When is the need for lubricants truly necessary?

Prepared by:

Roberto Cruz-Nemer

Senior Drilling Engineer

K&M Technology Group

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This presentation will emphasize the utilization of rigorous, baseline T&D modeling during planning to evaluate whether lubricants are genuinely required or if high friction factors are operationally acceptable, ensuring cost-effective well execution without compromising integrity

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Water-based muds (WBM) offer environmental and formation-damage benefits over oil-based muds, but present a higher friction environment in complex, high-angle wells

Table 2

Lubricity coefficient of typical drilling fluids

Lab prepared muds	Coefficient
Water	0.36
Low-solids mud	0.42
Low-solids mud treated with special lubricant	0.06
Low-solids polymer mud	0.42
Low-solids asbestos mud	0.47
Unweighted organic thinned mud	0.24
Unweighted organic thinned mud treated with special lubricant	0.16
Medium density organic thinned mud, 13 lb/gal	0.24
High-density organic thinned mud, 18 lb/gal	0.22
Seawater mud unweighted	0.20
Sat. salt-water mud unweighted	0.24
Oil mud, unweighted	0.09
Oil mud, 18 lb/gal	0.08
Field muds	
Organic thinned mud, 14.5 lb/gal	0.28
Organic thinned mud, 12.6 lb/gal	0.23
Organic thinned mud, 12.0 lb/gal	0.26
Organic thinned mud, 9.8 lb/gal	0.31
Organic thinned mud, 10.1 lb/gal	0.25
Brackish-water mud, 16.3 lb/gal	0.25
Brackish-water mud, 18.0 lb/gal	0.24
Seawater mud 12.0 lb/gal	0.23
Oil-mud, 18.5 lb/gal	0.13
Brackish-water mud, 10.8 lb/gal	0.38
Brackish-water mud, 10.8 lb/gal treated with special lubricant	0.17
Sat. salt-water mud	0.27
Sat. salt-water mud with special lubricant	0.18

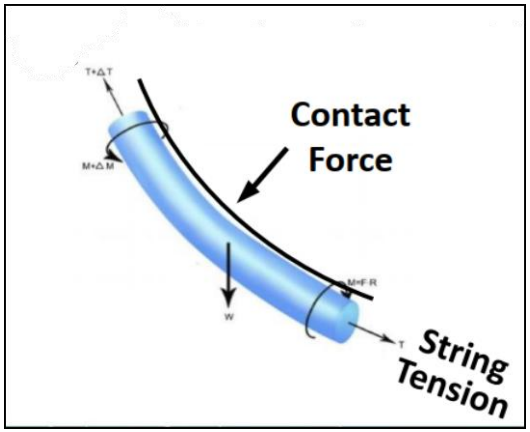
Reference: T.C. Mondshine. Guide to reduce torque and drag. Proceeding 1971, Volume 22 #1.

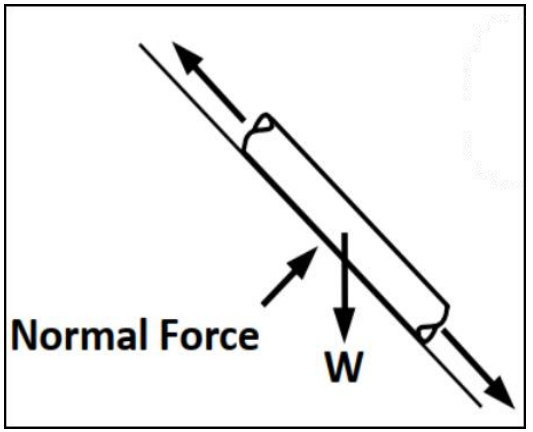
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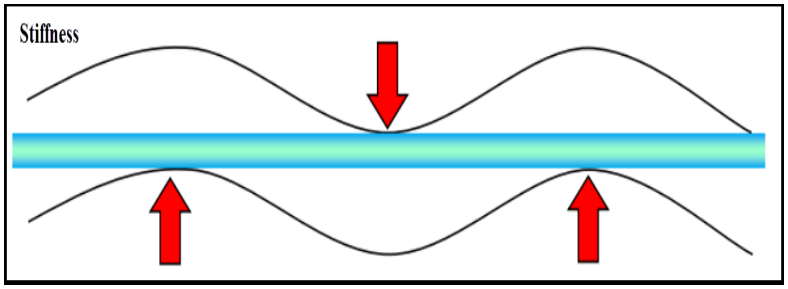
Coefficient of Friction (μ) ≠ Friction Factor (FF)

