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Live Webinar

Extended Reach Drilling:

- OCTG Torque vs Tension: A Growing Concern for Well Integrity
- From Design to Execution: Advancing ERD with Real-Time Intelligence and Automation

Interstate Oil & Gas Compact Commission

Environmental Defense Fund

WEDNESDAY, 18 MARCH
1100 CDT (UTC-5)

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Advancing Extended Reach Drilling

From Design to Execution with Real-Time Intelligence and Automation

Shashi Talya

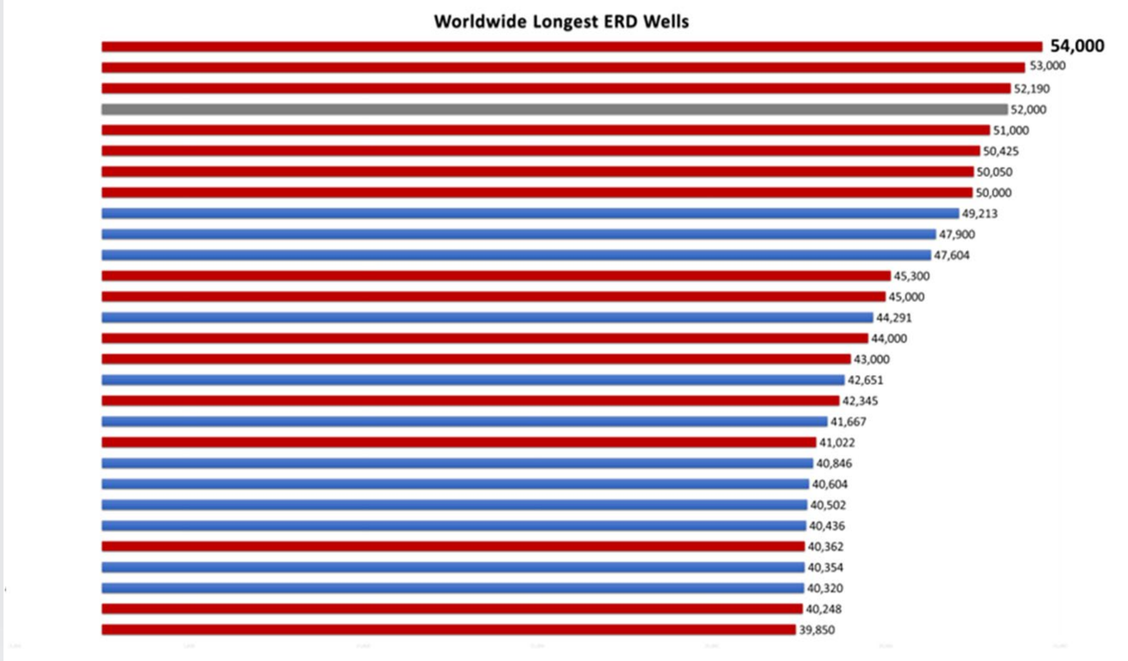
March 18, 2026

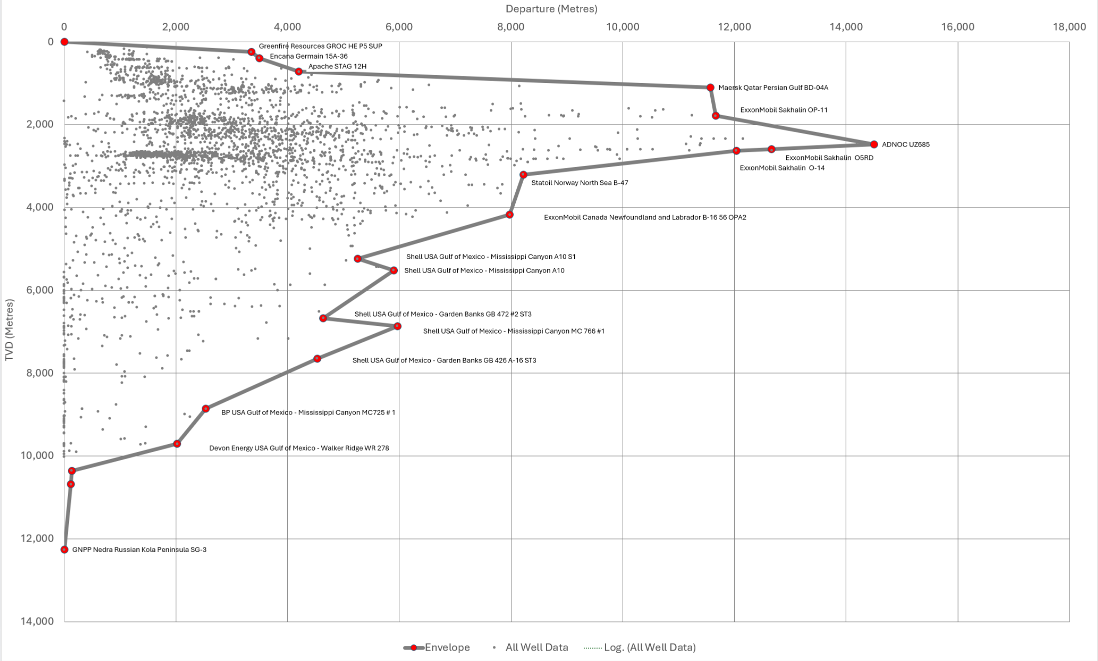
HALLIBURTON

Outline

- Evolution of Extended Reach Drilling
- Key Challenges in ERD Execution
- Integrated Digital and Automation Solutions
- What’s Next: Scaling Intelligence

