



*A New Acoustic Telemetry System
Enables Deepwater Operators to
Manage Pressures in Real-Time from
Drilling through Completion Installation*

APPLIED ACOUSTICS | DIFFERENT DECISIONS | RELIABLE RESULTS

The Need for Downhole Data

- Uncertainty and lack of information about well conditions are some of the biggest risk associated with operations in complex wells
- Getting the right information at the right time, is essential for safe, successful, cost effective operations.
- Real-time downhole data is currently limited to on bottom drilling time which on a deepwater rig can be less than 15% of total rig time.



Acoustic Telemetry Network

- Sends data almost anytime drill or workstrings are in the well

Features

- Acoustic Telemetry
- Distributed Real-time Measurements
- Fluid Independent/Works With No Fluid
- Flow/Pumping Independent
- Formation Independent
- Higher Data Rates Than MP/EM
- Optimized For Bi-Directional
- Fully Through-bore
- Easy/Rapid To Deploy And De-mob
- Data Rate Is Not Depth Limited

Exclusive Enabling Technology
Allows New Approaches To Well Construction/Completions

APPLICATIONS

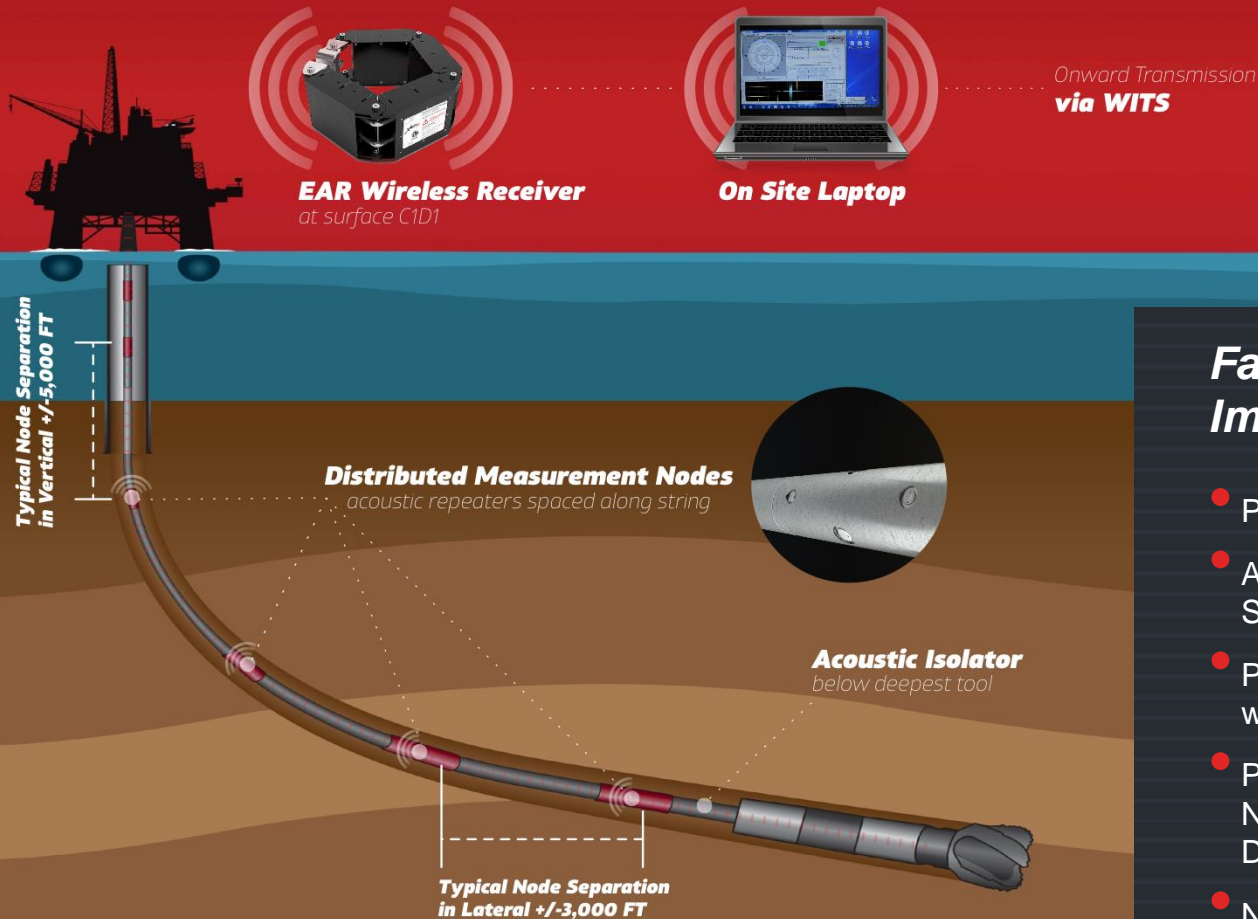
Same Telemetry Network Across Multiple Applications

- | | | | |
|-------------------------------------|---|---------------------------------------|---|
| ● Frac and Gravel Pack Installation | ✓ | ● Depleted and Fractured Reservoirs | ✓ |
| ● Cementing | ✓ | ● Downhole Negative Testing | ✓ |
| ● Liner and Casing Running | ✓ | ● Downhole Formation Integrity Test | ✓ |
| ● Drilling | ✓ | ● No Flow and Low Flow Operations | ✓ |
| ● Air Drilling | ✓ | ● Managed Pressure Drilling/Cementing | ✓ |
| ● Tripping | ✓ | ● Interval ECD's | ✓ |
| ● Well Testing (DST) | ✓ | ● Downhole Mud Rheology | |
| ● TCP Gun Operations | ✓ | ● Data below Closed BOP's | ✓ |
| ● Liner Drilling | | ● Data during Well Control Operations | |
| | | ● Downhole Tool Activation | |

✓ Denotes application where XACT has been utilized commercially.

