Deepwater Completions Offer Great Potential

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Probert began his career in 1972 as a field geologist with Exploration Logging Inc. He earned a BS degree in geology and geography from the University of London.

Deepwater E&P is a growing part of the world's energy supply. Estimates are that deepwater production will grow 78% by 2011, making it one of the leading growth sectors in our industry.

The explanation is simple: many of the world's largest untapped reservoirs are in deep water. The "golden triangle" of the Gulf of Mexico, offshore Brazil, and west Africa are joined by newer areas of opportunity in India, Malaysia, Australia, the eastern Mediterranean, offshore Norway, and eastern Canada. There are even more promising possibilities in the salt and subsalt reservoirs located in the basins of the golden triangle.

The industry's definition of deepwater exploration and its technical challenges are expanding along with knowledge of the reserves. Ten years ago, deep water was anything more than 1,500 ft water depth. Today, the deepwater frontier is more than 5,000 ft. The frontier of a decade ago is now practically routine. And along with these greater water depths, operators are facing increasing total well depths and higher temperatures and pressures.

The deepwater opportunity comes at a price—the high rig rates and capital intensity make it a high-risk and high-reward proposition. And the enormous technical challenges make deepwater wells a focal point for developing and deploying advanced technology in every aspect of well construction and production.

Completions technology brings operators more production, lower costs and lower risks, and holds the promise of enabling the future production the world demands. What follows is a snapshot of the deepwater completions picture, with emphasis on those areas that will contribute most to operators' success. All these elements are interrelated and complementary. Developments in one area contribute to the effectiveness of the others. Ultimately, it is the integrated development of all aspects of deepwater completions that promises to make possible the production the world is counting on over the next several years.

High-Rate Fracturing Systems

Stimulating production through hydraulic fracturing is a proven way of making deepwater wells economical. Frac packs of long, thick unconsolidated producing intervals in turn depend on the ability to pump frac fluid at a high rate and place proppant in large quantities.

Tools and techniques that make access to these zones profitable include using hydrostatic properties of frac fluids to increase bottomhole fracture pressure without unsafe surface treating pressures. This helps achieve the high pressure needed for the fracture without exceeding the pressure rating of surface equipment. Also, tool systems using carbide-protected crossover tool designs are now able to withstand the large volumes of proppant at high rates needed to capitalize on the high-rate fluid pumping. These technologies are valuable in their own right, and they are crucial to the development of single-trip multizone completions.

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Openhole Horizontal Completions

Openhole and horizontal completions are finding increasing application in subsalt and presalt reservoirs as well as in the traditional turbidite reservoirs that have been the mainstay of deepwater development. Even in consolidated reservoirs that do not require sand control, openhole horizontals offer the maximum reservoir contact and the opportunity for maximizing recoveries.

Openhole horizontal completions depend on a wide range of technologies to combine sand control, increased recovery, stimulation, and life-of-well production efficiencies from isolated, individual zones. These include multiple-stage fractures, controlled inflow from naturally fractured carbonate reservoirs, and inflow control.

Standalone Screen Completions

Filtration is the heart of any sand-control completion, and new filtration technologies are making standalone screen completions an attractive alternative to gravel packs. The new generation of premium screens resists plugging for a broader range of sand sizes and overcomes some of the traditional limitations of standalone screen completions. Such screens make possible a new level of sand control for a broader range of reservoir types. In addition, these screens have enabled efficient completions in deepwater multilaterals.

Multilateral Architecture

TAML Level 5 multilateral drainage architecture for deepwater development has been successfully demonstrated in the North Sea, where it was combined with standalone screen completions for sand control. New filtration technology can replace gravel packs, which are time-consuming and expensive to execute in Level 5 multilaterals because of their complex geometry. This combination makes the advantages of multilaterals available to deepwater reservoirs that need sand control.

Better Reservoir Management

As completions become smarter, they have increased ability to control selected zones to accelerate production and increase ultimate recoveries. Intelligent completions is a large category that includes many technologies that contribute to making completions more flexible and more responsive. The most salient for deepwater development in the near term is the use of inflow control valves (ICVs) with sand control screens to control different intervals in extended multizone wells. In addition, most deepwater projects use water injection for pressure maintenance, and ICVs enable effective management of water injection for maximizing indi-

vidual zone productivity and increasing overall sweep efficiency, while helping to minimize the need for more costly smart injectors.

Today's sand control screens have evolved to handle specific sand control tasks under different conditions. When combined with swellable packers for section isolation, ICVs balance flow from the sections of the pay interval, and with the design based on sound reservoir understanding, they can balance production from different intervals to prevent water coning, delay water or gas breakthrough, and choke inflow from higher-productivity zones while increasing drawdown on low-productivity zones to yield higher production and higher net recovery.

Single-Trip Multizone Completions

Completing multiple-zone wells that require sand-control frac-pack treatments are often prohibitively expensive, if each zone needs to be stimulated, perforated, and frac-packed with separate trips. Such an operation can consume weeks of rig time, and can make the cost of completion approach that of drilling the well. These wells can be economical, however, if they can be perforated in one run, and then all be fractured and completed in one run. Then the operator can achieve substantial rig time savings and significantly improve the overall economics of the project.

Single-trip multizone completions are enhanced by the ability to frac pack at higher pump rates and place larger volumes of highly abrasive proppant. This is made possible by advances in high-rate fracturing tools, and this capability helps ensure that the optimum stimulation design can be applied to each interval. And along with individual fracturing and isolation of discrete lobes, production from each zone may be selectively controlled. Also, the use of modular screens that provide the ability to isolate each zone helps control fluid loss after pack placement.

These single-trip completions, which are just entering the market now, are not just for subsalt reservoirs, where the economics may be most compelling, but for any deepwater well with long pay zones in unconsolidated formations requiring sand control.

The dramatic growth of deepwater production that the world anticipates is being made possible by these advances in completion technologies, which are taking time and cost out of the process, offering greater production control and more efficient reservoir drainage, and reducing the risks of working at the deepwater frontier. It will be the combination of these technologies and the ability to capitalize on their potential through integrated design that can bring the greatest rewards. JPT