Pump-Down Visualization Service with a Downhole Tension Tool

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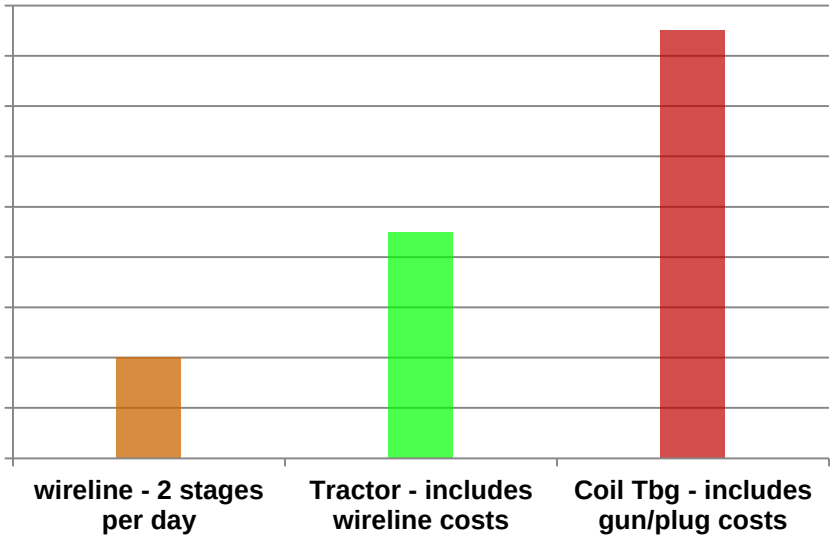
APPS-13-005

HALLIBURTON

Why Pump Down Perforating?

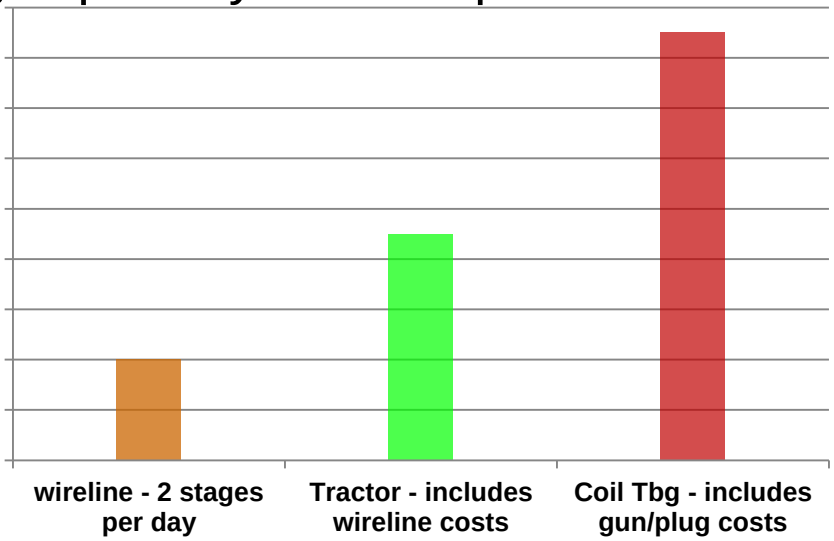
- Horizontal Drilling became practical and economical about 2000.
- Initial completions were time consuming and expensive
  - Each stage required tractor conveyed E-Line guns or Coil Tubing TCP type guns.



Why Pump Down Perforating?

- One – two stages per day considered acceptable
- Stimulation equipment idle between perforation stages

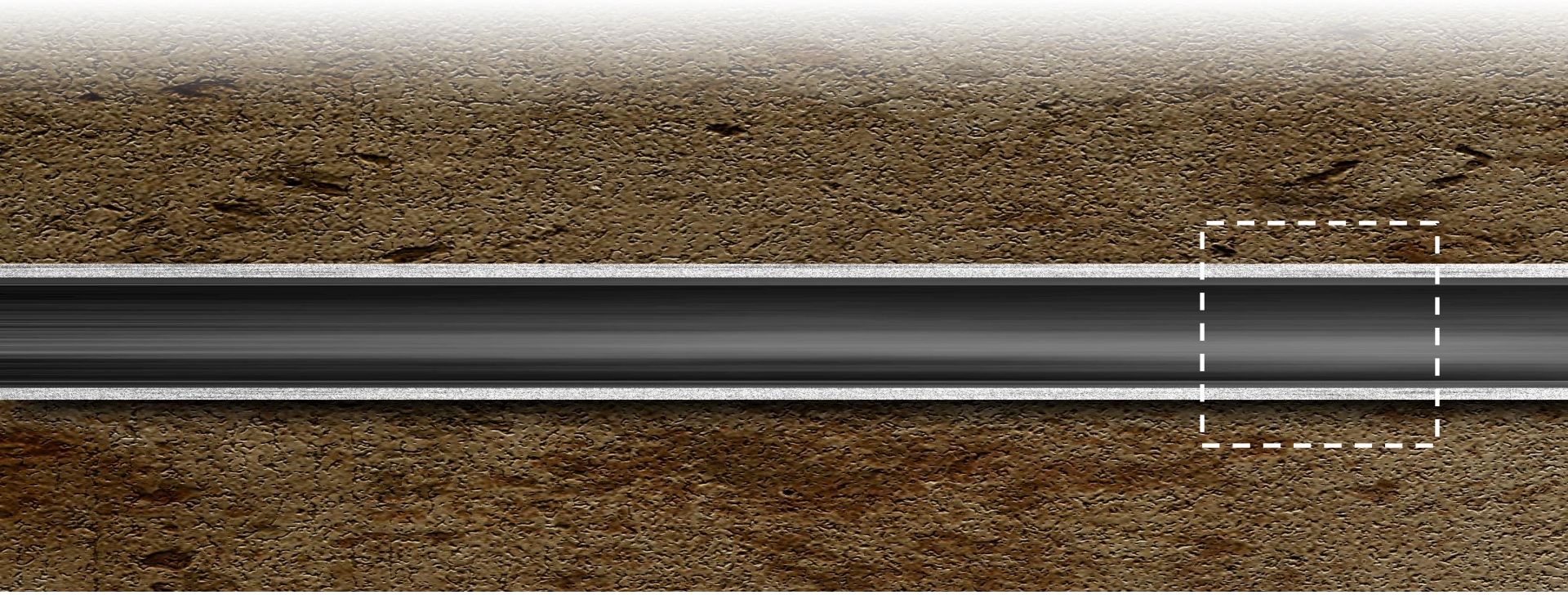
- Work in the Barnett Shale proved Pump Down economic viability
  - Eliminated added conveyance methods
  - Multiple stages per day became practical



Horizontal Multi-Stage Perforating

- Pump Down Services (PDS) offer quick, efficient and cost effective deployment of multi-gun/plug runs for multiple stage completions
- PDS has been deployed in the USA and Canada for horizontal completions and also for other e-line services – method is expanding globally
- Efficient PDS, depending on depths, now allow up to 5 stages per 24 hour day
- A typical single E-Line stage consists of
  - Multiple guns (3 foot - 6 spf carriers)
  - Explosive setting tool
  - Composite plug

Pump Down Plug and Perforate in Horizontal wells



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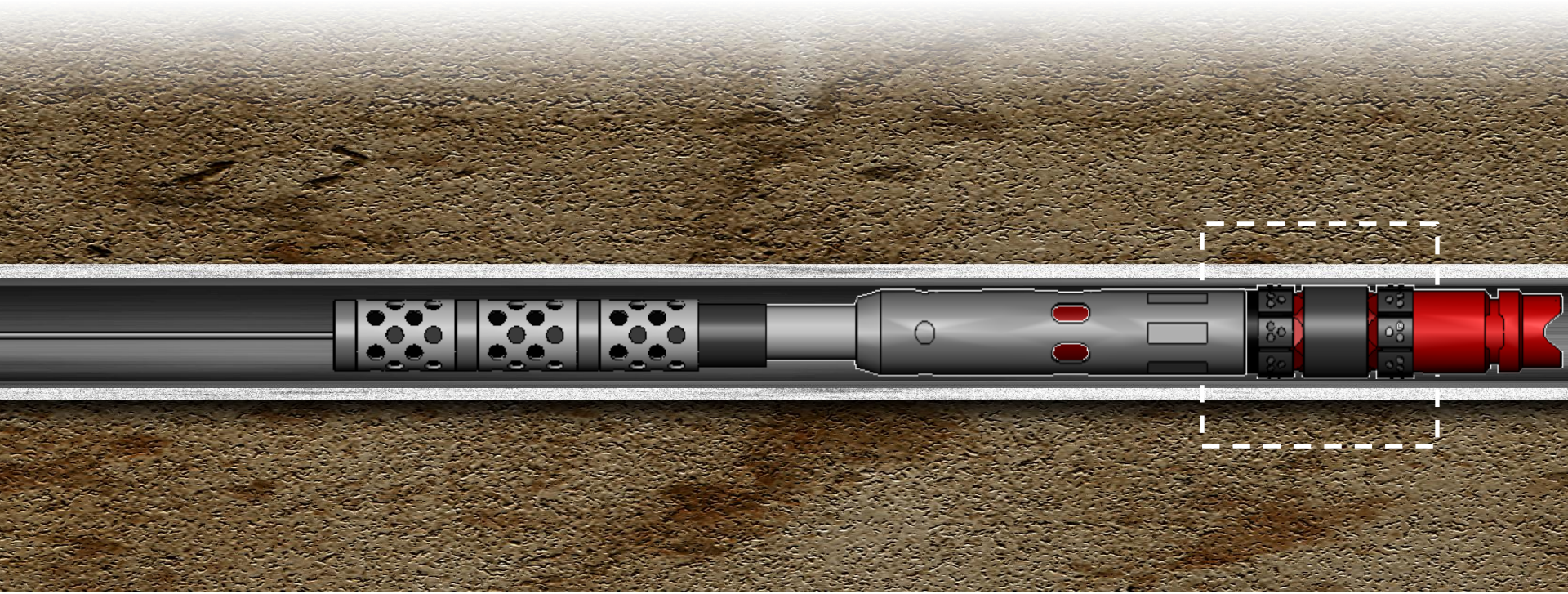