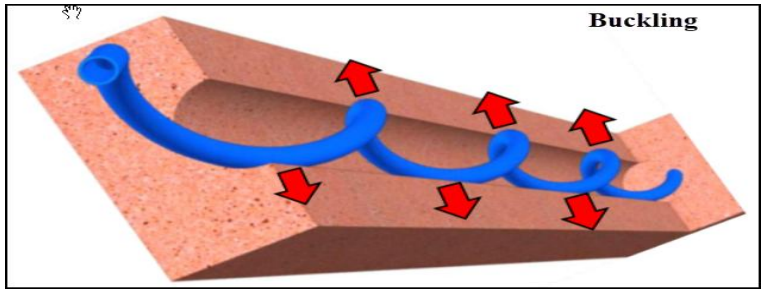
- Lubricants are frequently used to mitigate T&D, yet advertised reductions in coefficient of friction rarely translate directly to downhole friction factor reductions

- Factors such string buckling, stiffness, well trajectory & tortuosity can quickly override benefits of a lubricant that offers a low μ









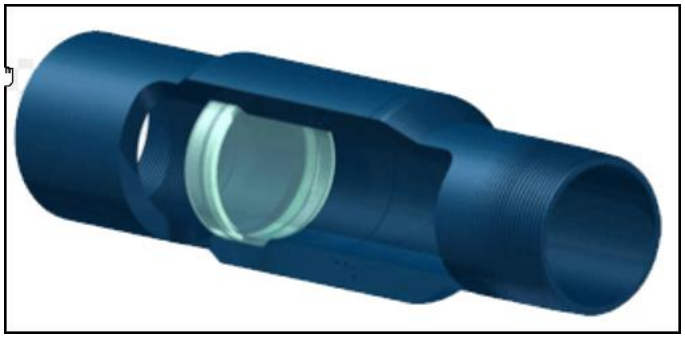
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Extended Reach Drilling (ERD)

- ERD wells can rarely be completed using “off the shelf” Equipment & Solutions
- Modern high-torque surface equipment, optimized drill string designs & drag reduction methods such NRDPPs & casing floatation can make lubricant additions redundant
- But often the use of lubricant it is necessary depending on specific cases:
  - Inability to ream strings to bottom (screens or low torque connection capacity)
  - Ability to circulate preferred (well control), floatation not an option



NRDPP (Non-Rotating Drill Pipe Protectors)



