Production optimisation in MENA using sonar surveillance

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Operators of fields in the Middle East and North Africa (MENA) are becoming increasingly aware of the use, and importance of, monitoring and forecasting tools that integrate production systems into a Field Management and Information System (FMIS). These system implementations optimise field development efforts and focus on maximising the recovery of hydrocarbon reserves. They require accurate and reliable models to predict the effects of operational decisions on the performance of the reservoir, wells, surface production volumes, gathering network, booster compressor stations, and central processing facilities. The ability to accurately predict the outcomes of modifications to the system set points is key for successful field operations.

An essential element to maintaining the integrity of these models is the acquisition of accurate flow rate data from the well and surface network. To this end, several large oil field operators in MENA are conducting full field metrology campaigns using clamp-on sonar flow metering to measure wells and facility volumetric data. These scheduled activities are playing a pivotal role in the integrated model (FMIS) tuning and calibration, and subsequently improving confidence in the operation and forecasted productivity of these assets.

Production optimisation challenges

It is widely recognised that production from many fields in MENA is chiefly constrained by reservoir performance, changes to the flow network and fluid treatment capacity. As a consequence, appropriate determination of the daily optimal operating conditions requires examination of the complex interactions of the reservoir, the wells and surface network facilities. Further complexity is added when other field management issues are considered, including problems such as early gas and water breakthrough, flow assurance issues, and operational issues through the use of artificial lift methods.

Typical ‘real world’ production optimisation challenges can include:

- Operators put a new well into production, but see no change in overall field production
- Field production is limited by back pressure in a particular sector
- Oil production can fluctuate significantly due to wells producing intermittently
- Choke settings are not optimised

- Investments in artificial lift methods are not realising the expected increases in production
- Candidates for gas lift are constrained due to the impact of increased injection gas volume requirement through the production and injection systems and the need for facility modifications.

The implementation of an FMIS is an essential part of addressing these production optimisation challenges in a systematic and holistic way. However, actual measured production and injection flow rate data is also essential to an effective FMIS.

Data acquisition challenges

While beneficial, obtaining timely and accurate wellhead measurements can be challenging due to a range of factors:

- Multiple CTS or MPFM packages would be required to accomplish the desired testing frequency. These may not be available and may be cost prohibitive.
- The production losses/deferral associated with traditional well testing methodologies may be significant.
- Shutting in wells to rig up test equipment can negatively impact the long-term performance of the well.
- Higher HSE risk associated with the increased number of invasive well tests.
- The amount of gas and oil flared to the atmosphere may exceed environmentally accepted levels, unless the existing wellhead connections and well test equipment are modified.
- Security concerns of having large crews of well test personnel in remote, desert areas.

Most fields do not have permanent wellhead and downstream surveillance infrastructure installed and in many cases, the need for this data is satisfied by periodic surveillance testing programmes. The equipment traditionally used for this purpose is either a Conventional Test Separator (CTS) or Multi-Phase Flow Meter (MPFM).

To overcome these challenges, several large operators in MENA have opted for periodic injection and production surveillance campaigns using Expro's clamp-on SonarTest™ services.

Integrating sonar surveillance with an effective FMIS in MENA

Across various areas of the globe, operators are adopting sonar technology for acquiring accurate production and injection surveillance data. What makes clamp-on sonar distinctly appropriate for the MENA region is its flexibility and operationally

simplistic approach. Expro can deploy clamp-on sonar technology through one of two delivery methods; SonarMonitor™ and SonarTest™.

SonarMonitor gives operators the ability to purchase a flow meter system for permanent installation; the meter is installed, commissioned and tied into the existing facility data acquisition system. This delivery method is suitable for critical applications that require 24/7 flow surveillance for reservoir management. It is also used by operators to non-intrusively replace meters that are faulty or out of operating range, consequently saving the operator costly shut downs.

The SonarTest method deploys the company's sonar meter and technician on a rental basis for periodic surveillance campaigns or one-off production/injection well tests. It allows operators to acquire reservoir data periodically for large volumes of wells without the need for capital expenditure. The acquired production data is presented to the client in the form of a SonarTest report. SonarTest has been the most popular delivery method in MENA, mainly due to the simple approach. A complete clamp-on sonar system (equipment, cabling, even personnel) is compact enough to fit in an SUV or helicopter, providing accessibility to remote well locations in the desert or offshore. Power from the site infrastructure, SUV vehicle, or a portable power unit can be selected as appropriate to the location. Not only does this simplify logistics, but it also keeps the operations on a low profile when moving to location and while operating; important when considering relations with local stakeholders and remaining discreet for security purposes.

The sonar meter is typically clamped on the pipe in about one hour, allowing for a relatively quick installation and commissioning. Within meter installation guidelines, the sonar meter can be installed on the pipe anywhere at the wellhead, either upstream or downstream of the choke. The clamp-on non-intrusive nature of the meter eliminates any pressure drop and production loss, and minimises the HSE risks associated with invasive well testing methods. The duration of the test may vary depending on the stability of the flow conditions. In general, an assumption of one test per day is reasonable. Multi-rate tests are also possible on an intra-day basis, provided the flow is stabilised at each rate. This enables testing the wells at various choke settings and/or Electric Submersible Pump (ESP) frequencies with the goal of determining the settings resulting in optimum production.

In one MENA onshore field, sonar has been employed to measure gas lift rates while measuring production rates using CTS. The field operator is correlating gas lift with production rates in an effort to optimise production. In the same field, Expro is using SonarTest to measure gas injection rates at the wellhead and upstream at the manifold origin locations to provide a sector-wide view of gas injection rates.

In addition in this field, Expro is using its ActiveSONAR meters to measure the water injection rates. This clamp-on technology uses pulsed-array sensors to track the speed of coherent flow structures. All of the data gathered is then summarised and reported to the operator's subsurface team and fed into their FMIS.

In another large onshore oil field in MENA, Expro has been contracted to periodically measure the production rates using SonarTest. Production data has been collected from hundreds of wells, many at multiple choke settings. The data collected is used by the operator's subsurface engineering team to validate, tune and improve production and reservoir models. Many of the wells in this field are ESP lifted. ESP performance is modelled using pump parameters and theoretical pump performance curves provided by the supplier. Theoretical pump curves make certain assumptions with regard to pump efficiency, the mechanical integrity of the pump, and reservoir deliverability.

The most useful tool to measure, analyse and ultimately improve the performance of an ESP system is to measure the actual pump flow rate from the well. Additionally, many failures of these systems occur at start up for a variety of reasons. Production surveillance at the wellhead during commissioning can help confirm successful installation of the ESP.

Conclusion

Field Management Information Systems are used to optimise production, which is especially important in a challenging industry environment. Actual flow rate data, both well production and injection and lift rates, are critical inputs into an effective FMIS. Clamp-on sonar flow measurement technology is employed in the MENA region and elsewhere as a cost effective way to gather the surveillance data required for an effective FMIS.