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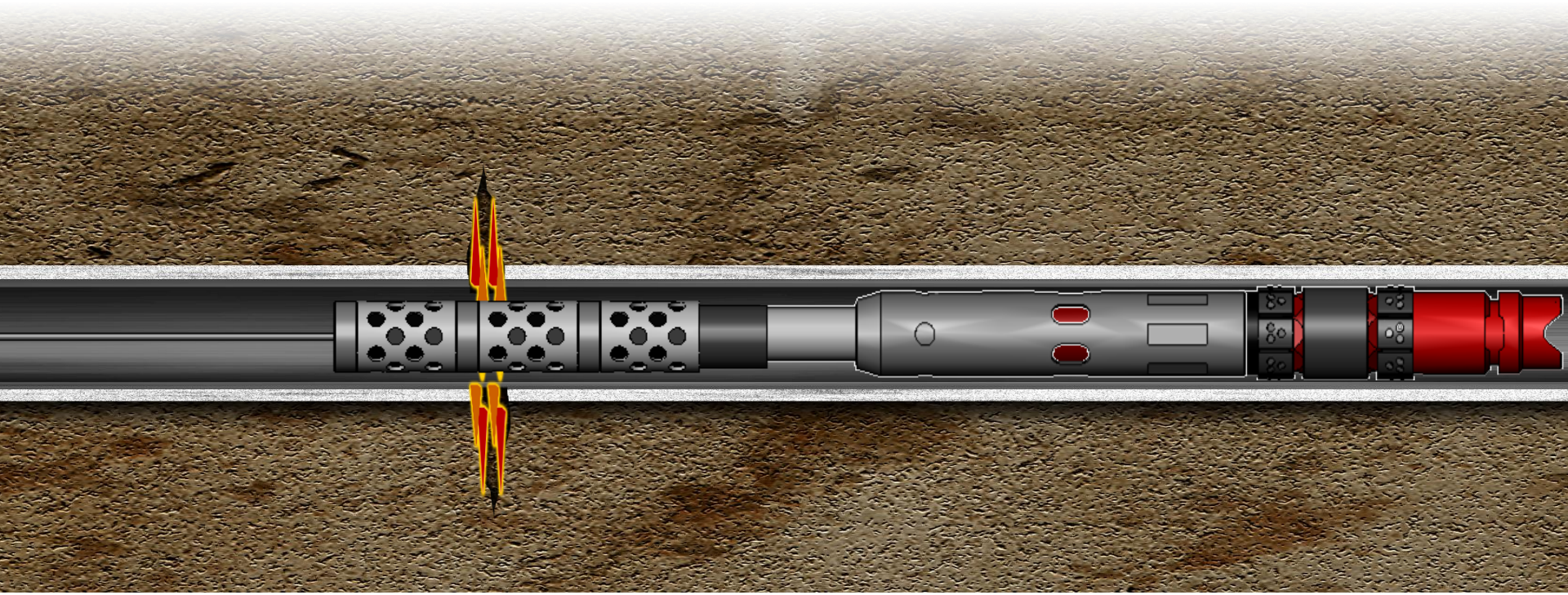

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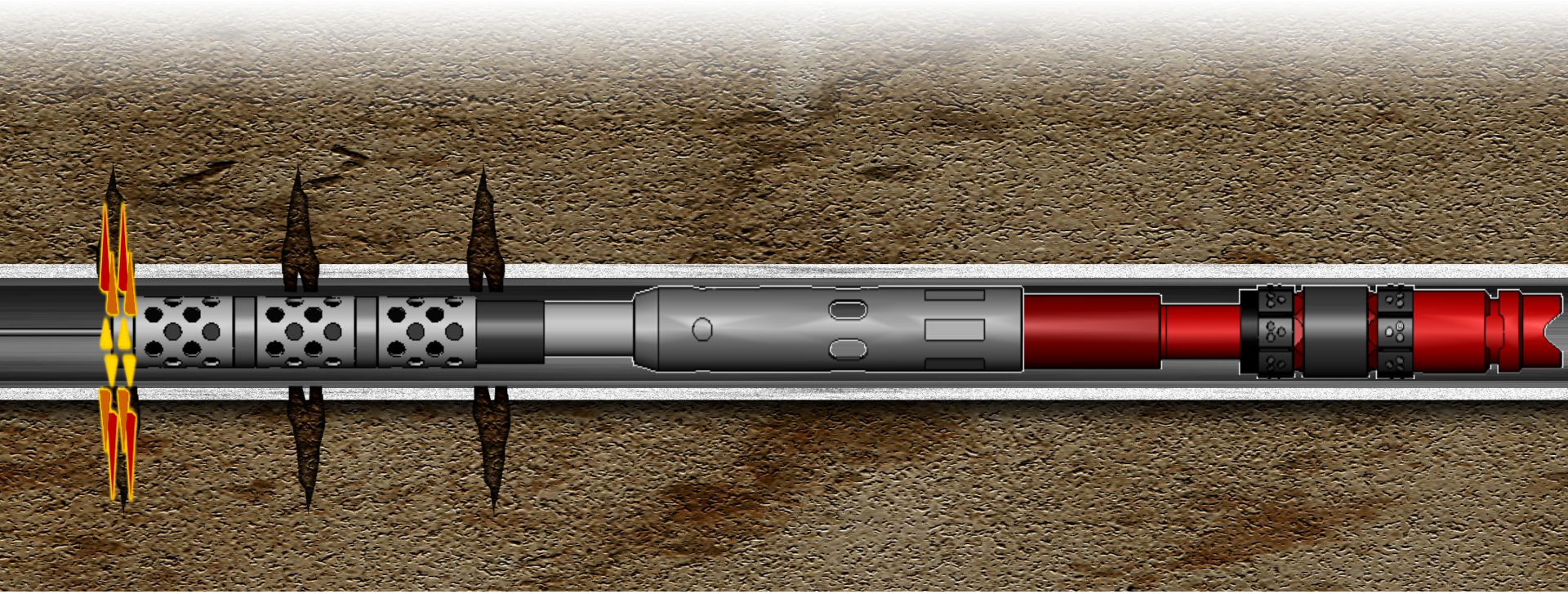