Casing Selective Floatation Collar

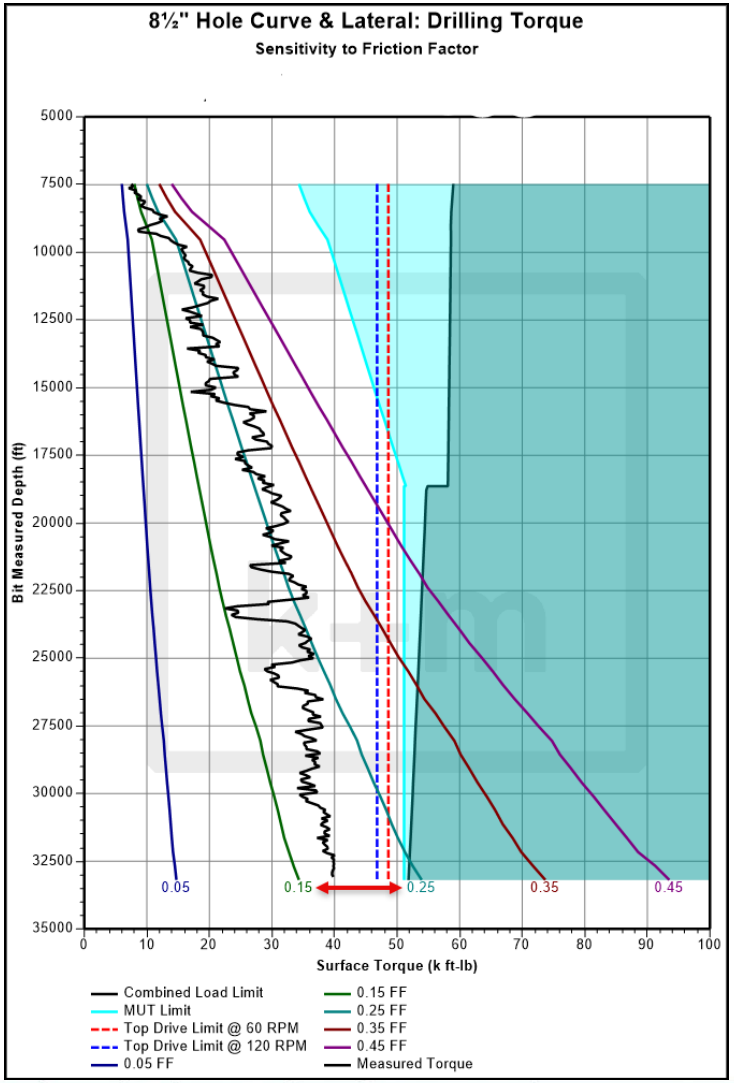


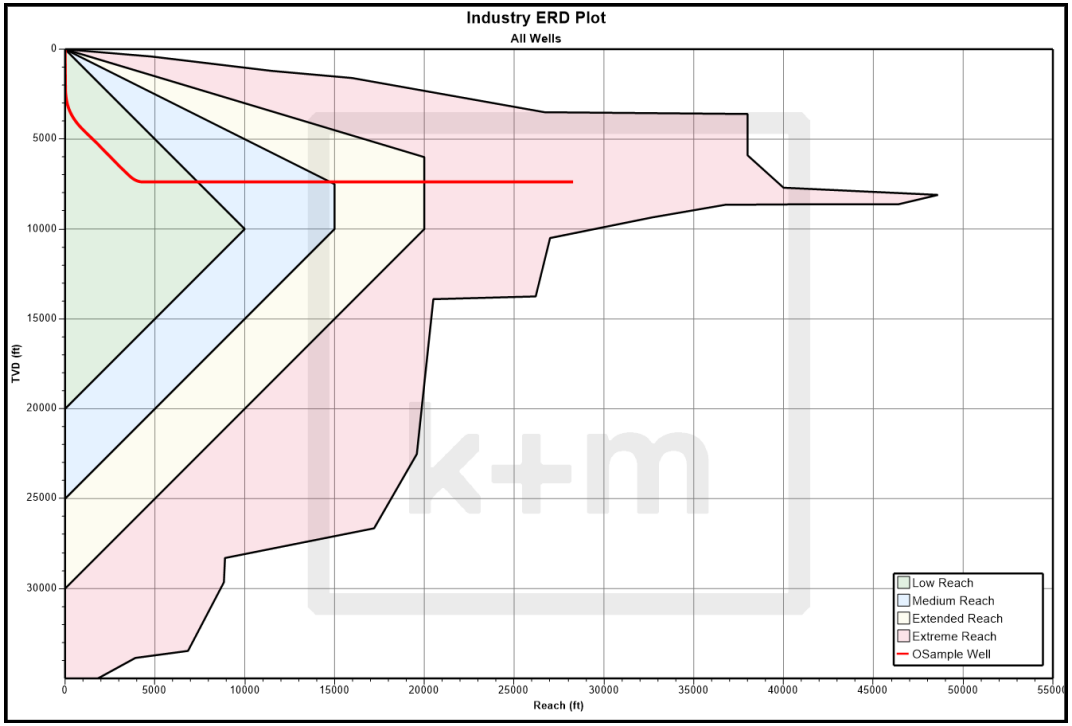
Fixed to Pipe Casing Centralizers

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Quick Glance - T&D ERD Step Ups

