

The Wonder of Wireless for Well Development

Following the abrupt decline in production caused by plummeting oil and gas prices, recent reports suggest a revival for Africa's oil and gas industry as drillers begin to return to the region. According to analysts Wood Mackenzie, higher crude prices, stronger balance sheets and growing demand for natural gas are enticing supermajors back for business.

Another report expects nearly twice the number of offshore exploration wells to be drilled this year – up from 17 to 30. With at least 41 billion barrels of oil and 319 trillion cubic feet of natural gas yet to be discovered in sub-Saharan Africa, the research by the US Geological Survey claims the prize is huge. Such prospects are comparable to more than five years of the USA's oil consumption and 12 years of gas.

To safely and efficiently maximize production, support and investment in a digital oilfield market is expected to grow by more than a quarter (28%) within four years – from \$21.14 billion last year to \$27.10 billion in 2022. The increasing focus on optimization through digitalization, particularly in mature fields, is being led by oil and gas markets in Africa, alongside Asia Pacific and the Middle East.

Digital completions

The challenges associated with achieving rapid uptake and acceptance of new technology in the sector are well documented. The industry's inherent risk-averse nature, and hence its 'race for second' attitude may hinder its impact on innovation.

However, there is no doubt the impact of digital oilfield integration and automation on the industry is substantial, allowing more efficient operations, optimized production planning and ultimately greater recovery.

In the completions sector, wireless and automated technologies have been successfully applied in the wellbore for many years enabling effective directional drilling, surface read-outs during drill stem testing, and more efficient operations. The latest technology is targeting the production phase, providing monitoring and intelligent control to manage inflow downhole with connectivity to the engineers' desktop.



All images are courtesy of Tendeka

Figure 1: Tendeka's PulseEight device

Tendeka, the independent global completions service company, is expanding its footprint in Africa's oil and gas exploration and production sector, by implementing new cutting-edge technologies to develop the continent's energy sector.

Dialling downhole via smart phone

Increasing wellbore complexity and the desire to drill longer wells with maximized reservoir contact means that traditional methods for monitoring and control are no longer adequate. The main advancement has been moving from costly and complex control line bundles for communication and actuation, to smart, wireless systems which negate the need for additional hardware, manpower and rig-time.

Tendeka's PulseEight wireless intelligent completion technology (Figure 1) uses pressure pulse telemetry to communicate bi-directionally between the wellhead and downhole. Sending pressure, temperature and status data to surface and instructions down to the tools, it provides a new way of controlling flow and optimizing production. It uses energy from the production flow to transmit the data which can be read on the surface pressure gauge without the need for additional surface kit or signal boosters (Figures 2 and 3). The ability to communicate down the well to 'talk' to the tools to open/close/choke was proven in field trials in late 2017 as was the ability to access the data, via the cloud,

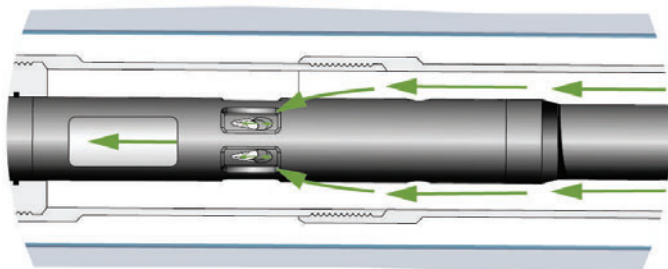


Figure 2: Flow from the reservoir enters ports in the tool and flows to surface

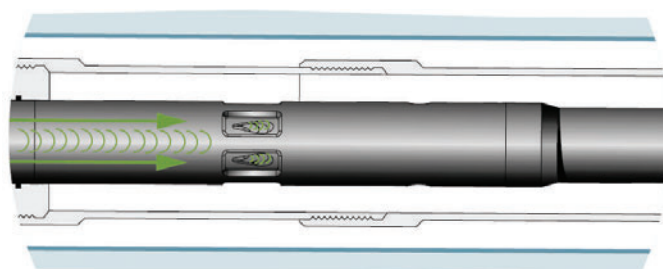


Figure 3: Commands are generated on surface using the wellhead choke and sent to the downhole device.

Technology and Solutions

from anywhere in the world: operators actually used their own smart phones to watch the pressure pulses occurring.

The ability to retrofit PulseEight devices into existing wells has created many new applications for the technology in addition to a pressure/temperature gauge and interval control valve (ICV). For example, formation integrity, multi-lateral wells, gas-lift optimization, gas hydrate prevention and water/gas shut-off to name a few.

Safety first

One of the more valuable propositions is to use the PulseEight tool as a safety device. This is currently under field trial in the UK. In wells where safety valves have experienced problems with the control line, ambient valves or storm chokes are typically run to act as a secondary barrier mechanism. Inherent issues with the reliability of these devices and loss of production associated with them have meant that operators are looking for a safe and effective alternative.

