In this issue:
Administration
Exploration
Field Development
Digital Environments
Adjusting to Climate Change Pressure
Dear “The First” Readers,

Norway has always had excellent engineering expertise despite its small size. In addition to having world-leading technology, the industries have had skills to adjust it to the environmental and economic changes. Transformation and implementing already acquired knowledge 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

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
cita@pss-geo.com
Maria Djomina
Maria.Djomina@agr.com

Light at the end of the pipeline
by Jon Fredrik Müller, Partner, Rystad Energy
Horizon 2020 – EU’s largest research and innovation programme ever — Open to participation from Norwegian actors on the same terms as actors of any other European nationalities
by Marianne H. Aandahl, Special Adviser, NCP Horizon2020, The Research Council of Norway

NPD’s Resource Classification System, RNB Reporting, and Annual Status Report for Fields
by Ann Bygdøyell, Senior Reservoir Engineer, NPD

Exploration
Sounds like oil….?
by Dr. Per Avseth, Adjunct Professor in Petroleum Geophysics, NTNU/Consulting Geophysicist, G&G Resources

Field Development
Back to Basics—the Use of Structural Reliability Analysis in Pipeline Design to Cut Costs in the Maria Development
by Reinert Hansson, Senior Pipeline Engineer, Wintershall
Making sure that the Deepwater Horizon won’t happen again
by Vladimir Andreev, Founder, Balanced Solutions

Utilising Spectral Noise Logging and Conventional Production Logging Tools to Assess Reservoir & Completion Performance
by Remke Ellis and Rita-Michel Greiss, TGT Oilfield Services
Continuous solids removal assures continuous production
by Giedre Malinauskaite, FourPhase

Bridging the Gap—Coupling Fluid Chemistry with Fluid Dynamic
by Andrea Shmueli, Martin Fossen, Heiner Schümann, SINTEF Petroleum AS

Digital Environments
Unlocking the value from the 50 years’ old Exploration Data
by Håkon Snøtun, Project Leader, AGR Software
Making the Digital Oilfield work—Collaborative Work Environments
by Frans Vandenberg, CWE Advisor, Smart Collaboration

Increase ROI of your E&P Applications with Software Metering
by Signe Marie Stenseth, VP, Open IT

Adjusting to Climate Change Pressure
Statoil’s Hywind concept—expanding the reach of offshore wind
by Sebastian Bringvåg, Head of Hywind Development, Statoil

A new offshore CO2 storage site in Norway
by Mike Carpenter, Senior Advisor, Gassnova
Utilising Spectral Noise Logging and Conventional Production Logging Tools to Assess Reservoir & Completion Performance
by Remke Ellis and Rita-Michel Greiss, 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 wellbeing 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. 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.

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 68kHz. 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 wellbores), however what hap-
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 under flowing conditions 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 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)

**Conclusion**

Assessing reservoir and completion performance is critical for effective reservoir management. The presented technology and implementation of spectral noise logging allows for effective work over planning with respect to water shut-off strategy and reservoir stimulation well candidates.

**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 helps to find injection profiles, locate leaks and to optimise production performance. In addition, it assists in making critical work over decisions and in optimising well performance.

**Continuous solids removal**

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 relating 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
- Erosion of process plant
- POB necessary for doing maintenance on equipment suffering from sand production

Gulffakes 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 production 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.


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

---

**DualFlow – dual non-motorized desander**