How it Works - Making your Drillstring Smart!

XACT's Easy to Deploy Network



Fast and Simple Implementation

- Place Surface Laptop in Safe Zone
- Attach Wireless Receiver at Surface
- Pick-Up Deepest Acoustic Node with Isolator as Making-Up BHA
- Pick-Up Subsequent Nodes as Needed During Trip in Hole/While Drilling
- Network is bidirectional

Acoustic technology is packaged in collar-based downhole tools

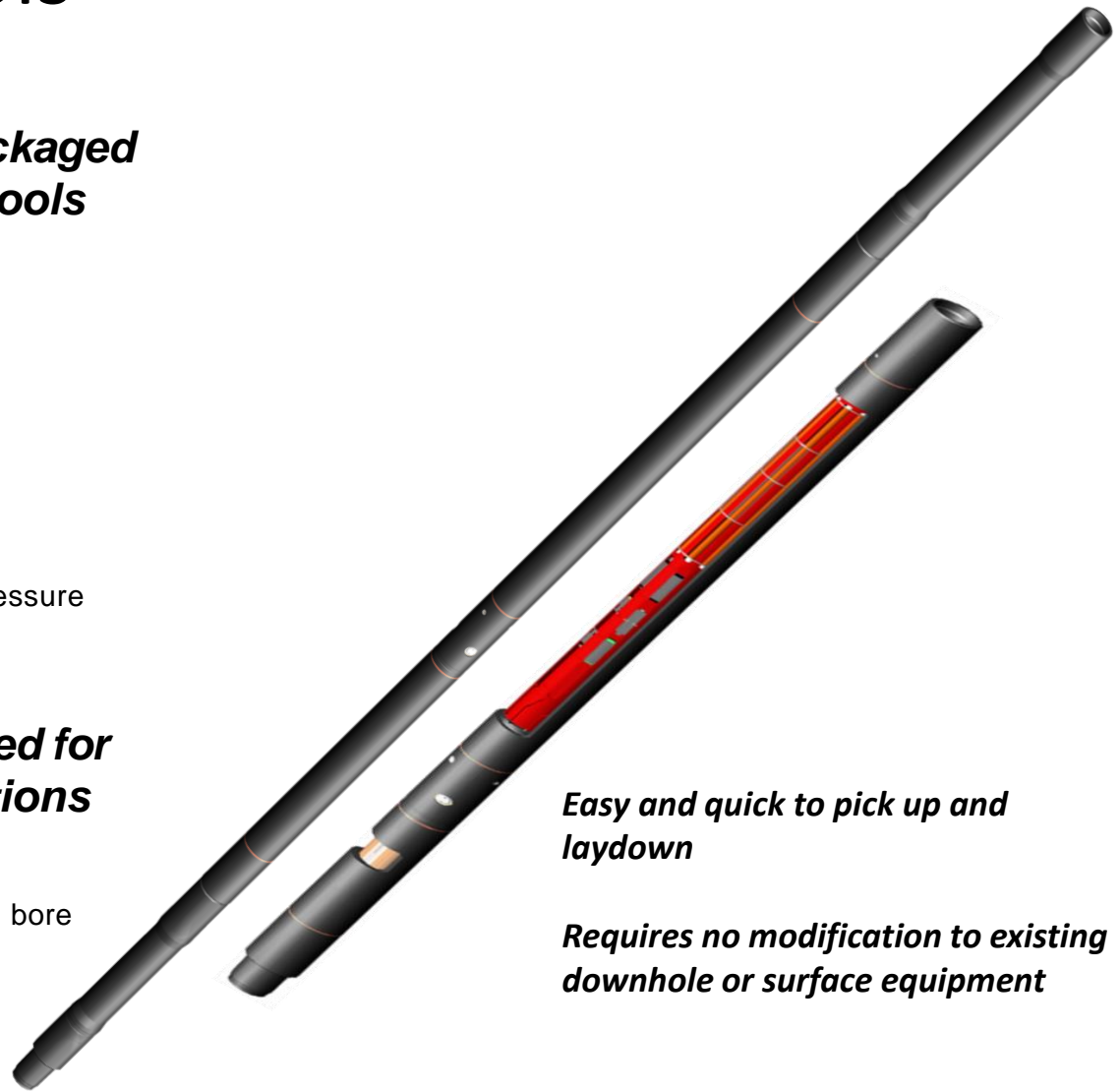
- PZT Stack
- Electronics, Memory & Sensors
- Lithium Battery Power Supply

Measurements Currently Available:

- ID and OD Temperature and Pressure
- Tension/Torque/Bending

Mechanical design optimized for drilling/completion applications

- No moving parts
- Large, concentric, open through bore
- 1M lbs Tension
- 30K PSI Pressure
- 90K ft/lbs Torque
- 23K PSI Differential Pressure
- 7.25" OD, 3" ID



