Sonar technology aids production

Brownfield surveillance for late life production

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Introduction

The ability to monitor flow from mature assets on an individual well basis is an important component in optimising reserve recovery and extending field life.

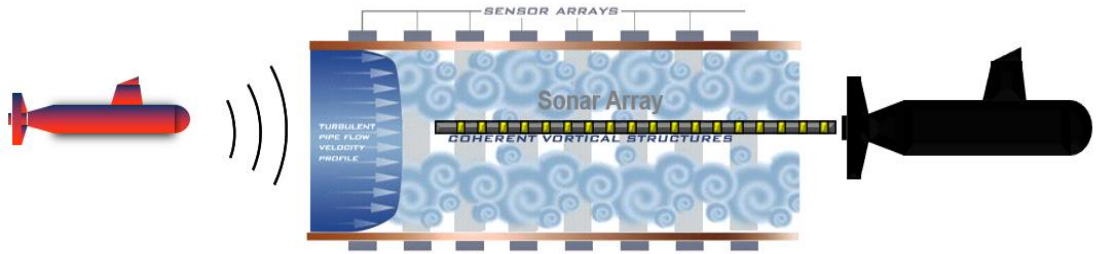
With ageing infrastructure, there is an increasing demand to find alternative techniques and methods to monitor and measure production.

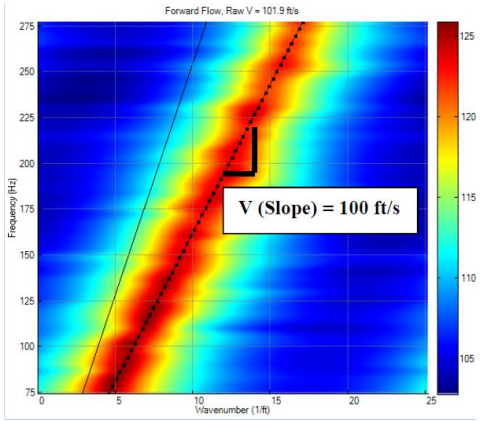
This presentation will give a number of case studies demonstrating how clamp-on sonar technology can be used to maximise production from mature fields.

Sonar meter technology

Sonar technology involves observing the naturally-occurring coherent vortical structures within the flow by monitoring interactions of externally-generated acoustic pulses with those coherent structures.

- Analysis of the spatial wavelength (distance) and temporal frequency (time) of the sensor signals over a range of values.
- Multiple spatial and temporal wavelengths are plotted to generate a k-omega plot - the slope of this ridge determines the flow velocity.
- The volumetric flow rate at standard conditions is calculated using the pipe cross-sectional area, pressure and temperature.

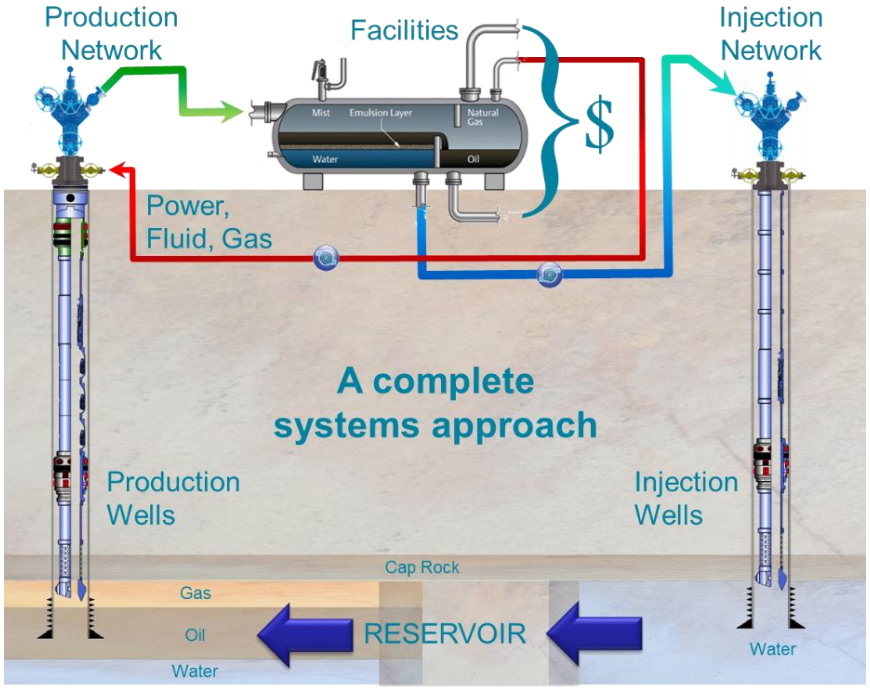




The benefits of surveillance

Water injection / gas injection / gas lift surveillance

- Production well testing
- Production allocation
- Production optimisation
- Reduced operating cost
- Lower capital expenditure



