CHALLENGE
Obtain early, rapid feedback of production rates and reservoir depletion effects over time from wells with sand control issues.

SOLUTION
Installed WellWatcher BriteBlue* multimode DTS fiber along the sand screen to allow early time-surveillance data acquisition.

RESULTS
Obtained rapid feedback that allowed a better understanding of reservoir performance, helped optimize new well placement, and improved the reservoir model. Achieved significant cost savings since conventional production logging tool measurements would have required interruptions to the drilling program.

Sand control, well performance and management, and reservoir uncertainty
A field located in the South Caspian region contained wells producing from three multilayered reservoirs. Sand control issues with soft sands and long, high-angle wellbores led the client to use gravel-packed sand screen completions. The high-deviation wells were capable of flow rates to 7,949 m³/d (50,000 bbl/d) in the early stages of production. Technical challenges facing the client included reservoir uncertainties, gas/oil and oil/water contact, and fluid contact movement over time.

Distributed temperature sensing for reservoir monitoring
Conventional reservoir surveillance programs frequently use PLT measurements to determine the flow contribution from individual sand bodies. In this South Caspian field, however, restricted wellhead access, high flow rates, and differential depletion of the reservoir intervals limited the use of PLT measurements. Consideration of delayed production and rig costs made PLT measurements even less attractive.

Because sand screen completions were standard in the field, installing the WellWatcher BriteBlue fiber with the sand screen was determined to be the best way to obtain the time-surveillance temperature data needed. Temperature measurements were made every meter along the length of the optical fiber. The data were continuous and showed how production varied with time because of changing reservoir conditions.

Successful monitoring of reservoir depletion and gas breakthrough
The WellWatcher BriteBlue fiber was installed in a new well producing at the rate of 5,565 m³/d (35,000 bbl/d) with a constant gas/oil ratio (GOR) of 880. Temperature data changed in layers after the well was on production for 2 months. Because the oil properties did not change, the only explanation for the temperature change was that reservoir depletion had occurred. The reservoir pressures in the thermal model were decreased until the Joule-Thomson inflow temperatures matched the data from the WellWatcher BriteBlue fiber and the calculated flowing wellbore pressure matched the pressure gauge recordings. These results confirmed that WellWatcher BriteBlue fiber measurements can be applied in multilayered reservoirs to determine the magnitude of changes in the pressures of individual layers after a well has been placed on production.

During the first 3 months of production, the GOR increased to more than 2,500 from 1,000 in one of the other new wells. The WellWatcher BriteBlue fiber showed rapidly decreasing temperatures in some reservoir layers, whereas temperatures in other layers remained unchanged. Comparing the
early DTS data with those recorded 4 months later clearly indicated that gas breakthrough was occurring in much thinner layers than suggested by the gamma ray shale indicator in the first thermal well model. Initial DTS data indicated a flow split of 50% between two of the reservoirs; however, after only 3 months of production, the analysis showed that the flow split had changed to 25% from one reservoir and 75% from the other. These results confirmed that the gas was not breaking through in a flat flood front but that individual layers were fingering gas through different parts of the reservoir.

Advantage of installing DTS system outside the sand screen
The temperature measured by a temperature log or a DTS system is usually the axial mixture temperature, that is, the temperature at the center of the completion. However, when a WellWatcher BriteBlue fiber is installed on the outside of the shunt tube in a high-flow-rate well that is gravel packed, the fiber measures the Joule-Thomson temperature of the layer flow before it passes through the wire-wrapped sand screen and mixes with the flow coming up the well from deeper layers. Measuring at that point has significant benefits because the temperature responds both to each flowing layer, allowing layer identification, and to the effects of changes in layer drawdown and fluid properties.

The WellWatcher BriteBlue fiber provided rapid feedback from wells early in their production cycle, which allowed a better understanding of reservoir performance, helped optimize new well placement, and improved the reservoir model. In addition, significant cost savings were achieved because conventional production logging tool measurements would have required interruptions to the drilling program.