Easy and quick to pick up and laydown

Requires no modification to existing downhole or surface equipment

Deepwater TCP Operation

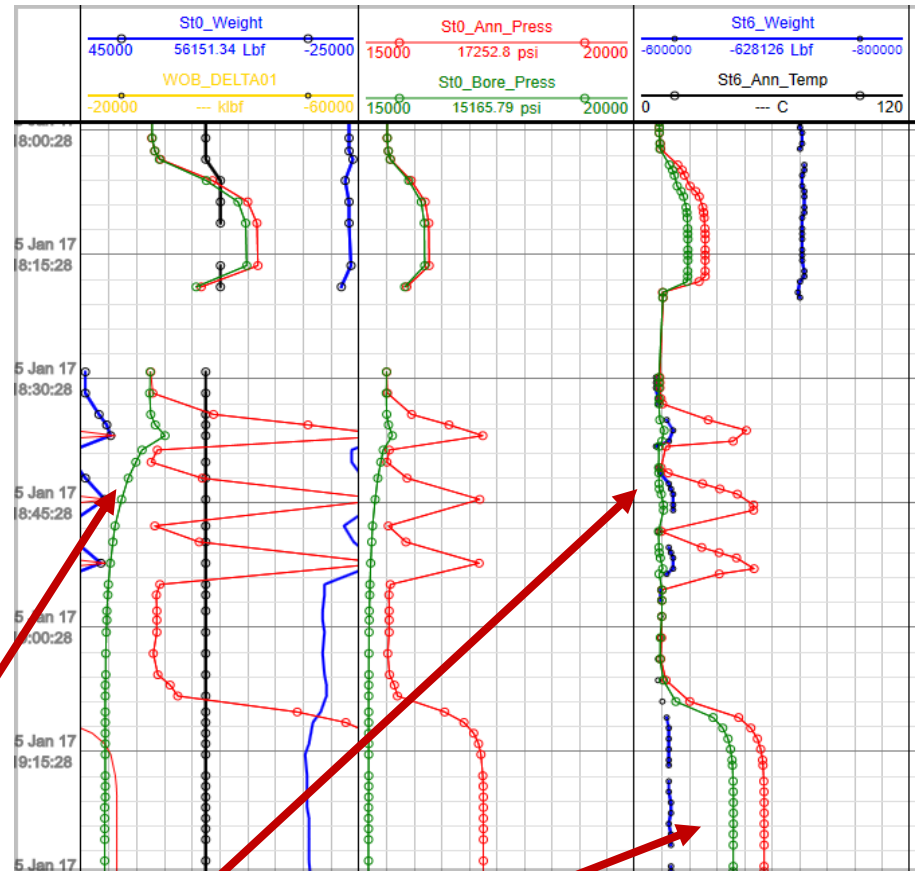
Objectives

- Gun firing verification
- Verification of IRDV positioning, in case of need to drop detonation bar
- Injectivity analysis

Benefits to Customer

- 6 hrs. from troubleshooting TCP valve position in next TCP run w/o XACT
- If troubleshooting is not successful in determining the position of the TCP valve then...
 - Contingency of dropping detonating bar is not available
 - ~54 hrs. of rig time:
 - POOH, installing down/up of TCP manifold and iron, RIH again

With upcoming Surface Tool ability to fire guns remotely eliminates surface rig up and rig down of high pressure lines for safety and efficiency gains



Valve cycling through positions – Bore pressure drops when in blank position reading reservoir pressure (with hydrostatic offset)

Station 6 shows response above valve confirming circulate position
Downhole tensions show set down weight

Deepwater – MINIFRAC Analysis

IMPROVE PRODUCTIVITY

Objectives

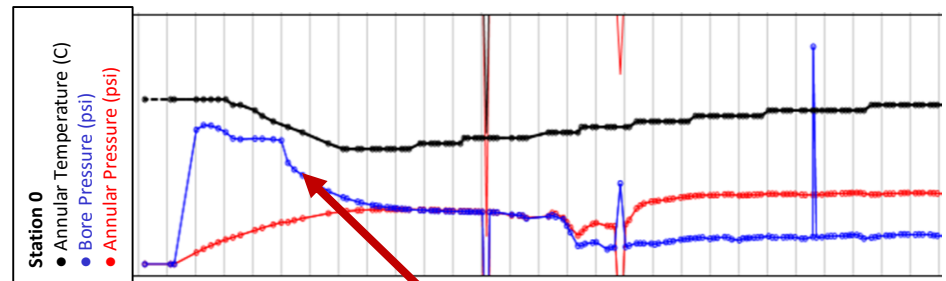
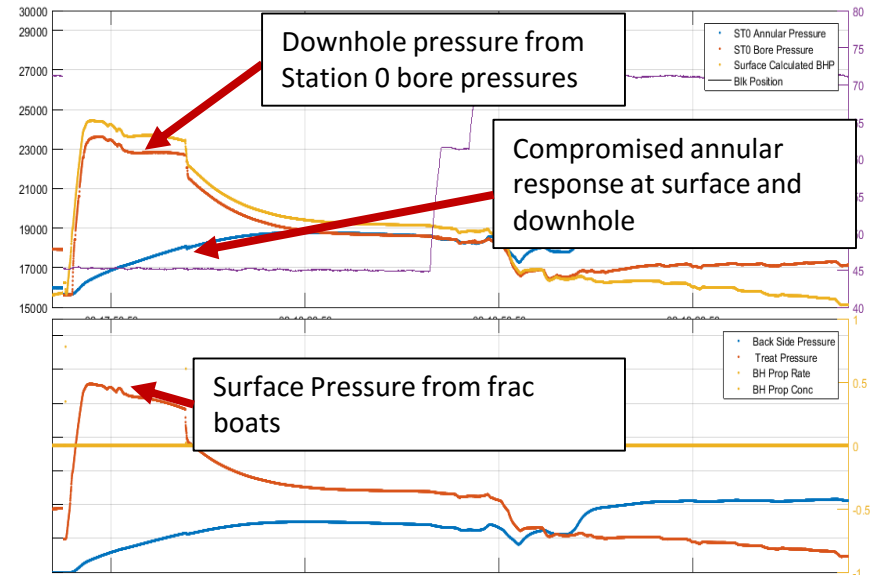
- Confirmation of Frac Model for optimum reservoir coverage
- Minimize skin, increase productivity index
- Increase time to intervention

