



Using Real-Time Downhole Data to Improve Milling Operations

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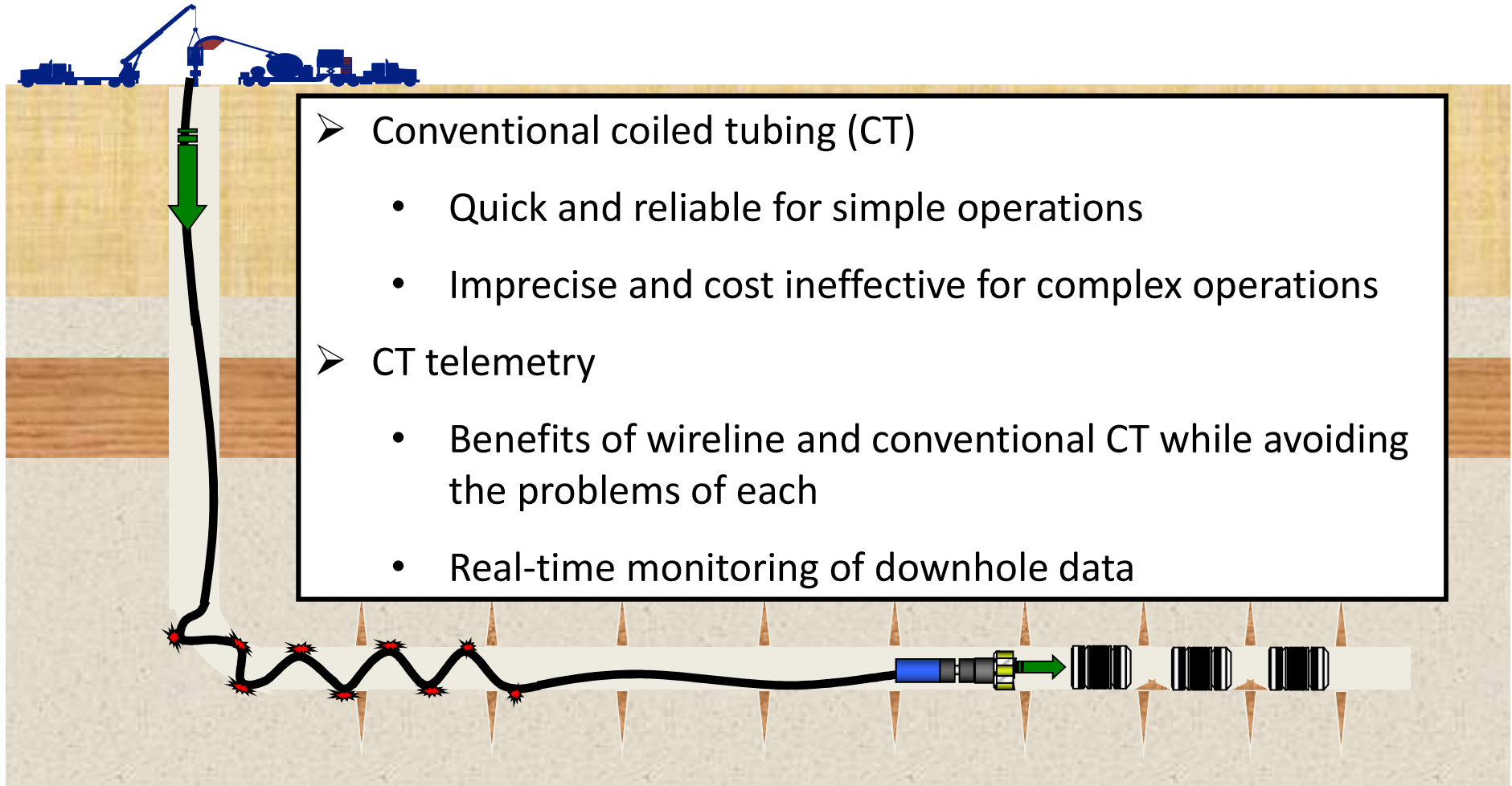
2017 ICoTA Canada Roundtable
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Overview

- What problem is solved?
- Telemetry with tension, compression and torque (TCT)
 - Description
 - Laboratory testing
 - Milling benefits
- Two case histories
 - Milling with telemetry and TCT
 - Milling with fluid hammer tool and telemetry without TCT
- Conclusions

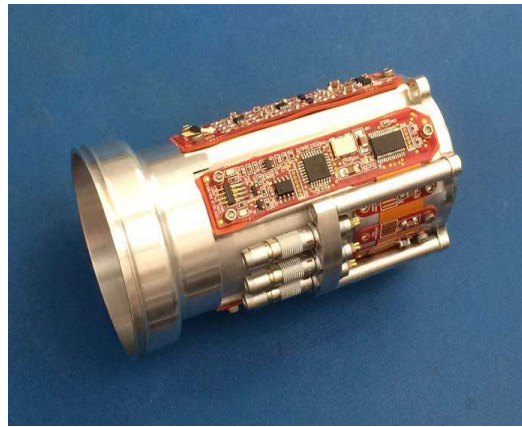


What problem is solved?

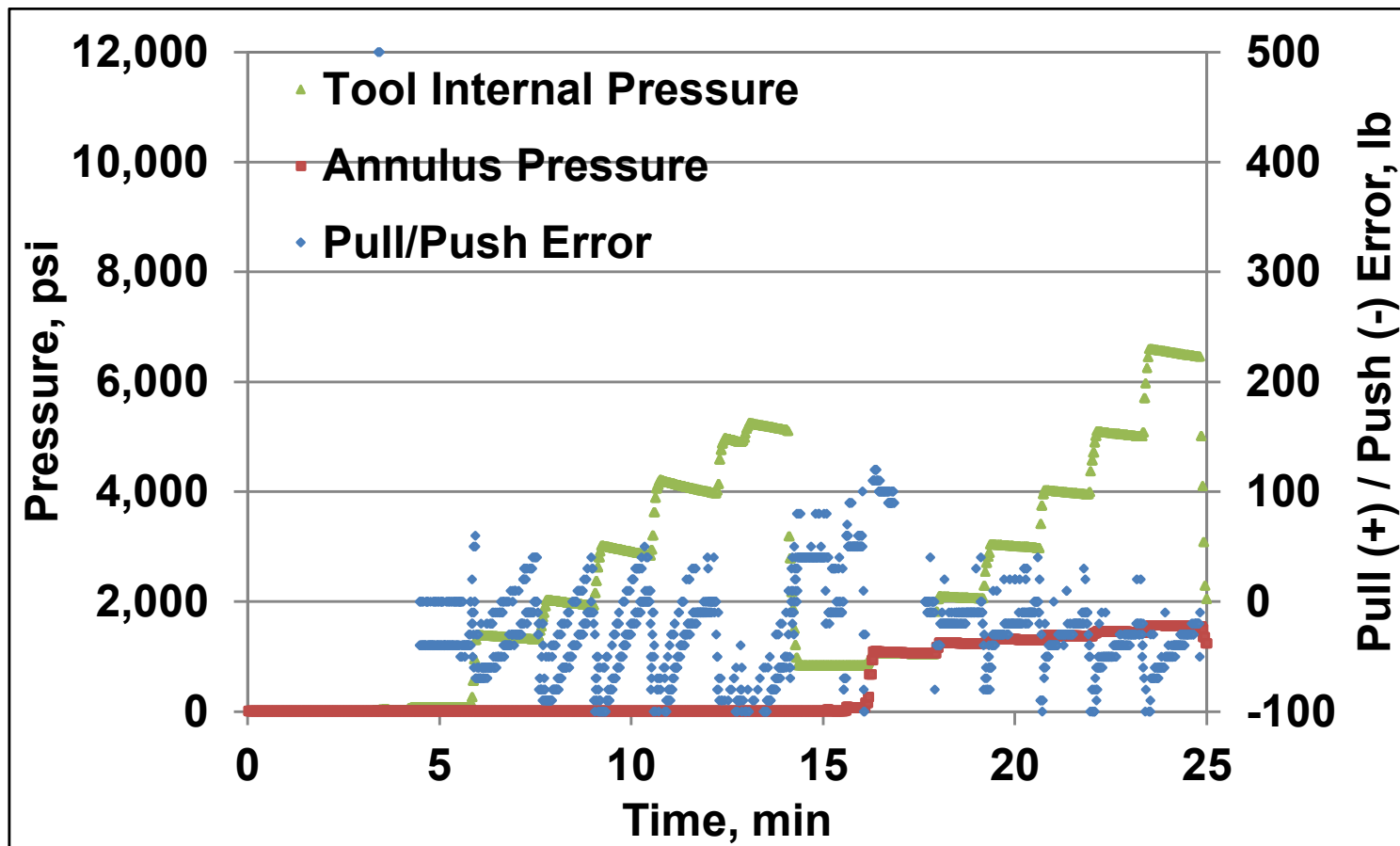


TCT Assembly Description

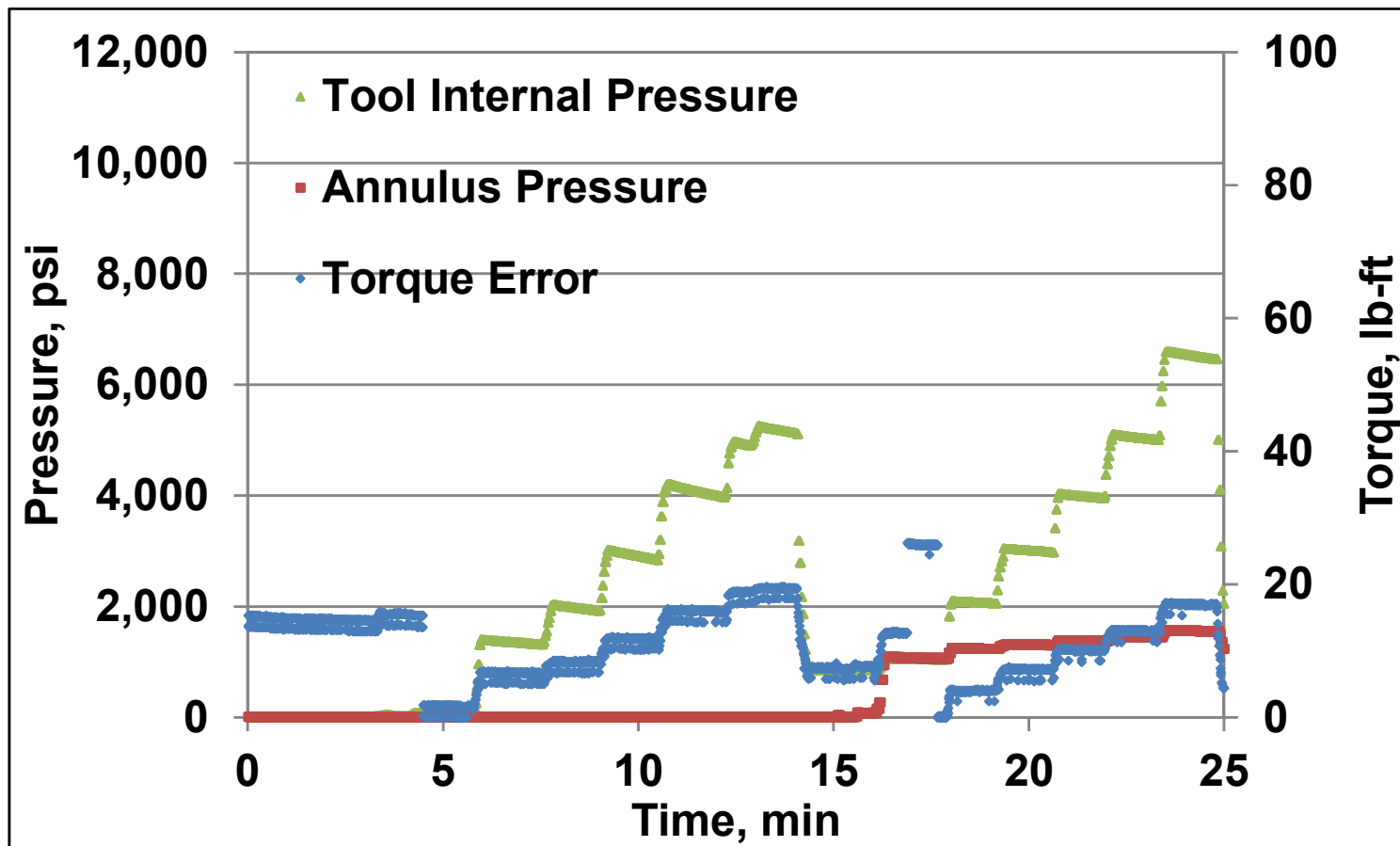
- Strain gauges glued on the inside walls (SPE-179101)
- Temperature and pressure compensation (SPE-183026)
- Design challenges
 - Recorded low signal comes with high noise
 - Printed circuit boards installed in small space
 - Inside fluid flow path



