

Inflow control for Troll

Karianne Amundsen, Scandinavia Area Manager, Tendeka

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In June, independent global completions service company, Tendeka announced it had secured the world's largest sand and inflow control contract for the Troll field on the Norwegian continental shelf (NCS) (Figure 1).



Figure 1: Tendeka has secured the world's largest sand and inflow control contract for the Troll field on the Norwegian continental shelf
Photo credit - Harald Petterson, Equinor

The major four-year exclusive contract with Equinor will see the Aberdeen-headquartered company deliver and install up to 100,000 metres annually of its sandscreens and FloSure Autonomous Inflow Control Devices (AICDs) for sand-face completion.

An initial contract between the two companies for Tendeka to provide screens and ICD/AICDs was signed in 2012 with a further two extensions later agreed. The new agreement offers an additional five two-year extension periods.

Since Tendeka first deployed FloSure technology in the Troll field in 2013, the field adjustable production optimisation technology has been enhanced for use in new and retrofit applications across five continents from marginal heavy oil developments in Canada to new field developments across Asia and gas cap expansions in the mature North Sea basin.

"The Troll field represents the backbone of Norwegian oil and gas production," said Karianne Amundsen, Scandinavia Area Manager with Tendeka. "As this is overlaid by a thick gas cap, the aim is to maximize oil production using our FloSure AICDs and thereby eliminate the associated problems of too much gas production, which could potentially render the well inoperable."

As a large subsea development, which started oil production in 1995, Troll's multilateral, horizontal wells are drilled with total reservoir length, between 3 to 5km within the thin oil column¹. By postponing gas breakthrough and then choking production after breakthrough, the use of AICDs will allow greater oil recovery. Currently, more than 50 wells on Troll are equipped with the technology.

Prior to the contract award, Tendeka worked closely with the Norwegian operator to further develop the FloSure rate controlled production (RCP) AICD, delivering improvements in overall performance and gas control.

Simple design with optimum performance

AICDs comprise of only three components: valve body, nozzle and disc and are small enough to be installed within standard passive ICD housings. Importantly, the size of the nozzle on the device is interchangeable at the rig based on drilling results. Deployed as part of the lower completion using zonal isolation packers to divide the reservoir into compartments, the AICD can be integrated with sand control screens for soft formations.

"It's an incredibly versatile technology," explained Amundsen. "Knowing how to apply the technology correctly by quantifying the value and optimizing the design is crucial. We've developed our own modelling software to be able to predict the performance of the AICDs in any application. This is where our expertise is second to none."

On Troll, all new wells are infill wells that are drilled in between branches of older or abandoned wells, these intersect areas of varying oil column thickness. Here, wells need to be drilled with care to avoid early gas breakthrough and sand production to surface.

The depth of the oil/water contact in these longer, horizontal multilateral wells varies, as does the reservoir properties. Therefore, the wells are completed with standalone sand screens and inflow control devices to monitor flowing and shut-in pressure for the individual branches.

When gas or water flows through the AICD valve at the same drawdown, the velocity of the water and gas will increase, reducing the dynamic pressure. To restrict the flow rate of low viscosity fluids, this action will levitate the disk toward the inlet to choke the flow.

AICD technology is fundamental for continuing oil production on profitable margins and as such, significant mechanical design modifications have been implemented for improved completion integration, robustness and longevity.

New and retrofit applications

FloSure AICDs have been deployed successfully in light and heavy oil wells to overcome water or gas breakthrough and ensure uniform production longevity.

For example, it has also been successfully implemented as a pilot project in horizontal wells at the Jasmine and Ban Yen fields, in the Gulf of Thailand to reduce gas breakthrough. The AICD well has now been producing for more than one year and at significantly lower gas to oil ratios than previously.²

In Canada, the design resulted in an overall increase in oil production by 150-250% with water production reduced by 40-50%. This led to an improved return on investment of more than 250% per well, with a far lower risk of water problems compared to the previous solutions applied.³

Several wells have recently been completed with AICDs for a major operator in the Middle East. The AICD completion has reduced the water cut of the wells to below 50% for AICD wells compared to 90% in the analogue wells, limiting the water production from the fractures. Several other new AICD wells are being planned in the Middle East.

Following successful installation in pilot wells, retrofitting existing completions with AICDs is now a common practice for some operators.

Tendeka has so far employed more than 35,000 FloSure AICD valves in over 210 wells worldwide. As seen at Troll and other developments, the implementation of AICDs has not added complexity or HSE risks to the completion and production of these wells. IT has clearly shown to significantly increase oil production, extend well life, and ultimately lead to greater oil recovery in a wide range of environments and applications.

To find out more, please visit: www.tendeka.com

In addition, Annabel Green, CTO with Tendeka, will be chairing the technical session on Field Development (Well Abandonment and Decommissioning) on Thursday 5th September from 10.00 – 12.00 in Room 4.



Karianne Amundsen, Scandinavia Area Manager with Tendeka

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2. M. Triandi, I. Chigbo, T Khunmek, Mubadala Petroleum and I Mohd Ismail, Tendeka (2018) Field case: Use of autonomous inflow control devices to increase oil production in a thin oil rim reservoir in the Gulf of Thailand. ADIPEC, 12-15 November, 2018. SPE-193305-MS
3. M. Moradi, M. Konopczynski, I. Mohd Ismail and I. Oguke, Tendeka (2018) Production optimisation of heavy oil wells using autonomous inflow control devices. SPE International Heavy Oil Conference & Exhibition, 10-12 December, Kuwait City, Kuwait. SPE-193718-MS