Case study

Individual well surveillance

Objectives

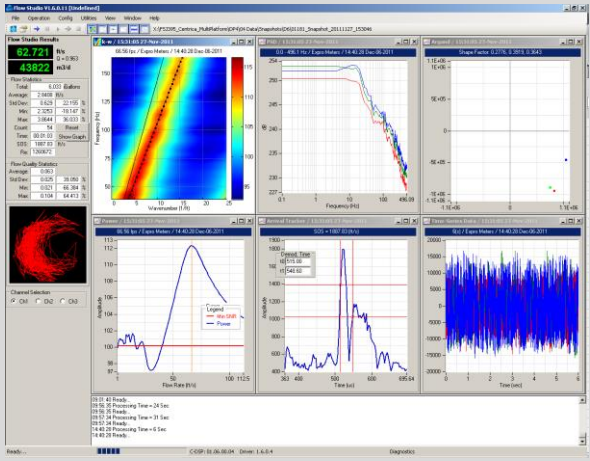
- Customer was producing 14 MMscf/d from 5 wells, there was a requirement to understand how much was being produced from each.
- No way of testing each well through a test separator due to configuration.

Solution

- SONAR meters were deployed with a technician to perform surveillance on the 5 wells.
- No leaks to monitor with a low installation cost.
- Work performed on a hot work permit so minimal management of change required.
- Results confirmed at the well site so further tests could be performed if required.

Value to customer

- SONAR meter diagnostics gave overwhelming evidence that only 1 out of the 5 wells were flowing.
- Flowing well was > 14 MMscf/day
- There was production from only 1 well.
- Intervention was performed on 4 other wells with wireline followed by halite wash, nitrogen lift on the water column and wells taken back on production.
- Overall field production increased after the intervention.
- Proved that their decision to perform individual well surveillance is more valuable than just looking at gross production from any one facility.



SONAR meter surveillance confirmed that all production was from only one of the 5 wells, where client was expecting equal amounts from each. After intervention a significant increase in production was noted.

Case study

Production allocation for Centrica North Sea

Objectives

- Customer wanted to monitor production rates on 42 wells in mature and declining fields at the same time.
- Each well suffering with some water breakthrough and salt build-up.
- Legacy wellhead metering out of range and in disrepair.

Solution

- Installed 42 clamp-on sonar meters at each wellhead.
- Continuous production during installation.
- No leaks to monitor with a low installation cost.
- Communications link direct into existing DCS/ SCADA system.

Value to customer

- Standardised all metering at wellhead to SONAR meters.
- Production allocation – instantaneous rate, daily rate, monthly rate direct to the control room, then onshore.
- Able to use the well flow data to perform well performance modeling by understanding when gas rate declines and intervention may be required to maximise production.
- This is important when gas is sold in advance of production, especially in the UK where there are swing periods between summer and winter with heavy penalties for shortfall in promised deliveries.

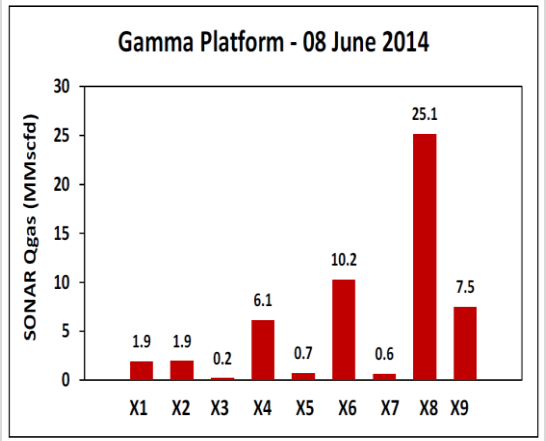


Figure 5: Individual Well Production Gamma Platform – Jun 2014

SONAR meter is currently being used for production allocation for all wells, when previously all was done by WHP and WHT trending. These accurate results also allow to trend well cycling for huff and puff wells.

Case study

“Huff and puff” well cycling optimisation for Centrica North Sea

Objectives

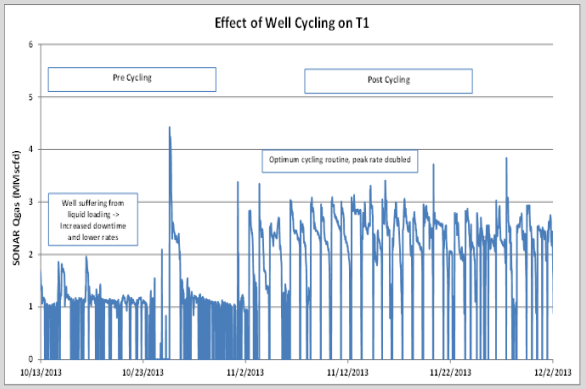
- Producing wells in mature fields had intermittent production and others dropped off in performance after the addition of a high pressure field.
- The customer wished identify the affected wells and optimise the cycle duration in a “huff and puff” scenario to extend the production cycle and increase the average production rate.

