Utilising Acoustic Communication to Create Great TCP Technologies

APPS-13-10

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Agenda

• Acoustic Firing Head
• Acoustic Distributed Temperature System.
Agenda

• Acoustic Firing Head
Current Firing Head Systems

- Mechanical – Bar Drop, Ball Drop
- Pressure – Direct, Differential
- Electronic – Pressure, Pulses, Acceleration, Time

- All have their place but all have a limitation...
  - Requirement for pressure or mechanical interventions
Plugging the Gap

• An acoustically operated firing head
• Uses tubing as the communication conduit
• Proven advanced acoustic and hardware technology
• Two way communication
• Optional real time pressure temperature data and detonation confirmation
• Surface safe
System

- Allows communication to the firing head at all times without the need of pressure or mechanical intervention at the firing head.
- Transmits through dry pipe, closed valves, packers, plugged profile nipples, Hi-Vis fluids etc.
- Allows maximum freedom while pressure testing, circulating, gas lifting, e/slickline intervention etc. without fear of gun detonation.
Operation

Acoustics

• Acoustic Signals via tubing from surface to firing head
• Requires multiple repeaters on tubing string
• Actuate single or multiple gun sets as required in any order

Pulse

• Annular pressure pulse to receiver above packer
• Receiver relays acoustic signals via BHA to firing head
• Actuate single or multiple gun sets as required in any order
Safety

• Electromechanical system – requires minimum hydrostatic to fire
• Firing piston is retained by a detent mechanism so will not function accidentally if a seal failure occurs
• Minimum Temperature Requirement – motor power is provided via a thermal switch
• “Fire” command must be preceded by an independently sent “Prime” command
• Tool will come out of “Primed” state and revert to “Safe” state if “Fire” command is not received within a preset time limit
• Acoustic command sequences are very complex multi-character messages with built in error detection so cannot accidentally be received if not specifically sent
• Independent FMEA concluded system complies with API RP67
• Drop tested to comply with API RP67
Surface trials

Trial 1
• Completed successfully with gun detonation achieved from first signal transmitted. 4½” 12 spf system.
• Firing head continued to operate after gun detonation.

Trial 2
• Completed successfully with gun detonation achieved from first signal transmitted. 4½” 12 spf system.
• Firing head continued to operate after gun detonation.

Trial 3
• Completed successfully with gun detonation achieved from first signal transmitted. 4½” 5 spf system.
• Firing head continued to operate after gun detonation.
## Run History

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Applications

Will this change the way we plan perforating?

• DST – Multizonal tests? Pressure testing regimes?
• Horizontal Wells – Non sequential perforating for clean up and/or evaluation.
• Completions - Eliminate concerns with pressure cycles to the well during completion.
• Wells with open perforations
• Acoustic Distributed Temperature System.
System Overview

• Unconventional distributed temperature system
  • Positioning of multiple temperature sensors
• Individually autonomous sensor system, each with its own battery pack.
• Robust can be run alongside perforating gun system.
• Multiple system compatable
• Can communicate to surface via acoustic telemetry eliminating the need for packer feed throughs.
Gun Orientation
Gun Orientation
Specialised Clamps
Specialised Clamps
Surface Tests

Trial 1
• Slight collapse seen in control line
• 1 sensor damaged (from control line)
• Data recorded from all other sensors

Trial 2
• Higher pressure rating control line
• Trialled new style control line clamp
• Damaged sensors
• Data recorded from all other sensors

Trial 3
• Utilised improved sensor design – no sensor failures
Work History

• 3 surface tests completed with perforating gun system. Data received on all tests
• Standard prototype system has been operating since 2009
• Standard system is currently in hole with screens and operating successfully in West Africa for 3 months.
• Standard system run successfully in gas well on screens in North Sea and producing data.
Work History

Asia Pacific Perforating Symposium Kuala Lumpur 2013 - GeoKey Limited -
Applications

• Temperature profiles across the reservoir directly before and after firing.
• Monitoring of multiple independent zones
• May eliminate the need for production logging
• Long term reservoir information available even when guns are left *in situ*.
Summary

Acoustic Firing Head
- Perforating isolated wellbores is now possible.
- Firing system will allow more complex zonal perforation in a single TCP run.
- Possible to confirm firing before moving to next section.

Acoustic DTS
- TCP compatible distributed temperature system.
- Pre and post perforation temperature profiles.
- No packer feed throughs
Questions?