Downhole Gauges Meet Challenges of Operating Beside ESPs in HT Reservoir

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Talisman Energy needed to enhance its continuous downhole monitoring capability at the Gyda field offshore Norway with a system that could perform in high-temperature (HT) conditions and operate beside electric submersible pumps (ESPs) in two oil production wells.

Situated in the southern Norwegian Sea 270 km from Stavanger, Gyda is a mature field in which production peaked in 1995. To address the increasing water production and decreasing reservoir pressure, the company installed ESPs in the completion of new wells A-19A and A-26 in 2011. Estimated field production for 2011 was 8,000 BOPD, according to the Norwegian Petroleum Directorate. The field's production license was recently extended to 2028.

Challenges for New Monitoring System
The Gyda field has an extensive permanent downhole monitoring network that tracks information on individual well conditions, such as temperature and pressure. Through sensors, gauges, and other downhole operating equipment, Talisman can monitor and, if necessary, maintain pressure; control each well; and optimize field production. However, adding monitoring systems to the A-19A and A-26 wells presented special challenges.

The systems, which would need to monitor well zone conditions and the ESPs to ensure their function at the optimum points of their pump curves, would face reservoir temperatures as high as 160°C (and pressures as high as 300 bar). The HT environment can put enormous stress on instrumentation and impair its ability to generate reliable data. The standard gauges designed for the ESPs were not qualified to operate at the higher temperature levels found in the Gyda reservoir, thus further justifying the need for enhanced permanent monitoring.

Another challenge was that the new downhole monitoring systems would have to operate effectively next to the ESPs. These pumps require large amounts of power, which is transferred downhole on a three-phase cable. This cable runs alongside the ESP cable and is susceptible to noise disturbance from the pumps' motors and variable speed drive (VSDs).

The VSDs—at 12 and 24 pulse, for example—can cause total harmonic distortion. This can be induced onto the downhole gauge control lines and interfere with downhole communication and gauge electronics, particularly during an ESP startup when the drive current can be six to eight times the normal operating current.

Gauge Selection and Testing
Talisman selected Emerson Process Management's Roxar downhole HS gauges to meet the challenging requirements at the Gyda field. Manufactured and delivered on a fast track to meet a tight timeline, the gauges were subjected to 5 months of comprehensive onshore testing to prove that they could work seamlessly next to ESPs without being affected by the noise.

In the onshore testing, the gauges operated beside an ESP system that consisted of an integrated downhole network from Emerson that used a twisted cable pair connected to a gauge.

As part of the testing, the ESP was connected to a 12-pulse VSD using a 30-m cable. The gauge under consideration was strapped on top of the ESP cable, and 10 m of tubing encapsulated cable was run alongside the ESP cable. The ESP was operated across the full frequency range of the VSD.

Oscilloscope plots of the induced noise were obtained and analyzed, with the results showing that the new gauges experienced no noticeable loss of performance or interference when run in close...
proximity to the operating ESP. The gauges were fully operational at the moment the ESP started.

For comparison, a standard monobore gauge system was also tested. This system encountered a high number of communication dropouts related to temperature and pressure measurements the moment the ESP was switched on. These problems increased as the pump continued to operate. These failures were in line with expectations regarding this type of system functioning beside an operating ESP.

**Performance of New System**

Following the successful tests, Talisman completed wells A-26 and A-19A in early 2011. Fig. 1 shows the diagram for the well and the alignment between the pressure and temperature sensors and ESPs. Both wells employed two ESPs along with a motor oil temperature sensor and vibration sensors. The system consisted of two of the new gauges and two custom-made gauge carriers in addition to a twisted cable pair (tubing encapsulated) and a topside downhole network controller card.

The standard ESP gauges were installed to measure motor winding temperature and vibration. It was expected that they would begin to fail during startup as this regime would be beyond their qualified operating temperatures. The new gauges were in place to ensure the downhole monitoring could continue seamlessly. Thus, the control system was programmed to switch automatically to the new downhole system and begin obtaining data from it after 2 minutes of static data from the ESP gauges.

Once on production, well A-26 experienced temperatures of 153°C and pressures of approximately 300 bar. The downhole system and new gauges have been used for a number of months so far, maintaining the ESPs within the optimum operating conditions after the ESP gauges stopped supplying data approximately 40 days following startup.

The A-19A well experienced temperatures of 131°C and pressures of approximately 300 bar. The well, which produced as much as 65% gas, had a difficult startup with huge vibration exerted as a result of continual attempts to start the ESP with shocks of up to 4.2 G. Throughout this difficult time, with high electrical interference, extremely high vibrations, and a number of startup attempts, the new gauges performed as expected.

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