AFES Cased Hole Workshop 20th April 2016

Keynote Speaker Abstract

Mike Webster (BP) Distinguished Advisor Petrophysics

The Changing Face of In-well Surveillance

Over the past few years we have seen a renaissance in cased hole measurements. Historically resources and investments have been focused on developing newer and better openhole and LWD measurements with cased hole measurements being largely side-lined. However technology evolved and made a number of advances in both saturation monitoring, flow profiling and distributed sensing which have added a richer data set to the mix and opened up more opportunities for well and reservoir optimisation. The variety of conveyance methods have increased adding to the flexibility of data gathering opportunities. Drilling a new well is costly and the current low price cycle places greater emphasis on making the most from the existing well stock. The combination of flexible deployment options, enhanced tool technology and drive towards optimising current well stock opens up some unique opportunities for cased hole measurements. The cased hole market can be quite fragmented with no single service provider having all of the pieces of the jigsaw. A greater degree of collaboration between suppliers to offer operators a comprehensive service would help stimulate growth in surveillance and well work that even in these tough times would be value adding. Being more proactive will help the cased hole sector thrive.

Well Integrity – New Logging Technologies

Marvin Rourke, GoWell

Tubing and casing integrity inspection typically consists of some combination of mechanical multi-finger caliper logs (MFC), electro-magnetic (EM) pipe thickness logs, ultrasonic casing inspection logs and downhole cameras.

A more recent development is to use a technique called Pulsed Eddy Current (PEC) where a short high-energy EM pulse from a transmitter coil "energises" the surrounding concentric pipes. Immediately after the excitation pulse a co-located receiver coil measures the collapsing eddy currents. Embedded within this received "decay" curve is a complex signature which is a function of the surrounding pipe's geometry and properties. By employing an inversion processing technique the composite decay signal can be unravelled allowing for determination of multiple tubular thicknesses. In particular the identification of corrosion defects in a second or third outer tubular. The advantage to this technique is that casing problems can be located without the need to "pull the completion". GOWell's latest generation PEC tool the MTD-E is configurable for optimum data acquisition and is fully combinable with other casing inspection and logging sensors.

Surface casing vent flow is another example of a serious well integrity problem where formation fluids uncontrollably escape to surface. In such cases running only standard casing inspection tools may not tell the whole story, if at all, such as pinpointing the exact depth of the fluid entry and the flow path in order to drive remedial actions. However in situations where a downhole problem is causing a fluid leak in the tubing or casing additional diagnostics can be used to locate the source of the leak. Such abnormal flow conditions can be assessed by various techniques including a simple temperature log to more sophisticated noise log. Temperature logs have been used for decades and should not be forgotten but can be tricky to interpret definitively. GOWell's noise logging tools consist of a wide-band hydrophone with digital signal processing to produce a frequency spectrum log. However noise logging does have its challenges. These include how to eliminate unwanted noise not associated with leaks while still having enough sensitivity to pick up minor leaks. In many cases this can only be achieved by a series of stationary measurements which are time-consuming to acquire and can completely miss the leak interval. GOWell's next generation noise logging tool will feature a large array of acoustic sensors and employ processing that allows for a robust extraction of the small leak signals while logging continuously.

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Well Integrity Abstract

Virginie Schoepf, BP

Evaluation of Gravel Pack Completion

Effective sand control is extremely important for high rate wells producing hydrocarbons from unconsolidated sand reservoirs. Mitigating the risks associated with sand production through petrophysical surveillance helps designing the adequate completion.

The presentation will focus on new instrumentation technologies as well as new workflows used to assess the quality of the gravel pack and the integrity of the screens.

The developments of engineered proppant (gadolinium doped) opens the arena for new nuclear attributes acquired with multidetector pulsed neutron technologies, moving from a qualitative into a quantitative evaluation. Advanced nuclear modelling benchmarked against specific completion is critical in screening and selecting the nuclear attributes and the optimal instrumentation mode that will further reduce the rig time without diminishing the data quality.

Similarly, there are emerging electromagnetic technologies which show promise for monitoring the screen integrity. Understanding the operational limits requires advanced testing and benchmarking in controlled environments.

With few published operator-driven examples, our aim with this paper is to encourage the collaborative efforts through Manufacturers, Logging Providers, Software Developers and Academia to improve sensor design and characterization for these specific applications.

Improved Cased-hole Formation Evaluation: The Added Value of High Definition Spectroscopy Measurement

Chiara Cavalleri, Schlumberger

The commitment to maintain a viable oil and gas industry and maximize profitable reserves in the current business climate put's operators' margins under increasing pressure. The ability to accurately locate and assess the quality of hydrocarbon-bearing reservoirs and accurately quantify the remaining potential of mature fields are of paramount importance.

The subsurface geology and formation properties of new targets and re-entry oilfield candidates are often complex and structurally heterogeneous. Lack of original data complicates the field management eventually leading to production mismatch, hence intelligent logging assessments and workflows are required. Even when comprehensive logging at the time of drilling is available and accurately described, after years of production or shut-in, uncertainty related to lithology, cement bond and well integrity, changes in hole conditions and depletion rates effect the current reservoir value; hence the need to re-estimate reserves (and monitor their remaining capacity). Quality reservoir data has to be delivered with high level of efficiency and diligence to boost hydrocarbon production and sustain the planned production rates at minimum operating costs.

Cased-hole formation evaluation has a primary role for the proper description of existing reservoir systems and for the definition of additional productive sand units to assist improved reservoir description and completion optimization, as well as guiding intervention programs or plug and abandonment operations.