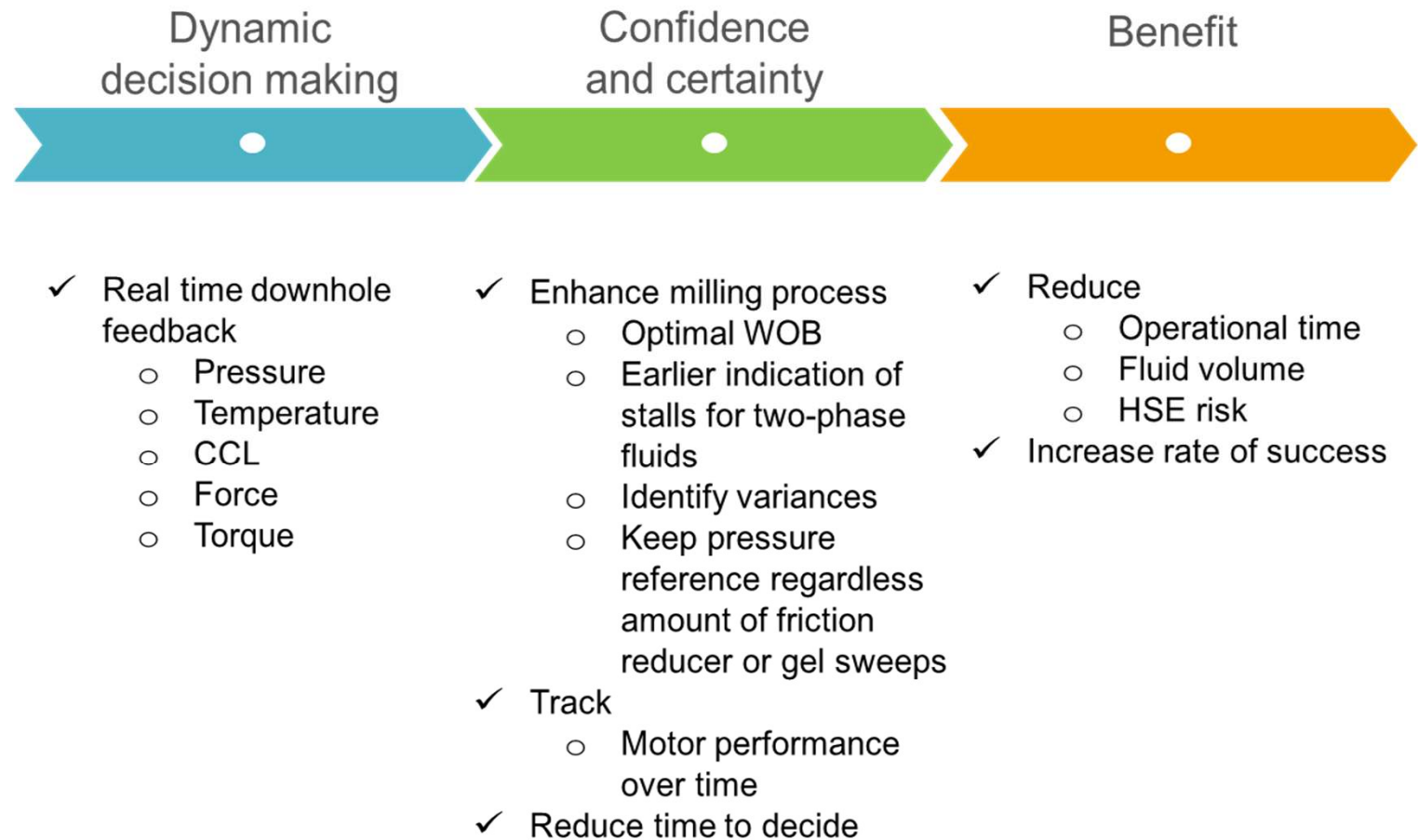
Laboratory Testing – Pull/Push



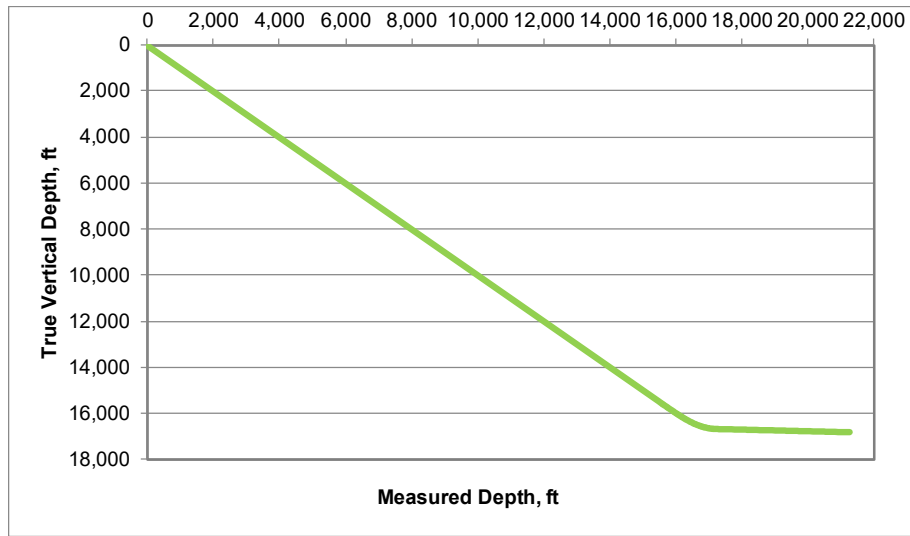
Laboratory Testing – Torque



Milling Benefits (SPE-187374)

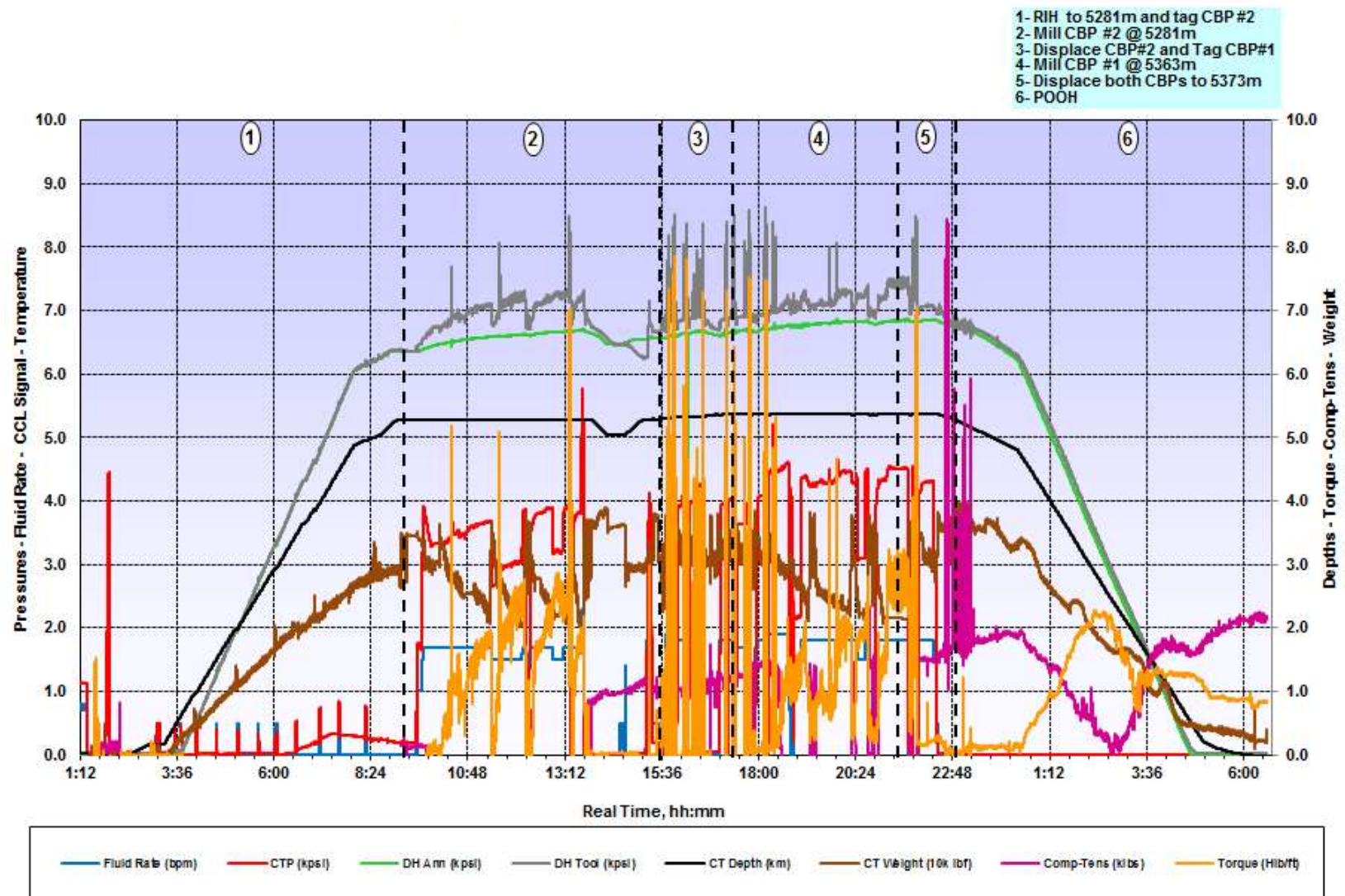


Case History 1 – Operation Overview (SPE-189910)

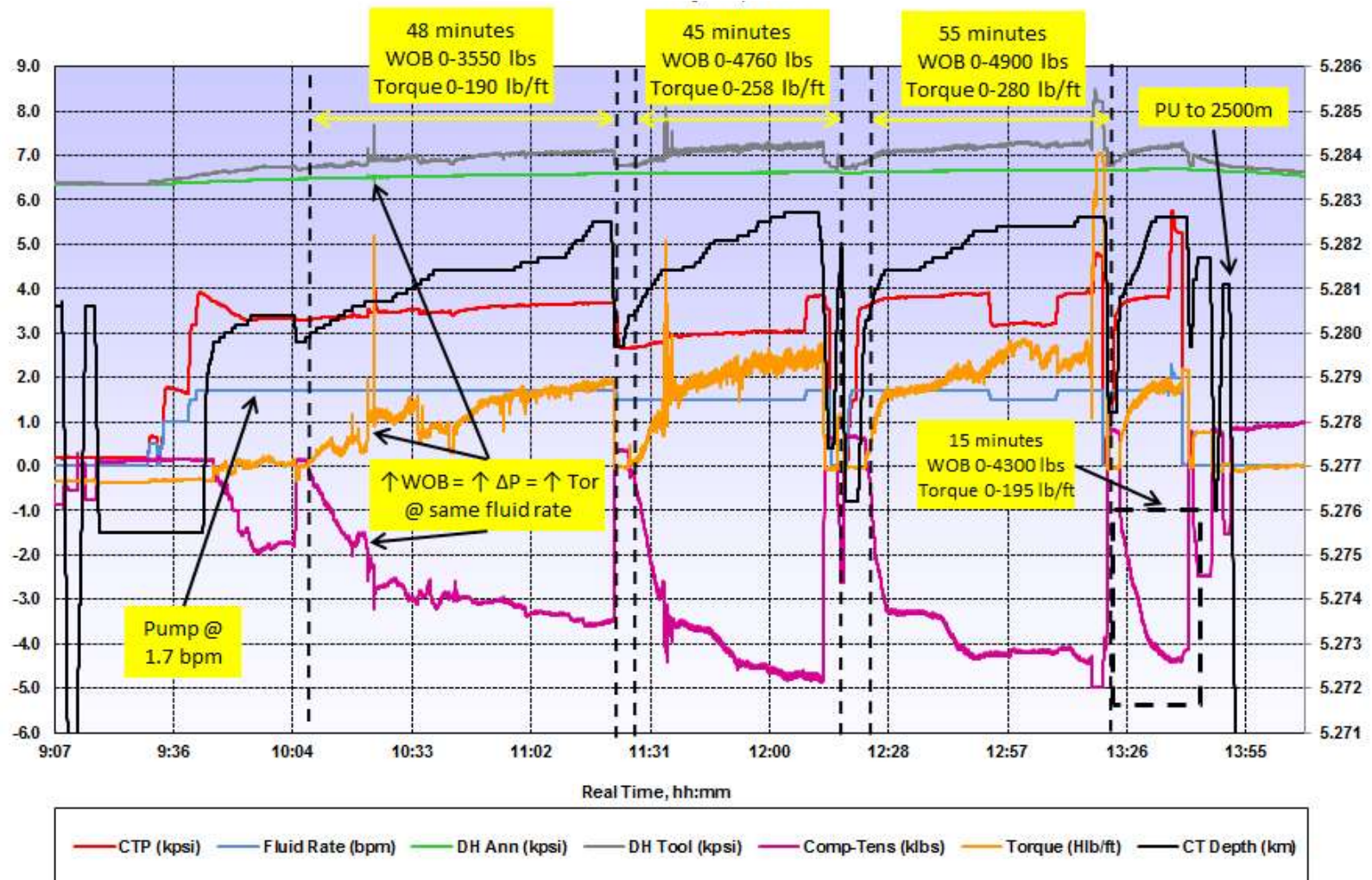


- Objective: perforate, stimulate and mill two composite bridge plugs at 17,300 and 17,600 ft
- 21,000 ft long well completed with 10 swelling packers, eight ball-activated sleeves and a perforated joint (open hole)
- Challenges: depth and local restrictions for flaring and flowing back H₂S
- Outcome:
 - Two plugs were milled in one run by permanently adjusting the WOB and torque while keeping the pumping rate constant
 - Milling time reduced by 25% compared to similar operations without TCT

