Volume 1
2017 February

SPE International
Norway Council
www.spe.no

The First

SPE Norway magazine

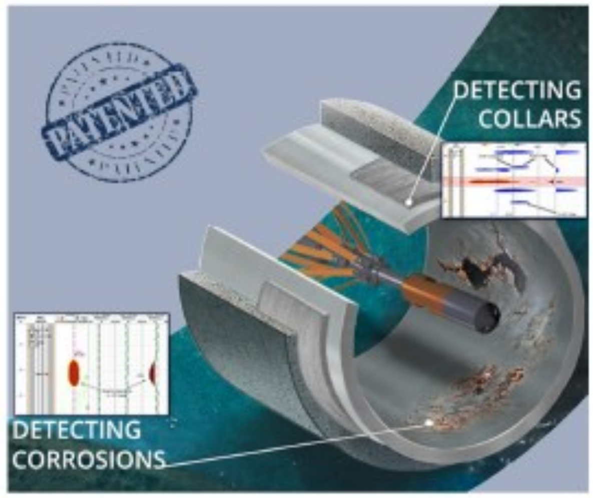
To gather members
To share knowledge

In this issue:

Administration
Exploration
Field Development
Digital Environments
Adjusting to Climate Change Pressure

The electronic version is available on the page of your section website.

Picture: Bredford Dolphin, source AGR/Dolphin Drilling



Inside this issue

Dear "The First" Readers,

Norway has always had excellent engineering expertise despite its small size. In addition to having he world leading technology, the industries have had skills to adjust it to the environmental and economic changes. Transformation and implementing already acquired know-how to new frontiers only reflects the professionalism of the regional engineers. Our Winter issue reflects on many topics actual in our current assignments and the environment around us. We hope you enjoy reading about individual examples of transformation.

On behalf of "The First" editorial team,

Maria Djomina
Editor The First/
Communications Manager, AGR

SPE Oslo
SPE Stavanger
SPE Bergen
SPE Northern Norway
SPE Trondheim

The First is SPE Norway Regional publication and is distributed to a multidiscipline audience. Circulation: 200 printed copies, 4,500 electronic copies

The electronic version of this Issue and previous Issues are available on SPE Norway websites.

The editorial team takes no responsibility for accuracy or content of the articles provided. Technical articles, professional overviews and SPE section news have no editorial fee. The editors are working on voluntary basis.

If you would like to support production of our magazine by publishing commercial information about your product/company, please contact editorial team.

Editors:
Vita V Kalashnikova
vita@pss-geo.com
Maria Djomina
Maria.Djomina@agr.com

Editorial content

Technical articles

Administration

Exploration

Field Development

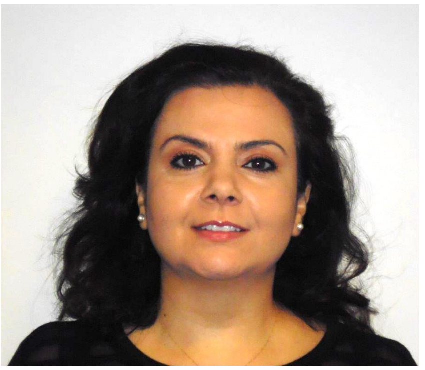
Digital Environments

Adjusting to Climate Change Pressure

Utilising Spectral Noise Logging and Conventional Production Logging Tools to Assess Reservoir & Completion Performance

by Remke Ellis and Rita-Michel Greiss, TGT Oilfield Services

Remke Ellis
Reservoir Engineer
Domain Champion
TGT Oilfield Services



Rita-Michel Greiss
Business Development Manager
TGT Oilfield Services

Introduction

This article explores challenges many Operators face today – the compliance of reservoir and completion performance to field development plan in order to maximise longevity of optimal production. In this article we examine the importance and added value benefits of acquiring Spectral Noise Logging (SNL) and conventional Production Logging Tool (PLT) data to this effect. We refer to previously published case studies for which spectral noise logging and conventional PLT data allowed oil and gas companies to resolve poor performance issues in both production and injection wells; reviving overall production levels and sustaining field life.

Reservoir and Completion Component Flow

Reservoir flow noise is produced by grain-to-grain, pore throat and fracture vibrations caused by transfer of energy from the flowing fluid to the media. Completion flow noise is typically generated by the vibration (resonation) of the production string (tubing or casing), pipe through-holes (leaks), perforation tunnels, and cement channels. Each source of noise can be distinguished based on acoustic frequency range, amplitude and continuity of the signal with wellbore or reservoir unit limits. Combining SNL and temperature measurements with conventional PLT measurements from flowmeters, heat-exchange sensors etc. allow for differentiating between flow occurring within the borehole or that behind pipe[1]. In the same way assessment of reservoir performance (SNL) and completion performance (PLT) is achieved, all with the same survey run.

High Precision Temperature Logging

Though temperature logging has been extensively used over several decades, the more recent development in simulation methodology and advanced numerical temperature modelling has enabled better interpretation and understanding of fluid flow. The methodology includes thermal model validation and accounting for injection / production history fluid volumes and temperatures. Additionally, the sensitive input parameter, of active unit thickness which previously has been assumed from open-hole logs, is now measured directly with the Spectral Noise Logging tool. This data acquisition now aids in a more robust and representative quantitative determination of fluid flow profile[2].

Spectral Noise Logging

The Spectral Noise Logging tool is specifically designed as a passive acoustic hydrophone, recording sound in the frequency range of 8Hz to 60kHz. The Spectral Noise Logging captures noise associated with liquid or gas movement through a media. This noise is generated from the streamlining (vibration) of the media and from within the fluid itself (if flow is turbulent). The frequency of the noise is inversely proportional to the cross sectional area (aperture) of the flow path. The volume intensity (amplitude) of the noise is dependent on the fluid and medium properties, and proportional to the delta pressure and flowrate.

The SNL tool is used to survey producer and injector wells, under both shut-in and flowing conditions. For shut-in surveys SNL captures noise associated with any cross-flow, crucially fluid cross-flowing behind completion components (tubing and casing). This allows for assessment of completion isolation performance (cement, packers, SSDs, etc) and realisation of inter-layer differential pressure depletion. Under flowing conditions SNL captures noise associated with reservoir flow, enabling assessment of layer performance (e.g. for identifying stimulation candidates) and out of zone contributions (water breakthrough / thief injection).

Injector Wells

The primary objective of injector wells is to ensure that water or gas is effectively placed into the targeted formation layers, to maintain reservoir pressure and mobilise hydrocarbons. Failures in completion component isolation (principally cement sheath or ISO-packers) can result in significant volumes of injected fluid bypassing the target zone. Insufficient layer pressure support and reservoir sweep results, causing reservoir conditions to deviate from field development plan and negative impact on production forecasts and recovery factor. Furthermore, if a polymer or surfactant injection is planned, it is important the calculated volume of chemical reaches the target layer.

In this case conventional PLT could provide quantitative perforation tunnel injection profile (within the wellbore), however what hap-

[1] Arlen Sarsekov, Ahmed Khalifa Al-Neaimi et al ADMA-OPCO, Vasily Skutin, Ruslan Makhiyanov et al TGT Oilfield Services, 2016, Quantitative Evaluation of the Reservoir Flow Profile of Short String Production with High Precision Temperature (HPT) Logging and Spectral Noise Logging (SNL) in the Long String of a Dual Completion Well, SPE-182889-MS

[2] A.I. Ipatov, Gazpromneft LLC Research and Development Centre, G.M. Nemirovitch, M.N. Nikolaev,, Messoyahaneftegaz CJSC, I.N. Shigapov, A.M. Aslanyan et al, TGT Oilfield Services, 2016, Multiphase inflow quantification for horizontal wells based on high sensitivity spectral noise logging and temperature modelling, SPE-181984-MS