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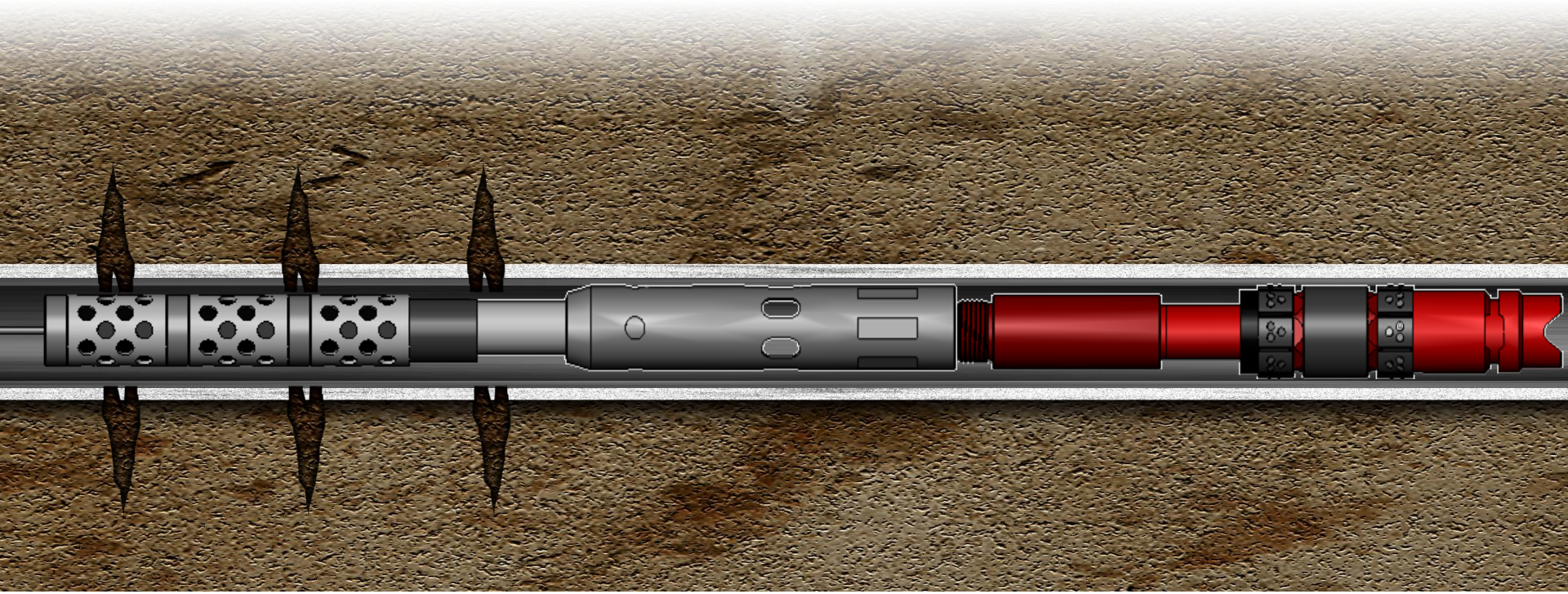

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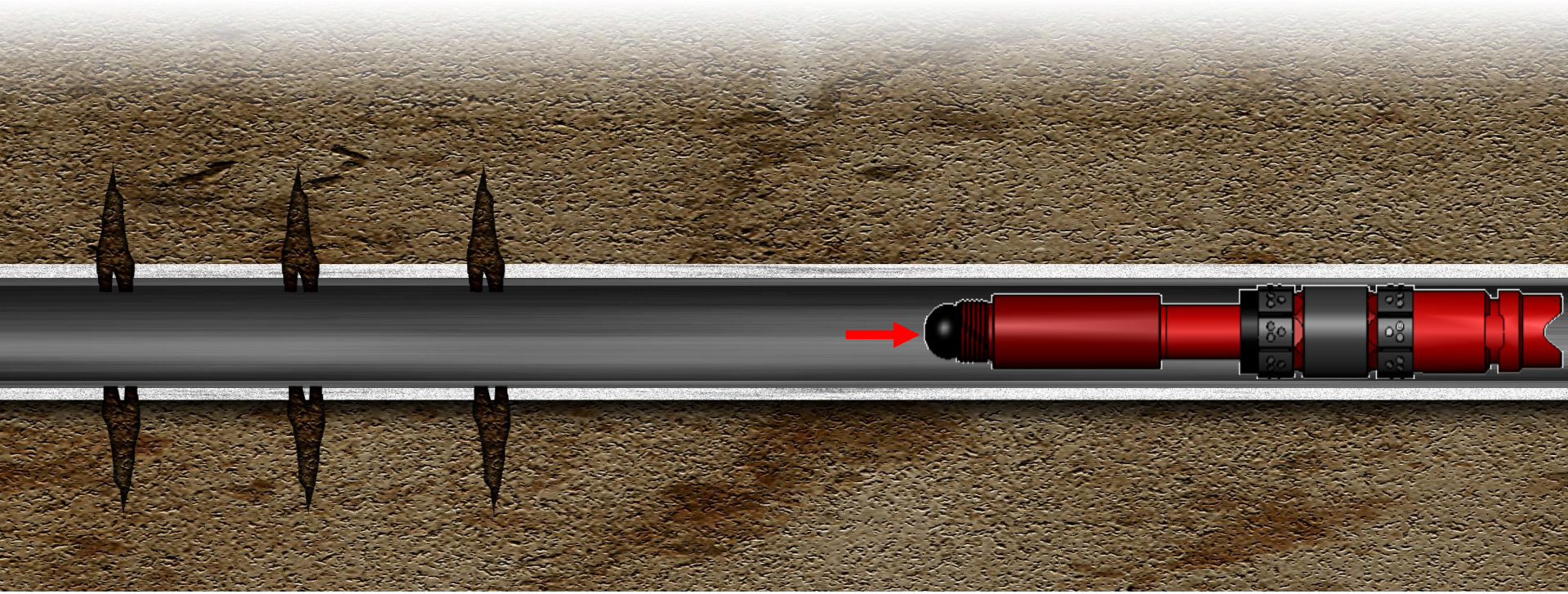
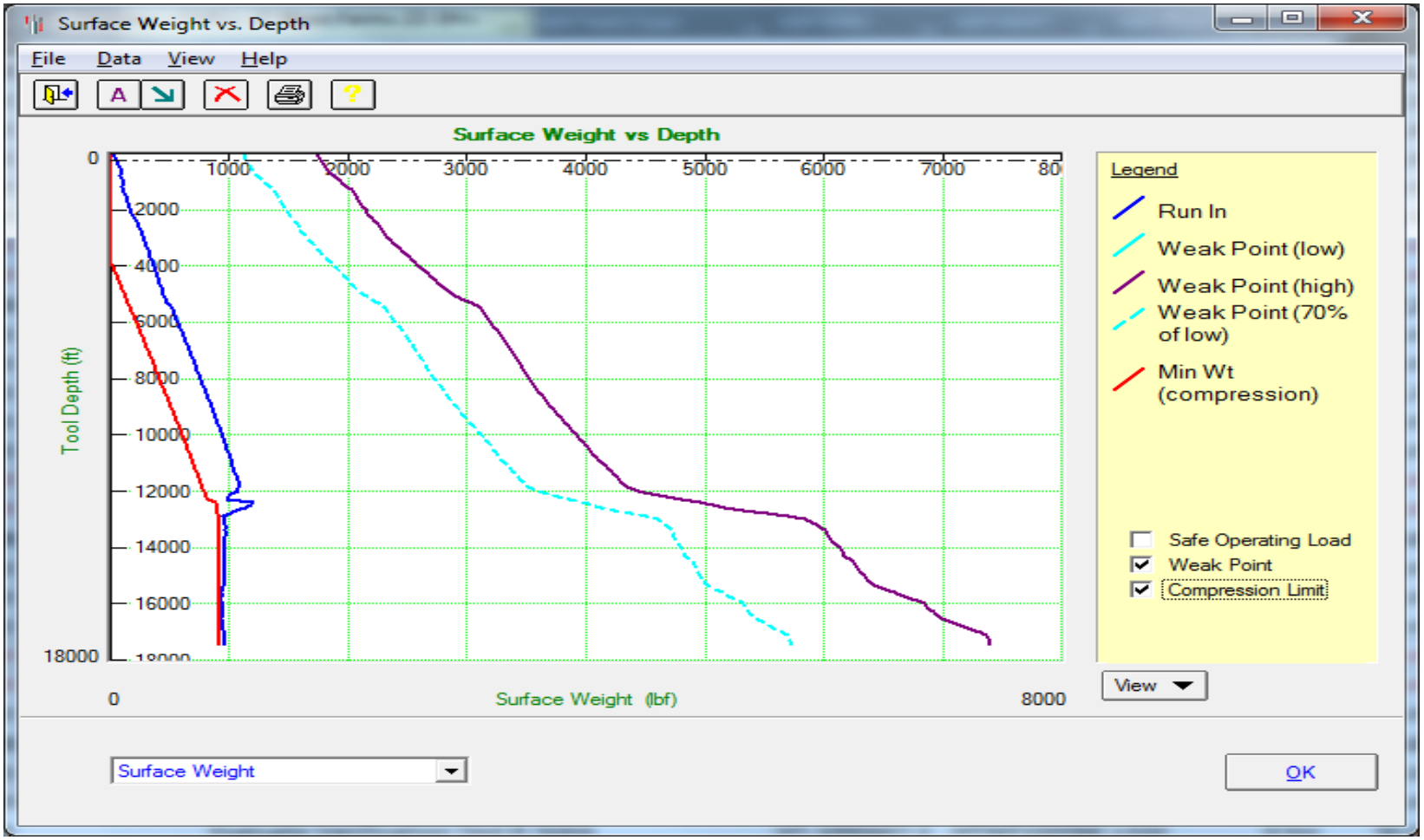


Pump Down Operations Today

- Wireline and Stimulation operate separately but not independently.
- No difference in operating method if Stimulation and Wireline are same company.
- 2 way radio communication between wireline operator and pump operator is only communication
  - No pre-run planning
  - Always reactive, never proactive
  - Neither party has all the information to identify a potential problem and adapt the operation ahead of a failure.

