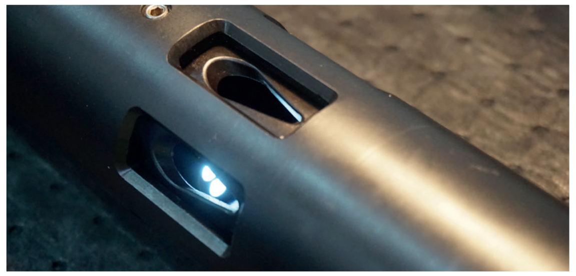
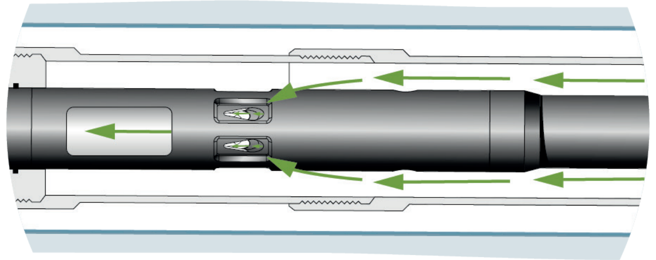
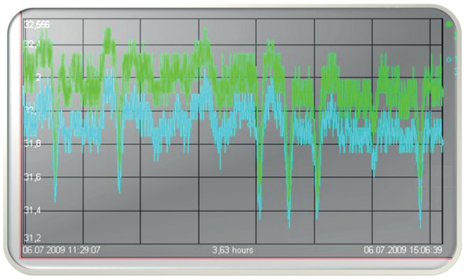


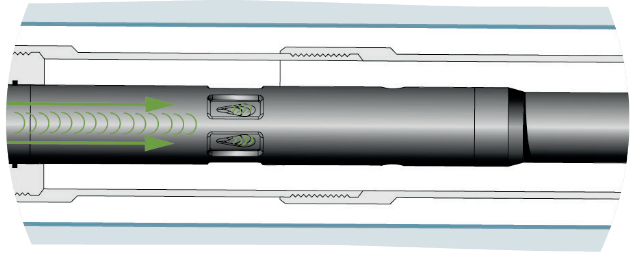
(figure 1)



(figure 2)



(figure 3)



(figure 4)

Wireless Well Completions

To combat the limitations associated with the use of downhole hydraulic and electrical control lines, the development and deployment of wireless completions equipment is now becoming more prevalent. Oil & Gas Vision spoke to Kevin Buchan, Tendeka's Application Engineer

- Advanced Completions with independent global completions services company Tendeka, to find out more...

• Wireless telemetry-based technology represents potentially huge efficiency and performance savings, as well as improved safety for completions activity. How has this evolved?

From drill stem testing to multi-node intelligent completions, there has been a significant shift from downhole equipment requiring control lines or manual intervention to wireless telemetry-based technology. For existing wells in particular, the options for deploying or replacing hardwired downhole monitoring and control devices are limited and typically require a workover of the tubing string. This comes at a significant cost compounded with associated risks.

While all completions activity incurs significant costs, one of the key components, when used, is the control line for downhole communication and actuation. Using single, multiple or bundled hydraulic and/or electric control line strings, project costs can significantly swell once additional hardware, manpower and rig-time are included.

While control line systems typically require increased CAPEX, the alternative of a conventional completion system can often see the savings on equipment nullified due to increases in OPEX and deferred production through increased intervention and poor reservoir performance.

• What are the distinct differences and advantages of wireless intelligent well technology compared to traditional technologies?

Wireless intelligent well technology can extend the operating envelope for the advanced completion by enabling interval control in places currently unachievable with conventional systems. Independent valve assemblies without control lines can also be rotated in the well during deployment and function without physical connection to the surface.

Other advantages include the retrofit capability for existing wells and reduction in feed-through connections in downhole and surface barriers.

Wireless systems can help to provide a hybrid of the key features, whereby the completion is kept simple allowing a quick and safe installation, but offers the communication mechanism required to monitor and control wells effectively.

Moreover, this will have a direct impact on the bottom line as well construction costs are reduced as cost savings in control lines, downhole connection and completion times are made.

Basic top-hole workovers can be performed more simply and economically without affecting the advanced completion functionality. In the long-term, the addition of real-time data can lead to informed decision-making, while the ability to act immediately and without intervention leads to an optimal production environment.

