it was the Spontaneous Potential Survey that attracted the most interest among Trinidad operators. Discovered almost by accident by Henri Georges Doll, son-in-law to Conrad Schlumberger and Schlumberger's first field engineer, the SP as it came to be known, provided the first clues to formation permeability, the basis for reservoir characterisation. The combination of resistivity and SP recorded continuously using an electric logging sonde helped resolve formation complexity and eliminated the requirement to take expensive cores. It's small wonder that the logging process at that time went under the name of 'Electrical Coring,' (Figure 1). Coming as it did in the midst of the Great Depression, the efficient technique may have sustained the nascent petroleum industry in the country, allowing many companies to not only survive, but expand their operations.

All photographs courtesy of Schlumberger

Figure 1: Intrepid oil pioneers make their first tracks in the sands of Trinidad in 1932

In 1936, the logging suite was increased 50 per cent by the introduction of Marcel Schlumberger's invention, the sidewall coring tool. This provided depth-accurate core samples to satisfy operators who missed the tangibility of conventional cores, but at a fraction of the cost and time. In addition, to combat the deep invasion of drilling fluid filtrate into porous and permeable strata that flushed hydrocarbons away from the near-wellbore region, new electrode spacings were designed for the resistivity equipment that allowed it to see beyond the invaded zone.

To say the relationship between Schlumberger and Trinidad was serendipitous is an understatement. During the Nazi occupation of France, the government invited Schlumberger to move its overseas headquarters to offices in San Fernando in 1940, which it did. In 1955, the administrative offices were relocated to Port of Spain. Then, and now, the company has steadfastly adhered to its principles of determination, commitment and integrity, which has sustained it for three-quarters of a century.

Challenging times

The oil prospects of Trinidad & Tobago continued to present technical challenges through the years. Not only was the geology complex, but native hydrocarbons ranged from natural gas to heavy, viscous crude oil. Many sandstone lenses contained hydrocarbons, but in most cases they were not connected. In the early days, there was no solution but to place a well, or several wells, in each lenticular formation – a costly and time-consuming task – and one that bypassed several small, but oil-filled, zones that were considered uneconomical to justify a well.

In the 1960s the industry moved offshore, bringing a whole new level of technical and logistical challenges to be solved.

As has been the case all over the world, technology came to the rescue, and Schlumberger has played no small part in this. The integration of exploration, drilling, formation evaluation, completion and production technology has sustained the Trinidadian oil industry for more than 75 years, and continues to do so. 3D seismic technology allows unprecedented imaging quality with applications from the discovery of new prospects to the monitoring of production from existing fields – enabling effective reservoir management and increasing hydrocarbon recovery factors.

Like the fabled Rosetta Stone that enabled linguists to crack the code of the ancient Egyptian hieroglyphics, the oil industry has developed its own Rosetta Stone – called visualisation (Figure 3). With different members of multidisciplinary asset management teams looking at the same data rendered in a 3D visualisation presentation, geoscientists, engineers and managers can all 'speak the same language' as they collaborate to solve drilling and production problems. This development was non-trivial, requiring thousands of man-years of painstaking work, writing and testing software applications programmes and operating systems to make them user-friendly and, as much as possible, universally-applicable. Such a system has been implemented by Schlumberger in Trinidad for one of the country's leading operators.

In drilling technology, the most significant advancement is precise well-placement within the highest quality portions of the

Figure 2: Programmes like SEED provide realistic context to academic coursework and encourage young people in selecting curricula that will complement their interests and career choices

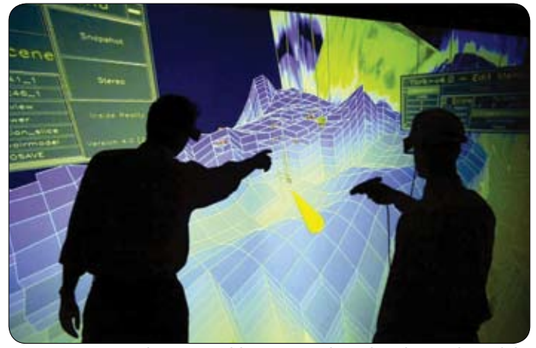

Figure 3: 3D visualisation enables unprecedented understanding of the dynamic reservoir and facilitates collaboration by all members of the asset team

Figure 4: The Multitasking Acquisition Imaging System (MAXIS) seamlessly integrates data from combinations or downhole logging instruments and presents them in easy-to-understand formats, available in real-time at the wellsite or via satellite at the oil company offices

reservoir. This technology has allowed operators to drill fewer, but much better, wells. The technique of geosteering, whereby critical geological information is transmitted from near the drill-bit to surface in real-time while drilling, enables drillers to stay within a reservoir for extended distances or identify and link adjacent reservoir lenses like pearls on a necklace, making a single well do the job of many. Schlumberger has employed these techniques for operators in Trinidad.

