FOURPOINT ENERGY

DATA PROCESSING & DESIGN IMPLEMENTATION

So Much Data, So Little Time

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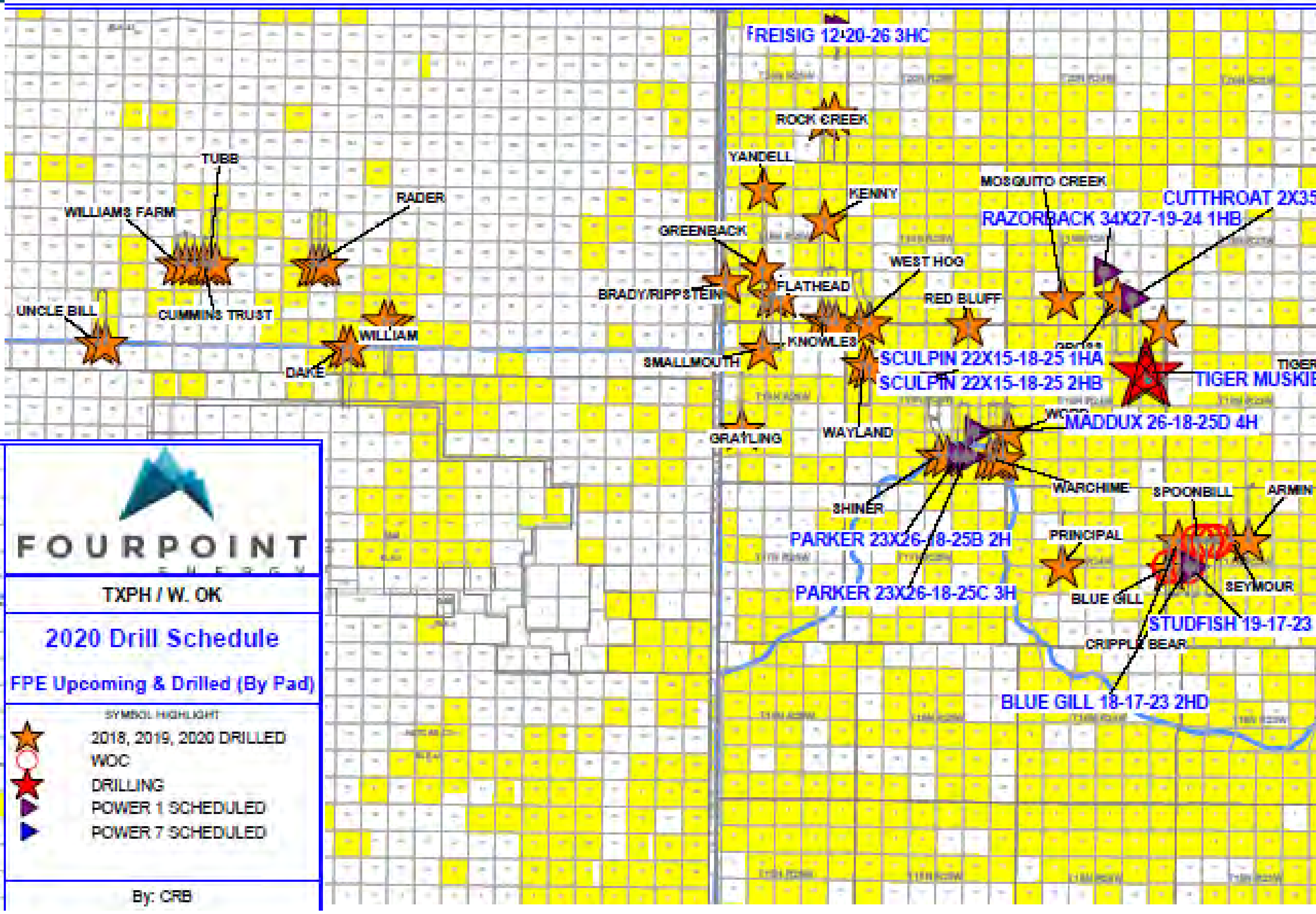
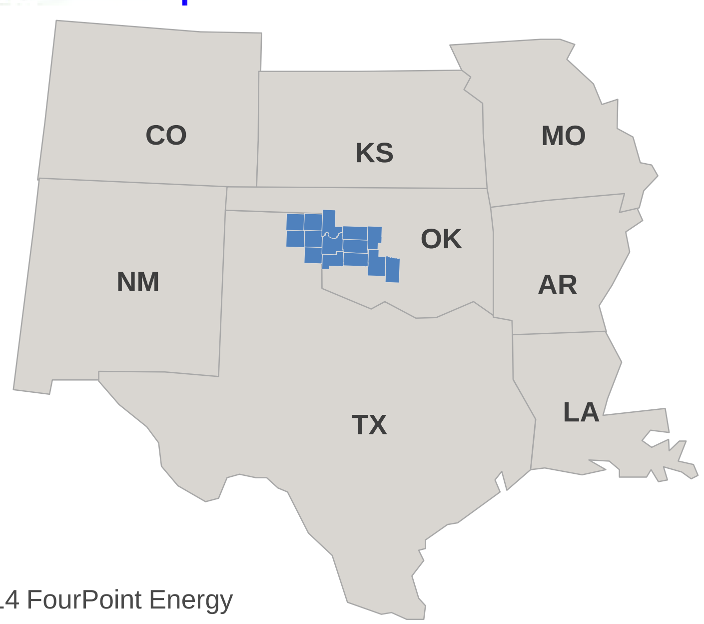
02-26-2020

OUTLINE

- Background Information
  - FourPoint Energy's (FPE) Shelf Overview
  - Where I left off 2019's AADE Talk
  - Updated DvD and FPE's Process to Move Curves Left
- Data Collection Methods
  - Typical Drilling Data Stream
  - FPE Data Collection Work Flow
- Data Analysis
  - 8 ¾" Intermediate Data & Results
    - Managed Parameters
    - Bit Development
    - Motor Degradation
  - 6 1/8" Production/Lateral Data & Results
    - Bit Design & Motor Selection
    - Ground Truthing
    - CUCs
- Conclusions & Future Testing

FPE SHELF WAB Drilling Program Review





■ - FourPoint Acreage

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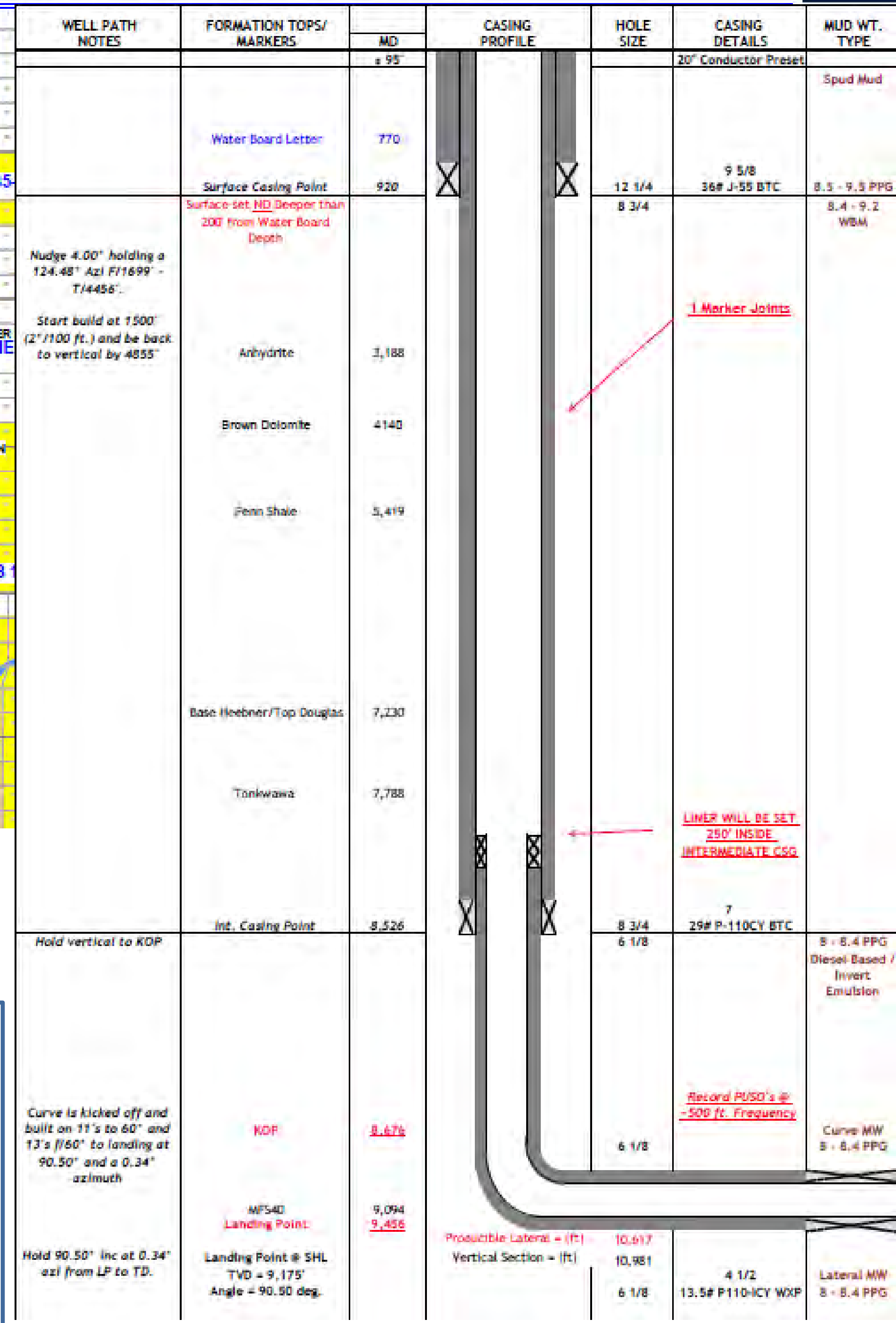
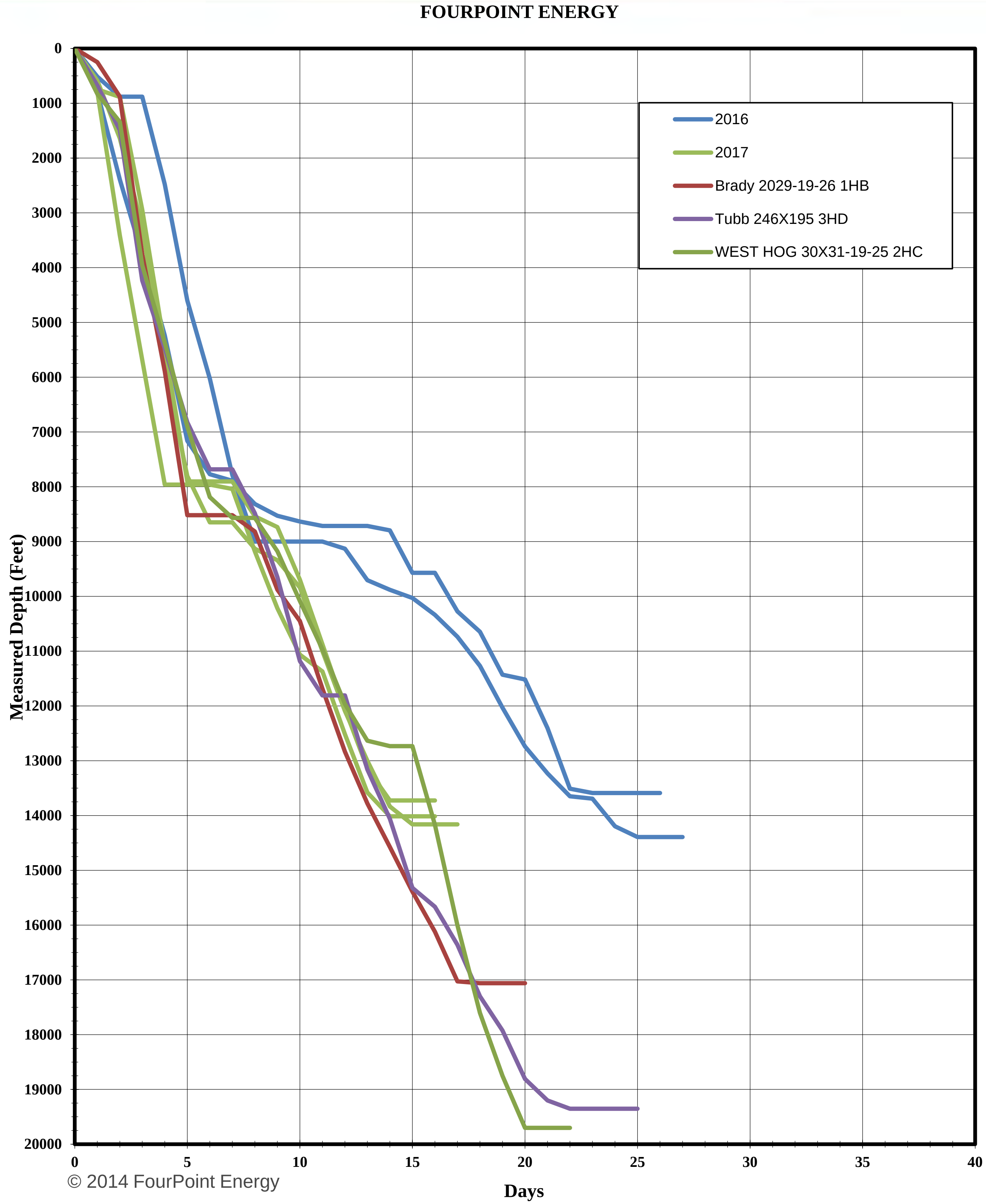
Operated Wells	2,100	
Daily Production	67,000	Boed
Liquids	50%	
Net Acres	746	Kacres
Operated Rigs	2	
Frac Crews	1	
Target Zones	10*	