No Room to Guess Friction Factors





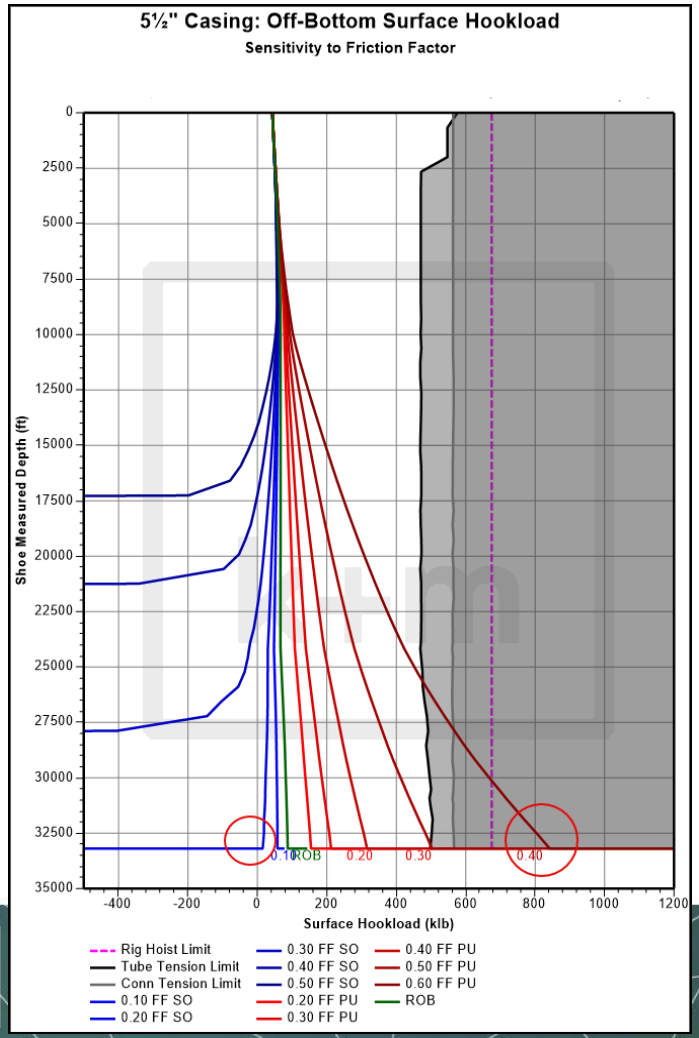
- ERD wells usually come with extreme FFs step ups
- This example, 0.10 TQFF increase it is equivalent to more than 20 k ft-lb of surface torque load increase

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Quick Glance - T&D ERD Step Ups

No Room to Guess Friction Factors

Aside from Torque FF, drag FF are equally important. Getting casing/liners to bottom & having the ability to pull them out of the hole if needed