ERD History: 2019 – 2025

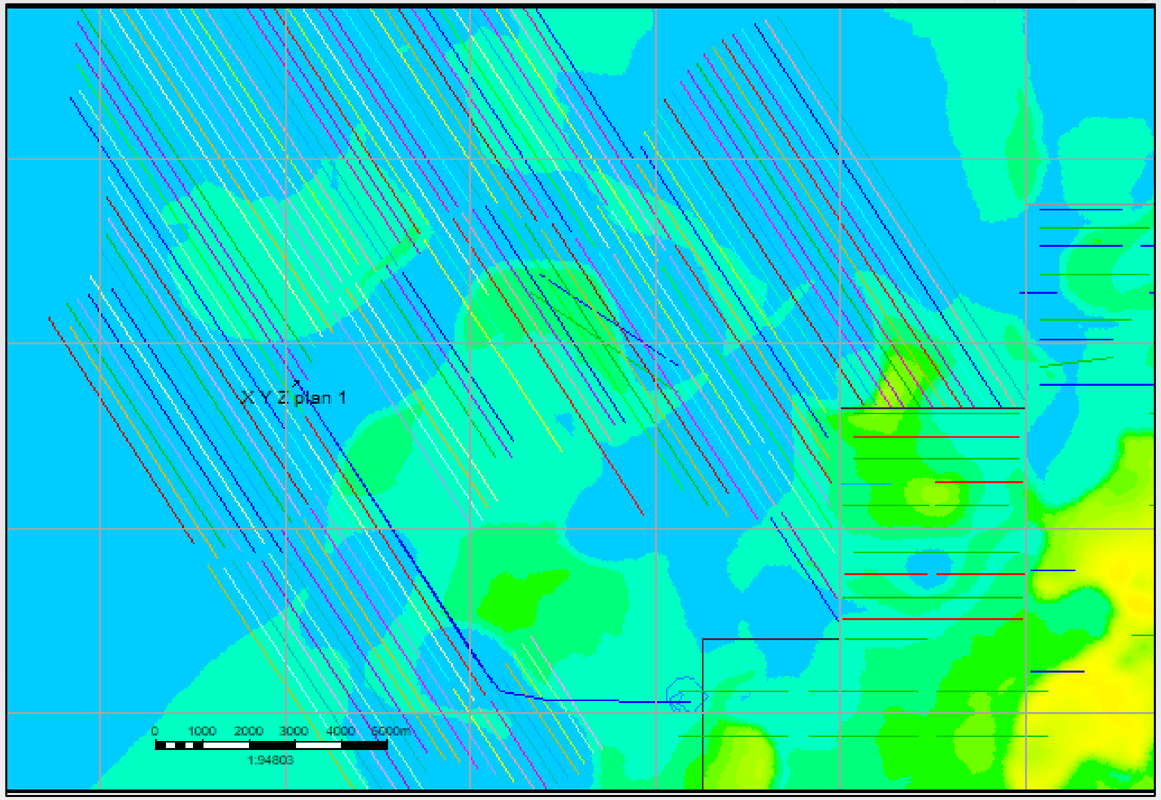




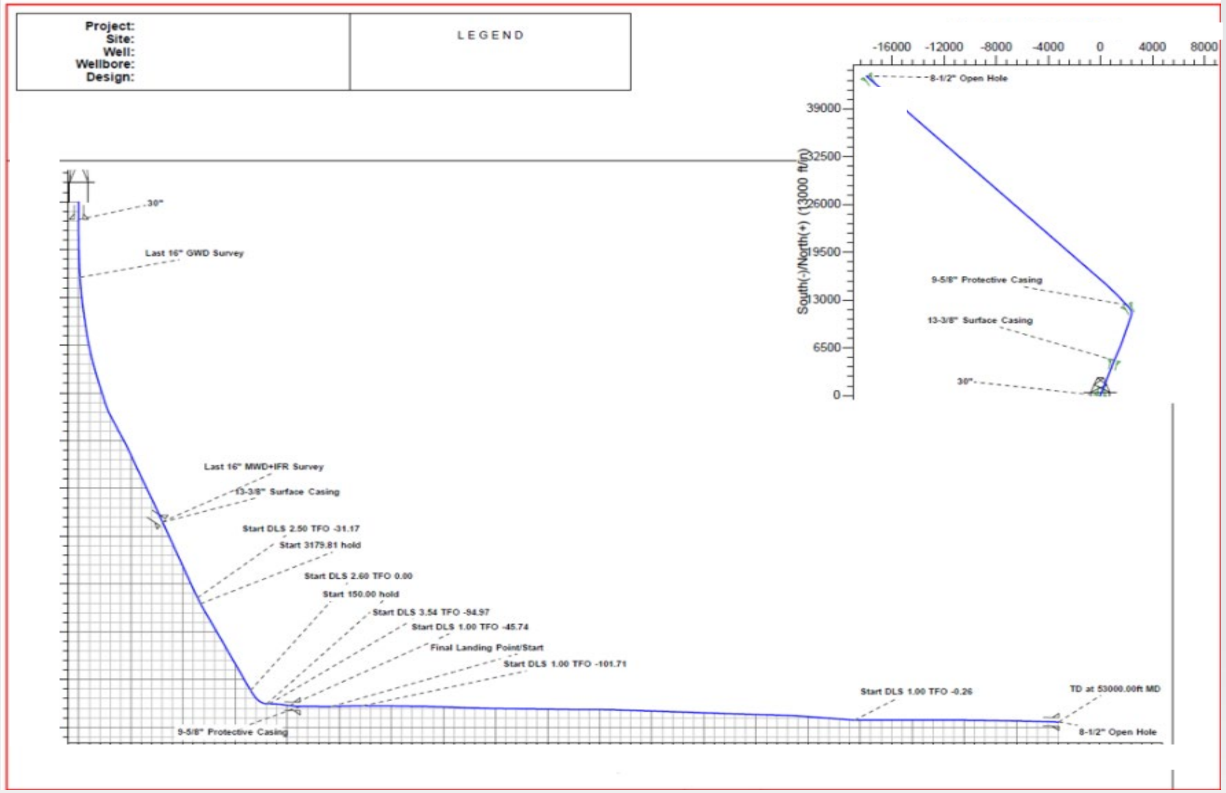
Source: MerlinERD

Key Challenges in ERD Execution