*Cleveland, Marmaton, Tonkawa, Granite Wash



2019's AADE "Present Benchmark Slide"

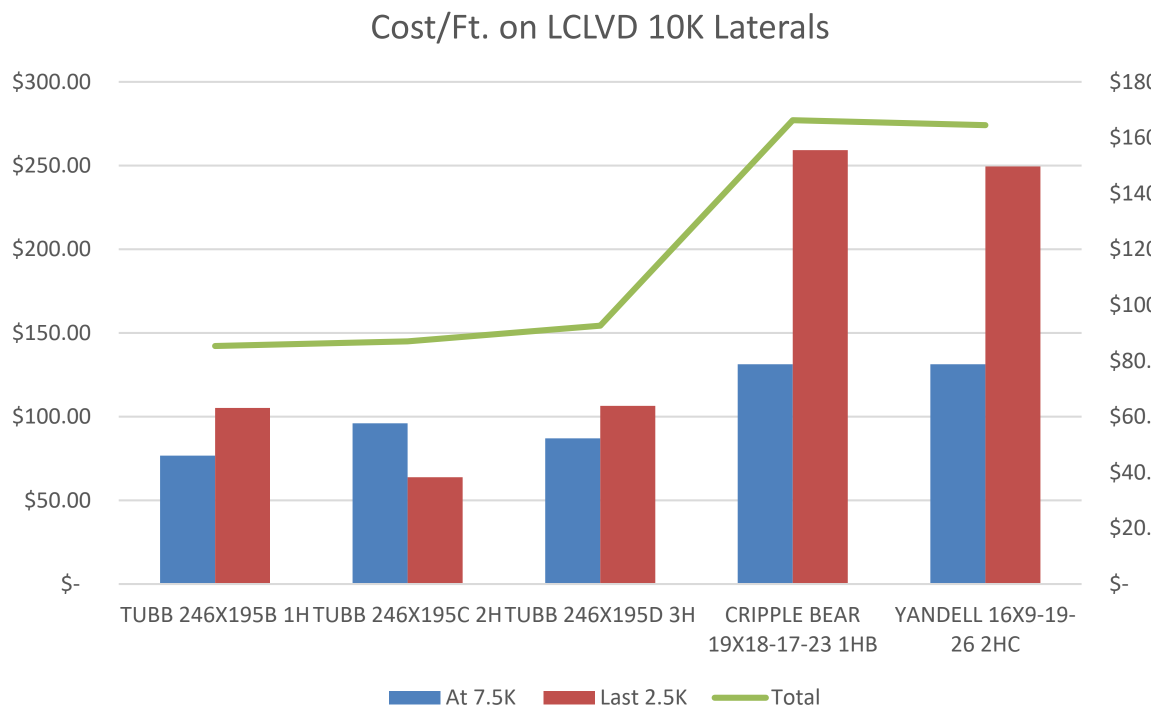


Applying and Successfully Executing all Discussed Techniques

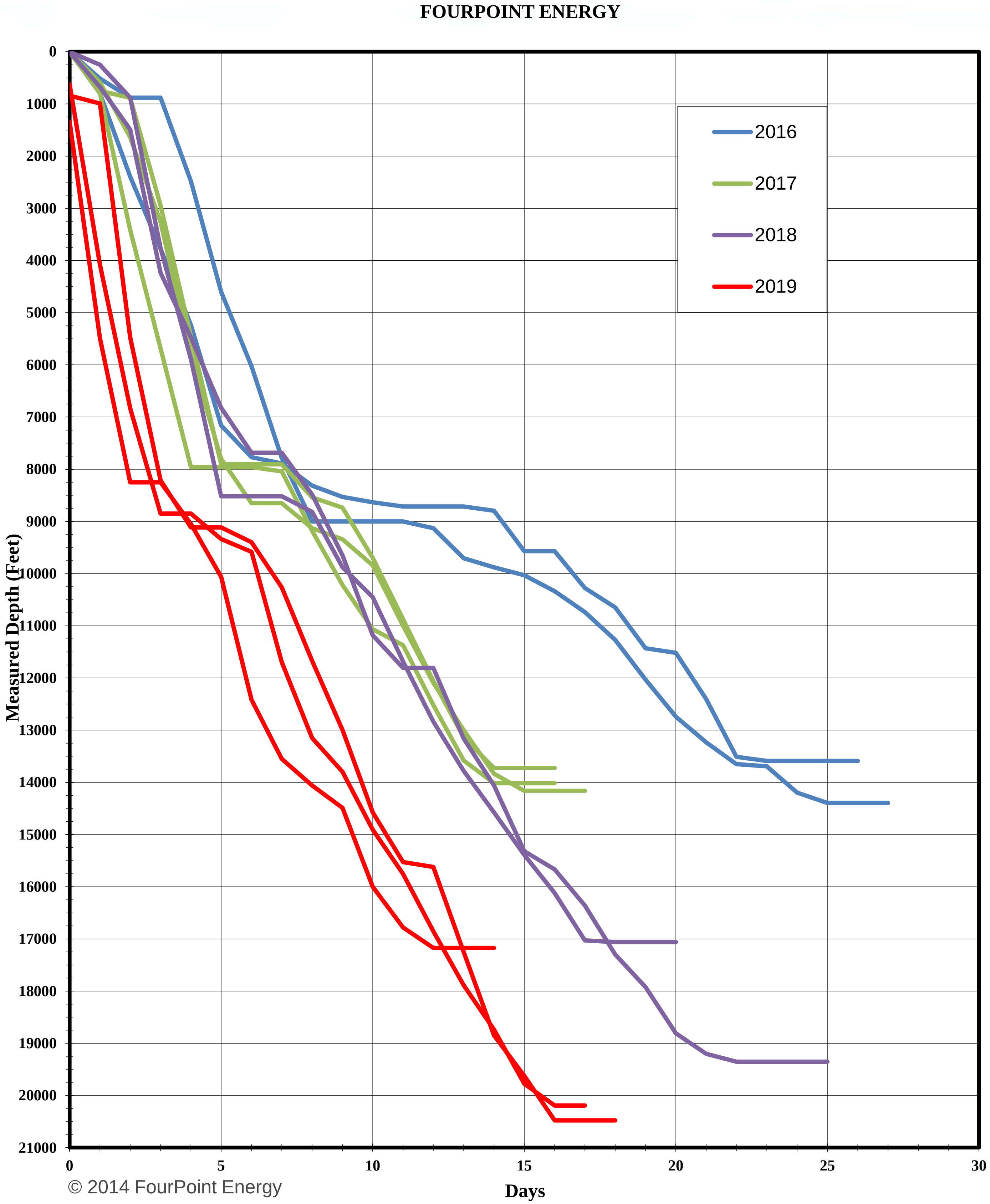
- Continue to gather data and refine processes

Lateral (Production)

- How to Efficiently Drill that Last 2.5k is the current challenge.



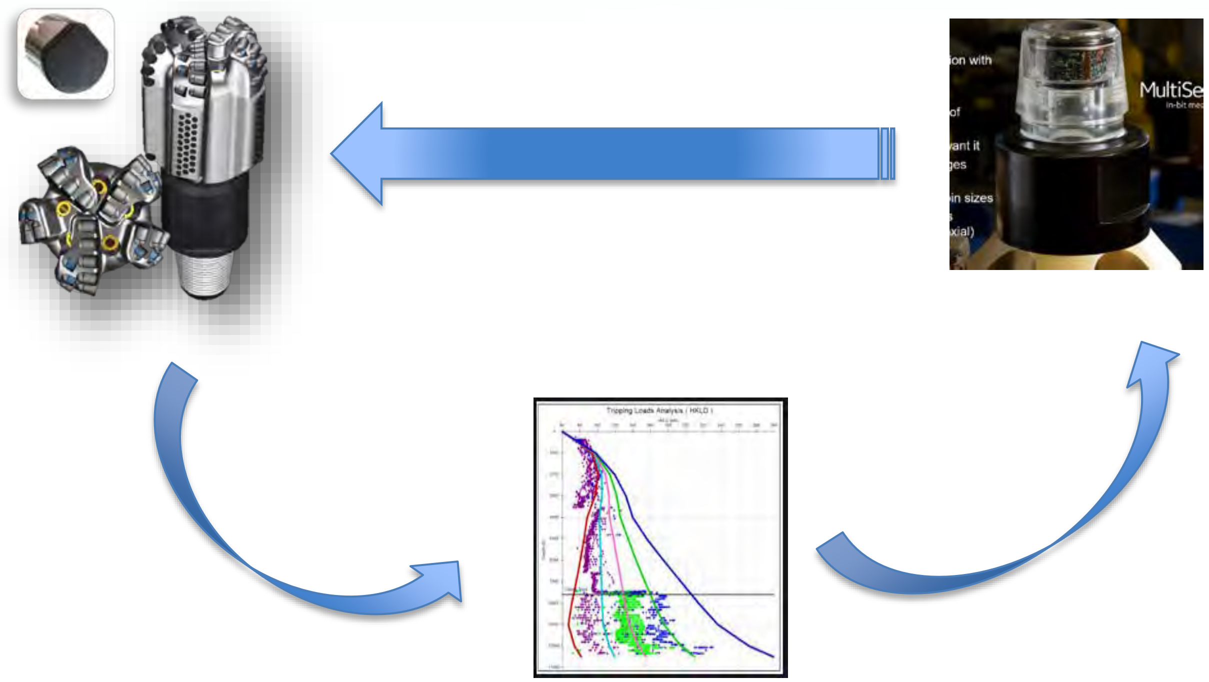
Current SHELF DvD (Interval Appraisal)



Hole Interval Performance Change from 2019 to Present:

- **Intermediate:**
  - ICP from 7 DFS to 4 DFS
  - Single Run
- **Curve:**
  - Curve Section (KOP to LP) from 36 hrs. to 12 hrs.
  - Single Run
- **Lateral:**
  - Average daily footage from <1,000’ +/- 250’ to 1,500’ +/- 250’
- **Overall by the EOY 2019 FPE drilling had reduced rig cycle time by ~25 – 33%.**

FPE Application of Technology



1 **Improve bit technology with a focus on longevity – Trips to replace worn bits increase costs, time, and risk**

- **Refine** – Establish partnership directly with bit design engineers.
- **Measure** – For vendor to improve speed and quality of upgrades, FPE must follow strict parameter management guidelines in the field and provide access to proprietary data.
- **Repeat** – Improved design iteration time from six months to six weeks. Systematically reduced trips for dull bits from three to zero.

