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## **Reservoir Management Practices in the Offshore Oil Fields of Saudi Arabia**

Hassan B. Al-Qahtani, Phillip Warren, Ali M. Al-Shahri, Abdulrazzaq Al-Muhaish; SPE, Saudi Aramco

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### **Abstract**

Challenges associated in developing mature offshore fields of Saudi Arabia require the optimal integration of best reservoir management practices. Such complicated fields require effective collaboration between reservoir engineers and geoscientists for the application of latest technologies and best practices. A variety of practices were implemented to achieve significant improvements in drilling and completing horizontal wells. Some of these challenges have been addressed with the installation of over 200 inflow control devices (ICD) which are used to minimize water coning and gas cusping affects. Economic development of these offshore projects have involved the implementation of 20 Smart wells, in conjunction with, intelligent field monitoring that improves surveillance and reduces manpower requirements. Real-time geo-steering practices, advanced logging measurements, and seismic imaging techniques were successfully utilized for well placement of over 100 horizontal wells in a geologically complex sandstone environment. Also discussed are some future fit-for-purpose technologies that are being considered for these offshore field development projects.

### **Introduction**

The developed offshore fields (M, Z and S) of Saudi Arabia are located in the Arabian Gulf and consist of sandstones, siltstones and shales with minor limestones and coals deposited in a complex, fluvial dominated delta system. The main producing reservoirs consist of massive, clean highly permeable 1-5 Darcy sandstone units interspersed with shales. The primary drive mechanisms for all three fields results from natural aquifer influx with limited support from gas cap expansion in two fields. Table-1 shows some reservoir characteristics and completion type.

Historically, all wells drilled in these fields have been free flowed to the surface without any artificial lift. Recently, one of the fields installed a number of electrical submersible pumps (ESPs) to increase well productivity. For other wells that cease to flow at high water cut, a drilling program has been undertaken to convert these vertical wells to horizontal wells with passive inflow control devices (ICDs). Horizontal wells were introduced in the early nineties in all Saudi Arabian offshore fields to sustain production targets. Before 2003, most horizontal wells drilled in the sandstone offshore reservoirs were completed as cemented and perforated liners completions. After 2003, many of the new horizontal wells began using ICDs to improve production profile along the horizontal lateral section. These new completions increase the distance to the oil water contact (OWC), reduce water coning tendencies, and extend the life of the well. Additionally, for those those wells located in fields with a central gas cap dome area, Smart in-situ gas lift technology is available to increase production and further extend well life.

The objective of this paper is to share the best reservoir management practices and strategies to meet challenges associated in developing mature offshore fields of Saudi Arabia.

### **Reservoir Management Practices**

The reservoir management philosophy in the offshore environment is to maximize the economic recovery of oil and gas reserves while meeting production demand targets. In addition, the Saudi Aramco strategy offshore is to minimize water and gas production to avoid adverse affects on the facility infrastructure. Hence, best in class reservoir management practices and innovative technologies were adopted in offshore fields to mitigate some of these concerns. The successful practices and technologies used to achieve significant improvements in drilling and completing horizontal wells in very complex reservoirs include: