Downhole wireless PT sensor system measuring temperature and pressure behind the casing in subsea production wells

How subsea solutions can enhance oil recovery

There's no doubt that offshore operators today are facing significant challenges as they enter more remote and geologically complex waters, yet are still faced with the on-going pressures of maximising production whilst also reducing costs

Operators must look to increase production from older fields – fields which come with their own set of challenges, such as a complex set of interdependencies between ageing and new technologies and greater threats to flow assurance, such as the increased danger of water and gas breakthrough and vulnerability to infrastructure corrosion and erosion.

So how are operators attempting to increase recovery rates from the global average of around 25 per cent to the more healthy recovery factors of up to 40% which are being seen in some North Sea fields?

While improvements in drilling and completion technologies, closely followed by reservoir modelling and seismic interpretation, are likely to have the biggest impact on recovery rates, there is also a growing focus on subsea monitoring techniques. Such technologies have a central role in both maximising production and helping the operator understand reservoir behaviour during the production life cycle.

It's with this production lifecycle in mind that operators need to initiate production at an earlier stage through optimum design and reliable instrumentation; accelerate production through improved reservoir monitoring; and extend the lifetime of the field through a regular monitoring of subsea assets and a minimising of field downtime and subsea intervention. The result is reduced capital and operating costs and improved ROI.

Let's take a look at the application of subsea instrumentation and its effect on field economics across the oil & gas lifecycle in three key areas: flow assurance, reservoir management, and production allocation.

Flow assurance is all about ensuring the seamless and cost effective flow of hydrocarbons from reservoir to refinery. This can cover a number of areas, such as corrosion and hydrate management, and the accurate measurement of multiphase rates so that threats to production, such as water, can be nullified.

In the deepwater Independence Hub field in the Gulf of Mexico, for example, production flow rate measurement and hydrate prevention is taking place side by side with one subsea wet gas meter and one subsea chemical injection valve installed per well.

The ability for the operator, Anadarko, to predict and measure the water production profile for subsea wells is critical for optimising production, preventing hydrate, scale and corrosion in pipelines, providing input to hydrate prevention strategies, and ensuring reliability of supply

By measuring the early onset of

formation-water production through Emerson Process Management's subsea Wetgas meters, Anadarko is able to take preventative or remedial action, such as adjusting the pH in the MEG/water mixture, injecting the right amount of corrosion inhibitor, or more drastically choking the well. To this end, the Roxar subsea Chemical Injection valve provides increased control over the injection of hydrate inhibitors in the field with the result being an integrated flow assurance solution. While the field only came online in 2007, there's no reason why such an approach won't continue to be effective as the field matures further.

Secondly, there is reservoir management. Reservoir management is all about creating a sustainable production strategy. This requires a balancing act between the need to enhance oil and gas recovery while at the same time ensuring that there are no significant risks of the premature shut-in of wells.

In such environments, subsea multiphase and wet gas meters and downhole pressure and temperature tools are playing a vital role. In the West Delta Deep Marine (WDDM) concession offshore Egypt, for example, 49 Roxar Wetgas meters have been installed to help the operator – Burullus – monitor water production profiles in real-time.

Over just a four month period, the Roxar Wetgas meters from Emerson were utilised to avoid two water breakthroughs, identify zones for water production, and optimise gas production within acceptable and controlled water rates. By providing early warnings of the water produced, the meters have helped Burullus and its partners save three wells from water breakthrough and resulted in a sustainable production strategy moving forward.

Roxar subsea chemical injection valve

Another key element of reservoir management and asset integrity monitoring is that of sand management and sand erosion monitoring. In the North Sea's Heidrun field, for example, Emerson is working with Statoil to increase the field's sand monitoring capabilities, allowing for the maximum amount of sand without affecting production.

Finally, there is the issue of allocation. Many offshore regions of the world are today seeing the entrance of new players, the sharing of facilities, different ownership structures, and the development of tiebacks from different licenses. This has led to increasingly complex production allocation and royalty requirements, with allocation vital for reconciling oil, gas and water measurements at the entry and exit points of a production network.

Again, using the Independence Hub as an example, Roxar subsea Wetgas meters and Roxar sand detectors have been operational since July 2007, meeting the reporting requirements of 19 producers and three owners. In this case, the United States Federal body, the Minerals Management Service (MMS) has authorised the use of Roxar subsea Wetgas meters on each Independence Hub well for allocation purposes, providing accurate, real-time subsea measurement and allocation.

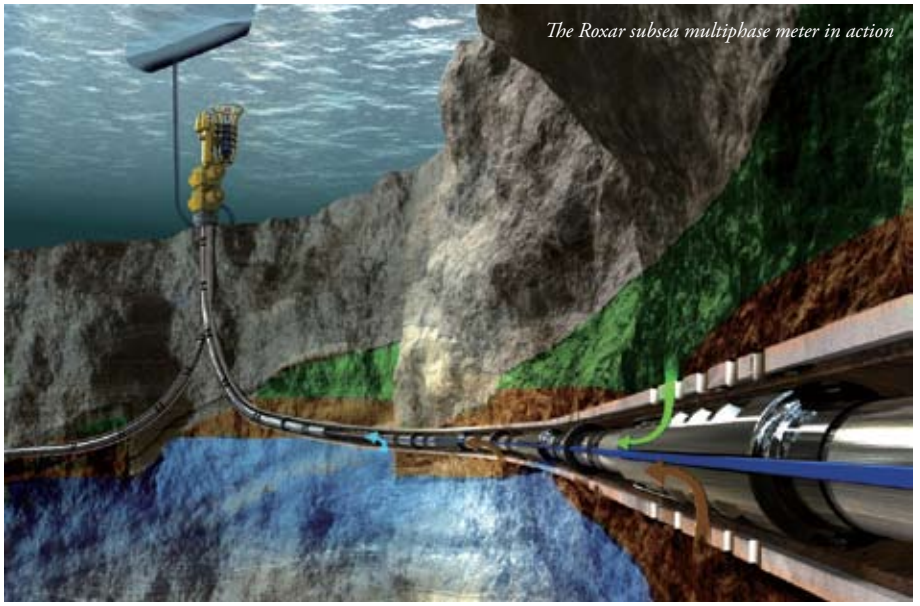
And there is much more to come in subsea monitoring....

Advances in wireless technologies, for example, are helping operators generate information from parts of the reservoir previously considered unattainable.

One such example is a new wireless tool – the Roxar Downhole Wireless PT Sensor System – which for the first time can provide pressure and temperature information from behind the casing in subsea production wells. The tool is expected to have a significant impact on both production and offshore safety, provide early warnings of high pressures, protecting casing integrity, and preventing pressure build-up and, in the worst case scenarios, shallow gas blow outs.

Just as operator challenges are increasing, so are the subsea technology developments designed to address them. The bottom line for operators will be enhanced recovery rates, a renewed understanding of risk, and improved production through intelligent and sophisticated subsea solutions. ■

This article was written by Vincent Vieugue, Emerson Process Management



The Roxar subsea multiphase meter in action