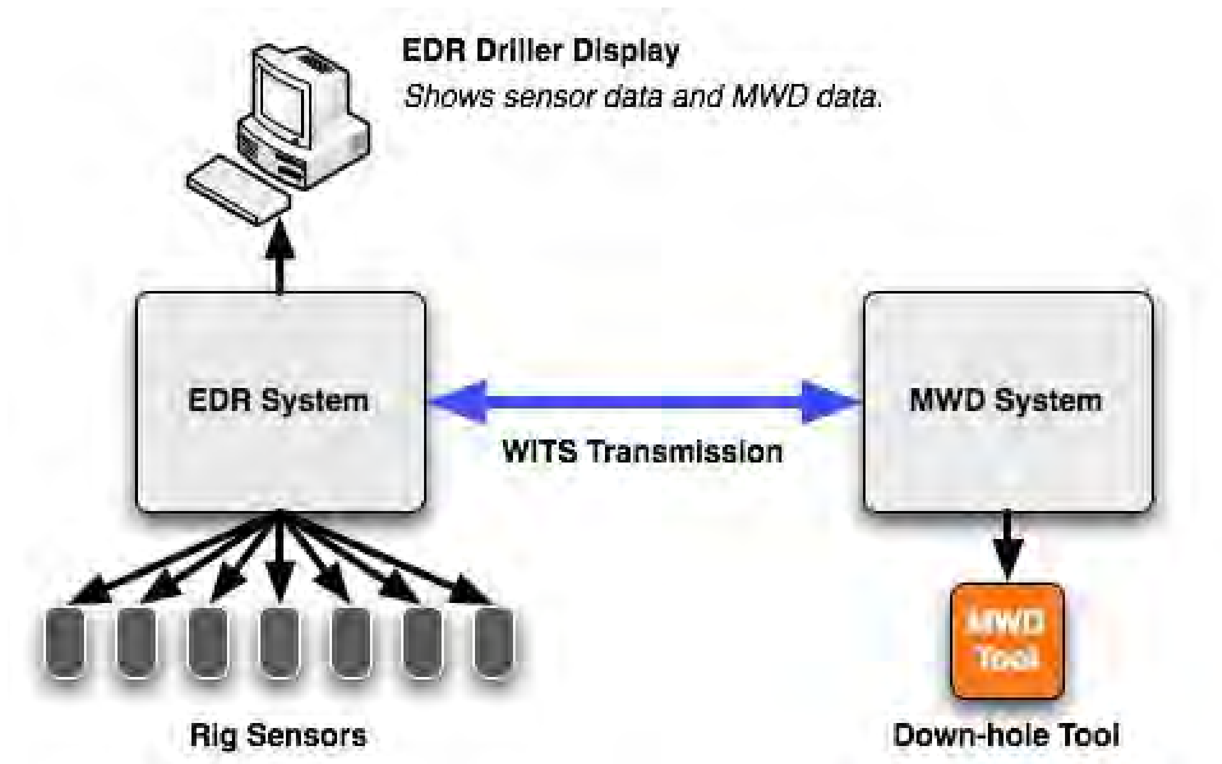
2 **Leverage learnings and new technology to double lateral length without reducing performance or increasing risk**

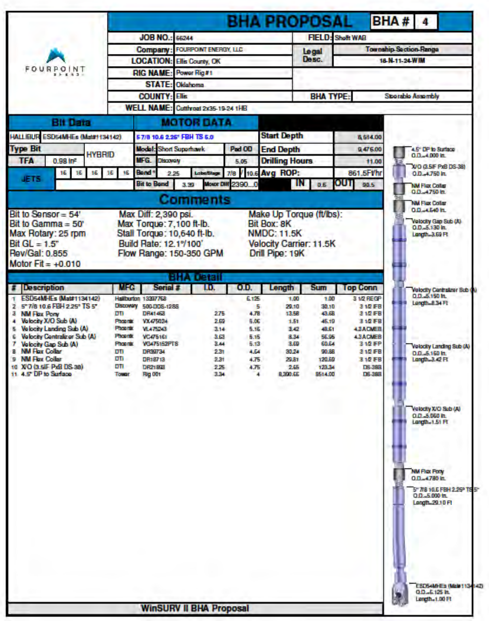
- **Refine** – Improve pre-well planning and field practices via T&D modeling, training, and rigorous peer reviews.
- **Measure** – Validate model with historical field data then use real-time to detect and react to deviations.
- **Repeat** – Engineers e-mail model updates to team daily or more frequent as needed.

3 **Further improve bit technology to retain longevity advancements while increasing ROP**

- **Refine** – Need better understanding of detailed bit, motor, and drill string interaction and resulting downhole dynamics.
- **Measure** – Utilize new technology to gather memory data at the bit.
- **Repeat** – Improving certain bit design aspects in a week. Moving towards better understanding of bit/motor combinations.

Typical Drilling Data Stream





Current Drilling Data Properties

- **Location**
  - Surface
  - Downhole
    - Position in Drill String
- **Frequency**
  - High = Continuous (1 – 1600 Hz up to 56k baud)
  - Low = Contextual (Reports)
- **Dataset Size**
  - Large (=>GB/TB)
  - Small (MB)
- **Timeframe**
  - Real-Time
  - Post-Run
  - Post-Well
- **Cost**
  - High (>$100K Well)
  - Low (<$10K Run)
- **Operational Impact**

Downhole High-Resolution Data-Logging

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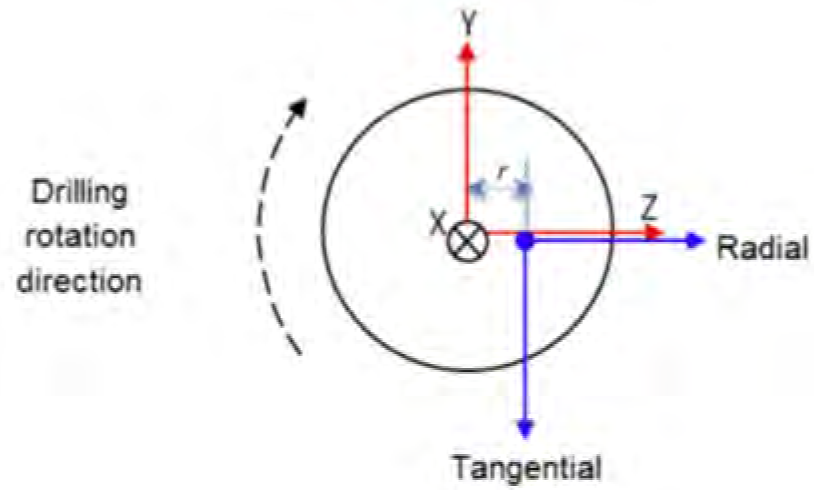
Sensor Specifications

Specifications	
Carrier Sub	✓
Embedded into Existing Equipment	✓
Tool Sizes	4 ¾" to 9 5/8"
3-Axis Vibration	-16G to -16G (+/- 10mG)
Vibration Sample Rate	25-100Hz
Vibration Record	Sequential
3-Axis Shock	-200G to +200G (+/- 100mG)
Shock Sample Rate	800 Hz
Gyro RPM	+/- 330 RPM
Gyro Sample Rate	20Hz
Gyro RPM Record	Sequential
Temperature	Standard - 150°C (302°F) High Temp. - 175 °C (347°F)
Pressure Rating	15,000 PSI
Battery Life	Up to 200 hours