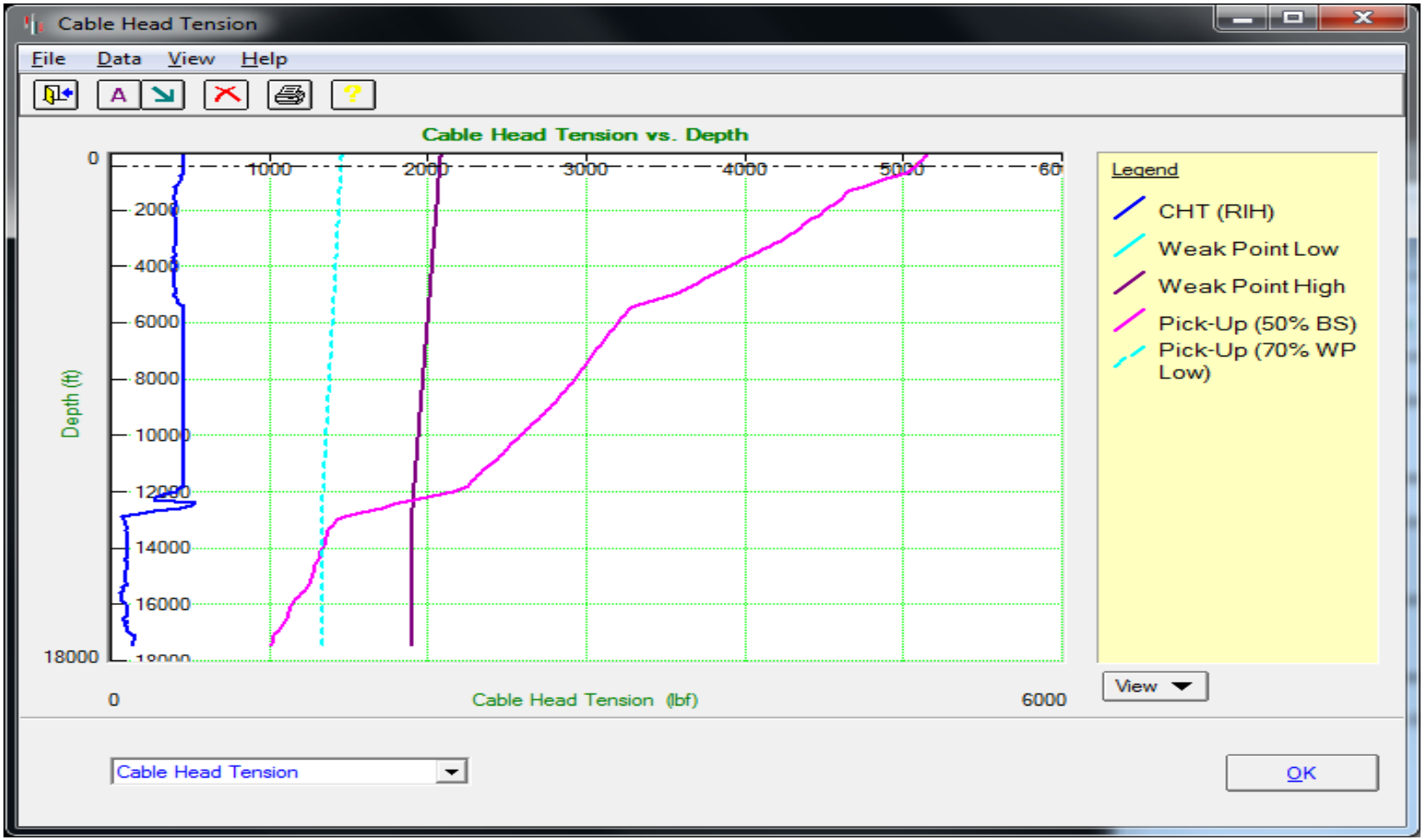
Horizontal Multi-Stage Perforating

Cerberus – Surface Tension Profile



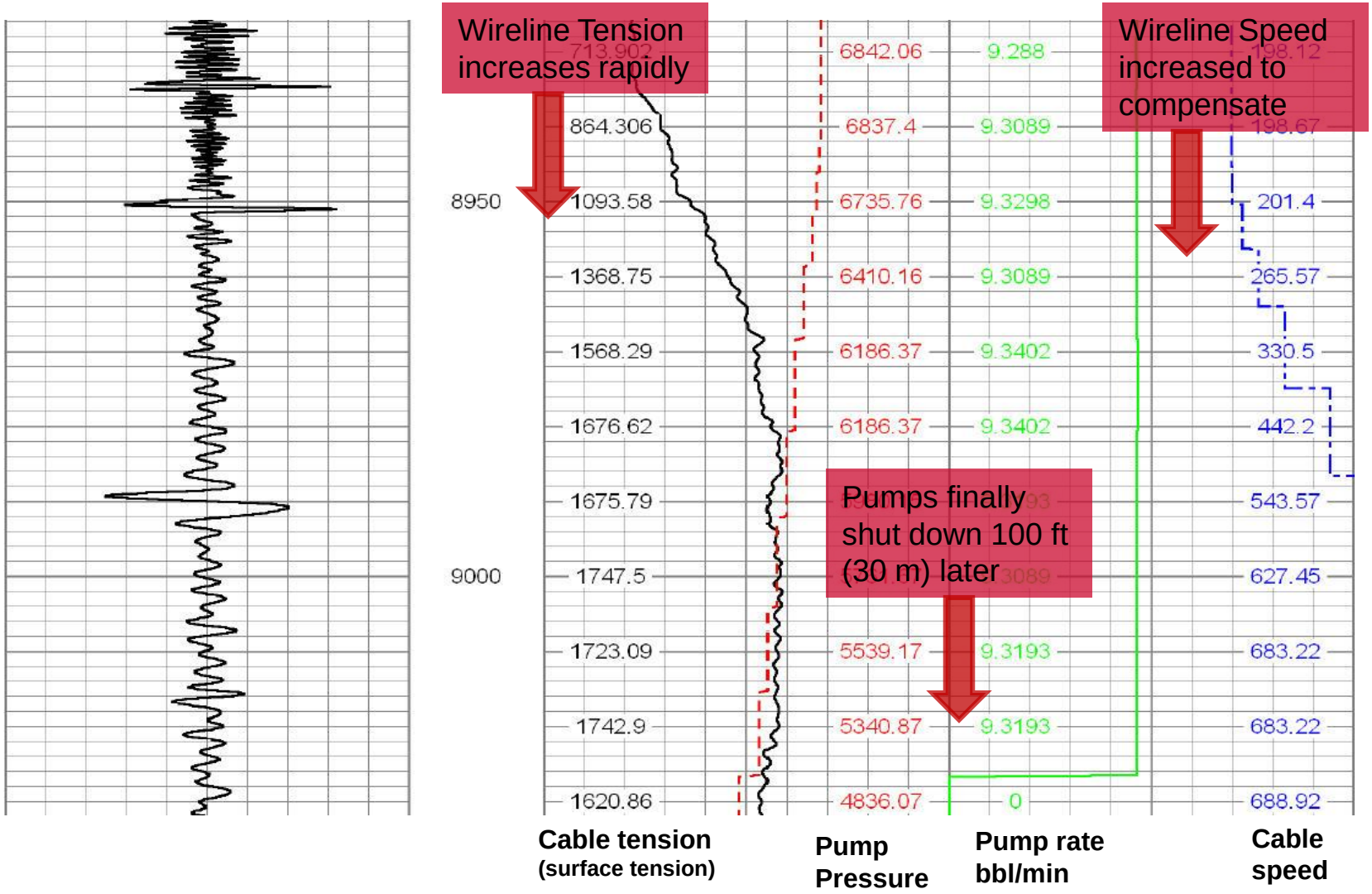
Calculations based on user determined pump rate and line speed