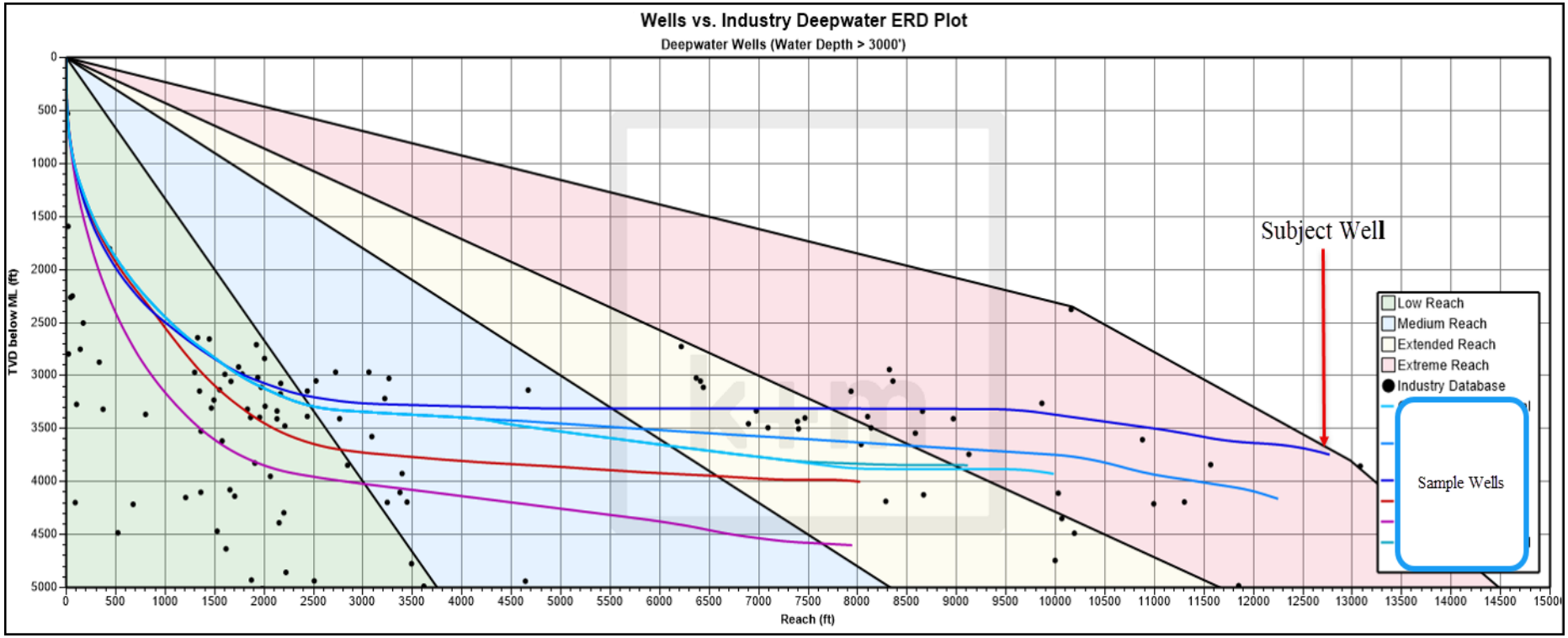


- A 0.10 PUFF (red curve) increase it is equivalent to more than 300 klb of surface hookload
- A SOFF >0.10 (blue curve) will induce string buckling, not allowing to slide to bottom

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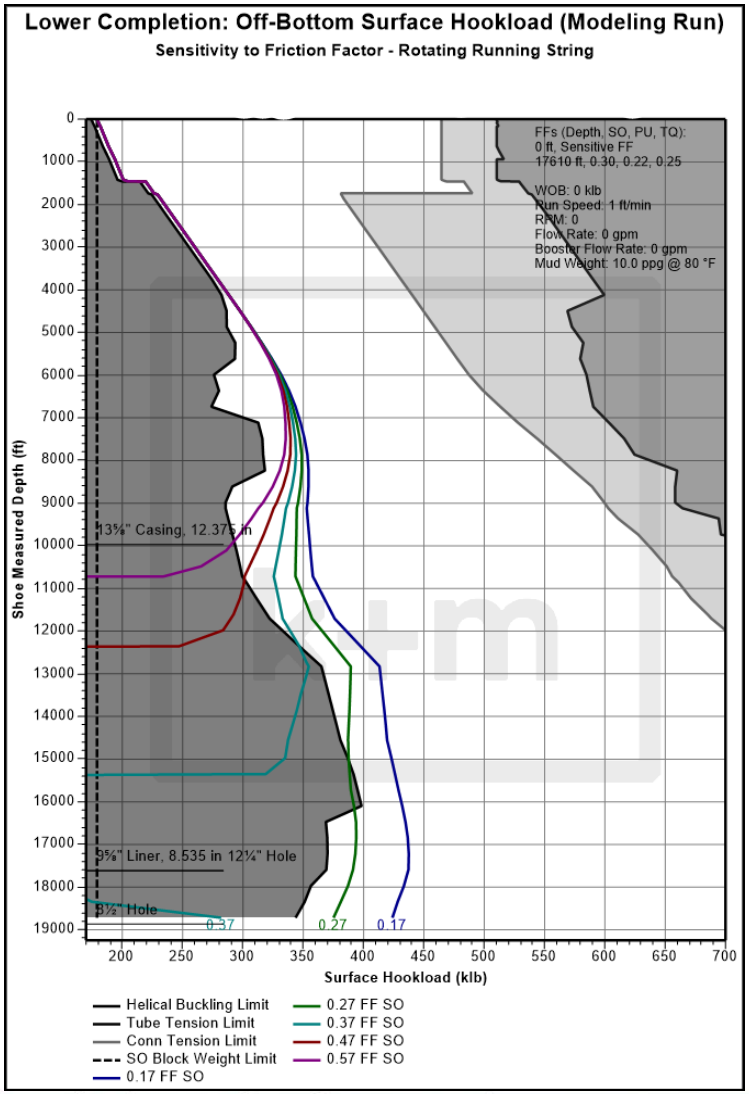
Case Study - Running Lower Completions