CUBIC®
DRILLING DYNAMICS

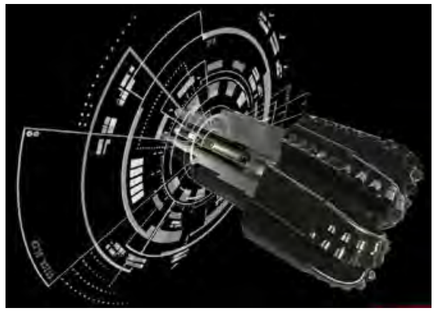
Axis Convention



Other Potential Down-Hole Data Sources

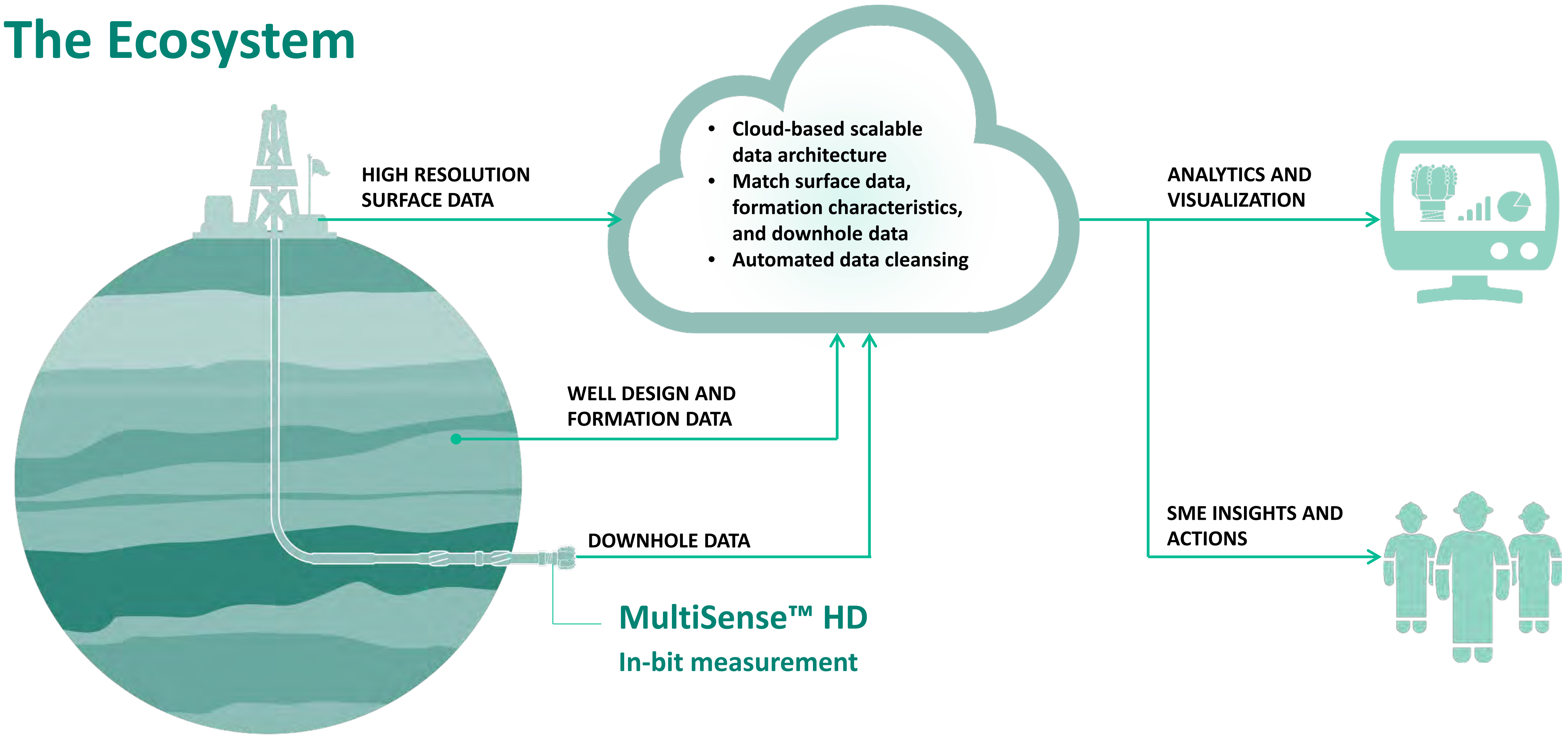
At-bit CuBIC PuK

BHA & String CuBIC



Cost Effective Data Analysis

The Ecosystem



1) Establish baseline dataset. Gather enough data to build a good fundamental understanding of current drilling conditions/practices

2) Run sensors on runs and in areas that need additional data or are built for a specific test/trial purpose

3) Merge all other data streams to generate as robust of a dataset as possible

4) Take a multi-disciplinary approach to analysis and solving problems. Include as many specialists/technical people in reviewing data

5) Use multiple platforms to process data and utilize those that are targeted to what the question is

CASE STUDIES & DESIGN IMPLEMENTATION

8 ¾" INTERMEDIATE INTERVAL

Fourpoint – Cleveland Shelf Program

8.75” Intermediate Section Case Study

Application Challenges

- Diverse formation types – Shale, Anhydrite, Dolomite, Sandstone
- Interbedded formations
- High angle tangent well profiles
- High power drilling motors
- Maximizing ROP and reducing bit damage

MultiSense Data Analysis Objective

- Characterize drilling vibrations for drilling parameter optimization
- Measure drilling motor performance for drilling parameter optimization and motor selection
- Drive bit design changes to improve total section performance

Drill Bit Selection: 8.75” D505TX

Tech Specs

Blade Count: 5

Cutters

- Size: 5/8”
- Type: Abrasion Resistant
- Geometry: StayCool

Gage Length: 3.0”

Hydraulics: 5 adjustable nozzles

Stability Features

- StayTrue inserts
- Asymmetrical blade layout

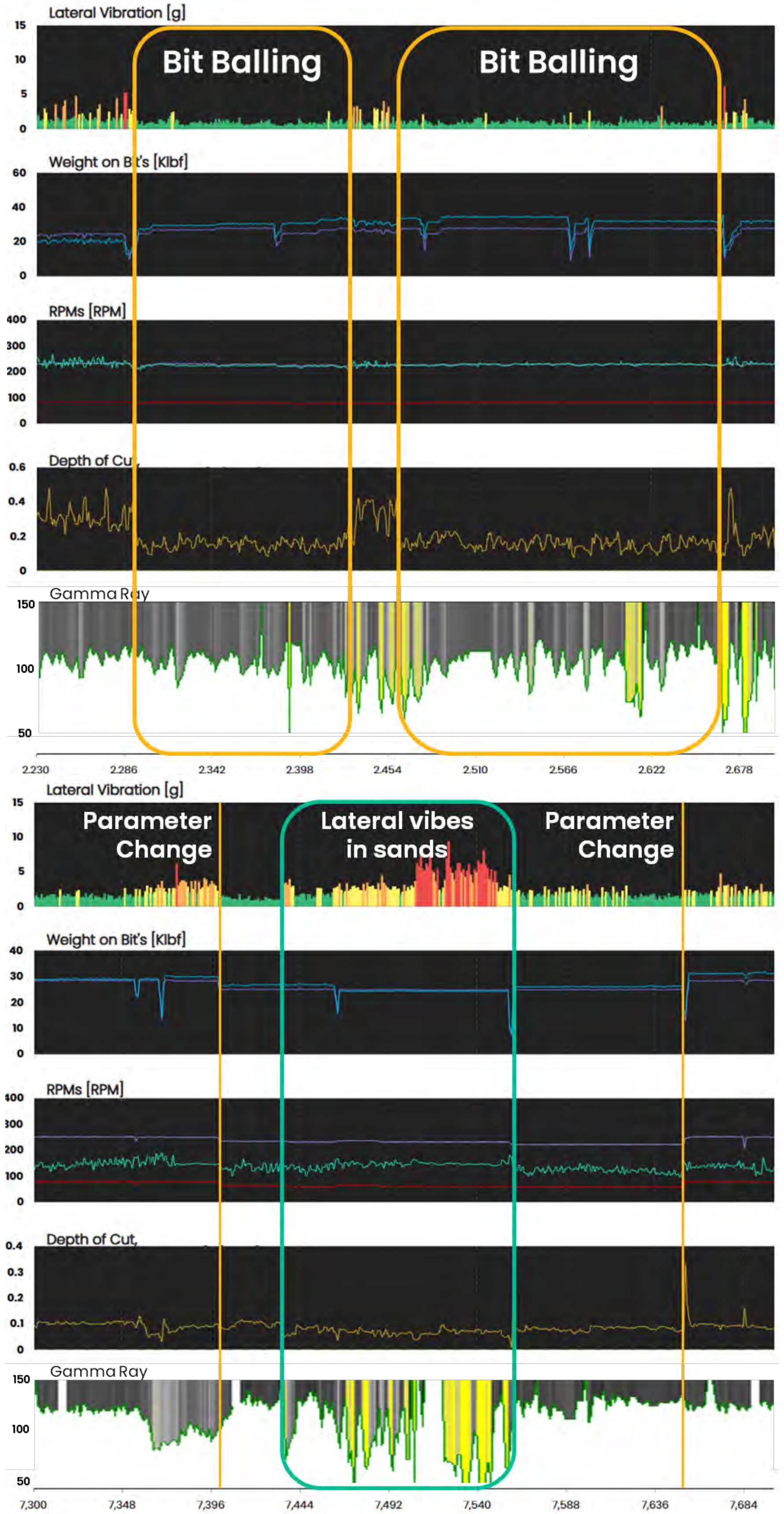
Drilling Parameter Optimization

Bit Balling in Top Hole Shale

- Observed low ROP and low vibrations
- Driller responded with higher WOB
- Resulted in DBR bit in Anhydrite formation below
- Recommendation – increase RPM and reduce WOB to mitigate balling

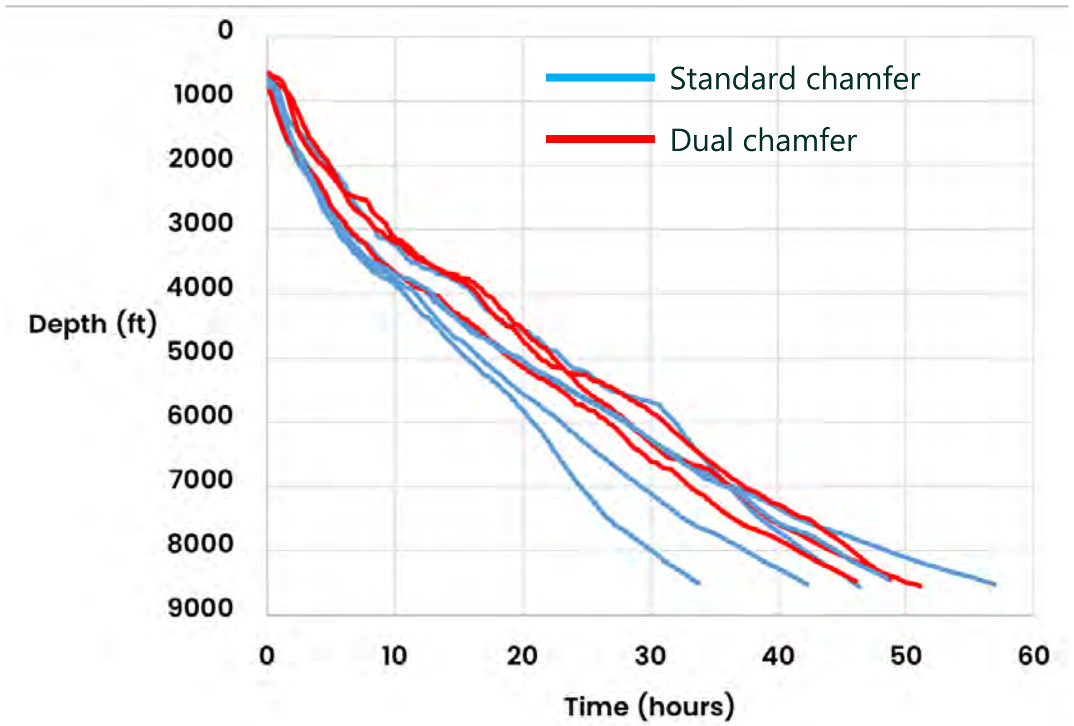
Bit Damage in Tonkawa Sands

- Experienced higher rate of DBR
- Measured high lateral vibrations in low gamma sand sections
- Recommendation – reduce RPM to mitigate lateral vibrations and abrasive wear



Bit Design Development

- Observed overall low stick-slip vibrations levels
- Opportunity to increase bit aggressiveness
- Design change to increase cutter sharpness
- Results – higher ROP, lower Laterals, no change to Stick Slip or Axials