Planned well spacing: 250 m



53,000 ft MD; Target reservoir: 6-10 ft thickness



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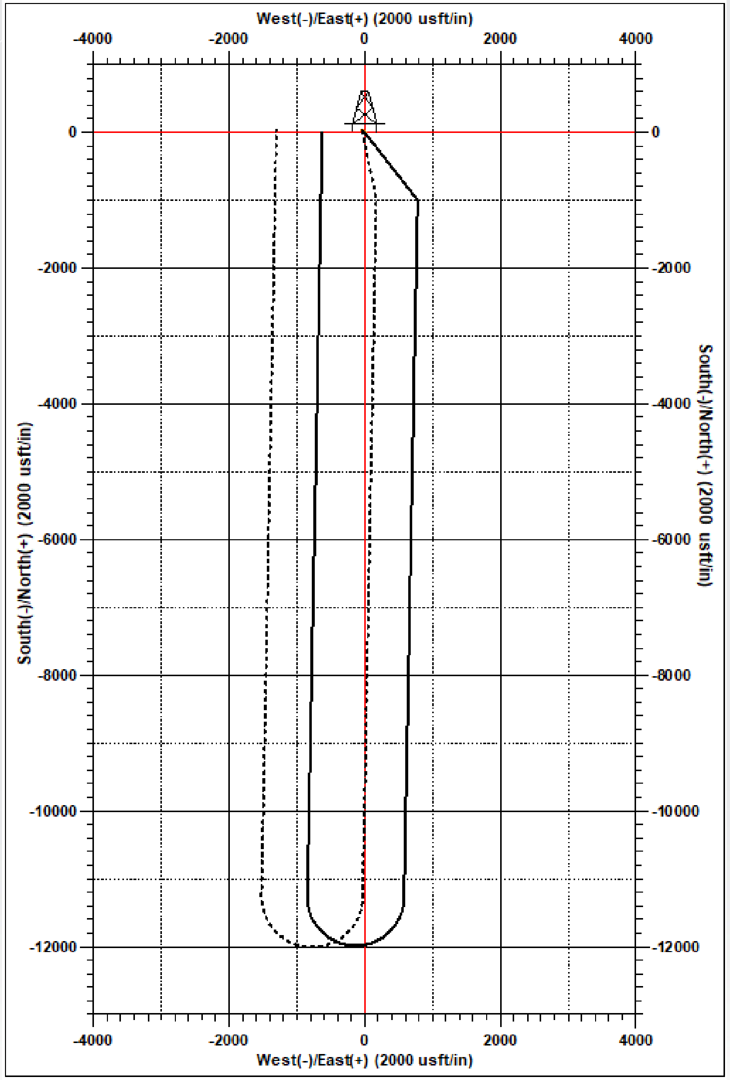
SPE-227830-MS