Benefits to Customer

- Minimize Frac interference in massive reservoirs
- 10-20% increase in PI
- Increase in production 100-200 bpd (1000 psi drawdown assumption, low KH reservoir <20000md-ft. 1 yr cumulative production: \$1.5-2.5M
- Reduced skin increased over time – increase time to intervention

Burst Telemetry

- Currently testing 1-3 second RT data resolution for critical analysis such as Minifrac in downhole conditions



Real Time Pressures show downhole response on minifrac

Deepwater Multi-Zone Frac Pack Operations 9

PREVENTION OF NPT BY FULL KNOWLEDGE OF DOWNHOLE CONDITIONS

Objectives

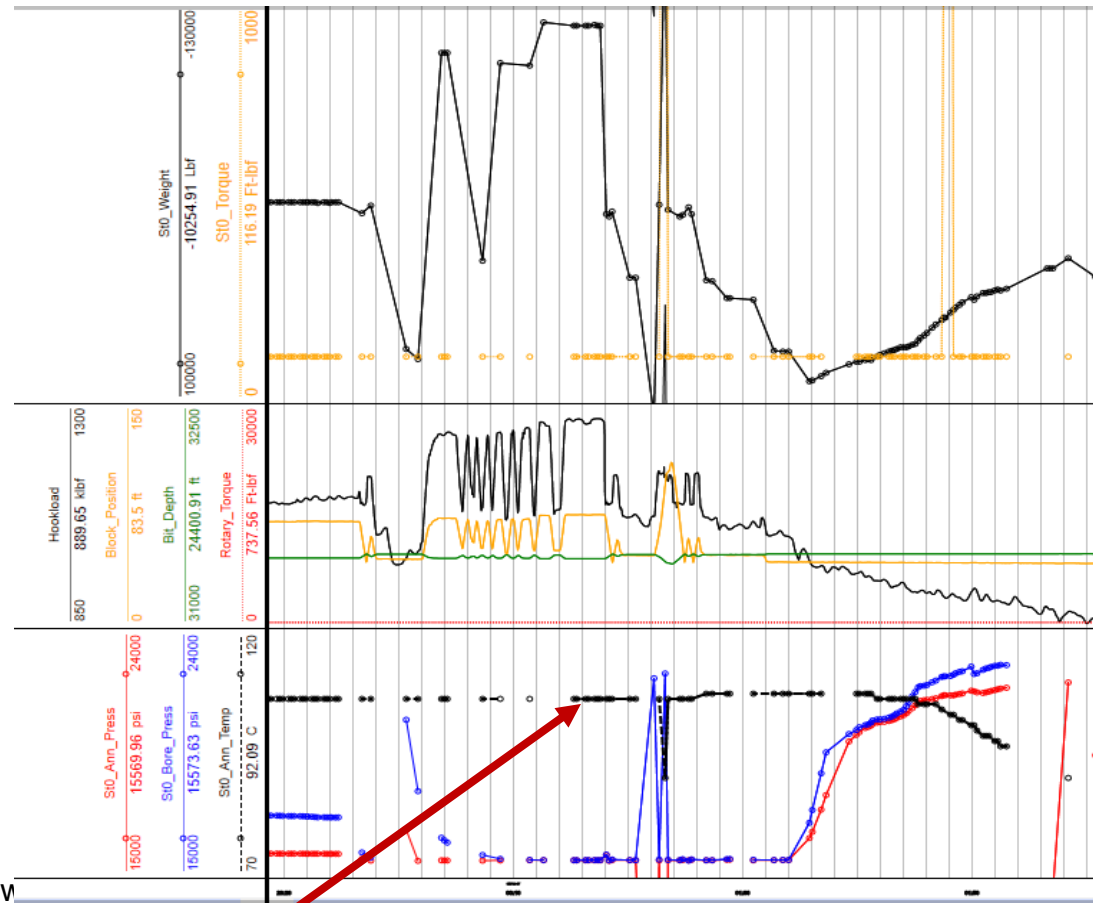
- Avoid wash pipe buckling
- Verify service tool positions
- Optimize frac operation

Service tool got stuck after spotting frac

- Got free after max pull-utilizing downhole data
- Pulled safely to maximum downhole without compromising assembly integrity
- Temp. measurements verified frac fluid condition avoiding reversing out/disposing fluid
- BH Pressures allowed frac to continue after high surface pressures were observed

Savings to Customer: 10-14 days of NPT

- Rig spread rate
- Coiled tubing unit for 4 days
- Reversing disposing of frac fluid + proppant and new slurry + Boat and Rig time
- Total cost savings > \$10M in 6 hours, three separate incidents, 3 separate decisions