Cerberus – Downhole Tension Profile

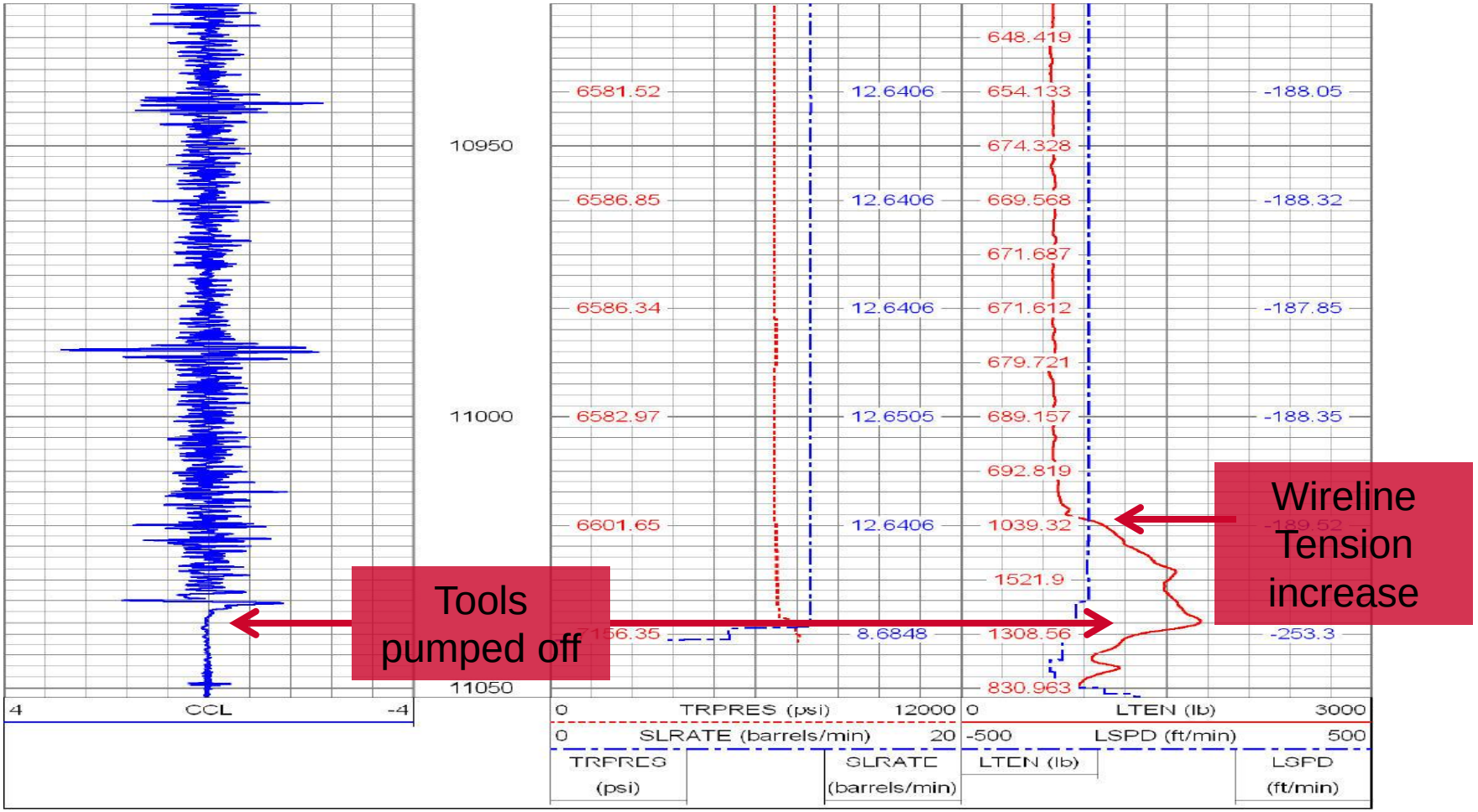


Calculations based on user determined pump rate and line speed

Typical wireline view

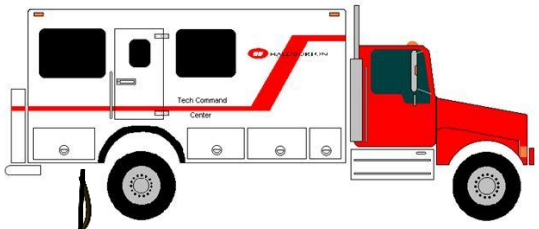


Tool String Lost



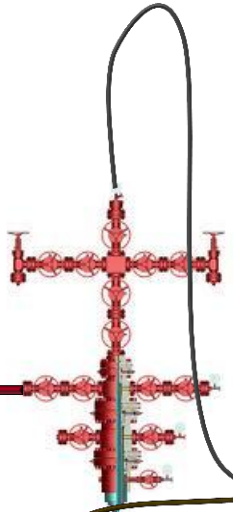
RTO

Monitor



TCC

- Pumping Pressure
- Pump Rate



Wireline Unit

- Depth
- Cable Speed

Mono-Conductor Tension Device

- Downhole Tension

Pump Down Software Input Table

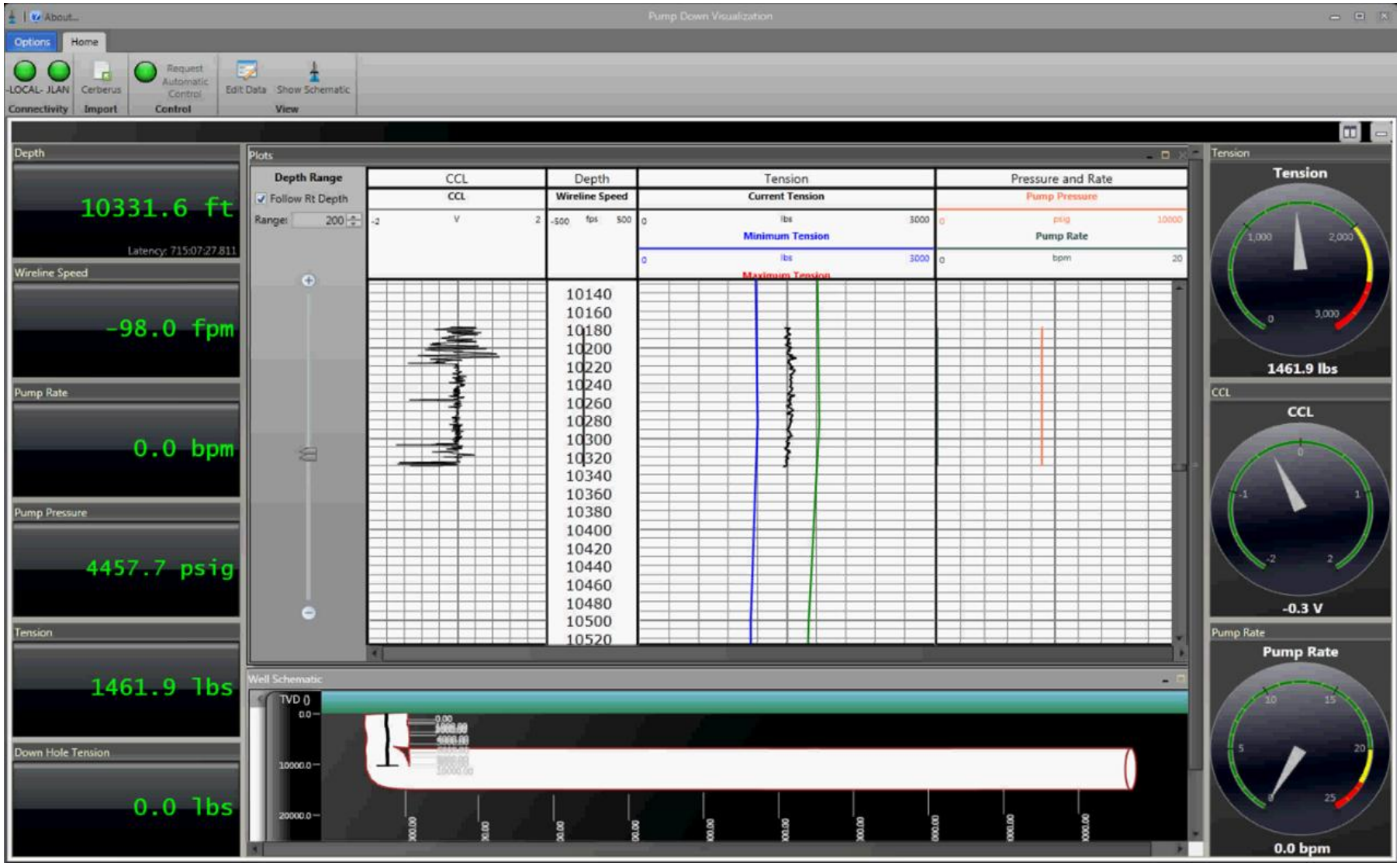
Pump Down Visualization Inputs	Outputs		
Wireline Unit			
Surface and Downhole Tension	Numeric Display	Gauge	Trend Graph
Line Speed	Numeric Display		
Depth	Numeric Display	Well Illustration	
Collar Locator (CCL)		Gauge	Trend Graph
Tech Command Center			
Pump Rate	Numeric Display	Gauge	Trend Graph
Wellhead Pressure	Numeric Display		
Customer			
Survey data (loaded into Cerberus)		Well Illustration	