North America ERD: Regulatory & Operational Constraints

- Tight lease space
- Manage distance to lease lines, while maximizing lateral length
- Pad drilling density constraints
- Well spacing: 150-330 ft
- Directional control in the “U” section



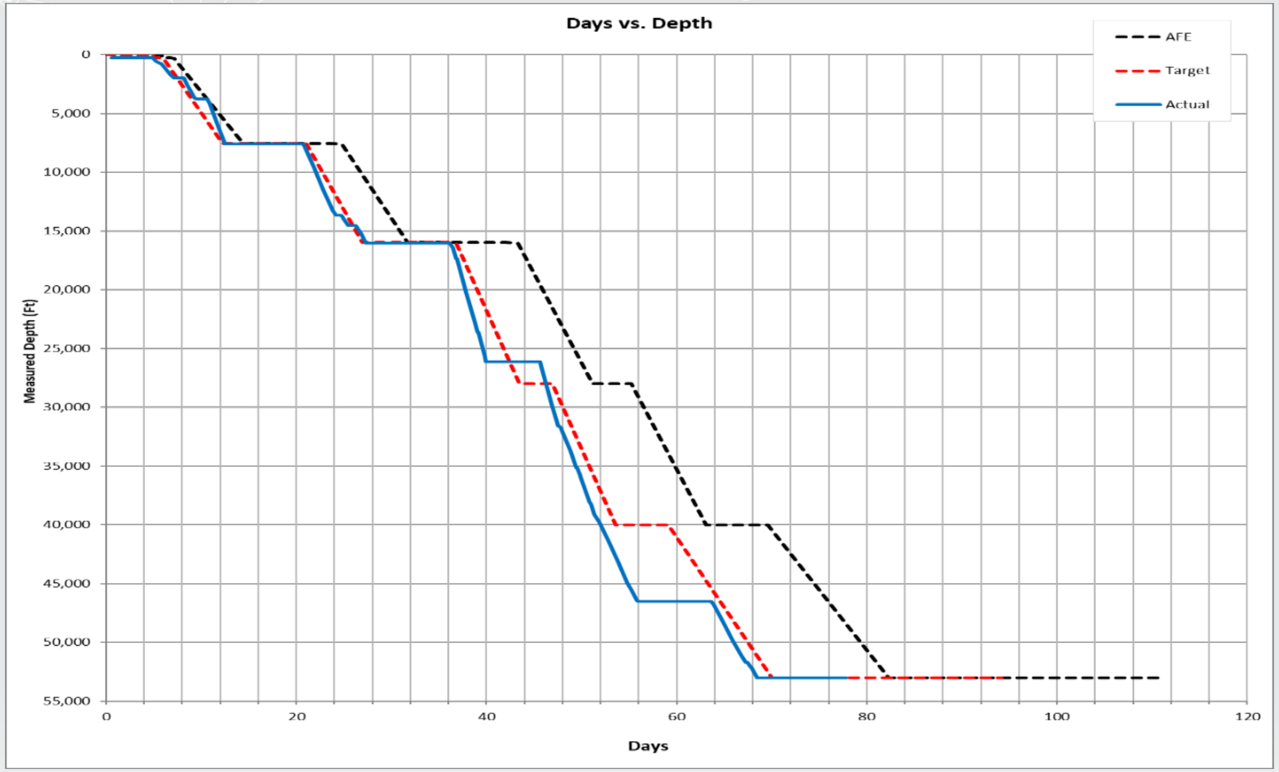
Challenges and Engineering Tradeoffs

- Subsurface uncertainty
- Survey uncertainty
- Torque and drag management
- Wellbore integrity
- Tool reliability and durability

