



SPE 110064

Monitoring Production From Gravel-Packed Sand-Screen Completions on BP's Azeri Field Wells Using Permanently Installed Distributed Temperature Sensors

I.D. Pinzon, SPE, J.E. Davies, SPE, BP, F. Mammadkhan, SPE, and G.A. Brown, SPE, Schlumberger

Copyright 2007, Society of Petroleum Engineers

This paper was prepared for presentation at the 2007 SPE Annual Technical Conference and Exhibition held in Anaheim, California, U.S.A., 11–14 November 2007.

This paper was selected for presentation by an SPE Program Committee following review of information contained in an abstract submitted by the author(s). Contents of the paper, as presented, have not been reviewed by the Society of Petroleum Engineers and are subject to correction by the author(s). The material, as presented, does not necessarily reflect any position of the Society of Petroleum Engineers, its officers, or members. Papers presented at SPE meetings are subject to publication review by Editorial Committees of the Society of Petroleum Engineers. Electronic reproduction, distribution, or storage of any part of this paper for commercial purposes without the written consent of the Society of Petroleum Engineers is prohibited. Permission to reproduce in print is restricted to an abstract of not more than 300 words; illustrations may not be copied. The abstract must contain conspicuous acknowledgment of where and by whom the paper was presented. Write Librarian, SPE, P.O. Box 833836, Richardson, Texas 75083-3836 U.S.A., fax 01-972-952-9435.

Abstract

BP is developing its Azeri field using deviated gravel-packed sand-screen completions producing from the multilayered Pereriv B, C, and D reservoirs. Restricted wellhead access, high rates, and differential depletion of the different reservoir intervals limit conventional production logging possibilities, so BP has chosen to install permanent fiber-optic distributed temperature monitoring systems with its sand screens and to use these systems to monitor production rates and changes over time.

The optic fiber has been installed on the periphery of the sand-screen shroud, effectively installing it in the gravel-packed annulus. When the gravel pack is completed, the fiber responds to the reservoir temperature plus the effect of Joule-Thomson warming of the flowing oil caused by the pressure drop (drawdown) in the near-wellbore region. Thermal mixing of the oil with flow from below only occurs once the flow has passed through the sand-screen wire-wrap. Thus a direct measure of each individual reservoir drawdown is obtained from the difference between the fiber-measured temperature and the geothermal temperature in the flowing reservoir intervals. Given the reservoir drawdown, the flow rate can then be calculated.

Thus installing the fiber outside the sand-screens gives a unique, direct measurement of individual reservoir layer drawdowns, enabling the effects of differential depletion to be monitored over time.

This paper outlines the completion technology used to install the fibers along the sand screens and shows the data and results obtained where reservoirs with different pressures are commingled through gravel-packed sand-screens. Thermal models of the near-well environment are described and used to analyze the data and to obtain the flow profile and reservoir layer pressures.

The use of permanently installed fiber-optic distributed temperature monitoring systems on its Azeri reservoir has allowed BP to acquire early time-surveillance data, adding significant value by reducing the voidage risk to the secondary reserves.

Introduction

The Azeri-Chirag-Gunashli (ACG) complex of reservoirs are located offshore Azerbaijan in the South Caspian region and extend a total of 48 km along their axis (**Fig. 1**). The fields were discovered between 1979 and 1987 and first production occurred in 1980. The Azeri field constitutes the south-eastern culmination of the structure and is being developed by a consortium of oil companies with BP as operator.

The main producing formations are the Pereriv units B, C, and D which consist of laterally continuous layers of sandstones with excellent intrafield connectivity and permeability, interbedded with shaly layers. The reservoirs are part of a multilayered sandstone anticline with approximately 5 billion barrels of reserves in place. The field's north flank dips steeply at about 35 degrees and has a 1000-m oil column between the gas/oil and water/oil contacts. The south flank dips less steeply (20 degrees) and is suspected of having perched oil/water contacts. Voidage support will be achieved by both water and gas injection, and effective voidage replacement is considered critical to optimum reservoir drainage (**Fig. 2**).

The development strategy of the Azeri field requires a good understanding of the production and injection conformance both geographically as well as by formation. Similarly, monitoring the gas-oil ratio (GOR) in the producers as well as water injection conformance is critical for a robust reservoir management strategy.

The high-deviation producing wells will be mostly completed with sand screens and are capable of up to 50,000 BOPD flow rates. The main technical challenges being addressed by BP are:

- Sand control issues in the soft sands – requiring sand screens and gravel packs.
- Well performance and management issues in the high-angle, long well bores.
- Reservoir uncertainty, gas-oil and water-oil contact location, and movement over time.