Pump Down Visualization Value

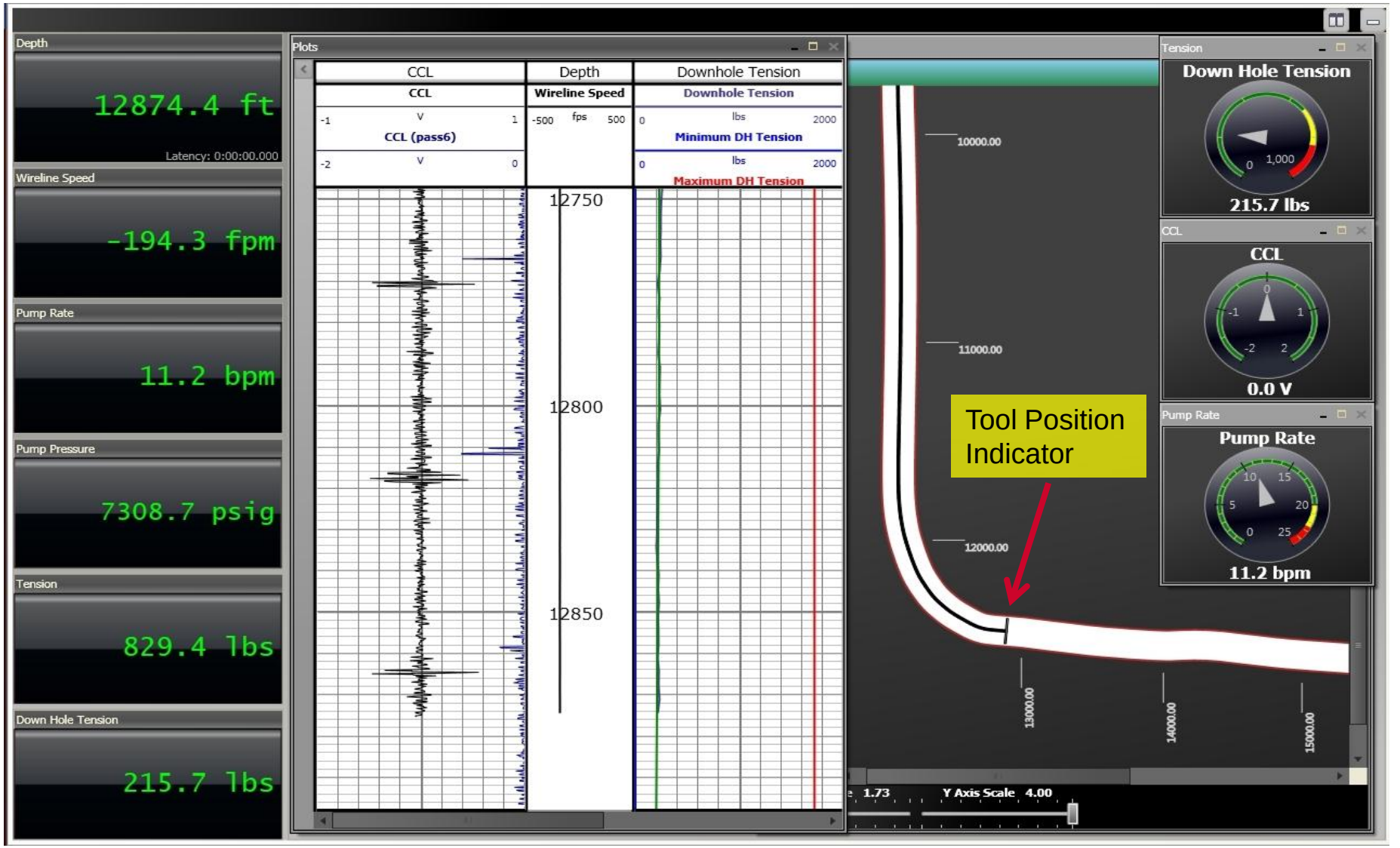
Improved efficiency resulting from Stimulation and Wireline sharing data

- Real time
- Easy to understand graphics
- Flag or alert if cable or cable head weak point nears or exceeds calculated failure value
- With Downhole Tension Tool (DTT) can compare run to run for changes that may occur downhole
- Post job diagnostics that captures all Stimulation and Cased Hole information in a single database

