Inwell-flow and flow-behind-pipe detection

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SPE In-well Flow Surveillance and Control Seminar
Inwell-flow and flow-behind-pipe detection

Principles of the application
• Production logging application for multi-stage completions
• Ultrasound logging technology
• Benefits of combined PL / ultrasound measurement

Case studies
• Ultrasound ECP leak detection
• Flow behind pipe
• ECP failure in multi-stage completions
• Other possible applications

Conclusions
Production logging application

Multi-stage zonal completions using external casing packers (ECP) provide:

- Options for shut-off of water or naturally depleted intervals
- Zonal isolation

Conventional production logging (PL) is the preferred method to evaluate well performance in this type of completion.

Challenge:
- Detecting integrity of ECP behind pipe is a challenge for PL particularly as these wells are commonly near-horizontal
Multi-stage zonal completions using external casing packers (ECPs)

Conventional PL identifies flow regime within the wellbore
Ultrasound technology

Turbulent flow generates ultrasound energy
Ultrasound logging tool key features

1. Responds to ultrasound energy caused by turbulent flow
2. Detects flow behind casing while deployed inside tubing
3. Can be logged dynamically or as series of stationary measurements

Stop for 15 – 30sec
Ultrasound generation

Ultrasound response

- Flow becomes turbulent when flowing through chokes
- Turbulent flow generates ultrasonic energy that can be detected by a tubing deployed sensor
- High attenuation of ultrasound gives high depth accuracy
Improving zonal integrity understanding using ultrasound

Providing information of flow behind the casing or leak in ECP

Detecting ultrasonic energy behind casing will help in evaluating:

- ECP failure
- ICV flow obstruction (closure, scaling)
- Cement seal effectiveness (flow)
- Improve decision-making in controlling unwanted fluid breakthrough
Example of potential benefit in multi stage completions

PL results:

Water production from zone 3 and zone 4

Combined PL and Ultrasound results:

Significant water production from zone 3 might be because of lack of isolation from zone 4
Can ECP leaks be detected?

Objective:

Locate the sources of communication between the production tubing and formation.

Verify flow of injected fluid after a mini frac operation performed through the bottom Fracport.

All frac ports were closed except the bottom frac port.
Example of ECP leak detection

• Results: Ultrasound leak detection run located six flow paths across the open hole packers during injection
Example results - flow behind casing entering through the liner hanger

Objective: The well had high casing pressure. A tubing leak was suspected.

Results: The ultrasound tool identified the source of the high casing pressure as flow from a gas layer behind casing entering at the liner hanger. The problem was not the tubing.
Flow behind pipe

Objectives: Identify a possible well integrity failure which resulted in high water cut in production.

Results: Ultrasound data revealed presence of flow behind pipe beyond the spinner environment across a zone that was isolated.
Leaking swell packer

Objectives
• Establish the flow profile in the wellbore
• Identify which ports are producing

Results
• PL identified production flow profile in the wellbore
• Ultrasound reveals swell packer leak compromising hydraulic seal between zones
• Production from the sliding sleeve picked up from the spinner may originate from either or both zones
Objectives: Locate oil and water entries and diagnose possible sand entry

Results: Liquid is entering the wellbore from four logged sand screens. The ultrasound data showed a localised response at the highest water entry indicating a possible sand production.
Conclusions

• Combining PL with ultrasound sensors provides a better understanding of flow in wellbore and behind pipe

• Fewer interventions eliminate the need to investigate the integrity behind pipe

• Ultrasound provides high precision identification of exact leak locations

• Ability to run dynamic or stationary measurements leading to better data and program integration

• Improving well management decisions (gas /water shut off, etc.) to better understand zone contribution
Thank you

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