• Tendeka launched the world's first wireless system, PulseEight, last year. How does this innovative device work?

Each PulseEight device **(figure 1)** functions independently and can either be fitted during the completion phase, or retrofitted into existing wells to maximise production.

It provides an infinitely variable choke and seal with pressure and temperature measurements for optimum control and can be configured to meet requirements ranging from low-cost single zone monitoring to full multi-zone, multi-lateral measurement and control.

It employs unique semi-duplex pressure pulse telemetry suitable for multiphase fluid environments. This channels wireless communication between a well's downhole monitoring and control system and the wellhead. Flow from the reservoir enters ports in the tool and flows to surface. **(figure 2).**

The device creates a downhole pressure response by briefly choking the flow, with the response being viewed at surface. Six pressure pulses are identified on the surface recorder **(figure 3).**

The time between pulses is analysed to give a unique binary code that is decoded to provide pressure and temperature readings as well as tool status information **(figure 4).**

These commands are generated by software application and carried out using the surface choke. The size of pressure change required can be established prior to deployment using well modelling. This offers an additional benefit over hydraulic control line valves as autonomy leads to faster decision-making and implementation of optimisation techniques.

The all-electric system is microprocessor driven and can also be programmed to function autonomously based on the well environment, for example detecting well shut-ins, changes in well pressure or metering mass flow rates. The valve's programmed parameters and targets can be adjusted while in-hole and data sent to surface can be used to update performance models.

• The simplicity of PulseEight means it is compatible with existing wells and can be retrofitted into place on a single intervention run. How can this ensure peak well performance? What examples are there of its success in the field?

It provides a simple solution for wells that were initially completed without downhole monitoring and control, or have suffered from pre-mature failure of permanent systems.

For example, PulseEight was deployed in an existing well to deliver an accurate understanding of reservoir pressure in Norway's largest gas reservoir. This has been online for nearly 20 years and expected to continue production for a further 70 years.

Seasonal variations in gas demand meant that production rates varied greatly from less than 30 mmscf/d to over 85 mmscf/d. More compression was required to address declining pressure to drive production, which is critical to meet contractual gas deliveries and achieve recovery targets.

The PulseEight wireless pressure/temperature gauge was installed to provide daily flowing bottom-hole pressure and static well data following a shut-in. No surface acquisition equipment or data relay system was required as the existing wellhead sensors were used to read the signal.

Pressure regulation was introduced to the pulse signalling to ensure data transmission over the large range of flow rates. The system remained highly effective with less than 0.5bar pressure pulses for 428 days. The gauge was retrieved and found to be in excellent condition.

Accurately and efficiently delivering data on the status of reservoir pressure can provide great value to operators in multiple situations such as monitoring of flowing bottom-hole pressure and efficiency of injection methods. The technology can also cover the functionality of a conventional memory gauge by recording high resolution data to memory, which can be downloaded once the device is recovered to surface.

• What testing has it undergone to ensure it is a robust and reliable solution?

The uptake of new digital technology in the oilfield tends to be slow due to the significant perceived risks and the financial cost of equipment failing downhole. To minimise the risks and deliver a reliable system to market, PulseEight has gone through a robust and staged qualification program including component testing, system testing and rigorous field testing.

Reliability of the design was ensured by using internal components common to previous system offerings, while testing sequences were designed in accordance with appropriate industry standards and regular input from operating companies during its development. The ability to test the system in live well scenarios has been invaluable in proving the communication mechanism over long distances, and under flow regimes that would have been impossible to recreate in a lab environment.

Communication between the wellbore and the wellhead was tested and proven in early installations. To unlock the full potential of the system and allow for greater control, the company embarked on a project to prove bi-directional communication, enabling remote activation and configuration in the system. This then led to increased application scope and incorporation of flow control features.

• How will the technology make an impact on the evolution of the digital oilfield?

PulseEight technology simplifies operations by removing the need for traditional hydraulic or electric control lines. This opens up intelligent downhole monitoring and control to new areas and provides a means of implementing the digital oilfield fully on existing assets.

While the immediate future for this technology will be to extend the operating envelope for intelligent completion technology and address its various applications, the long-term aim is for it to become a truly intelligent and autonomous completion tool and become a key component to realise enhanced production optimisation and improved field management.

This would involve developing a set of 'goal-seeking' devices to deploy into a well to communicate with each other, as well as with surface, to provide a fully autonomous, optimal production environment.