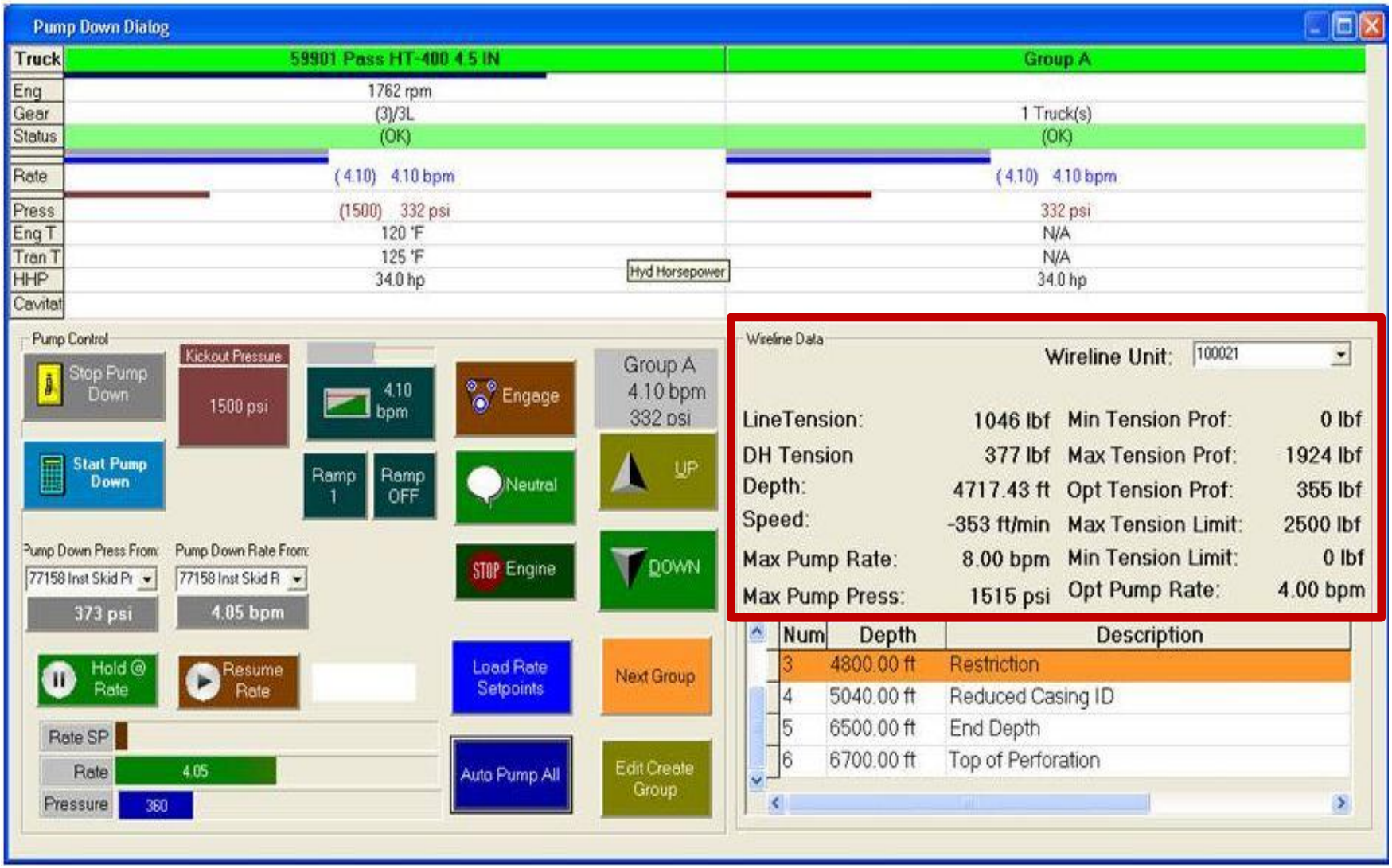
Pump Down Visualization – Wireline Unit



Pump Down Visualization – Wireline Unit



Pump Down Visualization – Pumping Unit



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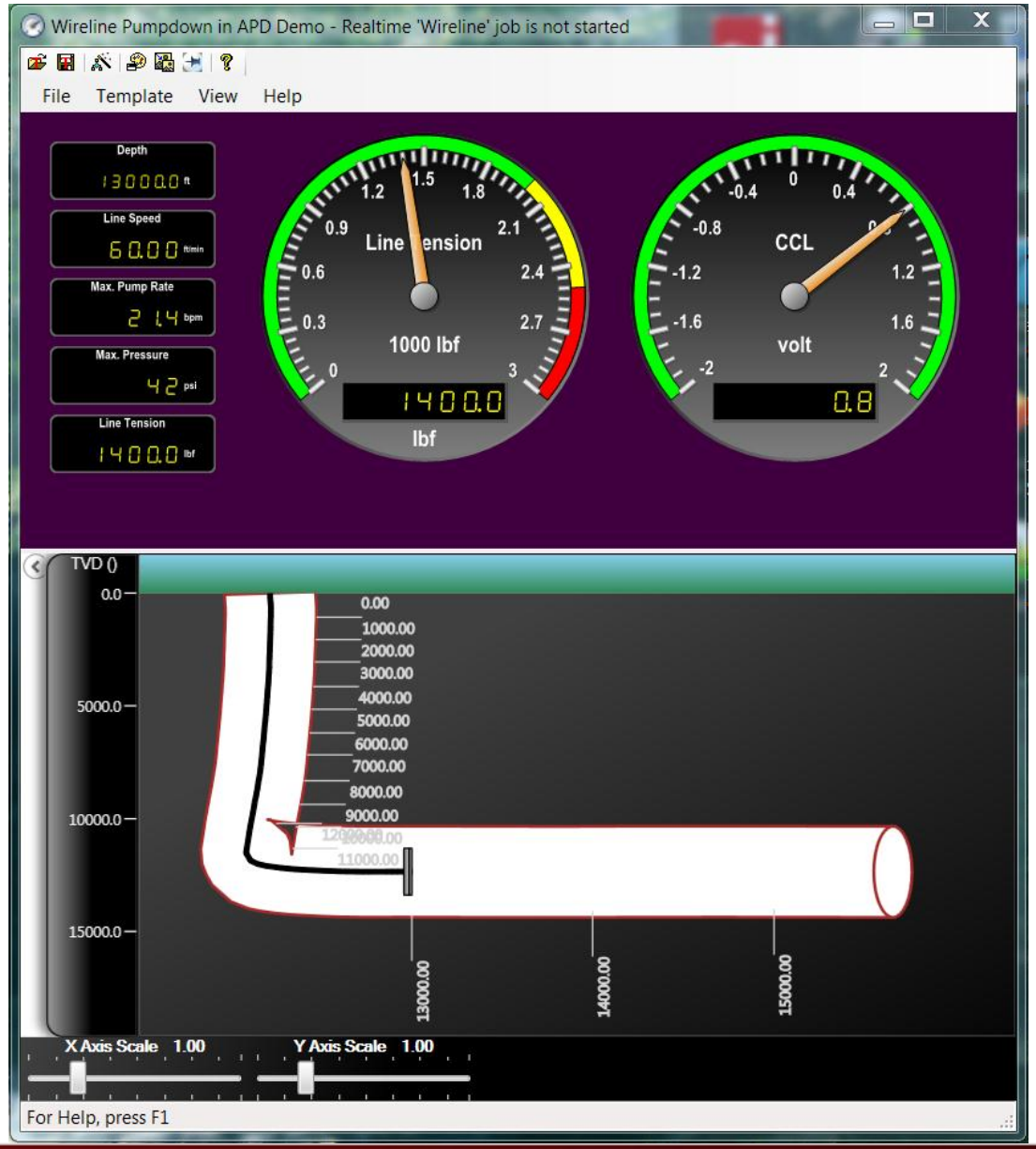
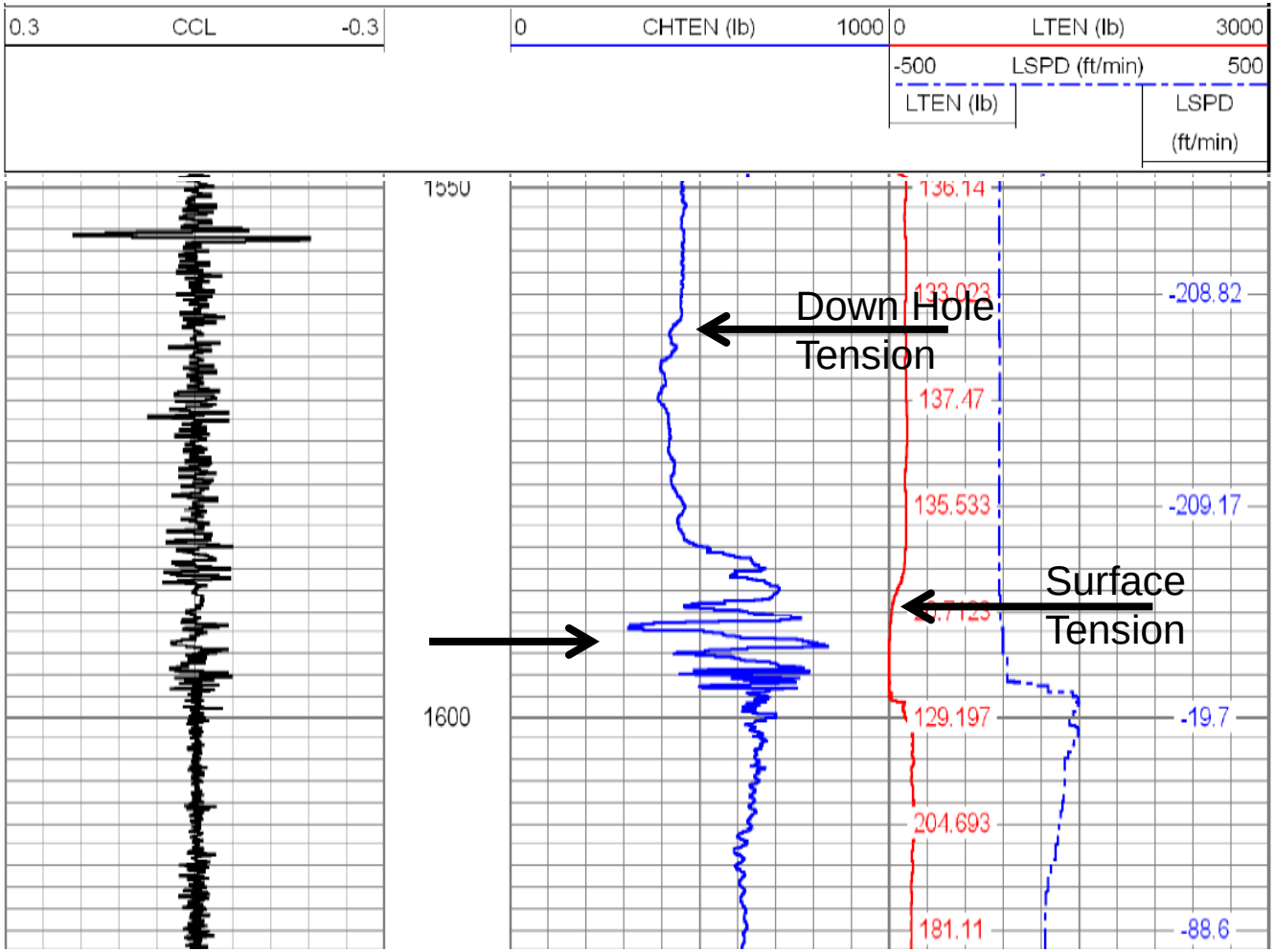


Downhole Tension Tool

Plugged grease injection return line stopped cable.

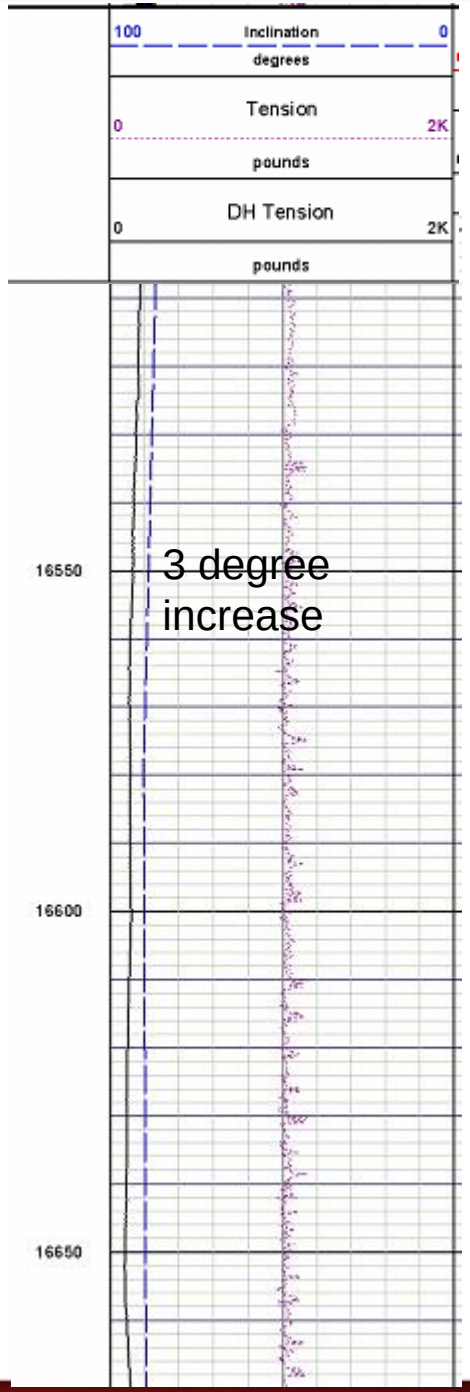
DTT indicates weight loss at tool well before cable stopped at surface.