- LWD sensors: Higher DOI (deep azimuthal resistivity) and near bit sensors
- Downhole weight and torque optimization
- Drive system: motor-assisted RSS or standalone RSS selection
- Optimized BHA stabilization
- Compact BHA design (fewer connections, fewer internal components)
- Mud system optimization, friction reduction, and hole cleaning

Drilling and Completing 53,000 ft Ultra-ERD Well

- Push-the-bit RSS with matched drill bit
- Advanced LWD and DAR tools, real-time formation evaluation and geosteering
- 100% reservoir contact achieved
- Delivered well 14 days ahead of schedule



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Real-Time Execution: Integrated Control

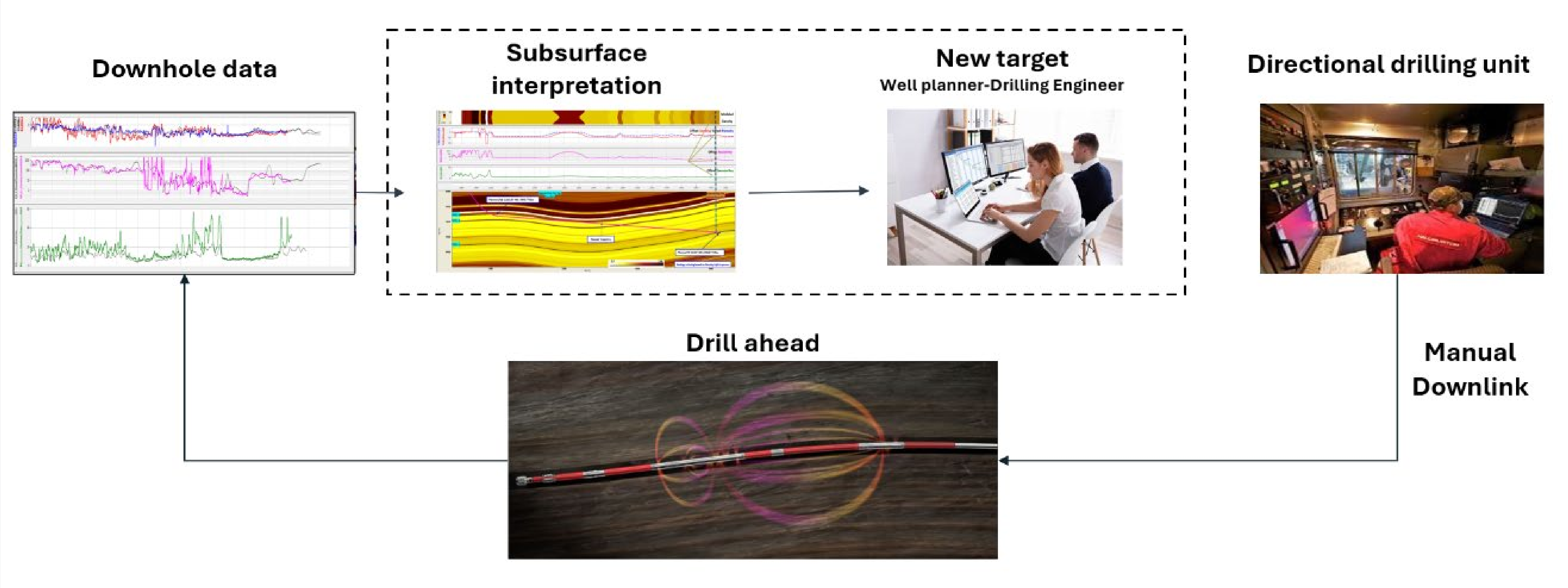
Drilling Rig Processes
Drilling activity & Safeguards