The system has intelligence built into the device so it can detect changes in the downhole conditions and react autonomously. For example, in the event of an emergency shutdown or loss of well control, it will detect a rapid increase or decrease in pressure and close.

Through the mitigation of hazards and the number of personnel exposed to them, deployment of the technology also has the potential to improve operational safety, compared to normal intelligent well system operations.

Regular intelligent completion functionality and communication tends to be conveyed by TEC lines, hydraulic lines or, in some cases, both. Typically, these lines are deployed as the completion is run-in-hole with the use of air-driven spooler units, which, depending on the control line or flatpack, may be cumbersome and take up precious deck space.

Although spoolers would perhaps be adequately guarded, rotating equipment poses several hazards, which while mitigated, are inherent by design. If their movement is initiated remotely as is the case when the completion is lowered, it may be prudent to have the spooler

manned throughout. This could mean another individual exposed to a hazardous environment, that may not be necessary during PulseEight operations.

Ultimately, fewer people on board the installation or asset means less people exposed to hazards and, in the case of retro-fit solutions, bed space may be at a premium on mature field assets where no MODU is alongside and where many PulseEight applications may be found.

As the technology can be run on wireline, this reduces operational time compared to running technologies on tubulars. Tubing retrievable (TR) intelligent well solutions can require large pulling capacity to replace as, once a TR system fails, there may not be much the well owner can do to recover functionality other than to recover the completion and workover the well. PulseEight offers a solution that can be run, communicated with bi-directional and configured in situ. Unlike TR options, the tool can be recovered and replaced as required.

Control lines themselves are not without potential to cause harm. Both electrical and hydraulic systems pose hazards to operators, whether that takes the form of electrocution or unplanned escape of pressurized control line fluid, some of which are attributed to causing contact dermatitis. Also, control lines could be susceptible to failure and dropping to deck from sheaves, endangering those in the firing line. This arrangement may present further hazards during adverse weather conditions and may even become inoperable in extreme instances.

Cross coupling protectors or clamps are the industry standard for affixing control lines to the conduit tubing. Generally installed with the use of pneumatic ratchet guns, these would usually number in the hundreds, with the quantity increasing with well depth.

Repetitive lifting and positioning clamps, which typically weigh a few kilograms, subsequently presents manual handling concerns, alongside the conventional pinch points and hazards associated with using hand tools.

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Figure 4: Wireless intelligent well technology can extend the operating envelope for the advanced completion

The use of Pulse Eight ultimately mitigates hazard exposure and reduces OPEX through less deployment time, manpower and possible accidents. The diversity of reservoirs and applications across the sub-Saharan countries are hugely interesting and advanced completion technologies can play a major role in maximizing recovery for operators.

African ambitions

The first installation of the PulseEight in sub-Saharan Africa is planned for later in 2018 (Figure 4) and is part of the company's long-term commitment to the region. Tendeka recently appointed Phil Stone as Business Development Manager for sub-Saharan Africa, who is working to establish key technology partners and local agents to bring the company's technologies to market. Phil has held several field and shore-based positions in sub-Saharan Africa including Operations Manager for Completion & Well Construction in Nigeria, Business Unit Leader for both Reservoir Monitoring and Upper Completions, based in South Africa, and Regional Applications Engineer, based in Aberdeen.


As a sign of its growth and influence in the region, Tendeka was recently awarded its first contract with a sub-Saharan operator to supply autonomous inflow control devices (AICD). The multi-million-dollar contract, which commenced earlier this year, will provide FloSure Elite sand screens alongside its FloSure autonomous inflow control devices (AICDs) and zonal isolation products for two major developments in the region.

The FloSure AICD device works on the principle of Bernoulli's equation and differentiates between different fluids within the reservoir based on their viscosity, preferentially choking those travelling through the device at higher velocity (lower viscosity). The AICD has now been installed in more than 140 wells and has shown significant increases

(up to 50%) in oil production by delaying the early breakthrough of unwanted gas and/or water.

The company is also about to deploy its first commercial installation of Cascade³ in the region by the end of the year to address the challenge of sandface injection flow for water injector wells.

This new well screen, flow control completion system utilises intrinsic check-valves to prevent any backflow or crossflow during shut-ins. Depending on well conditions, it also limits the damaging effects of water hammer. Its commercialization follows a three-year R&D program and field trial with a major operator in the Gulf of Mexico to improve performance on water injections wells which had suffered severe loss of injectivity within a short period of completion.

Tendeka is continually developing new technology offerings to enhance reservoir recovery, with sub-surface engineering and innovation teams working to bring reliable, cost-effective alternatives to meet operator challenges. With increased focus on the region going forward, Tendeka aims to support Africa's drive to be recognized as a major oil and gas hub again. 

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