

Achieving surveillance

Knowledge of production rates from individual wells is a critical component in effective oil and gas field management influencing production optimisation strategies and workover planning.

In Brazil, SONAR meters support the environmentally diverse requirements of the region, from sensitive marine locations to those in the rainforest and high, arid desert areas across the continent.

The ability to perform production well testing, without the requirement to flare hydrocarbons at the well site, is well suited to this remote and fragile diversity of ecosystems. This was most recently demonstrated during a contract over a period of two years whereby the customer moved from conventional well testing to SONAR testing their wells and reduced flaring by an equivalent of 2.3 million tons of CO₂, where all hydrocarbons were returned to production after testing.

Well specific surveillance is achieved by either equipping the wells with real-time monitoring equipment or by periodic testing. Wellhead metering is not typical, particularly in oil fields and gas condensate fields where the measurement is challenging due the multiphase nature of the produced fluids. For periodic production testing, the equipment most typically used are conventional (gravity-based) test separators (CTS) and conventional, in-line multi-phase flow meters (MPFM). Where there is a large population of producing wells, high frequency testing (one or more tests per well per year) is costly and can be challenging to execute given the logistical challenges of mobilising large packages of equipment. Multiple CTS and MPFM packages, of varying sizes and pressure ratings, are usually required to accomplish the desired testing frequency and provide the measurement range required for all wells. Facilities and infrastructure may limit the ability of the operating company to perform well testing on an individual well basis.

Normally unmanned installations and mono pod platforms may have weight, space and POB restrictions. Larger marine installations may not have permanent CTS facilities or tie in to a test header. Land and swamp wells may not be easily

accessible, especially to heavy equipment, requiring significant logistical support to access individual wellheads.

In all cases diverting the production to test creates additional issues in balancing and or maintaining production, without incurring significant production curtailment, or in the case of a marginal well risk killing the well and losing all production.

Faced with this list of challenges in achieving KPI's on well testing, operators have found it beneficial to augment their programme of CTS and MPFM testing with a regular programme of SONAR clamp-on production testing in order to gain efficient, higher frequency production surveillance at lower cost with lower operational and financial risk.

Clamp-on SONAR flow measurement in oil and gas markets is offered exclusively by Expro. SONAR-based flow measurement has a compelling list of differentiated features that make it the technology of choice for many upstream, midstream and downstream applications.

SONAR clamp-on technology is ideally suited for measuring the flow rate of injection wells. Accurate determination of injection rates enables operators to optimize their plant real time, maximizing production while collecting high quality empirical data to update reservoir models. Measuring water injection rates for water flood or pressure support, CO₂ rates for carbon capture, injection gas for gas lift injection are well defined applications for SONAR meters.

The high pressures and corresponding thick wall pipes typically found in injection applications cause challenges to traditional metering technologies. As a result, many injection wells have no flow measurement devices or have devices which are inoperable. SONAR meters, because of their clamp-on design, are able to overcome many of these challenges ideal for this service. In addition, SONAR meters are well suited for separator gas and oil outlet, co-mingled trunk lines, export oil and gas and overboard discharge.

The combination of the two technologies, PassiveSONAR™ and ActiveSONAR™ flow meters serve the vast majority of upstream and midstream applications.

The PassiveSONAR™ flow meter was introduced in 2003 as the first-generation clamp-on SONAR meter. The flow meter is well suited for high liquid loading multi-phase flows typical of black oil and low pressure gas wells.

In 2009, Expro introduced the ActiveSONAR™ flow meter, the second generation clamp-on SONAR meter. This flow meter is well suited for gas and gas condensate wells with heavy schedule pipes. Both meters are available in sizes from 2-inches to more than 32-inches in diameter. SONAR meters have been tested at independent, NIST traceable calibration facilities to an accuracy of +/-2% in liquid and gas flows.

Expro has pioneered a new capability for well testing which provides timely, cost-effective production surveillance which can be used to augment traditional well testing methods to improve production yields and reservoir management. This capability is available either as a service in the form of a well test surveys or as a permanent system installation and is applicable to a wide range of well types and applications.