Well #1

StabilisX
Dual chamfer

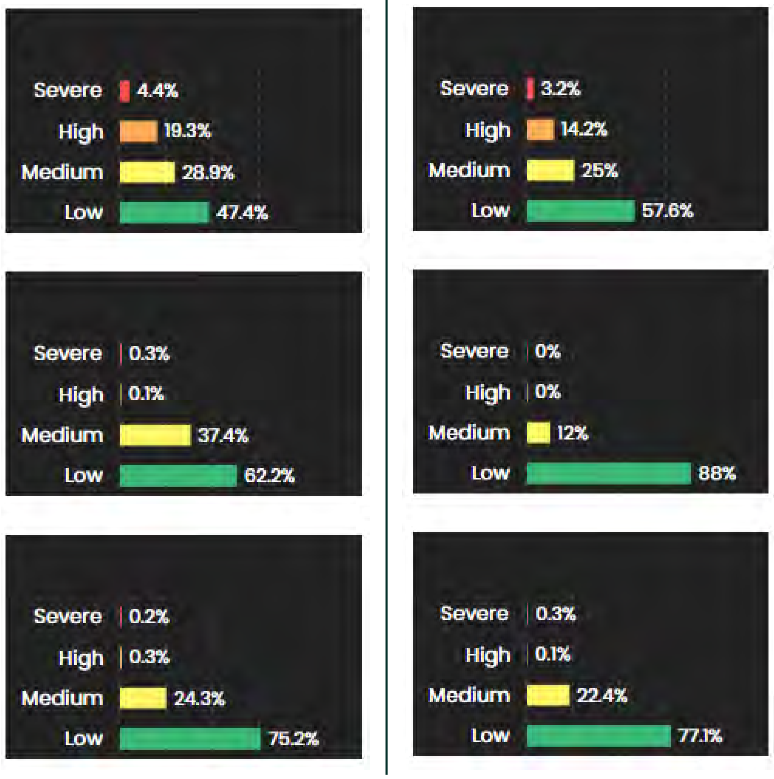
Well #2

Standard chamfer

Lateral Vibrations

Axial Vibrations

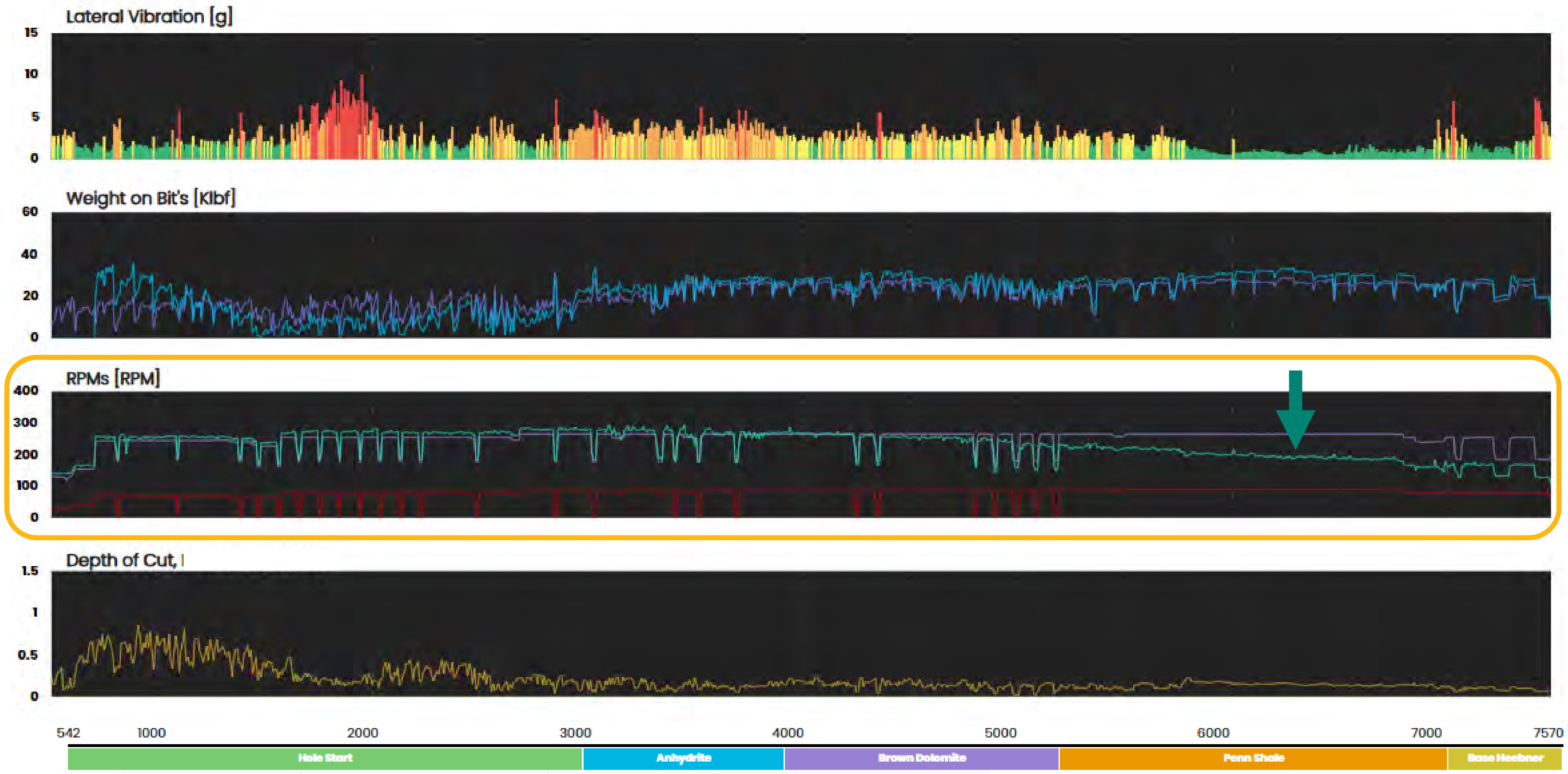
Stick Slip



Motor RPM Degradation

MultiSense RPM declines after about 4500 ft

Bit RPM is 65% of expectation at end of run



Deeper Investigation

Time-Matched Surface and MultiSense Data

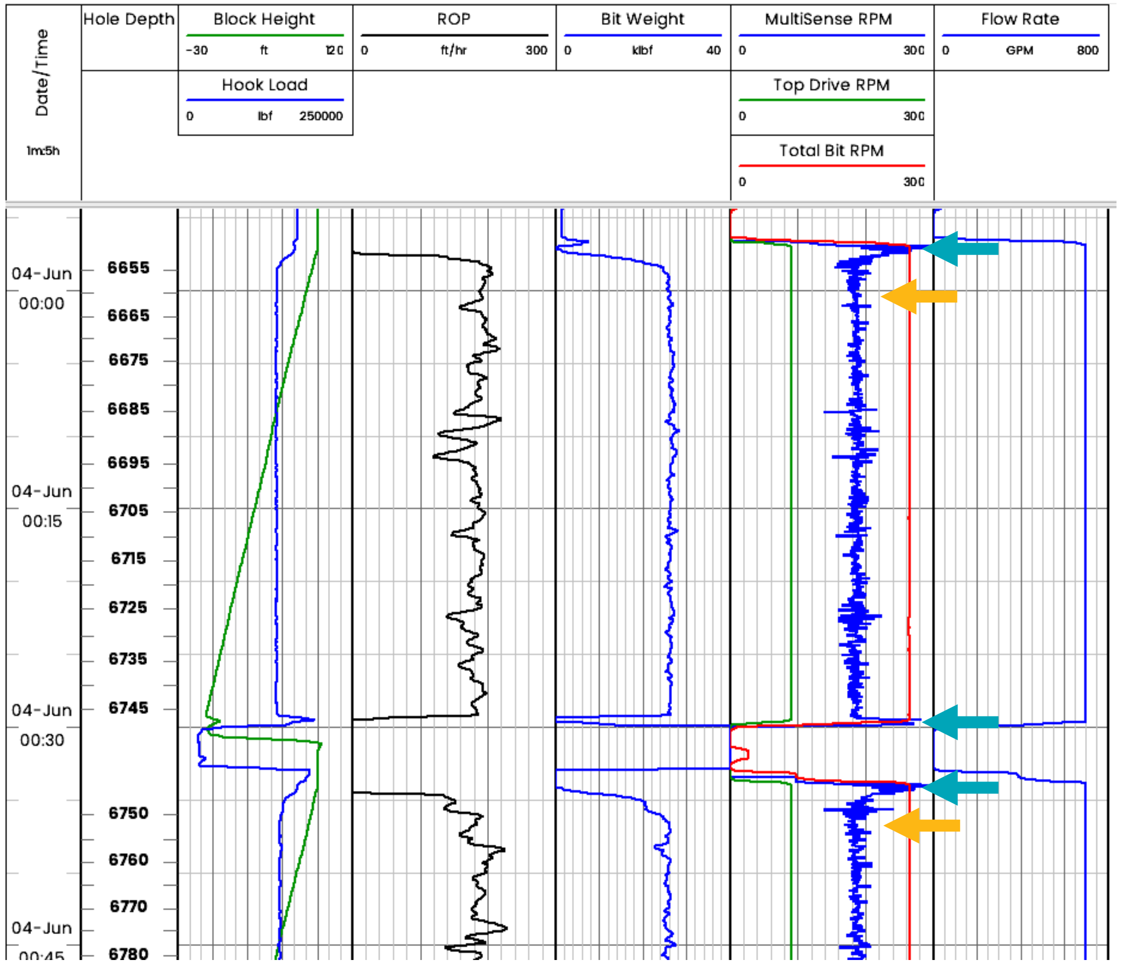
On Bottom

- MultiSense RPM is lower than Total Bit RPM

Off Bottom

- MultiSense RPM matches Total Bit RPM

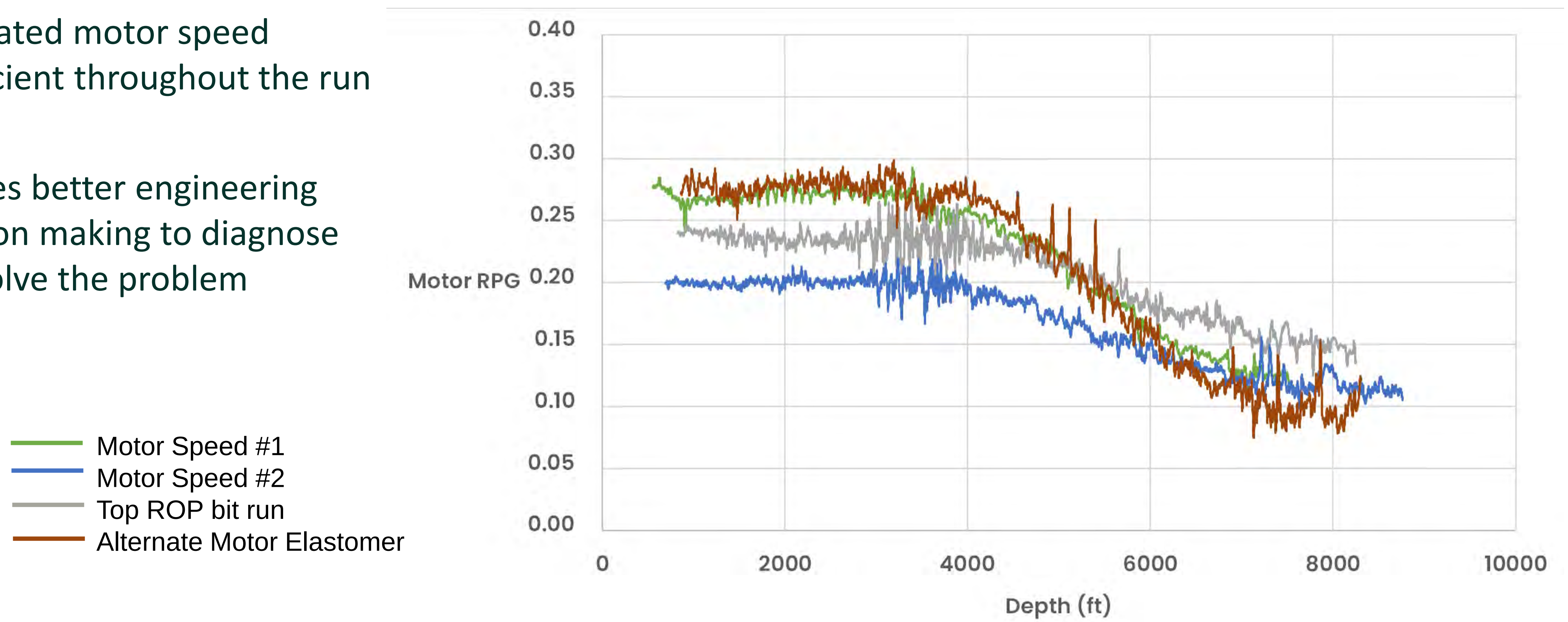
Demonstrates that RPM reduction is due to motor providing insufficient power while under load



