OTC 20136

Future Advanced Completion Technologies to Maximize Recovery

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Abstract

This paper addresses the evolution of advanced well completions as well as plans to develop future intelligent well completions in Saudi Aramco fields. Potential associated technologies to maximize recovery from future wells will be also discussed. To develop Saudi Aramco's vision of Extreme Reservoir Contact (ERC) wells that will facilitate better well/ reservoir management, maximize recovery from major producing fields and achieve full control in motherbores and laterals, Saudi Aramco embarked on several collaborative technology developments with major service providers and academia centers to develop required technologies to achieve this vision. Future ERC wells are set to play a pivotal role in the future oil field operations. ERC wells are intelligent multilateral wells that do not require individual control lines from the wellhead to each lateral or zone, and therefore theoretically allow an unlimited number of intelligent laterals. The plan to develop the next generation ERC wells builds on the recent success of using Maximum Reservoir Contact (MRC) wells in the Haradh field.

Introduction

With increasing demand for hydrocarbons, the industry is required to push towards advanced methods and technologies to maximize recovery and lower development costs in more complex reservoirs. Particular attention must be paid to well completion technologies as drilling complex wells becomes easier. The need to use advanced well design and architecture has been driven by the need for complete monitoring and control of the completion design, and therefore maximal reservoir sweep efficiency. Complexity of flow and potential gas/water production hinders and/or ceases flow. These wells are made intelligent by deploying intelligent systems that will provide data acquisition and flow control in real time. These advanced completions can reduce field development costs by reducing the total well count required to maintain set production targets (Yeten et al., 2001; Ramakrishnan, 2003; Artus et al., 2006).

On the other hand, reduction of life-cycle unit operating costs can be beneficial by allowing real time inflow control for multilateral well completions and real time access of flowing bottom-hole pressure and temperature data, therefore reducing well intervention and associated risks. These benefits will result in better reservoir management, enhanced production deliverability, and a positive impact on overall backpressure in the facilities system reducing the need for facility expansion over time.

In the early 1990s, operators were pondering whether drilling a multilateral completion would be possible and beneficial. Now, multilateral completions have become the de facto operational design and the current question in field design is what type of well configuration and multilateral deployment is suitable for the field development and required production at hand. Multilateral completion is an essential tool for actual and future development of hydrocarbon reservoirs worldwide. Thus, the development effort started from these ideas in the 1990s, and multilateral horizontal well technologies have indeed shown increases in production rates, especially from wells sustained by water injection. Multilaterals of 4 to 7 legs were typically drilled for both producer and injector wells. The initial distance between injector and producer legs decreased from 250 meters (m) to 60 m with time and development; this has improved the sweep efficiency and enhanced recovery (Boyle et al., 2003). The implementation of multilateral technologies has substantially enhanced oil production through decreasing drawdown pressures and increasing sweep efficiencies within the reservoirs (Oberkircher et al., 2003). Enhanced drainage contact area by adding more drainage sources yields in-depth drainage of the reservoir, especially in restricted zonal reservoir and/or production from multiple reservoir layers where available.