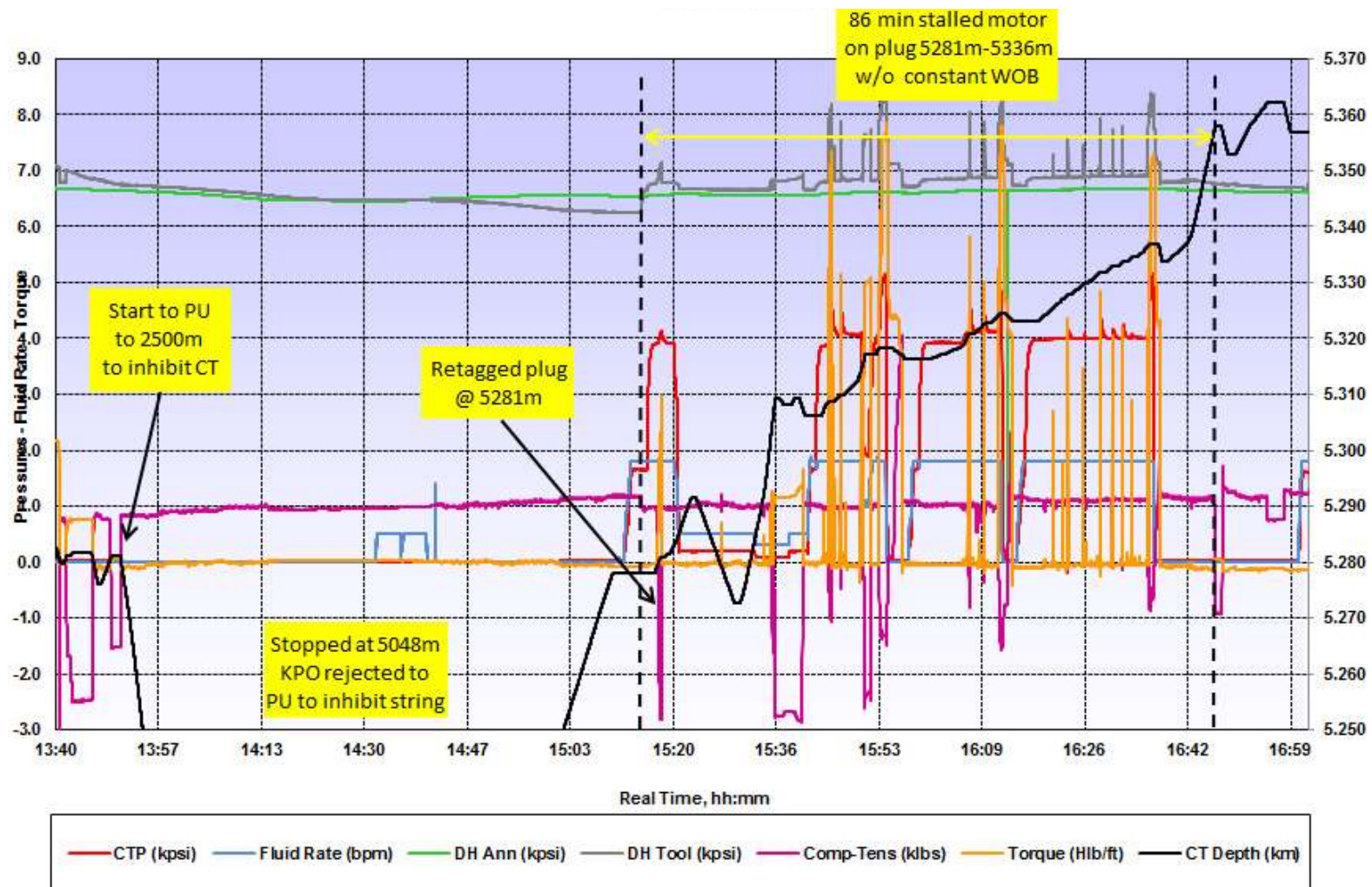
Case History 1 – Job Monitoring



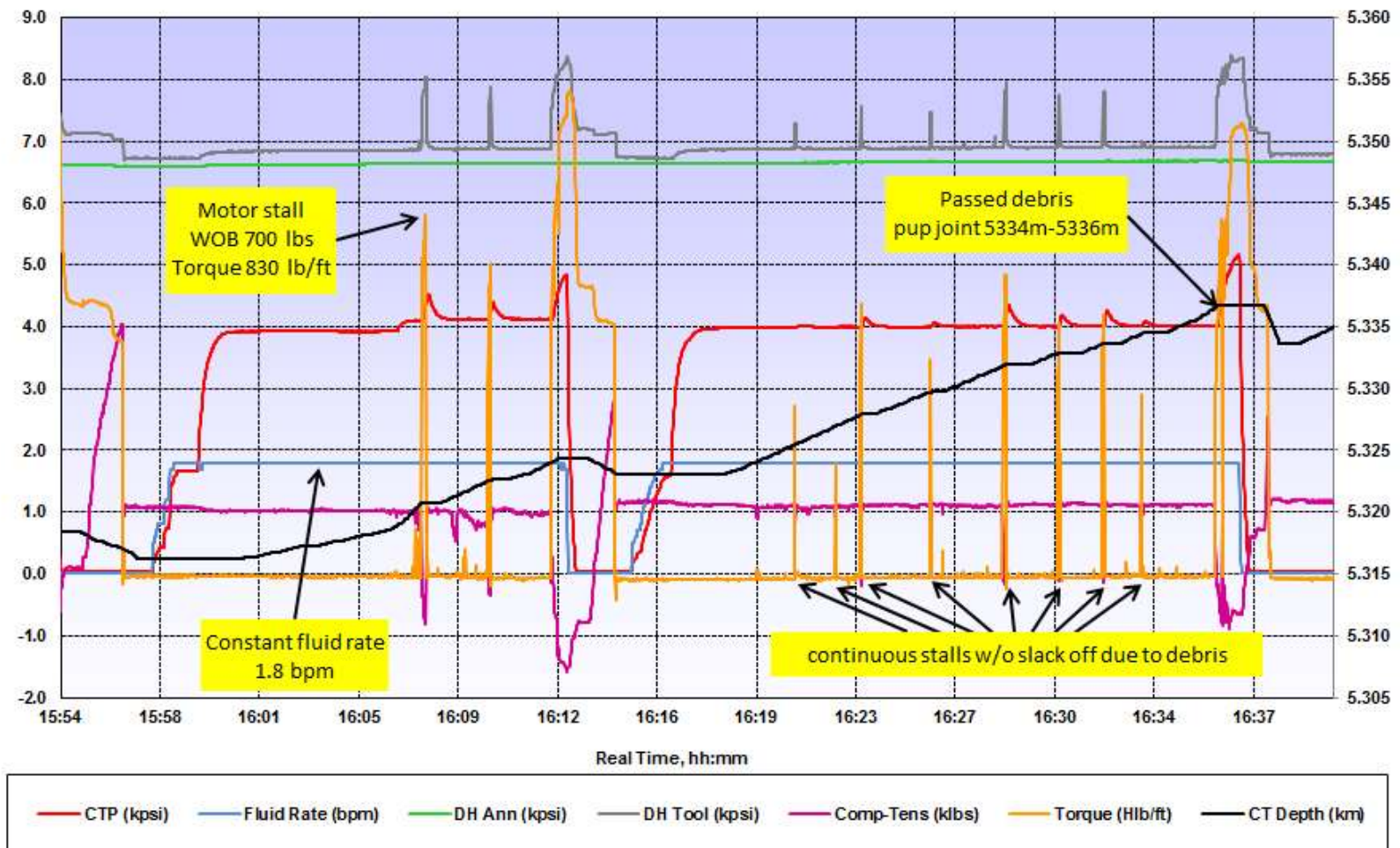
Case History 1 – From 9:07 to 13:55



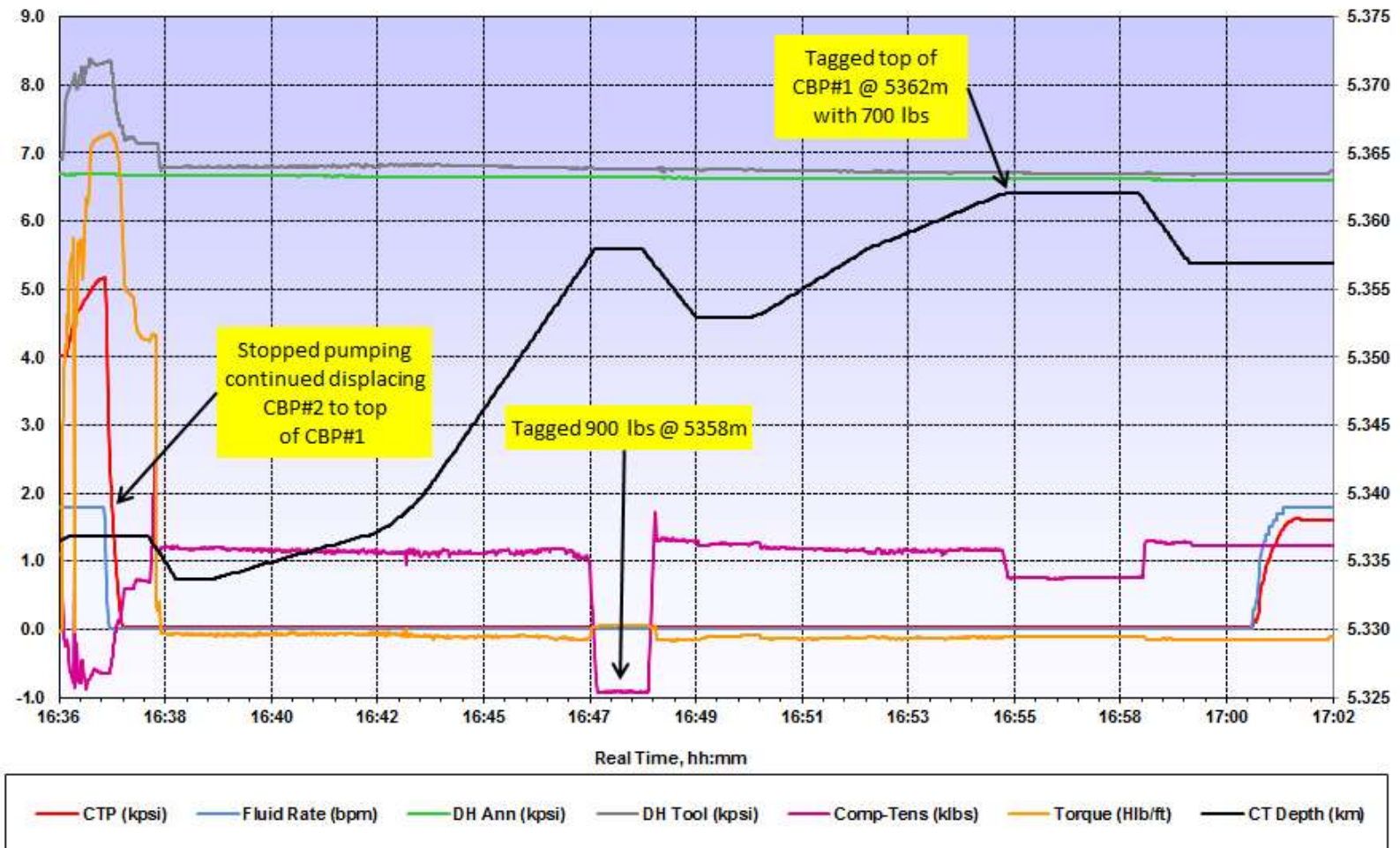
Case History 1 – From 13:40 to 16:59



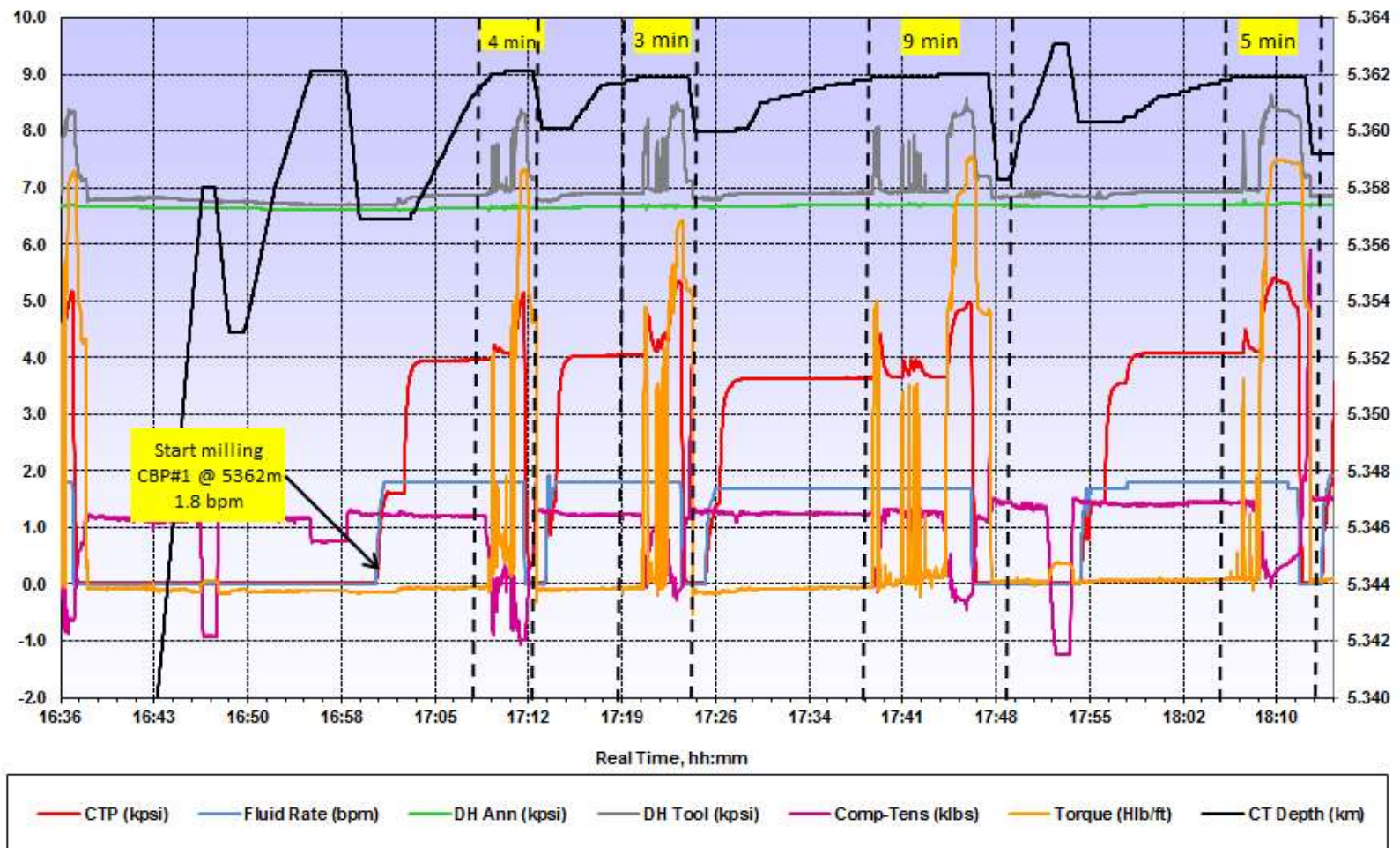
Case History 1 – From 15:54 to 16:37



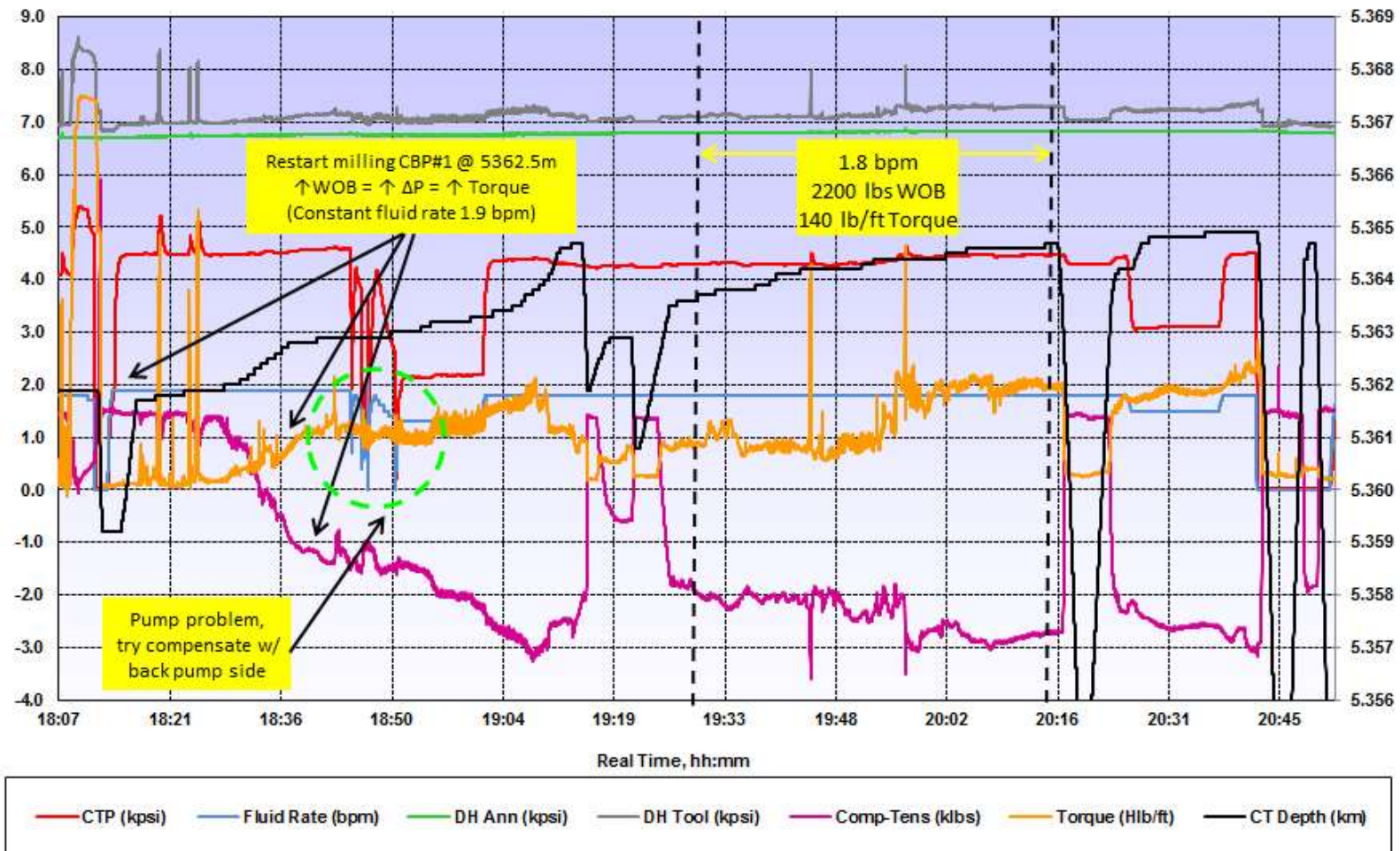
Case History 1 – From 16:36 to 17:02