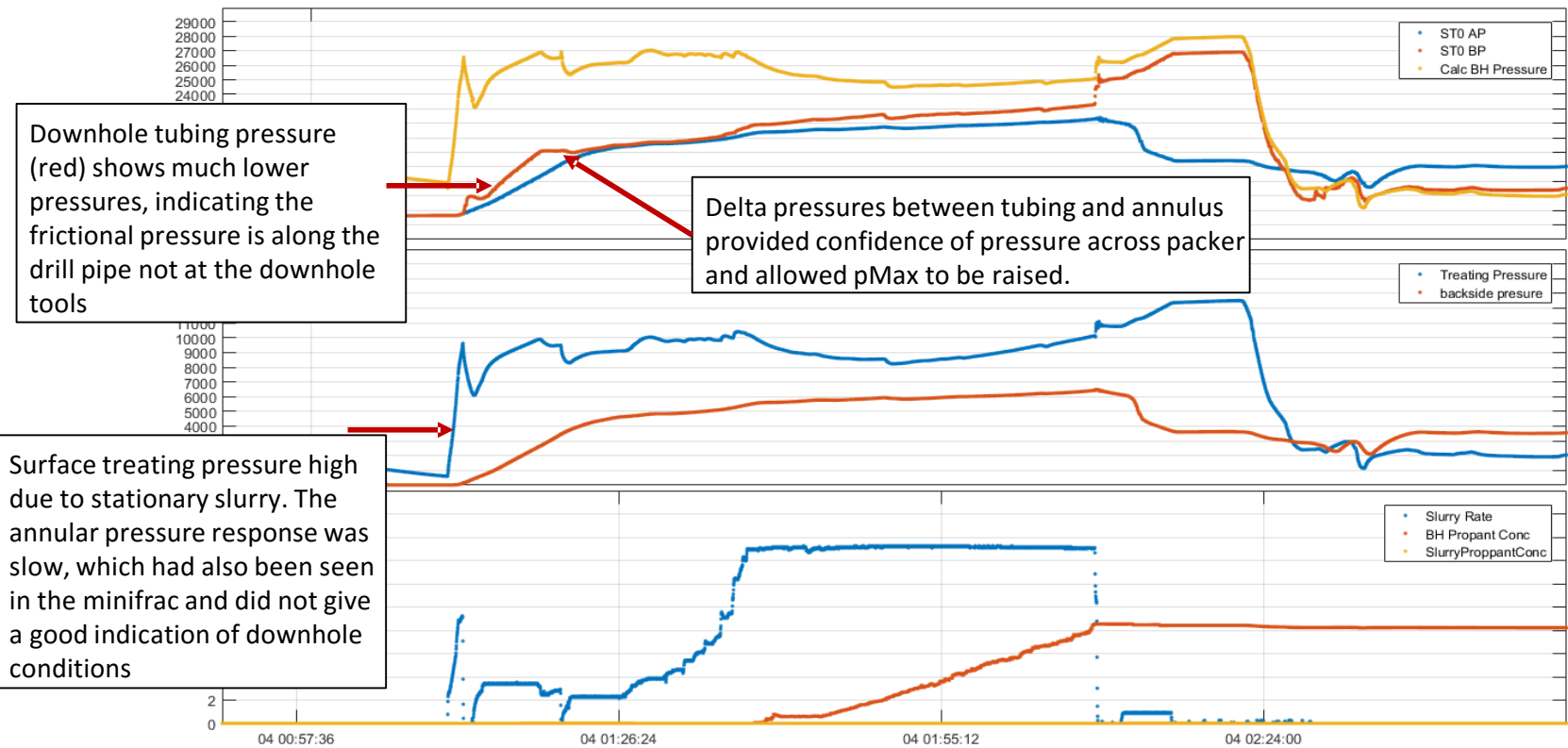


Real Time Downhole temperatures enabled decision to not reverse out frac slurry

Real Time Pressures show high surface pressures not present downhole when getting frac treatment moving – confirming no downhole issues

Surface and Downhole Pressures varied Materially

Comparison of downhole pressures to surface treating and annular pressures at the start of the lower frac. Downhole pressures enabled rapid evaluation of the cause of the high surface treating pressures and allowed the frac to proceed with minimal trouble shooting time and avoid reversing the slurry out.



FLUID LOSS CONTROL AFTER PERFORATING AND STIMULATION

Objectives

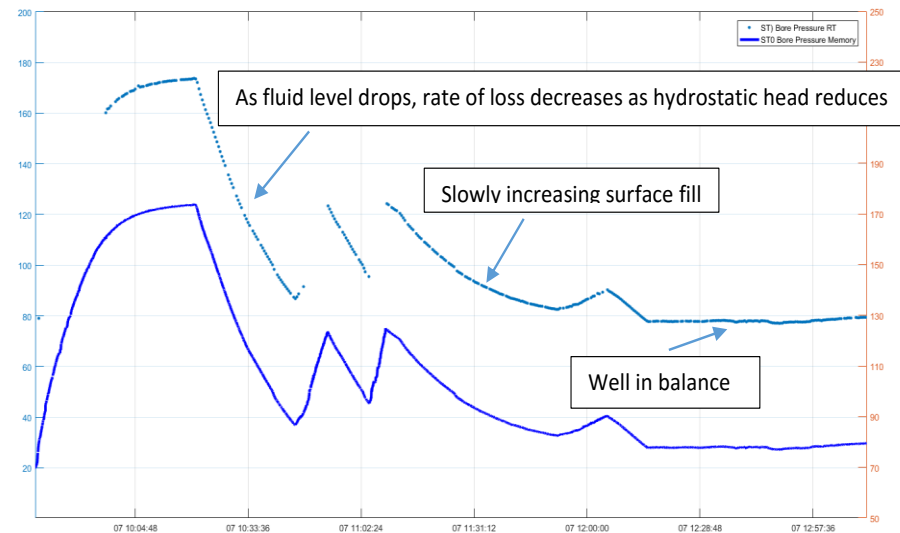
- Continuous validation of fluid barrier to avoid changing completion program
- Minimize fluid losses and avoid FLC pill
- Minimize formation damage