Growing the business

As the opportunities arose, Schlumberger established new technology divisions in Trinidad. Dowell Schlumberger (now Well Services), brought its pumping services expertise in the 1970s, and Camco completions division arrived then as well (although Camco did not become a part of Schlumberger until 1998). Anadrill (now Drilling & Measurements) arrived in Trinidad in the early 1980s, and immediately impacted drilling efficiency with its measurements-while-drilling and steering technology.

Most recently, during the early 2000s, Data & Consulting Services, Schlumberger Information Solutions and WesternGeco all came to Trinidad bringing their unique abilities to enable visualisation of the reservoir and transforming myriad data measurements into actionable information that helps operators reduce decision risk and optimise production. In 2004, the company opened its integrated operating base in San Fernando, allowing easy collaboration, cooperation and sharing of experiences between the disciplines represented, and then in January 2009, these facilities were significantly expanded with the inauguration of an adjacent base that more than doubles capacity. Service integration is a fundamental step in enabling the seamless and efficient delivery of customised services to the industry.

Figure 5: As certain as the surf, breaking endlessly on the beaches of these islands, the energy industry expects to enjoy a long and mutually-rewarding future in Trinidad & Tobago

Figure 6: Time-line showing Schlumberger's milestones of progress in Trinidad

Technology solutions

The coming of the electronics age following World War II precipitated a revolutionary change in oilfield technology. Not only could downhole tools and systems be made more reliable and accurate, but many more measurements could be run in combination. This advantage saved considerable time, but it also eliminated a major quality impediment, correlating the depths and data from logs run on subsequent descents into the well. Modern computer-based surface equipment was developed to handle the vast amounts of data – this equipment is routinely used on every well in Trinidad today (Figure 4).

Again, the challenges presented by Trinidad's complex reservoirs, supplied the opportunity to introduce the latest technology solutions. For example, the first commercial distributed temperature system (DTS) was installed in a Trinidad producing well. DTS provides a way using a fibre optics sensor to monitor producing well temperature across the entire profile of the well, thus enabling the early identification of flow anomalies so prompt remedial action can be taken to eliminate or forestall them. Permanent production monitoring, facilitated by DTS, is a key step in achieving production optimisation.

Inasmuch as long lateral wells can now be geosteered to access thin, but prolific, reservoirs, it has become essential to develop concurrently ways to convey production logging tools into wellbores that may be horizontal, or even up-sloping. The Max-Trac downhole tractor can pull more than its own weight in wireline logging tools into the well to measure produced fluids and how they flow. In fact in a recent 4-well project, the tractor pulled its string of logging tools more than a cumulative 50-miles during a single month for a local operator.

Footprints on the beach

As it has throughout the world, Schlumberger has hired, trained and promoted Trinidadians, and given them equal opportunity to enjoy success in rewarding careers both at home and abroad. As of mid 2008, more than 140 Trinidad & Tobago nationals were working overseas with the company. A significant number of those who have gone before have returned and use the experience gained with Schlumberger working in other companies here, many in positions of leadership. The majority of the staff at Schlumberger's Trinidad & Tobago operations are Trinidadian, but the tenets of good citizenship and community involvement go much farther.

The Schlumberger Excellence in Educational Development programme (SEED) provides opportunities for young people from local secondary schools to learn about science and mathematics in general and energy issues in particular. The insights they gain will help them in selecting their ongoing courses of studies to prepare them for their life's work (Figure 2). The culture of educational support is carried further by the contribution of state-of-the-art interpretation software to the University of Trinidad & Tobago and the University of the West Indies under the auspices of the CAMPUS Programme.

If it can be said that the tracks of the petroleum industry are inexorably wound throughout the history of Trinidad & Tobago; it can also be said that the influence of Schlumberger can be seen in those tracks as well (Figure 5). Through the steadfast commitment of the oil-operating companies as well as the service and supply industry, the oil and gas industry will continue to be important in developing these islands natural resources (Figure 6). There are 'diamonds' yet to be found. ❑