The latest wireline high definition spectroscopy tool revolutionizes the neutron-induced gamma ray methodology to support robust lithology and saturation interpretation even behind casing. Merging capture and inelastic data in a completely sourceless state-of-art design, significantly improves precision, accuracy, and interpretation consistency without the need for calibration or requirement for local, empirical interpretation models.
The ability to determine both the matrix mineral composition, sigma, and total organic carbon (TOC) for saturation monitoring are instrumental to geoscientists, petrophysicists, reservoir engineers, completion, and production experts.

The applicability of the measurement extend to cases of hostile drilling or logging environments where openhole LWD or Wireline tools may not be available and formation evaluation through casing become the last option and a cost-effective assurance for reservoir evaluation to assist completion decisions. The technology also allows analysis of clays and lithology in the overburden to help geomechanics and field management activities, including abandonment procedures.

The log examples presented demonstrate the effectiveness of the measurement, as standalone or combined with traditional logs, to accurately describe both reservoir and shale sequences in old wells, and to re-evaluate and monitor fluid content variations in development and production prospects.

A comprehensive set of output log curves is made available for accurate determination of reservoir quality; the required data processing is performed within a short time after logging to enable informed decision making related to the ongoing operations.

The Raptor Tool, case studies from a next generation pulse neutron tool

Abstract

Conventional pulse neutron measurements such as C/O and Sigma have been around since the mid-sixties and have been applied to formation saturation logging successfully during this time when the conditions have been suitable. In more recent times however a quantitative gas saturation measurement, as a third phase and in lower grade shaley sands and low contrast conditions of low porosity and water salinity has become desirable and has proved challenging if not impossible for these measurements to achieve with traditional instrumentation. In 2006 Multi Detector Pulsed Neutron (MDPN) technology emerged specifically to address these challenges and allows new generation measurements made possible by an increased-spacing detector array providing a larger range of source to detector spacing than in conventional dual detector instruments. The increased spacing provides higher measurement sensitivities to several important formation properties including gas. This presentation reports field experiences measuring quantitative gas saturation in complex completions, in thin bed shaley-sands, and low salinity gas reservoirs.

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AFES 2016 Paper proposal

Title:

Calculating the 3D geometry of deformed downhole tubulars using multi-finger caliper data

Authors:

Steve Helmore*, Garry Williams, Glyn Roberts; Epidote Limited

*Speaker

Abstract:

In many wells worldwide, fault reactivation caused by production related subsidence or tectonic movement has resulted in the shear deformation of downhole tubulars. This paper highlights innovative methods used to quantify the shear offset and shape of deformed tubulars from multi-finger caliper (MFC) data and to simulate the passage of downhole equipment.

Campaigns of multi-finger caliper (MFC) surveys are regularly carried out for assessment of corrosion and tubing integrity. With certain tool string considerations this data can also be processed to analyse the shear deformation, bending, or helical buckling of the inner tubular. Such damage potentially affects well integrity and the passage of downhole equipment.

In shear deformation pipes above and below the deformation are parallel but not aligned. We describe an inversion method which calculates the 3D centre line of the tubular shear deformation from MFC data and estimates the magnitude of the lateral displacement. We review pipe yard tests used to verify the software predictions.

We construct a 3D model of the inside pipe surface by wrapping centralised MFC data around the calculated pipe centre line, thus taking into account pipe ovalisation and other restrictions. We then simulate and visualise the passage of potential intervention equipment. By using simulation rather than conventional curvature calculations we can take into account the complex geometry of the inside pipe surface.

In our two case studies based on data from the North Sea, we calculate (1) The geometry of a deformed liner in an injector well; and (2) The geometry of deformed production tubing inside casing.

In the first case study we can relate each deformation location and direction to local geology and get an insight into the deformation mechanism.

When applied to the second case study, we use the knowledge of the tubing shear displacement and shape to estimate a model for casing deformation. The position of the tubing inside the casing then allows us to assess tubing retrieval options as part of a work-over or abandonment operation.

In summary his paper describes a consistent method to calculate the geometry of tubular shear deformation from multi-finger caliper data. It also describes how computer simulation can be used to

investigate well access limitations in situations where the deformation results in a complex internal shape.

Safety and operational risk mitigation by integrity logging for a well abandonment activity

Yu Ling Wu, Shell

Cased hole logging is often performed to aid well abandonment activities. In this example of abandoning a HPHT well, cased hole logging with an ultrasonic tool confirmed good casing integrity needed to withstand a potentially high pressure from below a shallow plug. A second run identified safety and operational risks if the casing would be cut: 1) the production casing and intermediate casing were in contact at the planned cutting depth and 2) gaseous material was present in the annulus behind the production casing. These observations led to the decision to temporarily suspend the well and update the plans how to fully abandon the well.

Ross Brackenridge

LR-Senergy

Production Logging – Conventional Vs Array Tool Data Interpretation

Downhole hardware used for the measurement of Well Production has moved on significantly in recent years from conventional Production Logging tools with borehole centric sensors to newly developed tools which comprise multiple sensors strategically positioned either vertically across or circumferentially around the borehole. So how do we interpret this type of data? How does the interpretation differ from the conventional interpretation? Which aspects of the interpretation become easier and which aspect become more challenging? At LR-Senergy we have recently been upgrading our Production Log Analysis module within our IP software platform to handle these new array tool datasets. During this process we have had much internal and external debate about the correct methodology to utilize. This presentation shares some of the main challenges we faced during the process and the solutions we have chosen to implement to address them.