Preparing for unconventional gas

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ANDREW GOULD began his career at Schlumberger in 1975. He held the positions of treasurer of Schlumberger Ltd, Executive Vice President of Schlumberger Oilfield Sevices and President & Chief Operating Officer of Schlumberger Ltd before assuming his current role in February 2003.

After four decades of nearly uninterrupted growth, worldwide natural gas demand is still expected to increase at an average rate of 1.5 per cent per year over the period from 2007 to 2030. This is nearly double the average increase in oil demand over the same period. As a result, significant efforts will be needed to find and produce considerably more gas than is currently available. At the same time, changing worldwide patterns in gas demand and supply are leading to greater inter-regional gas trading – an activity that will more than double over the next two decades.

In meeting expected demand, two recent evolutions predominate. First, a massive expansion of liquefied natural gas (LNG) capacity has begun, with much of this supply expected to become available by 2012. Initial trade in LNG had been mainly confined mainly to the Asia-Pacific region as a centre of demand, with supply drawn from sources in Asia and the Middle East. In the future however, sources of supply will expand to Africa and the Middle East while demand destinations will include new Asian, European and North American facilities.

The second major evolution over the last decade has been an increased supply from unconventional gas sources in North America. While some of the necessary technologies were developed and tested with public funding during the 1980s, it took a major R&D effort – particularly from the service sector – together with favourable market conditions and the innovative attitude of North American operators to yield such a supply expansion.

Amongst the technologies that have recently enabled a massive development of shale gas reserves, new processes can maximise the contact between the shale formation and the wellbore completion in horizontal wells that are drilled and then fractured hydraulically in multiple stages to enhance well productivity. Other new technologies include the use of three-dimensional seismic in conjunction with natural fracture detection, advanced petrophysical techniques, and a new generation of reservoir analyses using surface and sub-surface measurements, together with advanced core testing performed in laboratories such as the Schlumberger TerraTek Geomechanical Centre of Excellence in Salt Lake City, Utah, USA.

These technologies have led to impressive results from newly developed formations such as the Haynesville shale in Louisiana where initial production rates are an order of magnitude higher that the early wells in the Barnett shale in Texas. Production decline rates in the newer wells also show improvement, but will need to be observed for a while longer before firm conclusions can be drawn that this aspect of performance is also better than that of earlier wells. Some of the new technologies that have been used to achieve these results include the use of novel materials and techniques to target specific zones in the reservoir. Others employ micro-event-based real-time monitoring of fracturing operations to ensure

Shale gas wells require extensive technology deployment to reach their full potential

that the treatments are placed as effectively as possible. Such monitoring also brings enhanced efficiency to horizontal well fracturing through pumping only what is needed to accurately place the fracture. Similar productivity results are also being obtained in the Canadian Montney and Horn River Basin shales in British Columbia. However, concerns have been raised about the health, safety and environmental footprint of these fracturing operations. Schlumberger is advocating close cooperation between the regulating authorities, operators and service companies, including the open disclosure of components used in fracturing fluids.

Unconventional gas now represents more than 40 per cent of US domestic production and more than 10 per cent of world production, yet much remains to be done in characterising the real amount of unconventional gas resources worldwide. These resources include tight gas and coal-bed methane in addition to shale gas. And following the early successes recorded on land in the United States, a number of operators are actively investigating opportunities outside North America.

Indeed, an initial basin analysis has identified a number of such opportunities with a total of 688 shales having been assessed in 142 basins worldwide. More detailed analysis will provide better estimates of total gas resources in varying geographical areas as current estimates have a wide range of uncertainty.

In the rest of the world, natural gas prices and project costs will dictate whether, where and when unconventional gas development will expand: today, major coal-bed methane projects already exist in China and in Australia. However natural gas prices around the world have dropped even further than those of oil and coal over the last two years. This fall has been due to the combination of falling demand resulting from the financial and economic crisis, the increased contribution of shale gas, and the expansion of LNG liquefaction and regasification capacity around the world. The near-term prospects for major new gas developments are therefore somewhat dim. The total LNG liquefaction capacity scheduled to start between 2009 and 2013 is around 130 bcm per year – a figure that corresponds to 4.5 per cent of world demand. Nearly half of this supply comes from Qatar alone and the combination of new supply and decreasing demand is leading to the creation of excess capacity of approximately 160 bcm/year. This will require as many as three years of demand growth to be absorbed, and in the absence of any major coal-to-gas switch in power generation implies that the prospects for natural gas prices remain weak for a similar period. Therefore, while several OECD countries including some in Europe have significant unconventional gas resources, major developments are not likely to occur until the middle of next decade given the higher cost of developing those assets. However, replication of the North American success will require the development of technological, logistical, and operational resources that are currently not available in the majority of other countries. In response, Schlumberger has created two new centres of excellence for unconventional gas outside of North America, covering respectively Europe and Africa, and the Middle East and Asia. These centres are fully staffed with technical expertise ranging from geology and geophysics to reservoir and production operations. Lessons learnt from North American cases are captured through Schlumberger's knowledge management systems, allowing a faster evaluation of field development options. Still, unconventional gas fields vary widely in terms of geology and hydrodynamics, and fit-for-purpose solutions often need to be developed for individual fields. A recent example is the breakthrough made in the development of very hot, deep, potentially abundant, but tight gas resources in Oman. Numerous previous attempts had failed to break this very tough formation, but a solution was found that began with a complete geomechanical analysis of the reservoir rock using the latest acoustic scanner wireline logging measurements. After that, a totally new formulation was devised for the fracturing fluid, in which high concentrations of weighting particles provided enough weight to crack the formation.

In conclusion, the implementation of the successful technological solutions that have enabled the globalisation of gas as well as an excess supply for the next couple of years, have been the result of a long-term commitment by both operators and service companies. Provided demand for natural gas continues to grow, the second half of this decade should witness a push to diversify the supply base through a global expansion that includes non-American unconventional gas. Our own commitment at Schlumberger continues to grow and we believe it essential to maintain such commitment through industry cycles – both up and down. ■

Replicating North American success will require technological, logistical and operational resources currently not available in most other countries

New stimulation formulations begin with extensive laboratory development