The First
SPE Norway — Field Development

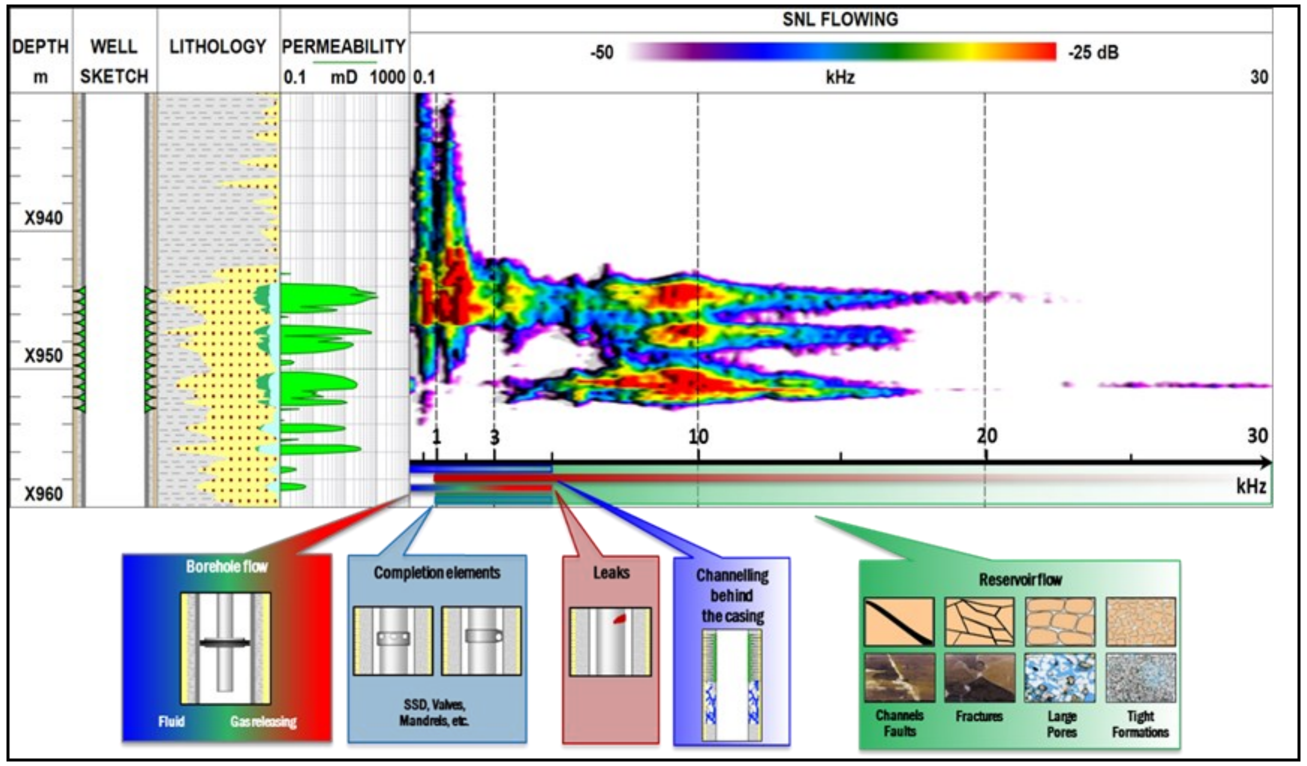


Figure 1. Acoustic Interpretation Fundamentals[3]