Solution

- SONAR flow meters were used to identify the worst affected wells and those which responded best to a well cycling procedure.
- Continuous production during testing of the wells.

Value to customer

- Able to optimise the production cycles by using live data and not a text book style approach.
- The cycle durations were extended, resulting in doubling the average production rate from a single well.
- Data from the other wells was used to perform production cycle test resulting in increased production across the field.
- Pre and post adjustment of cycles gave real time values to assist with the optimisation.



SONAR meter data can be used in different ways. For the customer the data was used to extend cycling frequencies to increase production. In one well the production doubled by adjusting the cycle procedure with real time measurements.

Case study

Production well testing for Marathon Oil

Objectives

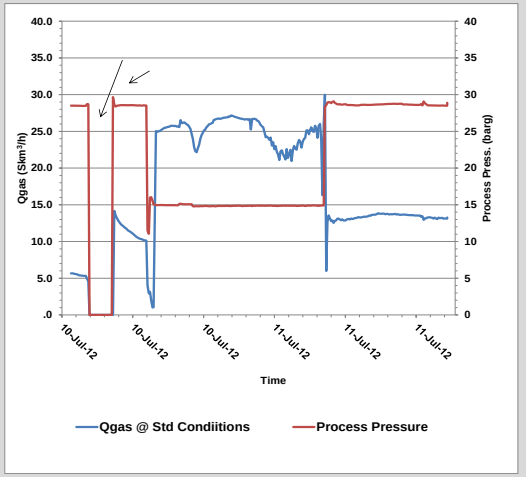
- Requirement to perform periodic well testing on core wells.
- The wells in the field included core producing wells and lazy wells which need liquid unloading to maximise production.
- The test separator traditionally used to test the wells could be better used to unload liquid from the wells, therefore a solution was required to test the core when using the test separator for liquid unloading.

Solution

- Bi-monthly clamp-on well testing for all ten wells, supplying manpower and meters.
- Delivering a well test report valid for the authorities.
- Clamp-on hardware is permanently mounted to wellhead piping for consistency of measurement and well site efficiency.

Value to customer

- Re-purpose well test separator for LP production vessel, 50/50.
- Use SONAR meters to test core wells when test separator is not available.
- Work with regulatory authorities to have SONAR meter accepted as alternative to conventional test separator based well tests.
- Use of SONAR meters to investigate individual well performance in LP separator.
- Identify performance based criteria for well swinging operations,
- Achieve 90% utilisation of LP separator for well unloading.



SONAR Meter has since established a successful track record in Marathon and has become the system of choice for Production Well Tests when the test separator is to be used for liquid unloading

Case study

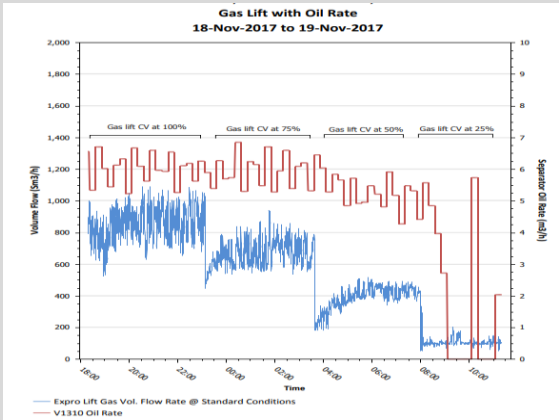
Well diagnostics for Shell UK

Objectives

- To ensure artificial lift was optimised for mature fields
- To gain better understanding the effect on volumetric flow rates on different choke sizes as a diagnostic tool.

Solution

- 2” SONAR meters were run on 6 different gas Injection lines.
- Continuous production during installation.
- Each well was flowed and the choke was changed from 100% down to 25% in increments of 25 to determine the optimum gas injection rate.
- Of the 6 GL lines all showed unstable flow at the 100% 75% choke setting confirming there was insufficient gas getting to all gas lift lines and not effective at higher gas chokes.
- One well showed no change in production rates at all. The choke settings confirmed that the choke was not functioning and a planned intervention could be performed.
- 4 wells showed a decrease in production rates with different chokes but no change on the pressure transmitters allowing the customer to change / re calibrate their meters.
- Meter diagnostics implied that there was wetness in the system enabling the customer to address the dehydrator and return to dry gas.



SONAR meters surveillance will be deployed on other facilities for a similar survey, also returning to the same platform to ensure interventions have been successful.

Conclusion

- Efficient solution to test mature / declining fields without intrusion / breaking into existing lines
- Measures at actual production conditions
- Wide turndown providing a solution for the life of the field
- Direct replacement of existing failed instrumentation , linked directly to DCS / SCADA system if required
- No leak paths , low installation cost, low planning and engineering fees in comparison to an intrusive solution

Questions and contact

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