SonarMonitor™

For real-time 24/7 surveillance, clamp-on SONAR flow meters provide an easily installed, cost-effective solution for permanent wellhead monitoring and high value downstream applications. ActiveSONAR™ and PassiveSONAR™ flow meters feature robust design and are manufactured by Expro under ISO9001 quality standards. The non-intrusive design enables installation in one day without shutting in the well or process. There is no pressure drop, no potential leak paths to monitor and the widest turn-down ratio of any flow meter. Well over 200 meters have been placed into service for permanent 24/7 flow measurement in a variety of oil and gas applications.

SonarTest™

Expro Meters provides clients with non-intrusive production testing solutions utilising SONAR meters, operated by trained and experienced field engineers and supported by our multi-disciplinary base engineering team. *SonarTest™* complements a programme of conventional well testing by offering a quick, safe, reliable and cost-effective solution for applications requiring periodic wellhead surveillance.

Expro delivers the SONAR meter to the job site complete with support personnel and the ancillary equipment required to conduct a single or multiphase well test in a small footprint, single-man lift package. For land applications, the equipment is transported by pickup truck, SUV or off road vehicle. For offshore applications, the equipment is heliportable. Crew size is one or two persons, depending on the scope of the job.

The SONAR meter can be installed, commissioned and logging data in typically one hour or less, maximising the potential for data collection at the well site, where well site operations are time or security constrained. In co-operation with production personnel, choke changes, ESP frequency changes and production valve configuration changes can be made to execute dynamic or multi-rate well tests.

In addition to SONAR meter data, the field engineer will collect upstream and downstream pressure and temperature data, validate the choke settings and, for oil well surveillance, sample the well stream and establish an oil gravity and BS&W at the well site. Where electrical submersible pumps are in operation, the field engineer will collect ESP drive frequency, voltage, current and where available discharge and intake pressures.

All the data collected is collated into the end-of-job well test report. Collating this data into a single report allows the client easy access to all critical well parameters. Report processing is a centralised function, with dedicated data analysts preparing the SONAR test report and petroleum engineers peer review the data before release to the customer. There is an automated workflow process for data entry, data processing, quality control and final review. Each report is vaulted in Expro's server and sent electronically to the client.

SonarTest™ Track Record

In excess of 1,000 SonarTest™ jobs have been successfully performed around the world for major IOC and NOC clients. Jobs have been performed on land and offshore locations, for a wide range of applications including oil wells, gas and gas condensate wells, water and gas injection wells and downstream pipelines. Applications for SONAR flow measurement include:

Single phase applications:

- Gas production rate measurement
- Programmes of individual gas and water injection well surveillance across the field to enable field-wide reservoir pressure optimisation
- Production enhancement verification – measurement before, during, after stimulation, acidizing, re-perforating, deliquification, and other production enhancement operations
- CO₂ and H₂S environments
- Verifying accuracy of existing flow meters in degassing stations and on downstream pipelines

Multiphase flow measurement applications:

Expro has developed the Total Production Surveillance™ (TPS) system for flow measurement of black oil and gas condensate production wells. Employing SONAR clamp-on flow metering technology, the TPS system utilises a combination of PVT models and multiphase flow correlations to report gas, oil and water flow rates.

- Multiphase reporting using TPS for under-saturated reservoirs with a known/stable gas/oil ratio (GOR)
- Clamp-on testing to verify Electrical Submersible Pump (ESP) performance
- Gas with inferred liquid rates for condensate/gas ratio (CGR) / water/gas ratio (WGR) trending

In the Latin American market, specifically Brazil, SONAR meters support the environmentally diverse requirements of the region, from sensitive marine locations to those in the rainforest and high, arid desert areas across the continent.

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Expro Meters are actively working with major national and international operators to bring this innovative type of well testing to areas of environmental significance, having recently participated in comprehensive 'Flow Loop Testing' at the Petrobras

World Class Test facility in Atalia Brazil, across a full range of Dry Gas, Wet Gas and Black Oil production conditions. This work has also been followed with a campaign of well tests on Offshore Production Platforms to demonstrate the operability of the technology as a viable alternative to traditional well testing techniques.

For further information on Expro Meters and any of the services they provide you can visit www.exprometers.com or email exprometers@exprogroup.com