Motor Performance Summary

Calculated motor speed coefficient throughout the run

Enables better engineering decision making to diagnose and solve the problem



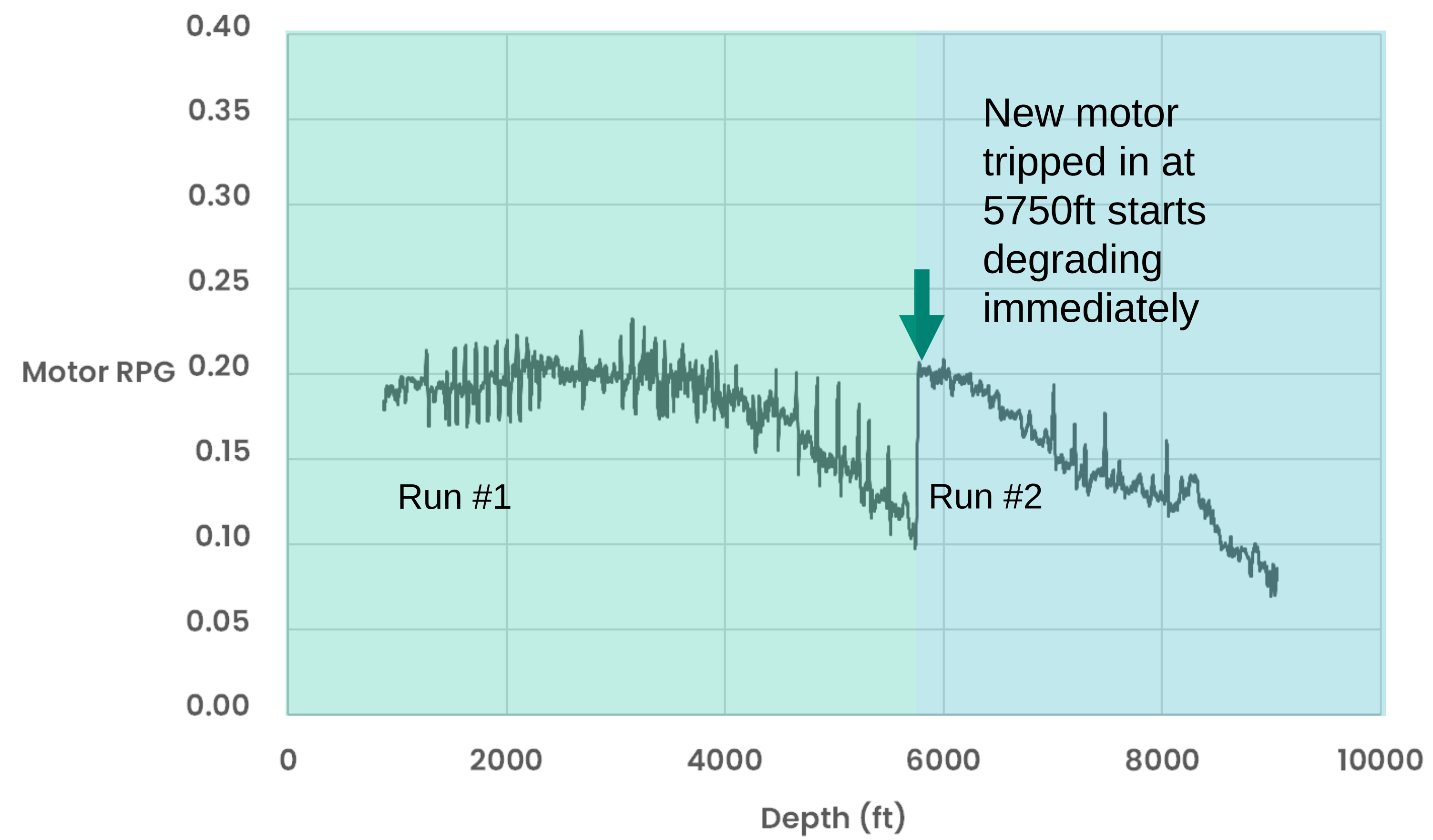
Intermediate Section Case Studies – Motor Degradation

Root Cause Analysis

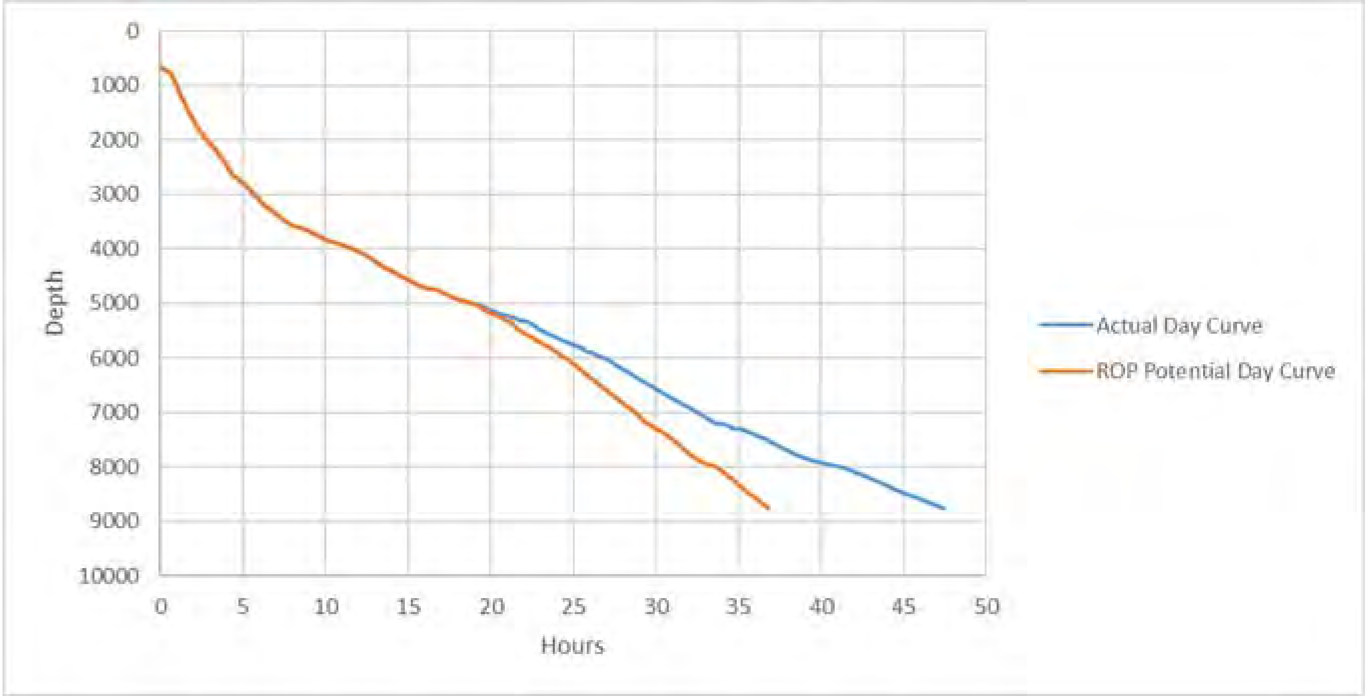
Hypotheses for the root cause of Motor RPM Degradation

1. Drilling vibrations in Anhydrite
2. Mud properties after displacement

Dedicated Trip test to identify root cause



Potential Interval Efficiency



CASE STUDIES & DESIGN IMPLEMENTATION

6 1/8TH LATERAL INTERVAL

Product Example 3: Multi-well / Multi-Bit Run overlay comparison

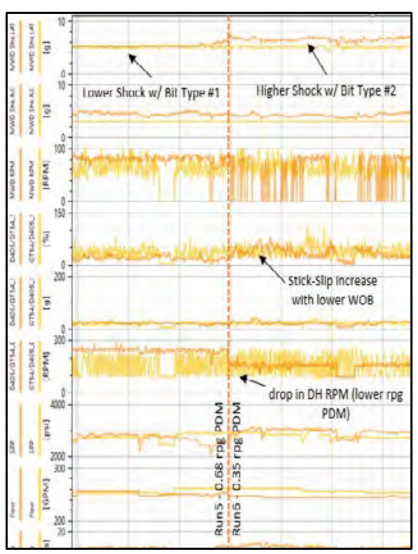
GameChanger Viewer software - Downhole Data Analysis

Stick-Slip & Shock Severity comparison with different Bits, BHA, & Operating Parameters

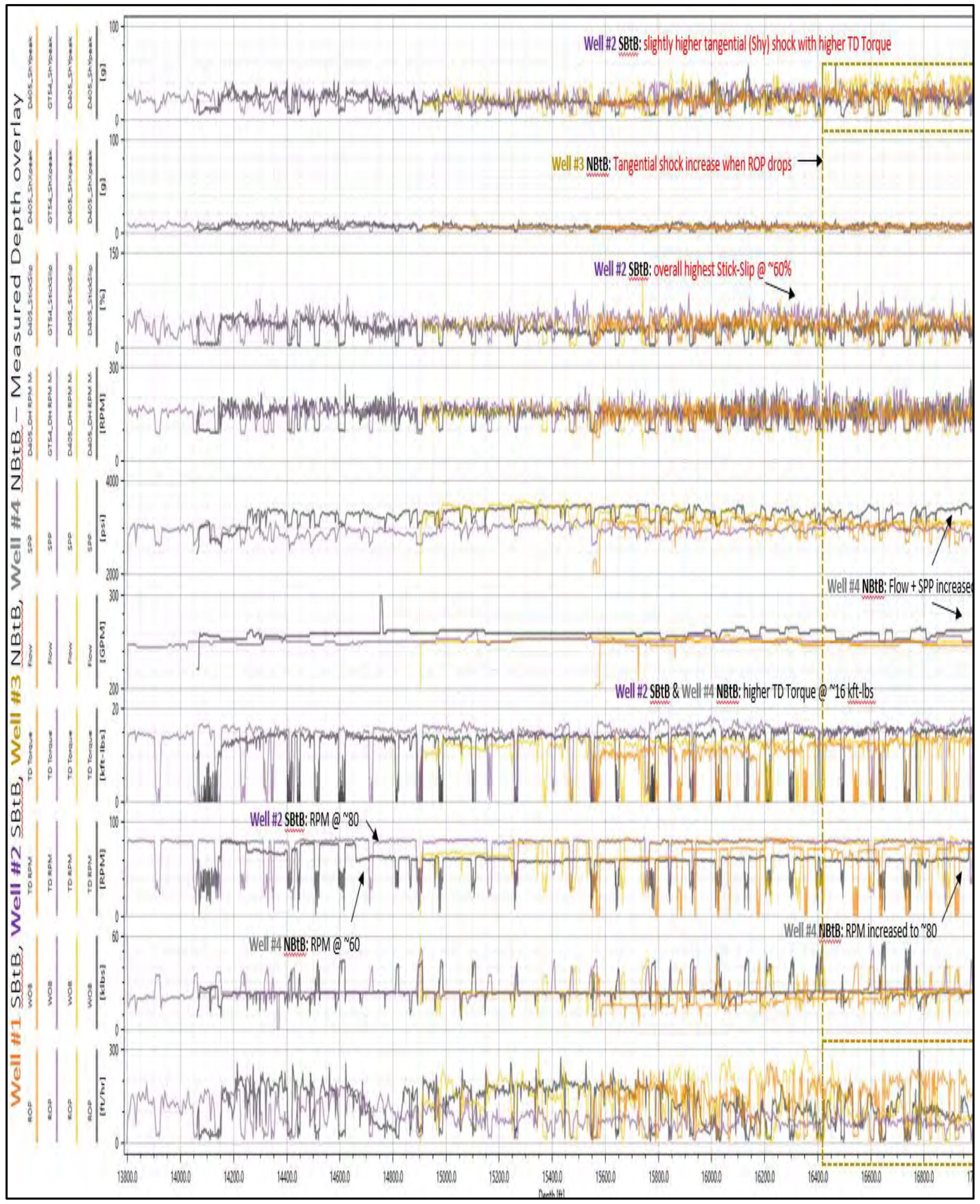
Multiple data sets can be over-laid on depth for well to well and pad to pad comparison in order to perform detailed data analysis zooming in and out of the tracks and traces for regions of interest to clearly see signal patterns and sensor response.