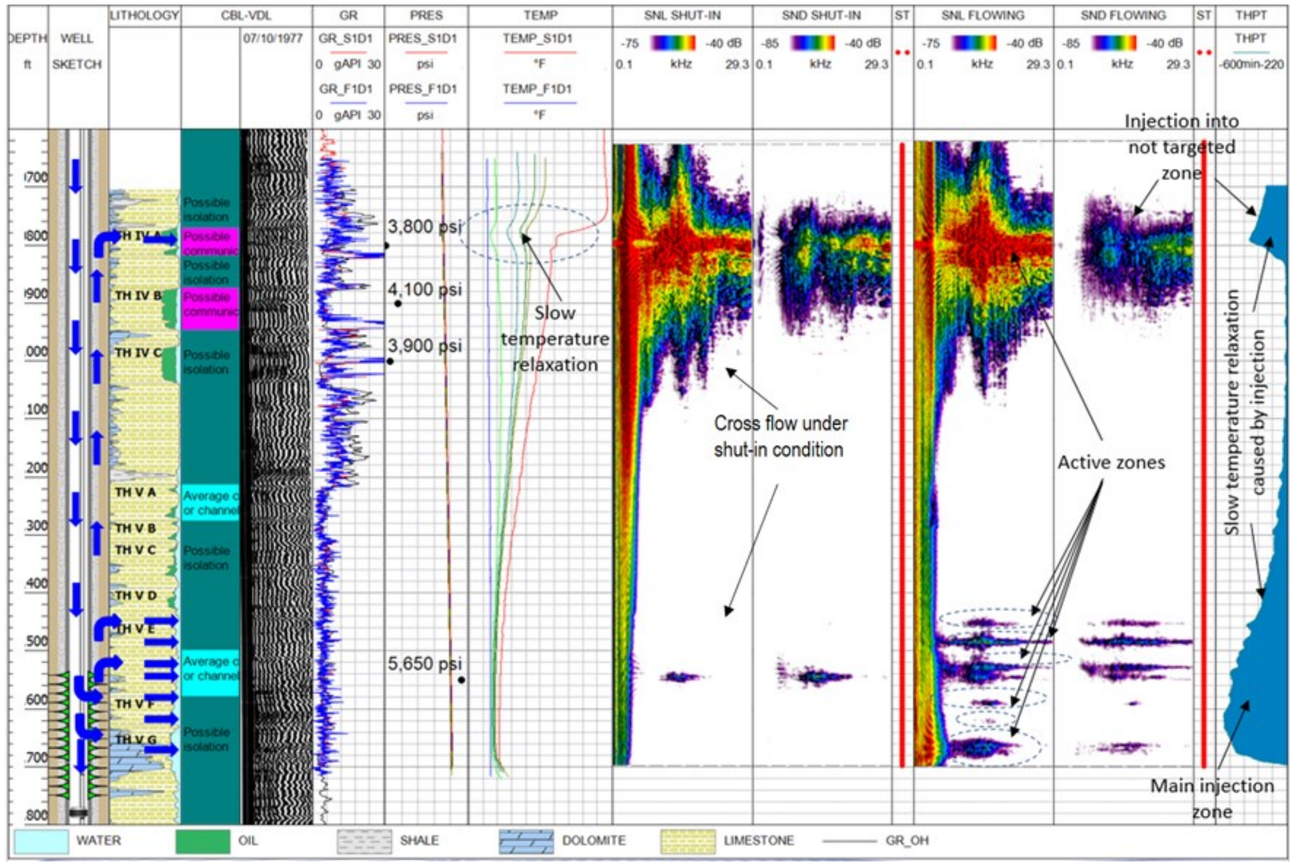


Figure 2. Extensive cement isolation failure resulting in significant volumes of bypassed injection[4]

[3] Arlen Sarsekov, Ahmed Khalifa Al-Neaimi et al ADMA, Raj Tauk, Maxim Volkov et al TGT Oilfield Services, Identification of Thief Zones and Water Allocation In Dual String Water Injectors With Temperature and Spectral Noise Logging, 2016, SPE-183491 MS, paper was presented at the Abu Dhabi International Petroleum Exhibition and Conference

[4] Arlen Sarsekov, Ahmed Khalifa Al-Neaimi et al ADMA, Raj Tauk, Maxim Volkov et al TGT Oilfield Services, Identification of Thief Zones and Water Allocation In Dual String Water Injectors With Temperature and Spectral Noise Logging, 2016, SPE-183491 MS, paper was presented at the Abu Dhabi International Petroleum Exhibition and Conference