- *Subject case study well falls within the extreme reach category as per K&M*



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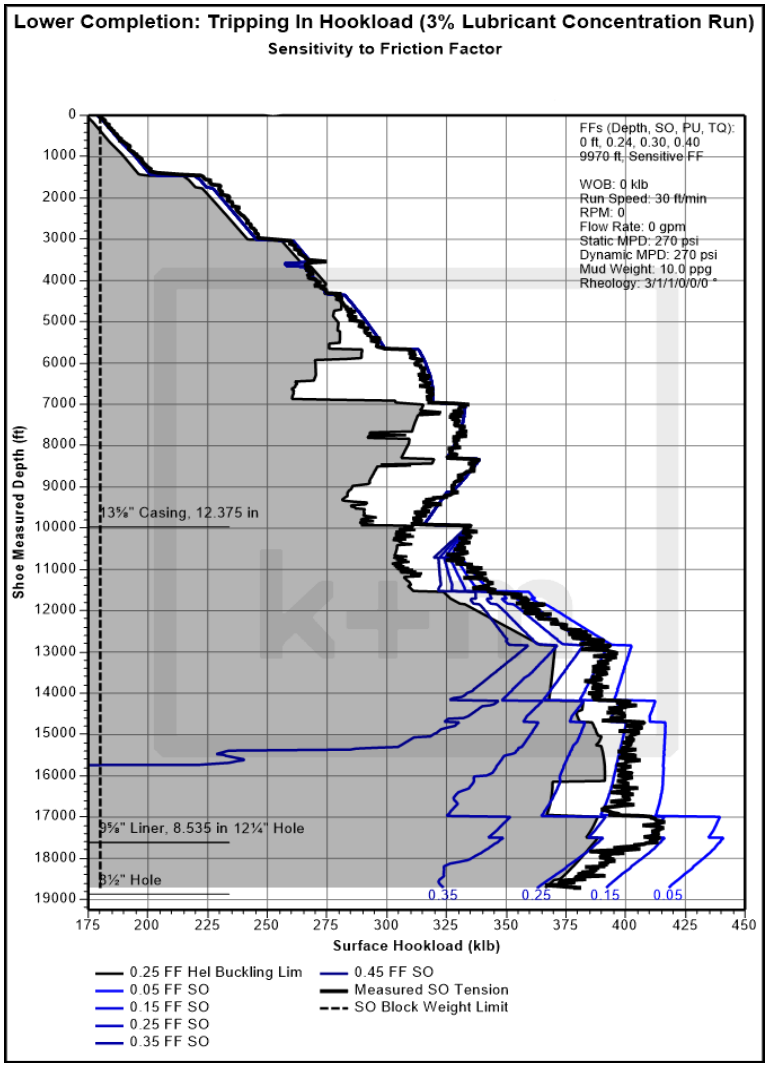
Case Study-Running Lower Completions



- Field hindcasted offset wells SOFF (without Lubricant) ranged at <u>0.35-0.37</u>
- With the given SOFF, Modeling initially suggested that string lockup was highly likely ~15,000'
- Given the low torque capacity of the liner hanger & string connections, rotation was not a possibility
- Use of a string swivel could have been a possibility. But equipment was not available in the county

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Case Study -Running Lower Completions



Modeling:

- Offset wells showed that mud systems with 3% lubricant concentration had provided a ~0.10 SOFF reduction during tripping in operations
- Assuming use of Lubricant an estimated 0.25-0.27 SOFF was more than sufficient to slide the lower completions string to bottom

Results:

- Using 3% Lubricant concentration, the string followed a ~0.25 SOFF, successfully allowing to run lower completions to bottom

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Case Study –Additional Information:

- Lubricant composition was split for fluid/lubricant compatibility:
  - 10.0 ppg Brine + 3% of brine soluble lubricant in Casing
  - 10.0 ppg SFDIF + 3% Polymerized Fatty Amides & Fatty Esters across Open Hole
- Lubricant across open hole was spotted just before pulling out with drilling BHA to reduce exposure time to static temperatures & reduce risk of lubricant degradation
- Observed SOFF reduction opens possibility to run completions deeper if required
- The benefit that the lubricant offered, allowed to save time and money
  - Not having to wait on a swivel assembly
  - Potentially having to redesign & purchase a new liner string that allowed for rotation
  - Eliminate risks associated with string rotation (connection failure, twist off, etc…)

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