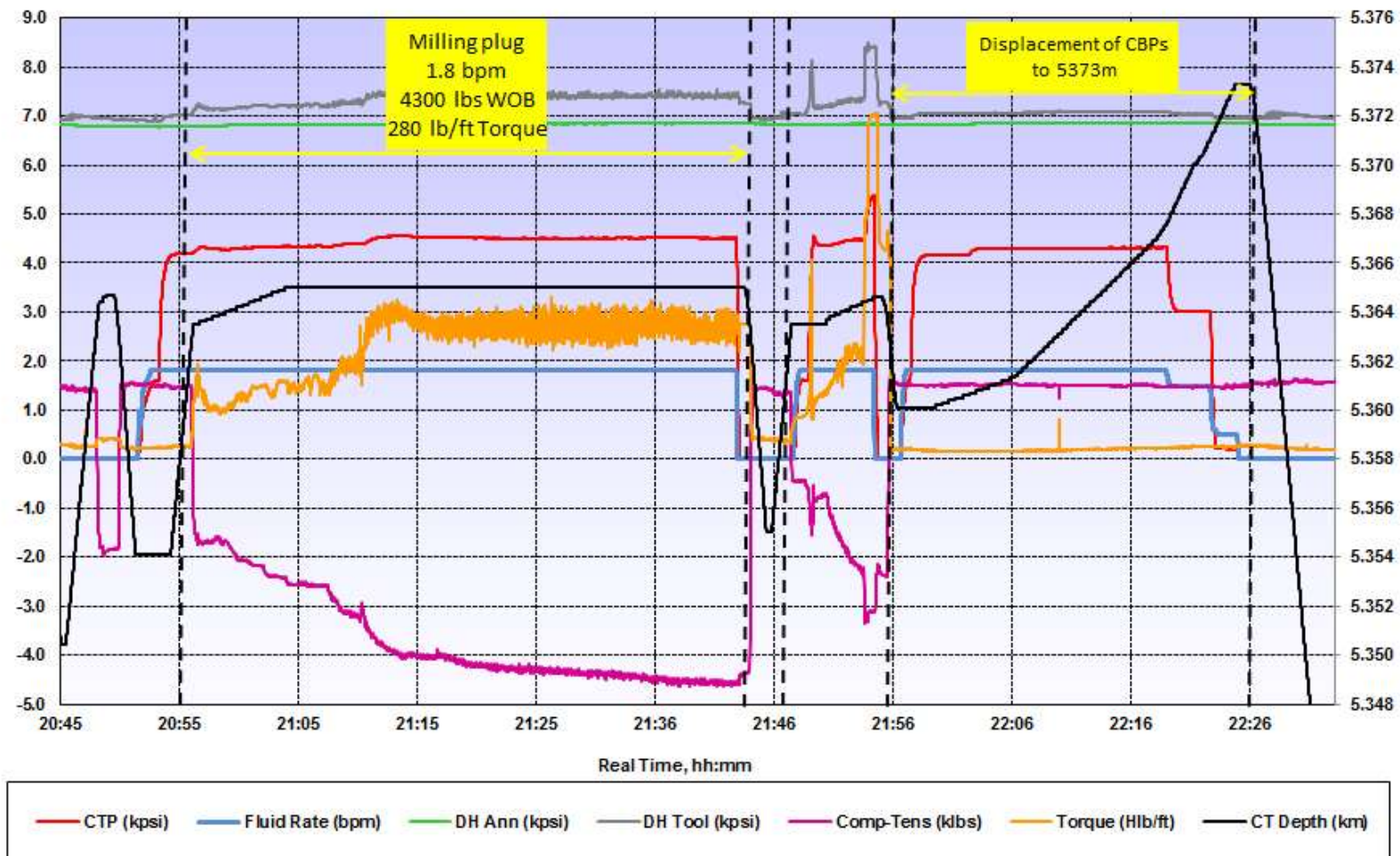
Case History 1 – From 16:36 to 18:10



Case History 1 – From 18:07 to 20:45



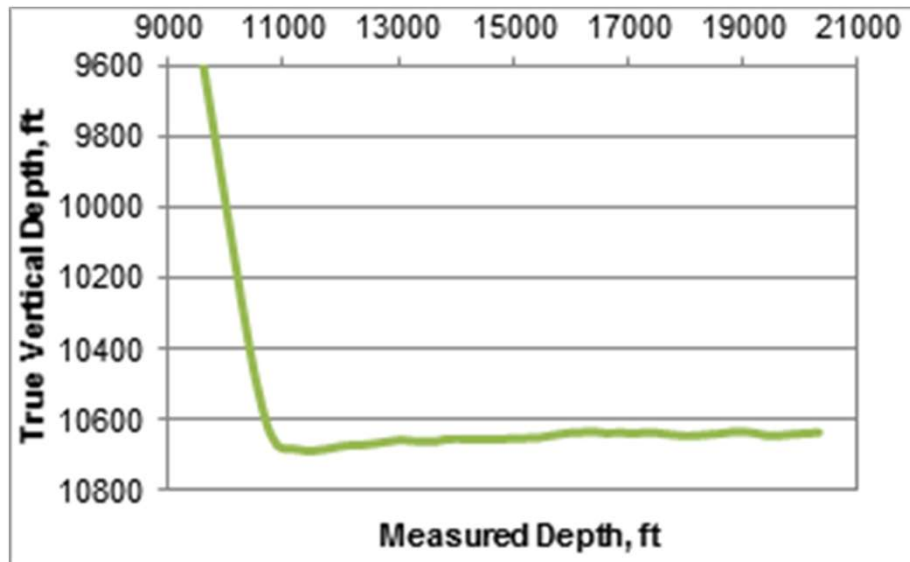
Case History 1 – From 20:45 to 22:26



Case History 1 – Lessons Learned

- More precise plug tagging when running TCT
 - Due to actual downhole slack off weight rather than surface slack off weight used with conventional CT
- Clear indication while milling at constant flow rate that the more WOB applied, the more torque response recorded
- Promptly detected motor stalls without applying WOB
 - Without TCT, decisions made based on CT pressure increments
 - Debris around mill preventing it from turning
- Milling time and confidence are critical under H₂S shut-in conditions

Case History 2 – Operation Overview (SPE-187374)

