

Maximus System Produces Gas from Methane Hydrates for 24 Days

WellWatcher Quartz Extend gauges deliver accurate and stable pressure measurements transmitted through the WellNet system, offshore Japan

CHALLENGE

Extend the duration of natural gas production from methane hydrates in a challenging riserless, instrumented deepwater well.

SOLUTION

Create a custom solution integrating Schlumberger technologies, including the REDA Maximus* electric submersible pump system, WellWatcher Quartz Extend* AC- or DC-powered high-resolution dual-sensor PT gauges, and WellNet* oil and gas well surface-downhole communication system.

RESULTS

- Produced approximately 35,000 m³ [1.24 MMcf] of methane gas continuously for 12 days from one well and approximately 200,000 m³ [7.06 MMcf] in 24 days from a second well.
- Completed installations without drilling risers in open sea for the first time.



Challenging ESPs in open-water

Methane hydrate is a white, ice-like solid consisting of methane molecules trapped in a cage-like lattice of ice. Methane is the chief constituent of natural gas. If methane is warmed or depressurized, it changes back to water and natural gas, with 1 m³ [35 cf] of methane hydrate yielding approximately 160 to 170 m³ [5.65 to 6 Mcf] (at 0 degC [32 degF] and 1 atmosphere) of natural gas. Methane hydrate reservoirs probably contain 2 to 10 times the currently known global reserves of conventional natural gas.

An operator in Japan has been researching the development of methane hydrate as a future energy source. The deposit of interest is located at the seabed, 1,000 m [3,280 ft] below mean sea level in the Nankai-Trough, Japan. It is a methane hydrate zone with a well temperature of 13 to 15 degC [55 to 59 degF]. A test in March 2013 used an ESP to reduce the hydrostatic pressure and liberate the methane gas, achieving 6 days of continuous flow. A second production test was planned for 2017 with the goal of extending the duration of gas flow. The operator asked Schlumberger to design, engineer, manufacture, and operate the upper completion.

This well completion presented several challenges:

- Riserless deployment
- Gas separation for high-GOR environment
- Reservoir monitoring for methane production
- ESP capable of operating at 0 degC [32 degF]
- Harsh sand environment

Creating custom solutions

Schlumberger created an integrated solution that included both upper and lower sandface completions. The engineers developed the fit-for-purpose Maximus system for two production wells in the deposit. A modified Y-tool bypass enabled natural separation of gas and water in the wellbore. The bypass leg was open at the Y-tool, which allowed gas to flow to surface while the liquid fell back naturally to the motor shroud at the bottom of the ESP. The liquid was directed by the shroud up past the ESP motor to cool the motor; it subsequently entered the pump intake and was pumped through the Y-tool pump leg to the subsea wellhead, where it was diverted to flexible hoses attached to a riser and then into the surface test equipment on the drillship.

The produced gas was diverted from the annulus to the riser at the subsea wellhead and then flowed to the surface test equipment before being flared off. Data collection was an important aspect of the design. WellWatcher Quartz Extend gauges were placed at multiple strategic locations to measure the change in pressure across the sandface. These gauges have the necessary resolution of 0.001 psi [6.89 Pa] and sampling frequency of 1 measurement per second to perform pressure transient analysis on methane production. The WellNet system, a proprietary technology used to avoid interference from the ESP power cable, was used for data transmission. Additional Phoenix xt150* high-temperature ESP monitoring system gauges were placed directly below and above the Maximus system to monitor the ESP and fluid level.

Achieving industry firsts

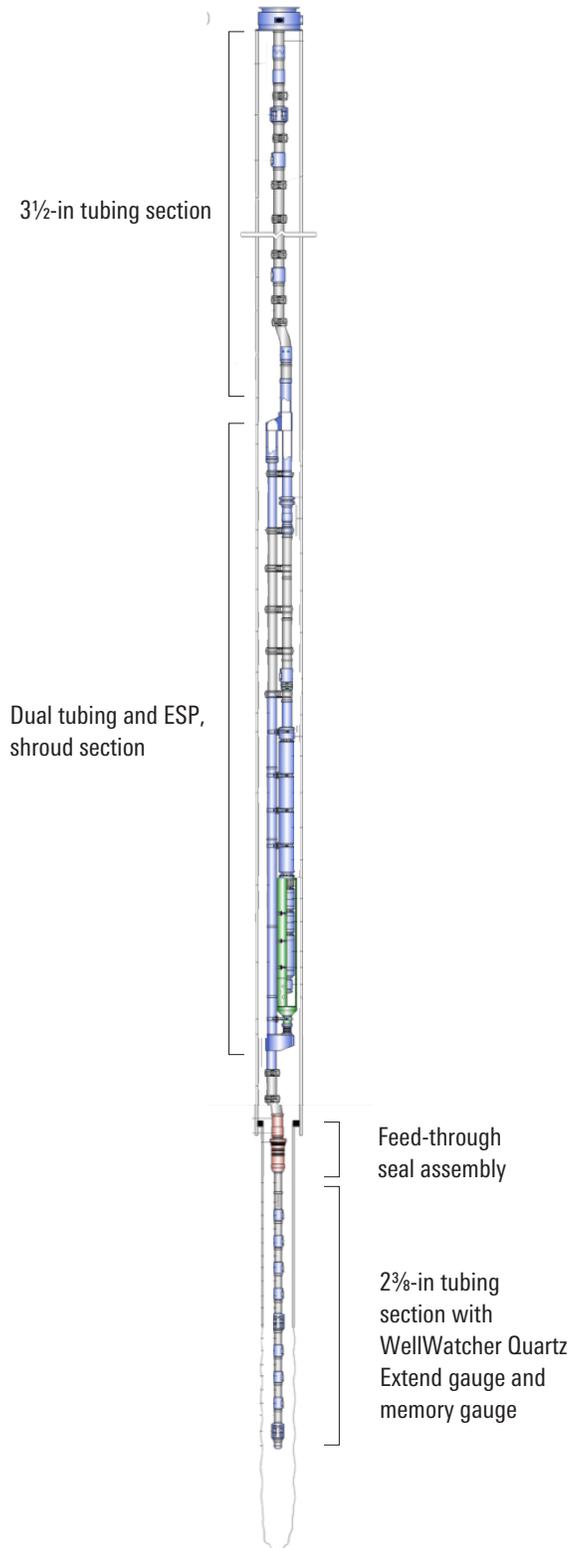
This was the first open-water deployment of an ESP. Assembly of the system on a moving drillship in a cold marine environment with strong currents and high seas presented numerous challenges. To minimize risk to personnel and equipment, sections were preassembled on land and in the

CASE STUDY: Maximus system produces gas from methane hydrates for 24 days, offshore Japan

mouseholes. Special locking washers and thread compounds were used to combat the effects of vibrations induced by rough seas. In addition, special tools were designed and developed for safer assembly of the bypass and pump.

The Nankai-Trough wells were the first with 10 WellWatcher permanent monitoring system gauges, four memory gauges, and an ESP, with successful management of multiple PT gauge cable splices and critical distances between gauges.

The first production well produced approximately 35,000 m³ [1.24 MMcf] of methane gas continuously for 12 days. The second production well produced approximately 200,000 m³ [7.06 MMcf] in 24 days.



Schlumberger designed a fit-for-purpose Maximus system for the production wells.

slb.com/maximus