Wellbore Integrity
Rheology, Hydraulics and Optimization

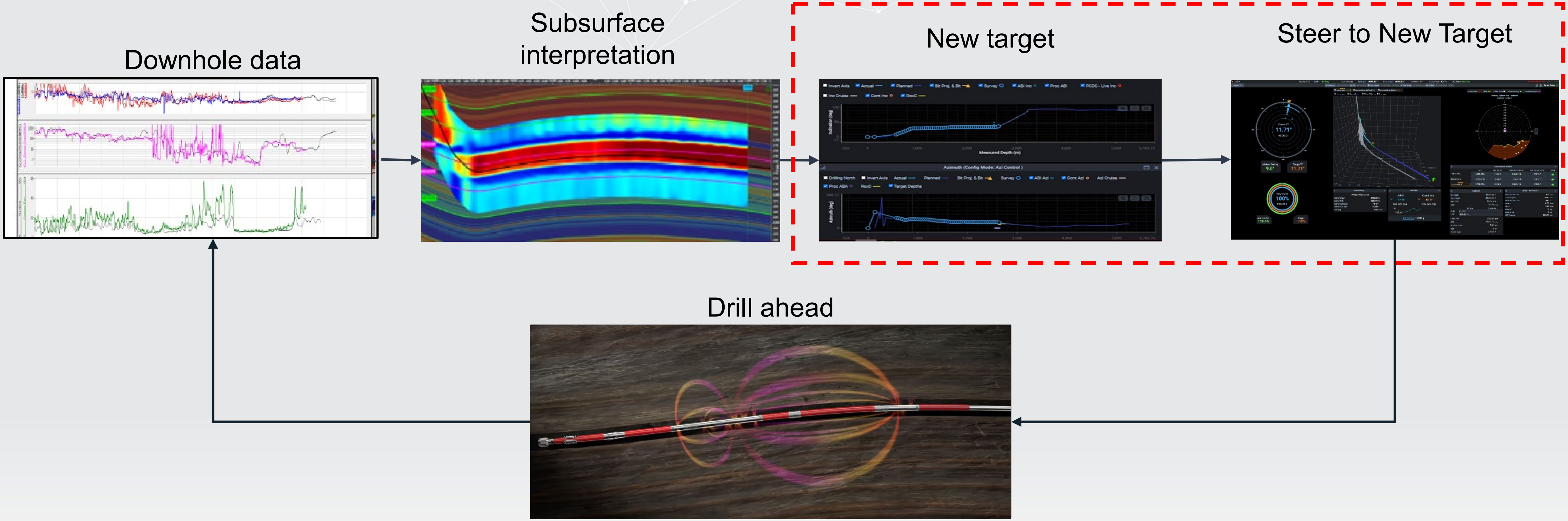
Well Placement
Trajectory and Sensing

Integration of these 3 core components drives the degree of Automation

Conventional Well Placement Workflow

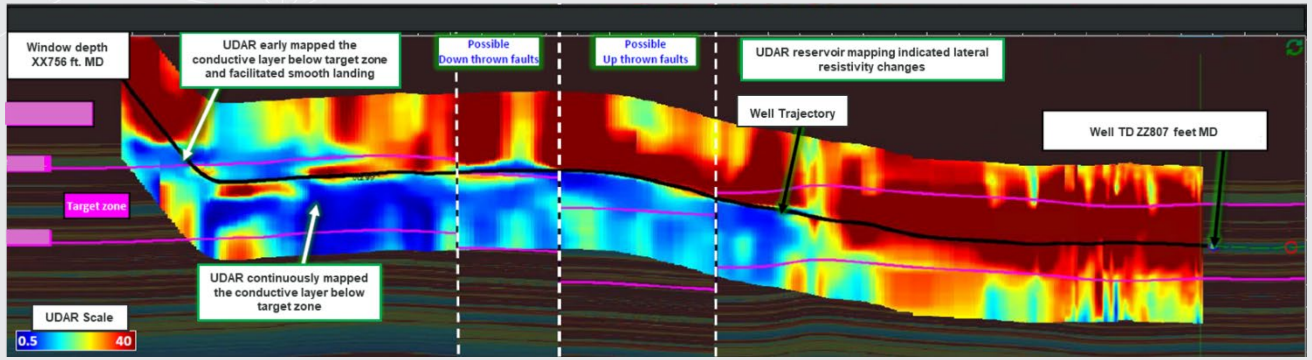


Automated Target Placement



Results

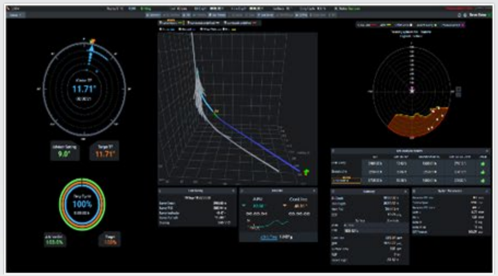
- 100% reservoir placement
- 19% ROP improvement
- >60% reduction in downlinks