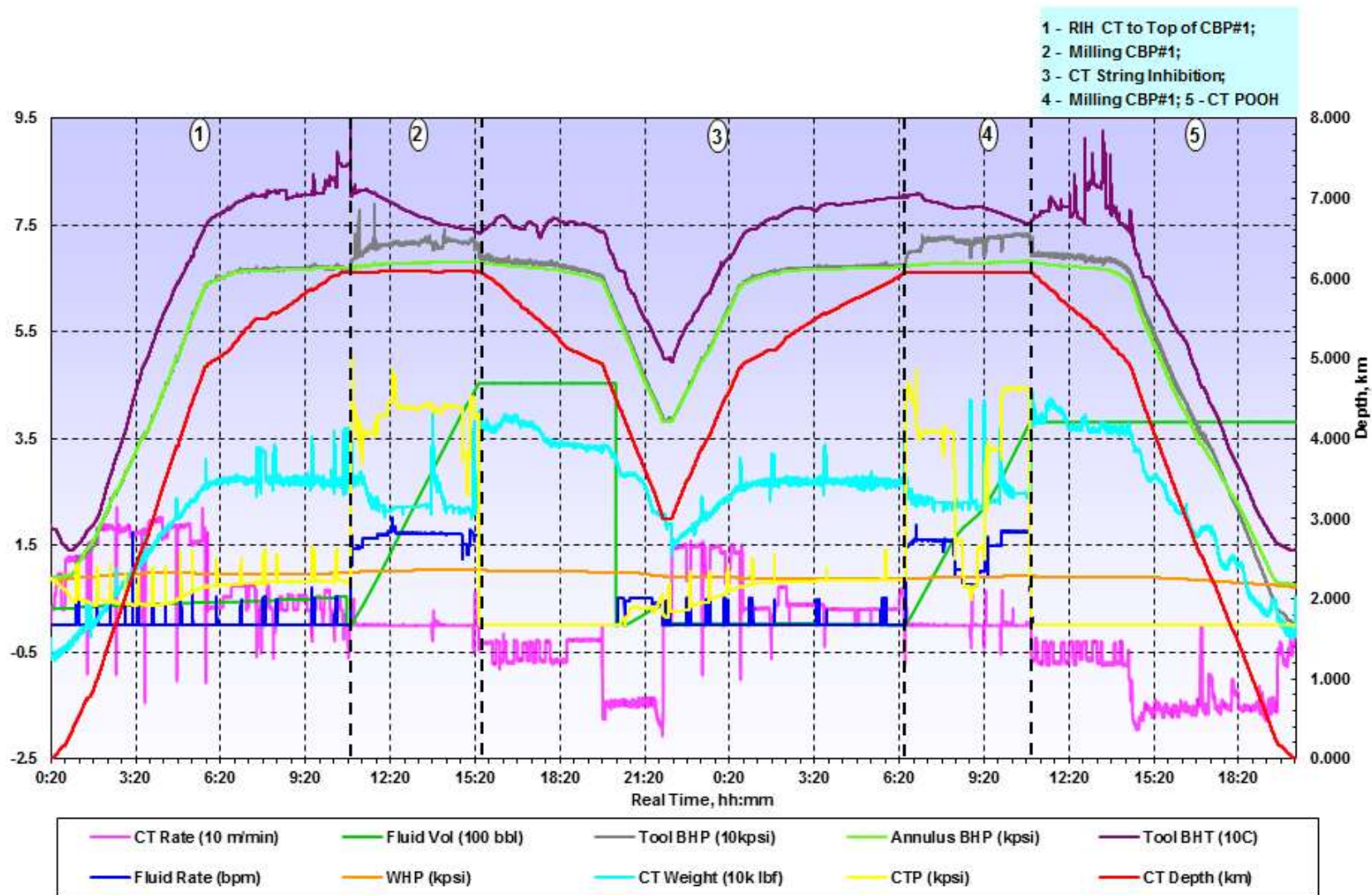


- Objective: mill three composite bridge plugs
- 20,500 ft long offshore well with 9,300 ft lateral (4 ½-in. tubing)
- Plugs located at 19,400; 19,600; and 19,950 ft
- Challenges: depth, low WOB and local restrictions for flaring and flowing back H₂S

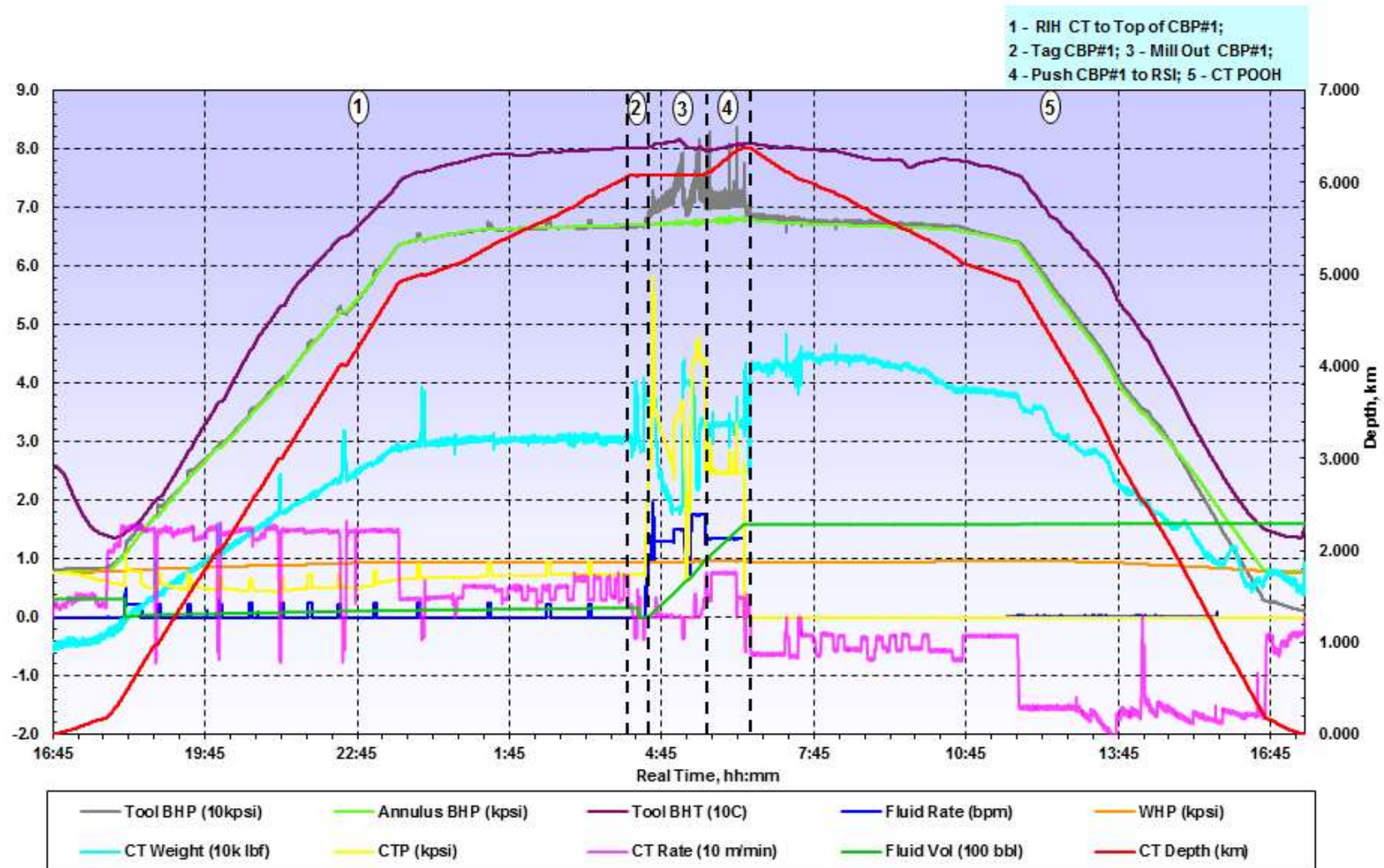
➤ Outcome:

- First two plugs milled with 2 ⅞-in. telemetry assembly on 1 ¾-in. CT
- Third plug milled with 2 ⅞-in. fluid hammer tool and 2 ⅞-in. telemetry assembly

Case History 2 – No Fluid Hammer Tool Run



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Case History 2 – Third Plug Milling Results

Description	Telemetry assembly and milling BHA	Telemetry assembly, fluid hammer tool and milling BHA
Total run time (RIH and POOH)	44 hours	25 hours
Volume of brine used	872 bbl	236 bbl
Volume of H ₂ S inhibitor used	370 gal	185 gal
Additional run needed	Yes	No (milled out)
Total milling time	8 hours	34 minutes

Conclusions

- Modular telemetry assembly
 - Easily installed and uninstalled assembly
 - Temperature and pressure compensation for TCT from extensive laboratory testing
- Real-time TCT data used to increase milling efficiency and reduce time
 - 25% milling time reduction compared to similar operations without TCT
 - Less fluid volume pumped into the formation
 - More precise plug tagging and prompt detection of motor stalls
- Real-time depth, pressure and temperature data and a fluid hammer tool increased WOB, reduced milling time, and decreased fluid volume

Acknowledgements

- CTRE staff
- BHGE field engineers