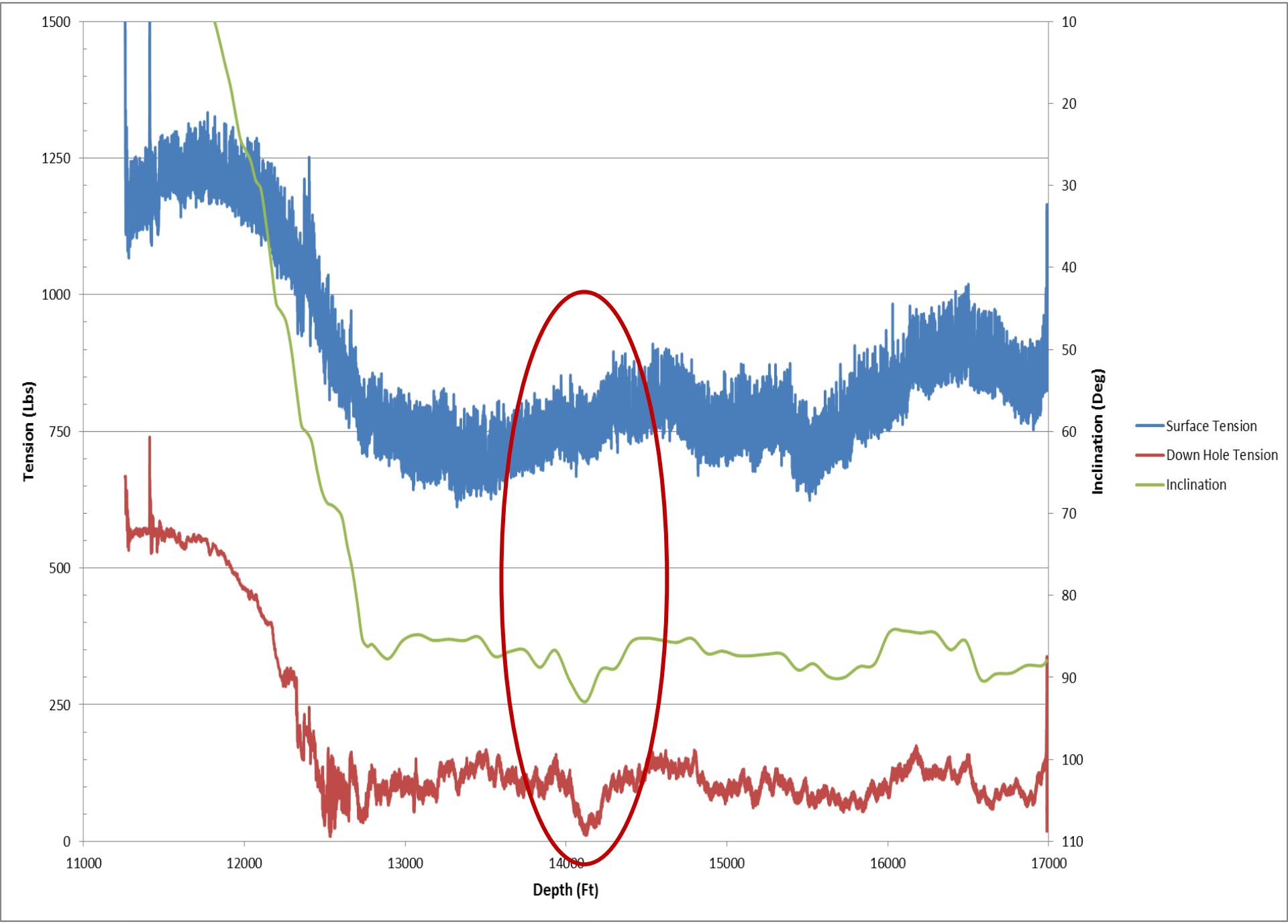
Note tool bounce when cable stopped



Downhole Tension Tool

- Pump down operations
- Surface tension insensitive to well trajectory changes
- Downhole tension follows well trajectory changes



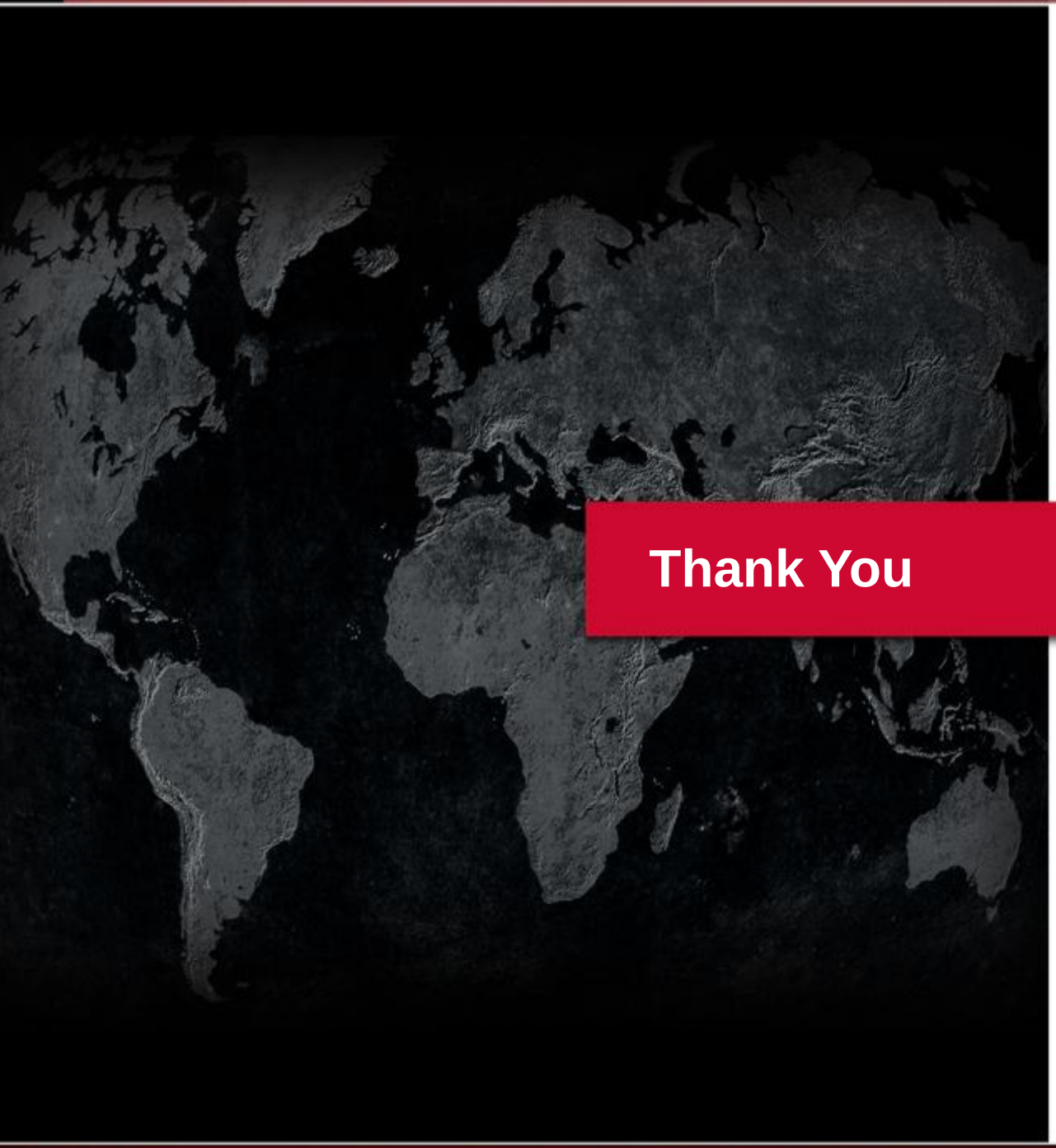

1500
1250
1000
750
500
250
0
Tension (Lbs)
10
20
30
40
50
60
70
80
90
100
110
Inclination (Deg)
11000
12000
13000
14000
15000
16000
17000
Depth (Ft)
Surface Tension
Down Hole Tension
Inclination

Downhole Tension Tool

- Faster reaction
- Improved accuracy
  - Sensor measures at the critical point
  - Not affected by line stretch
  - Not affected by weight of cable
  - Not influenced by cable friction or drag

Summary

- Pump Down Visualization combined with Downhole Tension Tool provides tool movement during a pump down run
- Allows real time viewing of data in user friendly interactive formats
- Offers run to run comparison of tension data to optimize run time efficiency
- Real time tension profile and caution indicators visible to both wireline operator and pump operator.
  - Can reduce or prevent stuck tools, accidental pump off of tools.
- Recorded data can be reviewed for post-job diagnostics



Thank You

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