- Overlay multiple wells or runs and easily zoom to areas of interest
- Compare stick-slip & shock dynamics from different BHA/Motor configurations (*ie: BHA stabilization, Motor bit-to-bend distances, different bit types/cutting structure*)
- Combine EDR, Sanvean Sensor, and MWD data for detail analysis
- View impact of drilling parameters against shock, stick-slip, ROP (auto-driller induced issues)
- Sanvean Sensor calculated MSE & RPG analysis

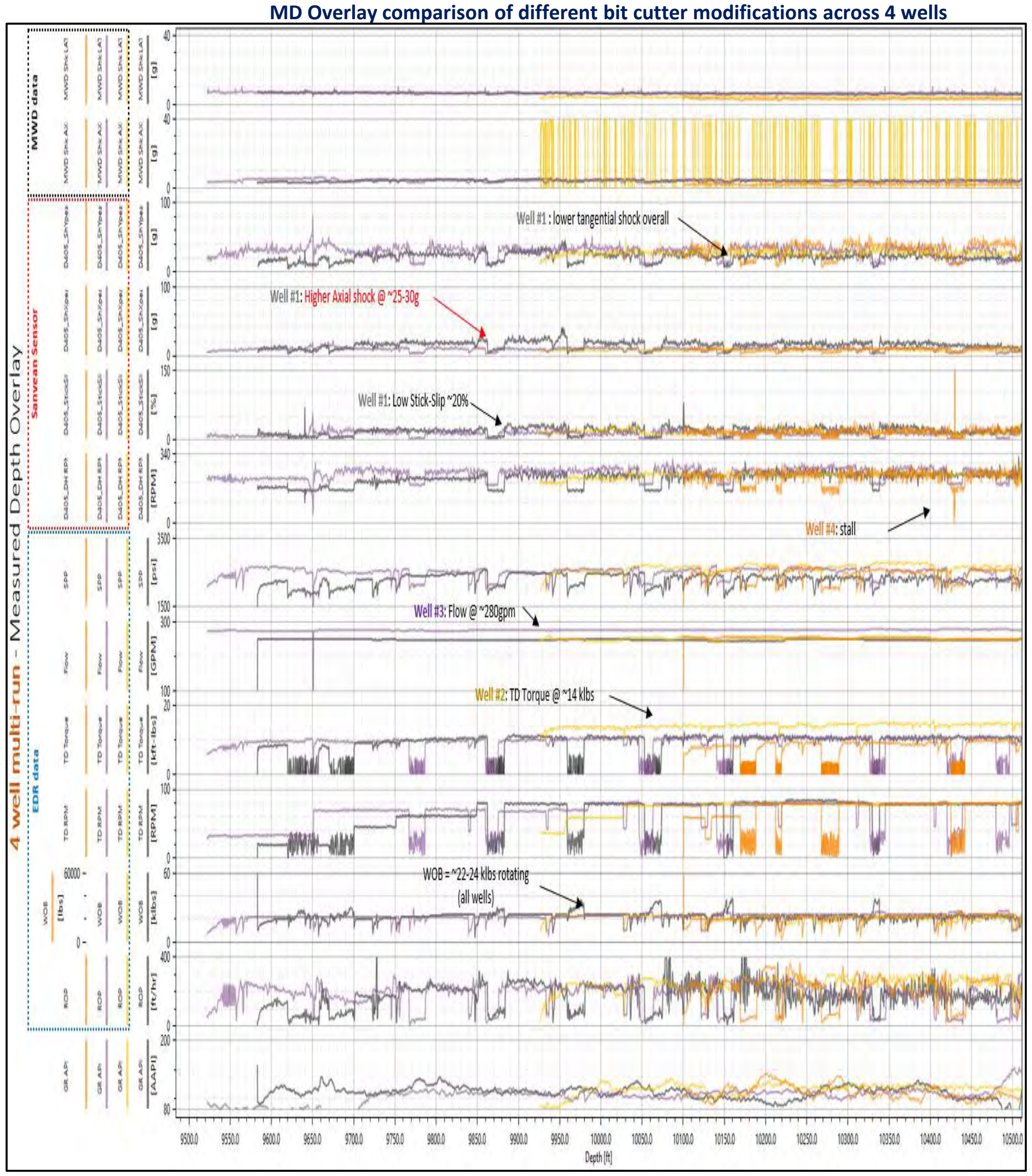
MD Overlay comparison of different bit types and motor configs



MD Overlay comparison of Short BtB vs Normal BtB motors 4 wells



MD Overlay comparison of different bit cutter modifications across 4 wells



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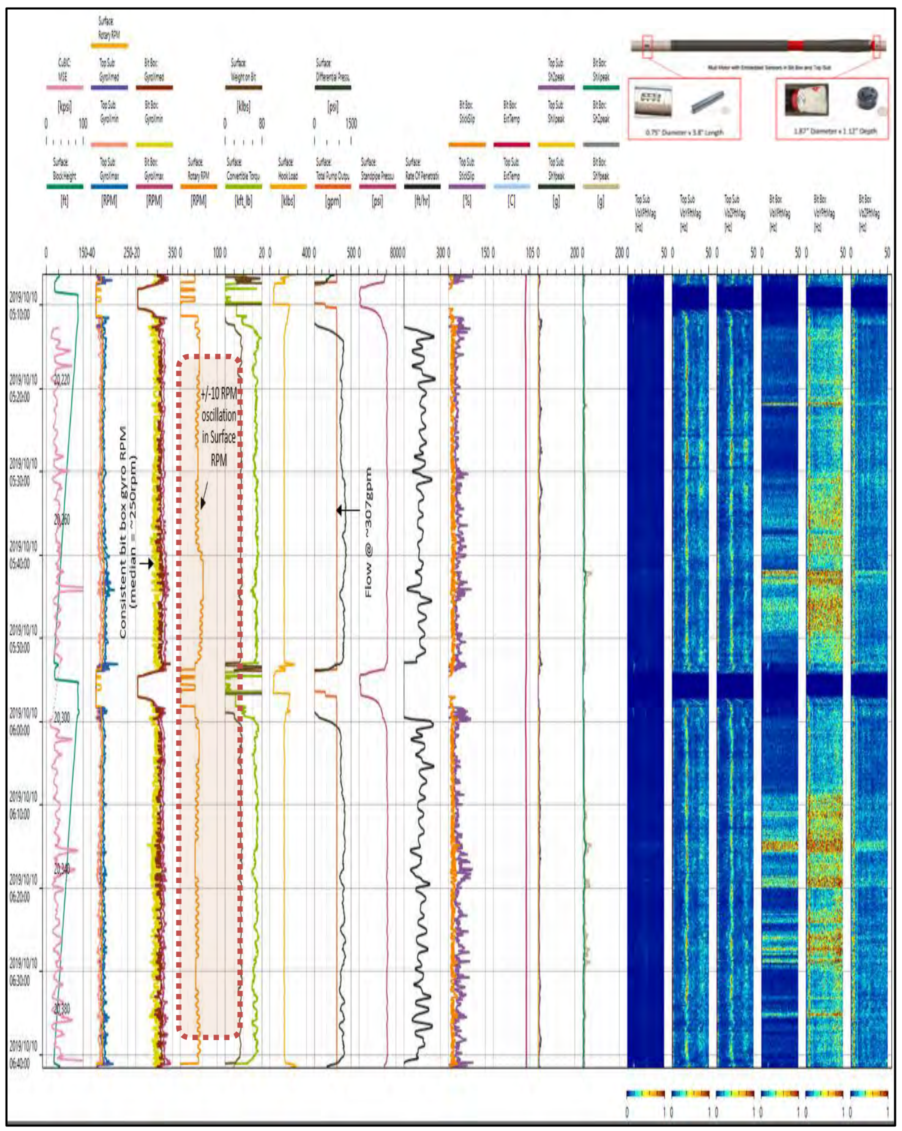
Product Example 4: Impact of Drilling Practices, Rig Problems, & Vibration Tools

GameChanger Viewer software - Downhole Data Analysis

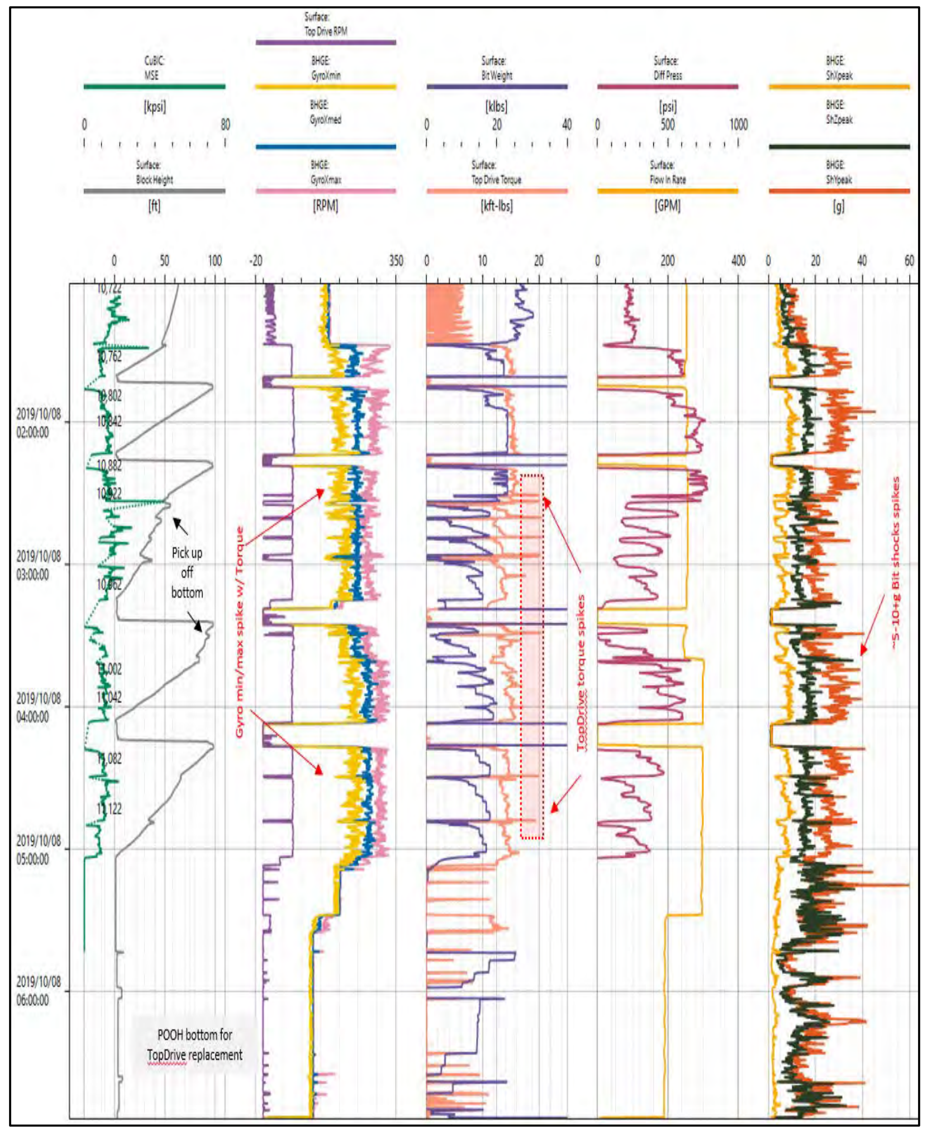
Identify auto-driller dysfunctions, drilling dynamic changes due to rig problems, and influence of string vibration tools

Quickly interpret data for root cause failure analysis, view various axial oscillation & friction reduction tools impact through sensor analysis, observe sensor responses due incorrectly tuned auto-drillers, & identify changes in drilling dynamics before and after rig services/repairs.