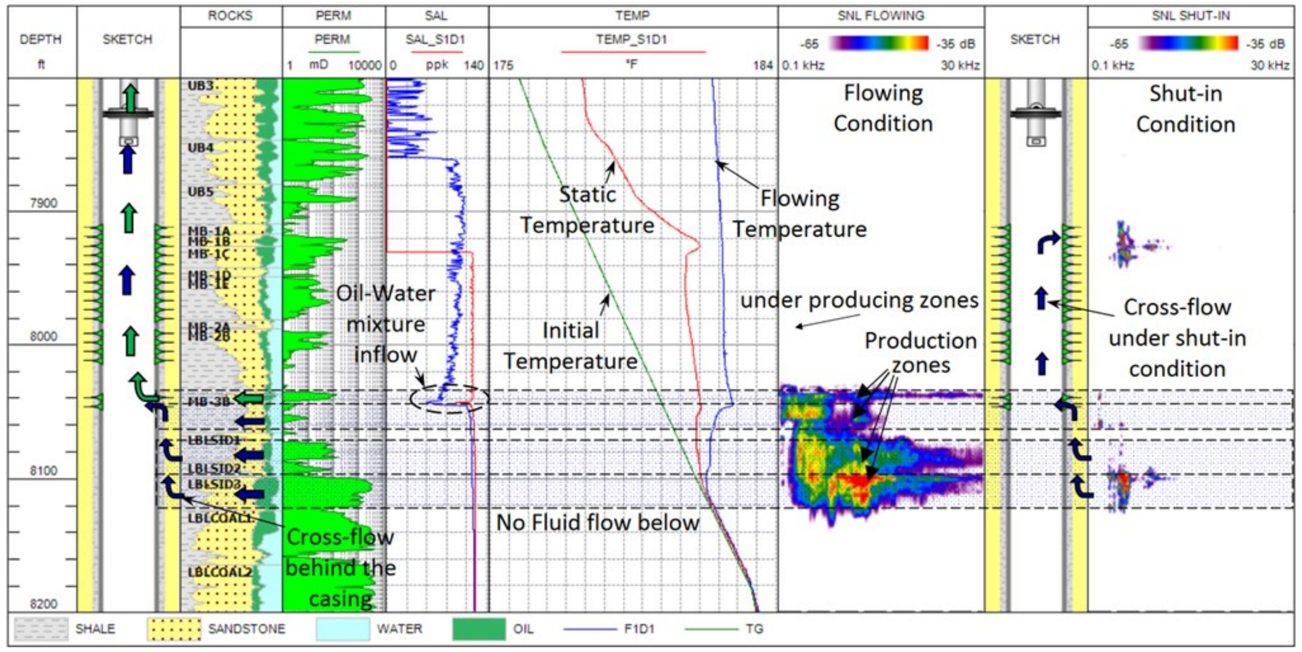


Figure 3. Underlying aquifer contributing water to perforation interval via cement channels[5]

pens after the fluid leaves the perforation tunnels is not realized. Under shut-in conditions SNL identified cross flow occurring behind casing, and under flowing conditions identified behind pipe (reservoir) injection profile. This behind pipe injection profile was then quantified by temperature simulation.

Producer Wells

Optimal production is achieved when reservoir productivity index and completion component (cement sheath, ISO-packer) isolation performance is strong. Under-producing pay zones result in delayed, and often uneven, layer production. Completion component isolation failure allows for out of target interval reservoir and/or aquifer fluid contribution. For smart completions this means a total loss of production / injection control. In this case SNL has identified contribution of layers outwith the perforation interval, and provided evaluation of the pay zone interval performance. Assessing wells with this measurement allows for effective work over planning with respect to water shut-off strategy and reservoir stimulation well candidates.

Conclusion

Assessing reservoir and completion performance is critical for effective reservoir management; sustaining optimal productivity and maximising recovery. Spectral noise logging captures and distinguishes between noise generated from flow occurring within the completion itself (leaking pipes and packers, cement channels, etc.) and flow happening 3 – 5 meters into the formation itself (matrix and fractures).

Spectral Noise Logging For Injectors:

- Locate and constrain limits of injection into layers behind pipe (within and out with perforation interval)
- Detect and differentiate between wellbore and behind casing cross-flows
- Identify leaks occurring across any completion components (tubing, casings, packers, completion jewellery, cement)

Spectral Noise Logging For Producers:

- Locate and constrain limits of producing layers behind pipe (within and out with perforation interval)
- Detect and differentiate between wellbore and behind casing cross-flows
- Identify leaks occurring across any completion components (tubing, casings, packers, completion jewellery, cement)

[5]R. Bhagavatula, M.F. Al-Ajmi, et al Kuwait Oil Company, F.Y. Shnaib, I. Aslanyan, et al, TGT Oilfield Services, An Integrated Downhole Production Logging Suite for Locating Water Sources in Oil Production Wells, 2015, SPE-178112-MS, paper was presented at the SPE Oil and

Continuous solids removal assures continuous production

by Giedre Malinauskaite, FourPhase

Giedre Malinauskaite,
FourPhase/
SPE Bergen Marketing officer
gma@fourphase.com

There are a number of aging oil and gas wells in production globally in addition to an increasing number of HPHT wells being drilled and set in production. Both aging wells and HPHT wells have significant challenges related to solids control while at the same time maintaining optimal well flow.