Top of fluid monitored continuously

- Approved by BSEE
- Optimum overbalance
- In-situ injectivity test to compare skin evolution after frac/stimulation treatment

Benefits to Customer

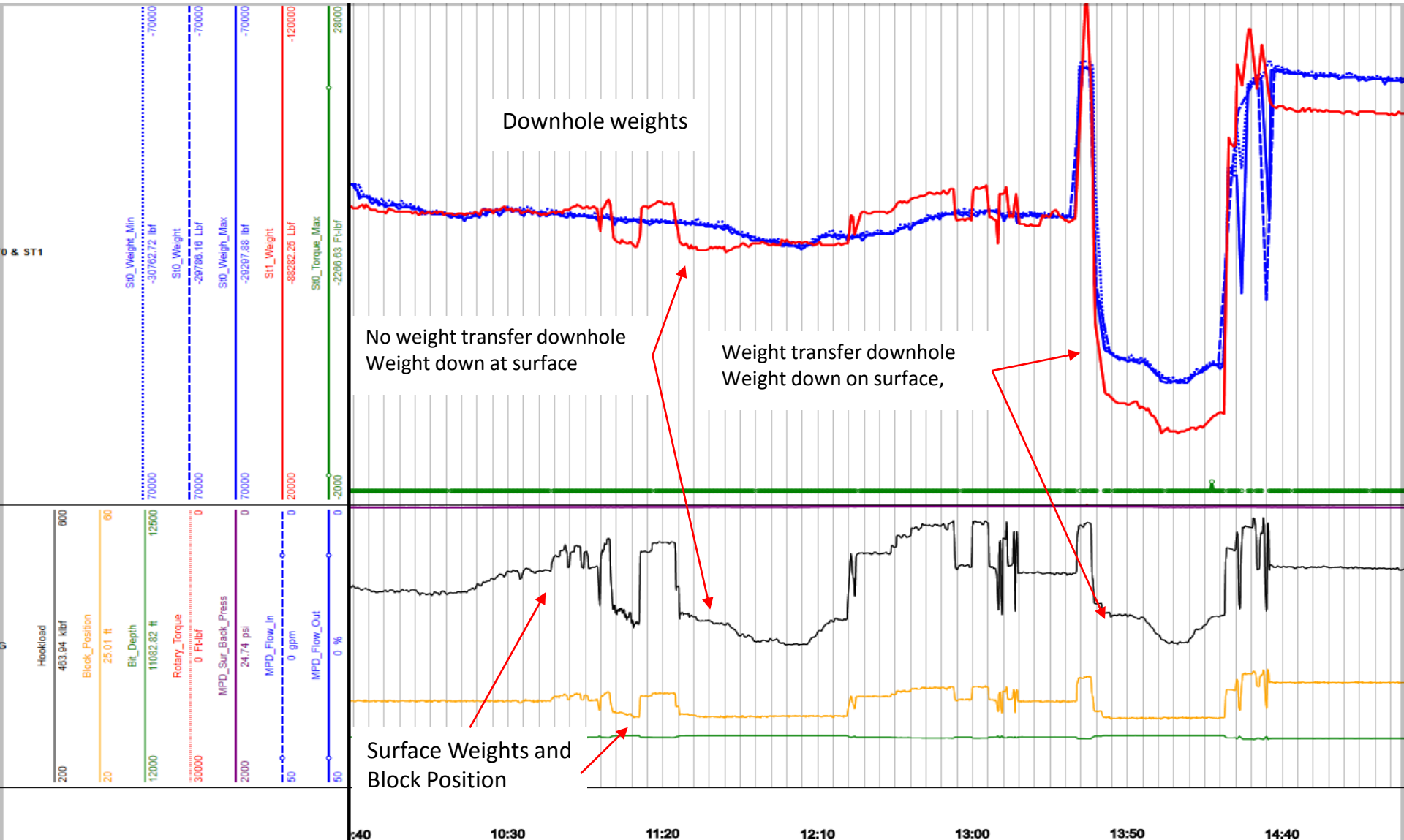
- Saved ~300 bbls of fluid lost in formation (average)
- Minimized formation damage
- Increase safety of operations by continuous pressure monitoring