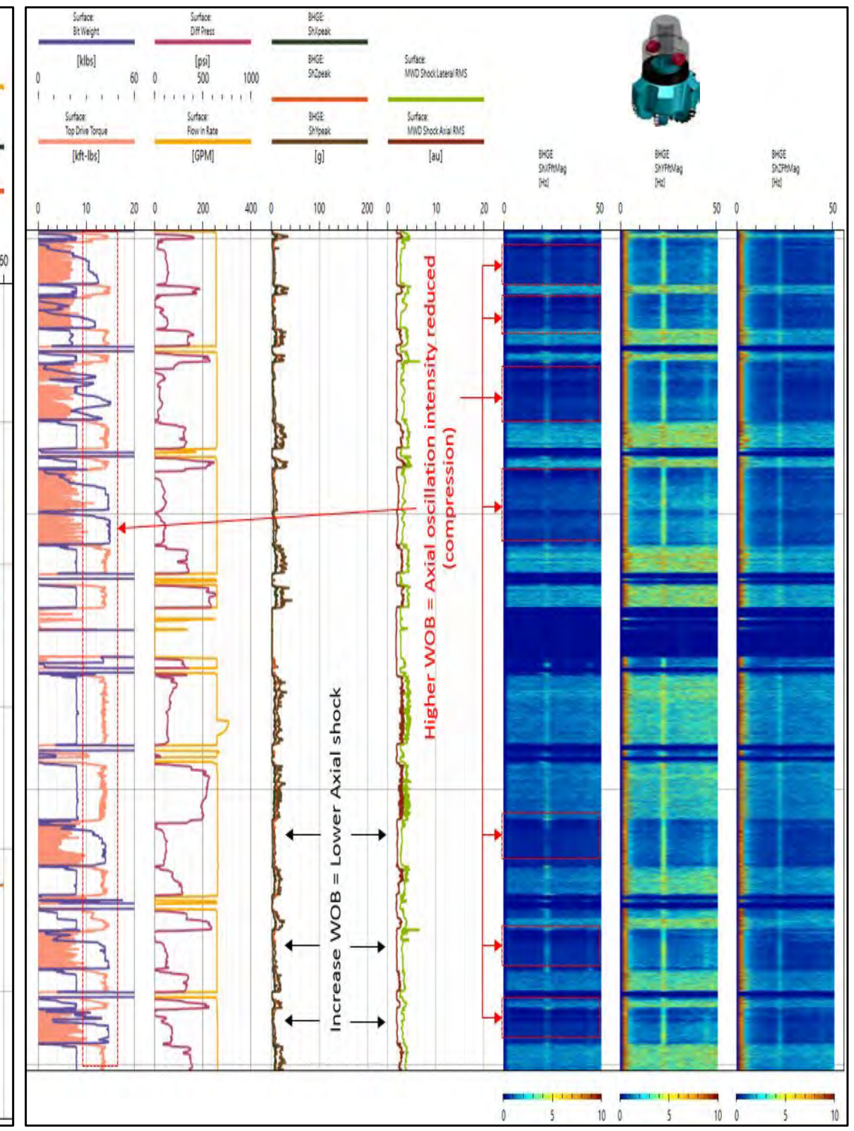
Auto-Driller functionality & Impact on Sensor Response



TopDrive issue seen in sensor dynamics



Vibration Tool: Axial Oscillation response & Weight Transfer



Lateral Section Case Studies - CUCs

<table>
<tr><th>Date In</th><th>Date Out</th><th>Rig</th><th>Well</th><th>BHA #</th><th>County , State</th><th>Motor S/N</th><th>Motor Spec</th><th>BtB (ft)</th><th>Sensor S/Ns</th><th>Hole Size (in)</th><th>Section</th><th>BHA Type</th><th>BRT Hrs</th><th>Depth In</th><th>Depth Out</th><th>Footage</th><th>Drlg Hrs</th><th>ROP</th><th>Bit Mfr</th><th>Bit SN</th><th>Bit Type</th><th>Material #</th><th>Bit Dull Grading</th><th>Agitator behind bit distance (ft)</th></tr>
<tr><td>12/20/2019</td><td>12/24/2019</td><td>Power 1</td><td>SPOONBILL 20X17-17-23 3HC</td><td>5</td><td>Ellis , OK</td><td>24XH513-103</td><td>5" | 6/7 | 8.8 | 1.83° | 0.68rpg</td><td>4.87</td><td>0007</td><td>6 1/8</td><td>Lateral</td><td>Steerable</td><td>114.25</td><td>10,263</td><td>15,621</td><td>5,358</td><td>83.83</td><td>63.9</td><td>HAL</td><td>13287557</td><td>GT54WKHE</td><td>1120891</td><td>1-2-WT-S-X-0-BT-PR</td><td>N</td></tr>
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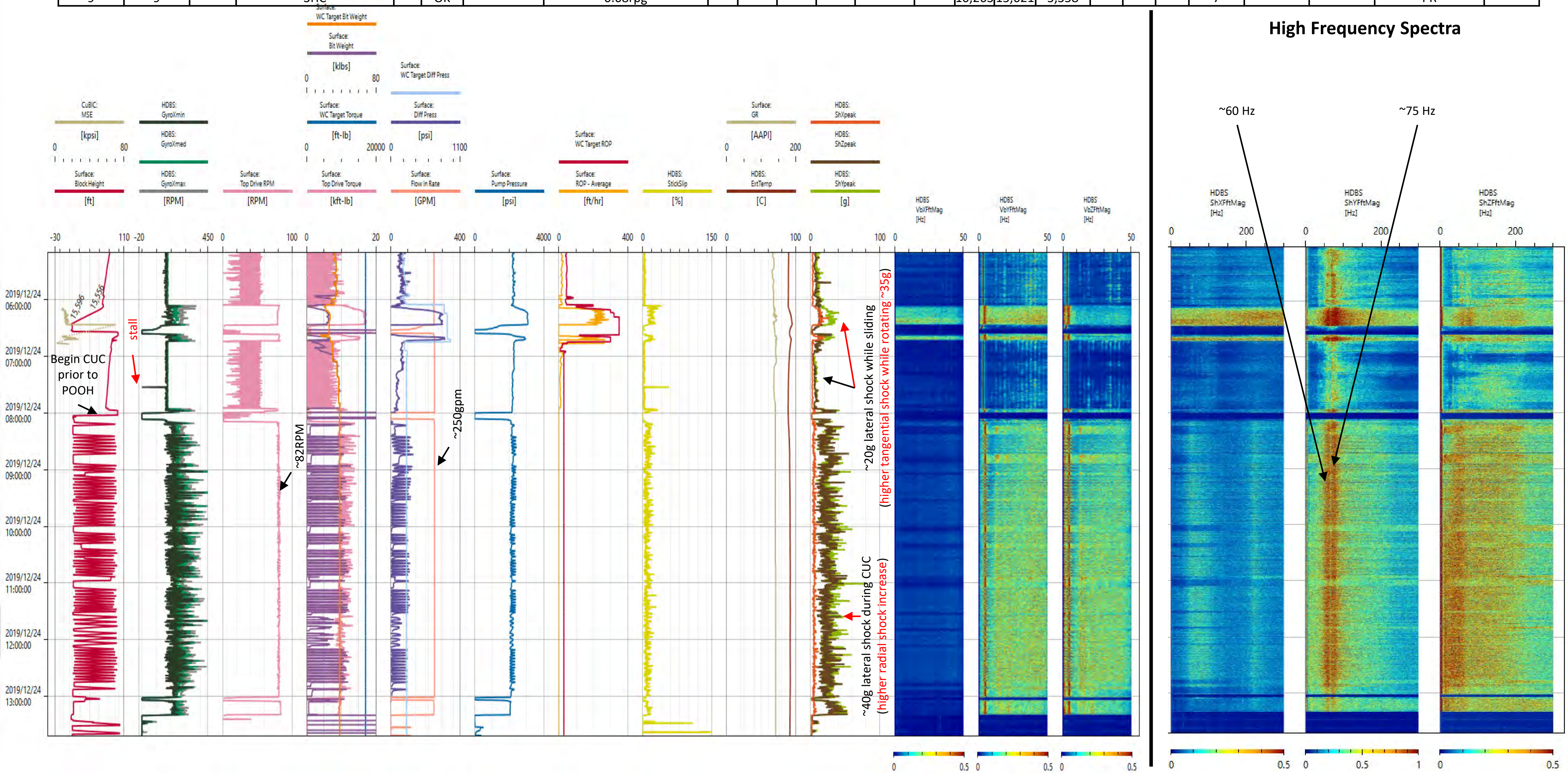

FUTURE TESTING & CONCLUSIONS

Future Testing & Conclusions

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Future Testing

- **Intermediate**
  - Continue trials to reduce motor degradation
  - When motor degradation has been resolved continue with bit design iteration
  - Keep refining managed drilling parameters to target high ROP and single bit run interval
    - Possibly geospatially (Requires Large Dataset)
- **Lateral**
  - Different BHA stabilization to reduce slide % (Monitor vibs. and stick-slip)
  - Push lateral bit design aggressiveness to increase instantaneous ROP w/o compromising durability
- **Other Downhole Tools**
  - Trials on different vendor's vibratory tools as well as additional shock sub placement

Conclusions

- Downhole Memory Data can be a very useful tool to the DE, as with any data it is only as useful as you make it.
  - Analytics Platforms (Sabio, Gamechanger)
  - Potential Analytic Platforms (Corva, Moblize, etc…)
  - Subject Matter Experts (SMEs). Find good industry experts and gather their view and analysis of the data.
  - Share proprietary data
- Return on investment comes from prolonged use of the data sensors
- Utilization of high-resolution downhole at bit data has discovered and/or verified problems or successes in our drilling program that otherwise would have taken longer to figure out or design around
- Cost Reduction with Widespread and Repeated Use

Thank You to My SMEs and Questions

HALLIBURTON - Christopher Blanton and Jonathon Hammack

Baker Hughes - John Fairbairn and the Baker Hughes Team

SDI SCOUT DOWNHOLE / SANVEAN TECHNOLOGIES - Steve Jones, Jake Blacklaws and Sanvean/Scout Team

PHOENIX TECHNOLOGY SERVICES - FPE/PHX MWD Field Hands and the Prism Group

PANTHER - Ricky Bourque and the Panther Motor Shop Team

BASIN FLUIDS - Kacy Kauk