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Enabling Efficient Permanent Production Monitoring of Advanced Well Completions in Saudi Arabia Using Fiber Optic Distributed Temperature Sensing

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Abstract

Although the recent focus in the industry on maximum reservoir contact (MRC) and Advanced well completions has provided significant improvements in reservoir depletion it has caused some data gathering disruptions for companies operating these wells. In particular, the options to perform well logging are much reduced, and the costs of performing a production log are extremely high. This is related to both the costs of the more advanced horizontal well logging tools and the more expensive logging methods, such as coiled tubing and tracker systems, used for the conveyance of these tools into the wellbore.

In an effort to acquire high quality downhole data in a timely manner in MRC wells, Saudi Aramco set about investigating the alternatives to traditional production logging methods. A technology gaining greater industry acceptance in recent years is permanently installed Distributed Temperature Sensing (DTS) and this became the focus of investigation. The limitations of conventional DTS technology was, however, soon realized; In particular the limited temperature resolution offered was not sufficient for evaluating high angle maximum reservoir contact intelligent wells. At the time of investigation a new generation of DTS technology became commercially available, providing a 10-fold improvement in measurement resolution. This allowed Saudi Aramco to proceed with field trials of the technology.

This paper will present the requirements for advanced DTS technology to provide quality data sets for use in rate and density modeling in highly deviated MRC wells.

In addition, the installation of the downhole hardware in an advanced well completion and the data from the field trials will be presented.

Background

Over the past six years, Saudi Aramco has pioneered the use of Smart and Intelligent well systems in its MRC wells to reduce development costs and prolong unwanted water production and control early gas breakthrough. Saudi Aramco's original maximum reservoir contract (MRC) wells included openhole laterals drilled from a 7" completion liner to provide the required contact/reservoir foot print to optimize rate and recovery[1].

More recent designs have utilized smart well completion technology in the 7" cased mother-bore to control inflow from each lateral to extend well life and increase recovery (as seen in **Figure 1**). In the event of water/gas break through in any lateral, the downhole valves are remotely operated from the surface through hydraulic and instrument lines run outside the production tubing.

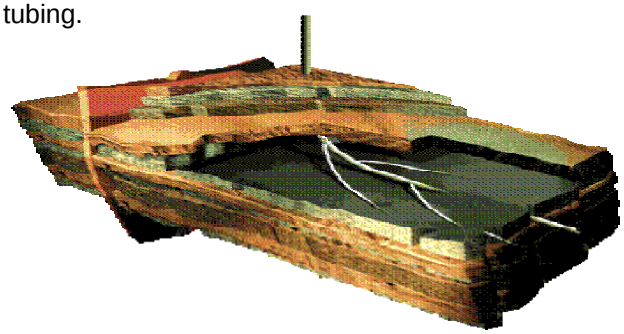

Figure 1 MRC Well Completion

Current MRC smart wells utilizing multi-position valves, multi-phase surface flow meters, and single point downhole pressure / temperature gauges allowing individual lateral well tests by shutting in all but one lateral. This technique dose not account for lateral interference and friction. In an effort to provide real time lateral monitoring, Saudi Aramco has performed a trial