3D Geosteering

New targets and well path projection

Automated Well Placement



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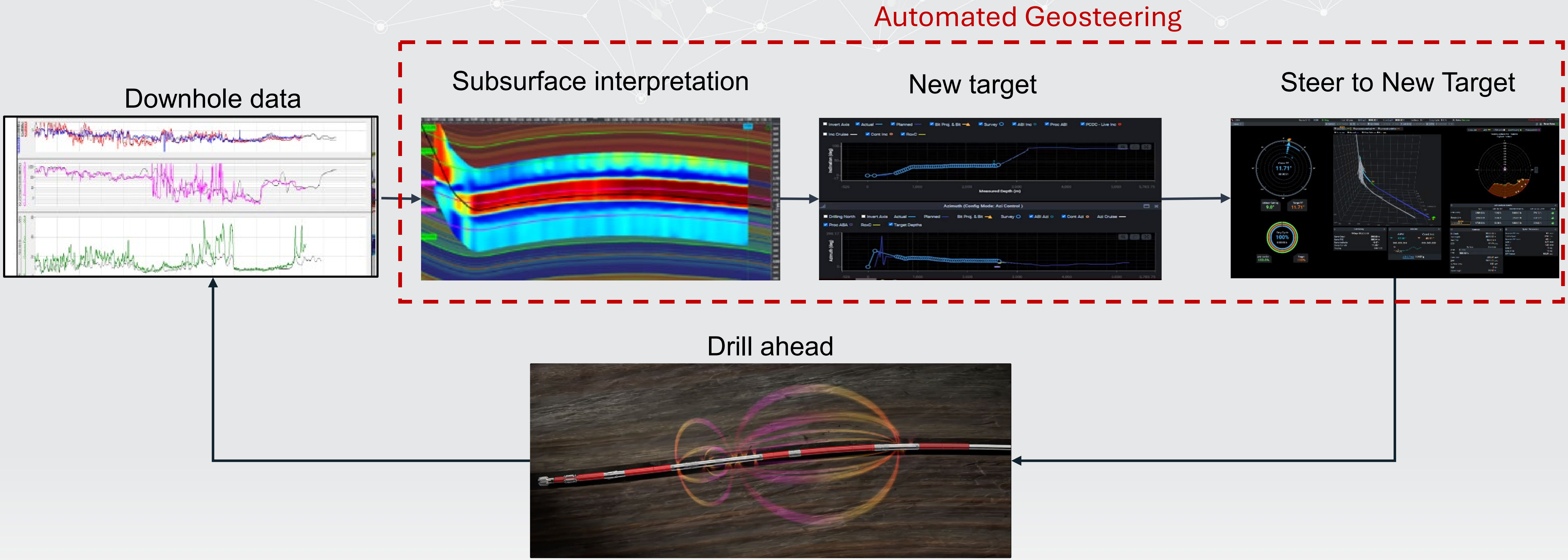
Geological Well Placement



Key Takeaways and What's Next

- Digital and automation are powering the next step change in ERD performance and consistency
- Stronger subsurface–drilling integration is key to maximizing reservoir exposure
- Managing torque and mechanical complexity becomes critical as ERD wells extend further
- Higher confidence in well positioning will come from improved surveying and modeling

THANK YOU

Extended Reach Drilling

OCTG Torque vs Tension A Growing Concern for Well Integrity

SPE-232499-MS

Wesley L. Ott

March 18, 2026

Extended Reach Drilling (ERD) / U-turn Laterals

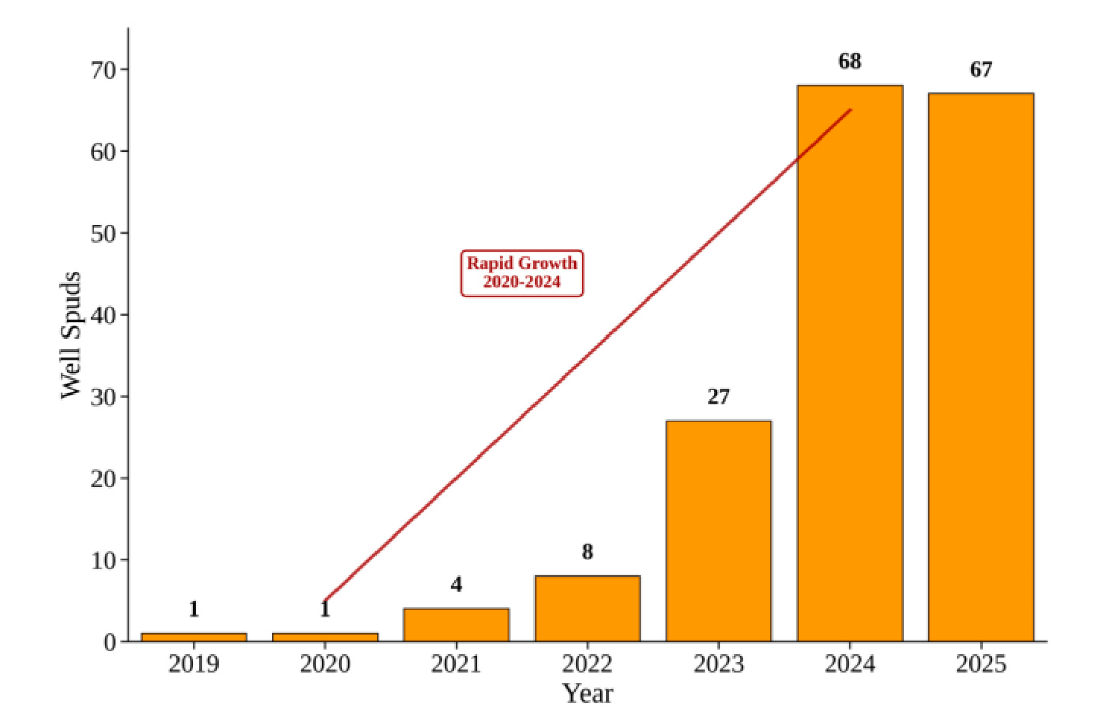
ERD is when HD > 2 x TVD [1]