Full Pressure management for all Well Operations

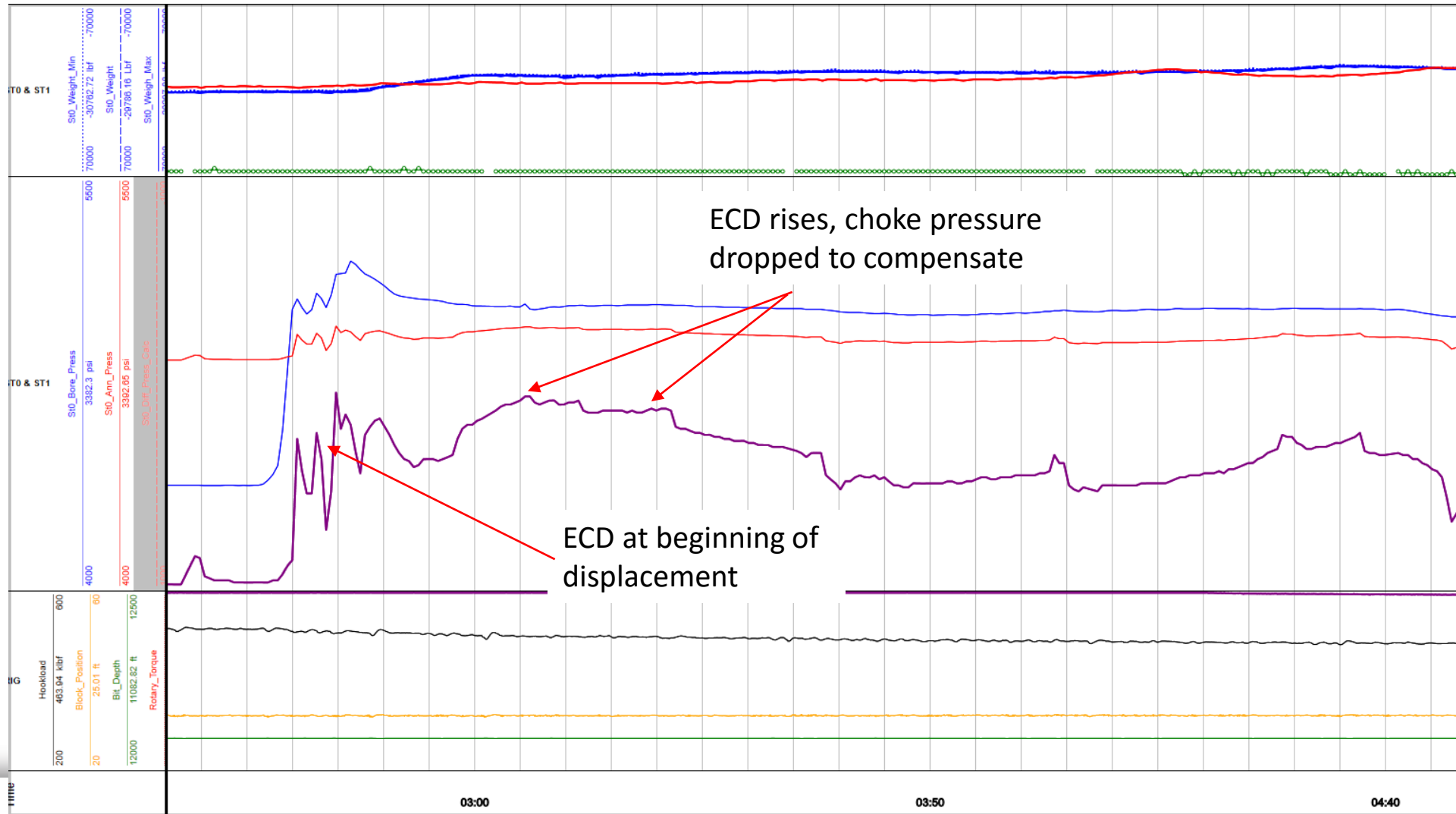
Weight Transfer is not always what you think?

Understanding the weight transfer downhole allowed the operator to fully understand the problem and rapidly react and proceed with the operational plan