With these challenges present the Oil & Gas Industry must focus on working smarter and more efficiently. There has never been a greater need to apply new technology and implement innovative solutions. It is a fact that solids removal technology plays a major role in materially reducing costs and improving production efficiency in solids producing wells.

Solids removal technology enables Operators to increase the flow rate from producing wells while at the same time staying within the acceptable sand rate (ASR) criteria. This results in improved oil recovery at a lower cost per barrel. Solids removal technology provides a proven solution to maximising profit from each barrel of oil and/or gas. While the oil price is not something Operators can directly affect – increased production rates can compensate for loss of revenue while the oil price stays low. Further, solids removal technology reduces all direct and indirect costs related to reactive sand management:

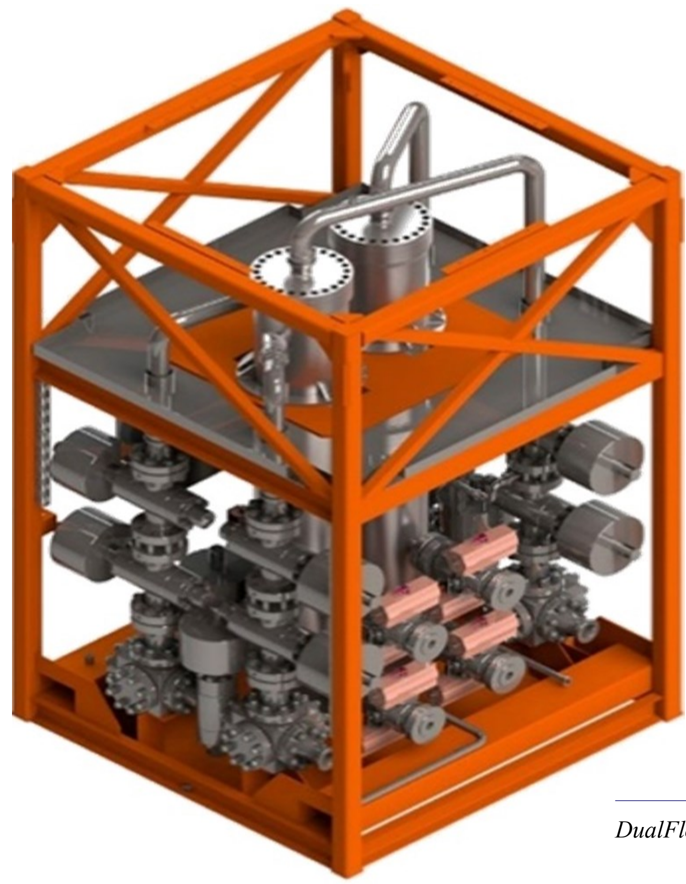
- Well intervention activities such as coiled tubing (CT) and snubbing clean-outs
- Separator cleaning and sand handling
- Heavy lifting
- Erosion of process plant
- POB necessary for doing maintenance on equipment suffering from sand production

Gullfakcs C, Statoil has been among the pioneers in implementing FourPhase's continuous production unit – DualFlow. In the paper presented by Statoil at SPE Sand Management Forum in 2014*, Statoil highlighted the benefits achieved by installing the DualFlow unit for continuous solids removal. According to the presentation, FourPhase's technology resulted in operational benefits (less jetting work, reduced sand problems in process plant, only one rig-up), cost savings (sand handling done offshore by reinjection, less need for CT sand clean out, more time for alternative CT operations) and improved oil recovery (higher flow rates without exceeding ASR, less down time for wells, optimised well performance).

FourPhase has proven to highly reduce and, in some cases, eliminate the need for costly intervention operations. In addition, providing uninterrupted continuous production.

Contact us to learn more about how FourPhase can revolutionize sand management on your installation.

*Optimization of well performance by use of a semi-permanent dynamic desander – SPE SMN European Sand Management Forum 26-27 March 2014



FOUR PHASE

DualFlow – dual non-motorized desander