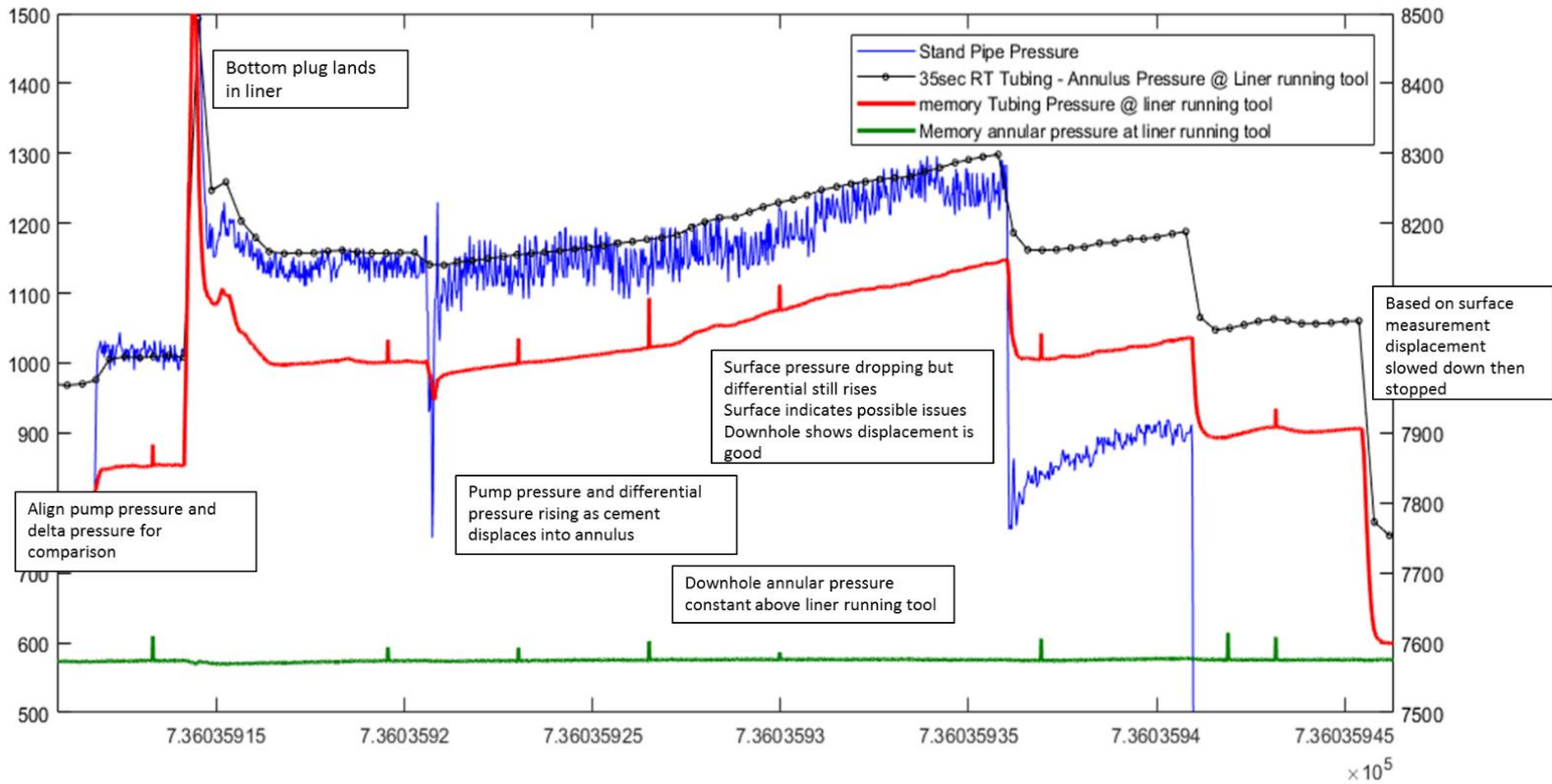


Real-time Management of Displacement in Tight Margin Well

Understanding the Equivalent mud weight downhole allowed the operator to safely remain within the tight mud window whilst maximizing the displacement rate and improving the efficiency of the operation.

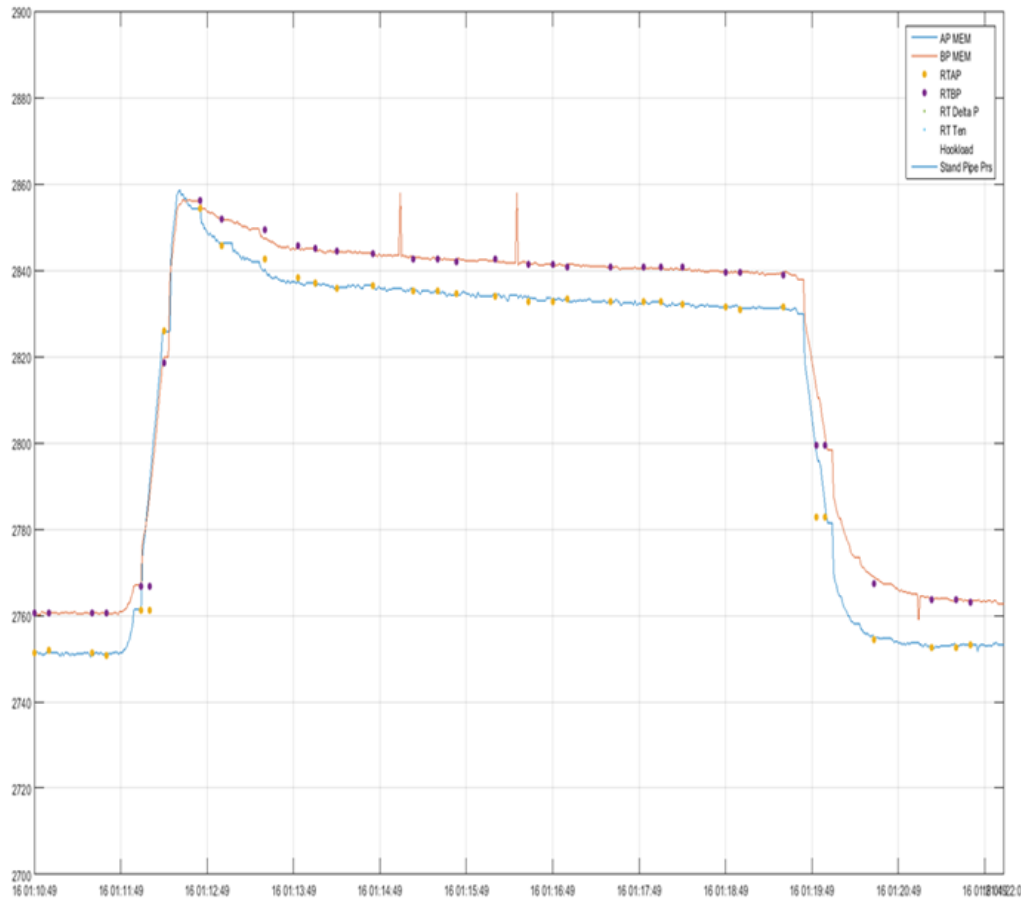


Data while Cementing and Installing Liners



Data while cementing looking at rise pressures downhole. The ability to rotate liners downhole whilst cementing utilizing downhole weight and torque to improve cement coverage for well integrity and zonal isolation. The possibility to revitalize liner drilling in problematical zones, depleted reservoirs and total loss zones

Riserless Formation Integrity Test



Objectives

- Real-time data supplied in riserless operation, either side of openhole packer.
- FIT pushed to the limit.
- Full through bore allowed activation of flow control valves using bars and balls
- Allowed wireline logging through the tools
- Allowed for the potential to cement in the same run as necessary
- BSEE Approved

Value and Efficiency Gains

- Attaching drilling riser and deepwater BOP to do a conventional test was uneconomic
- Identified packer inflating prematurely, ability to troubleshoot downhole devices due to distributed measurements
- 4-6 weeks of efficiency gains by going riserless plus cost of procuring drilling riser and BOP
- Slot has been recovered

Conclusions



Real-time data now available during operations where downhole data was never available before

Downhole data conclusively shows that what you are reading on surface is very often materially different from what is actually happening downhole

This technology has been field proven in the deepwater and in complex wells

The technology has been proven right across well construction from Drilling through Completion Installation