U-turn / horseshoe / hairpin / alternate shape / J-hook / Paperclip / Staple

Technology Adoption Curve

- Feasibility
  - Shell / Delaware and Chesapeake / Eagleford
- Confidence inflection
- Scaled up adoption

Annual U-lateral well spuds in the United States



[2]

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[1] Economides, 1998, Petroleum well construction.
[2] Ouadi, 2024. doi: https://doi.org/10.3390/fuels6040084

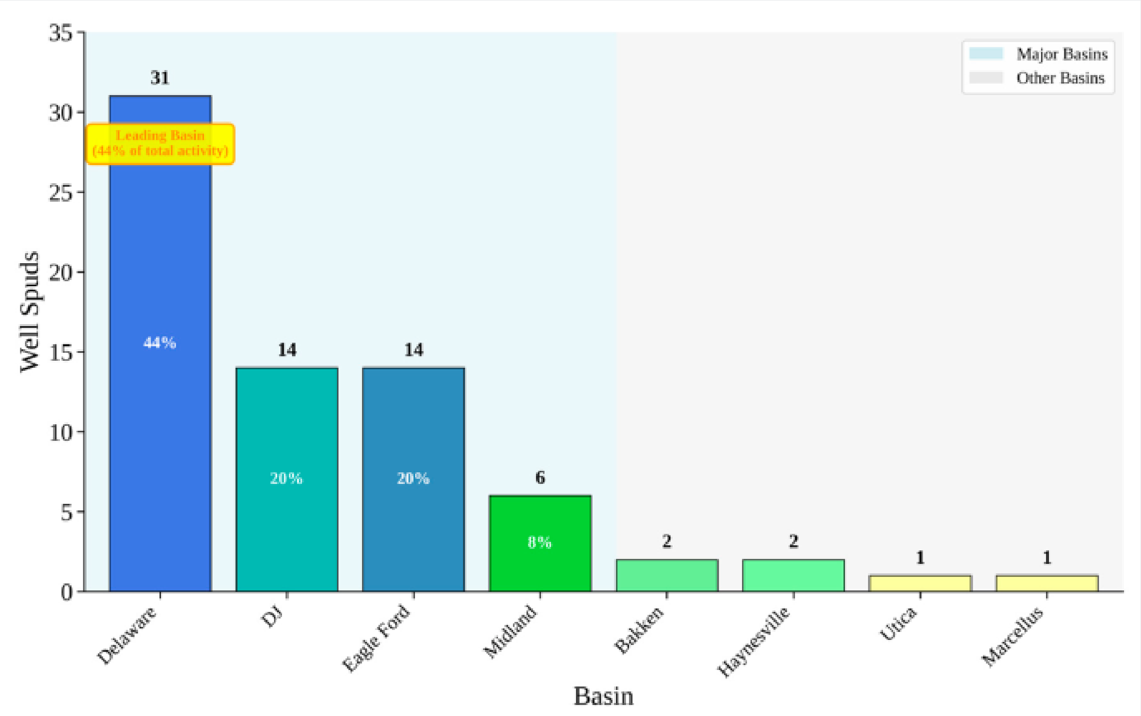
ERW U-turn Laterals

Primary Divers

1. Surface Lease Geometry / Stranded Acreage
2. Capital efficiency vs separate wells
   - 25% cost savings cradle to grave. [1,2]
3. Reduced surface footprint (regulatory)
   - 29.3% GHG reduction, 15.8% water reduction, 50% land disturbance reduction. [1,2]

U-lateral wells distribution by basin

[1]



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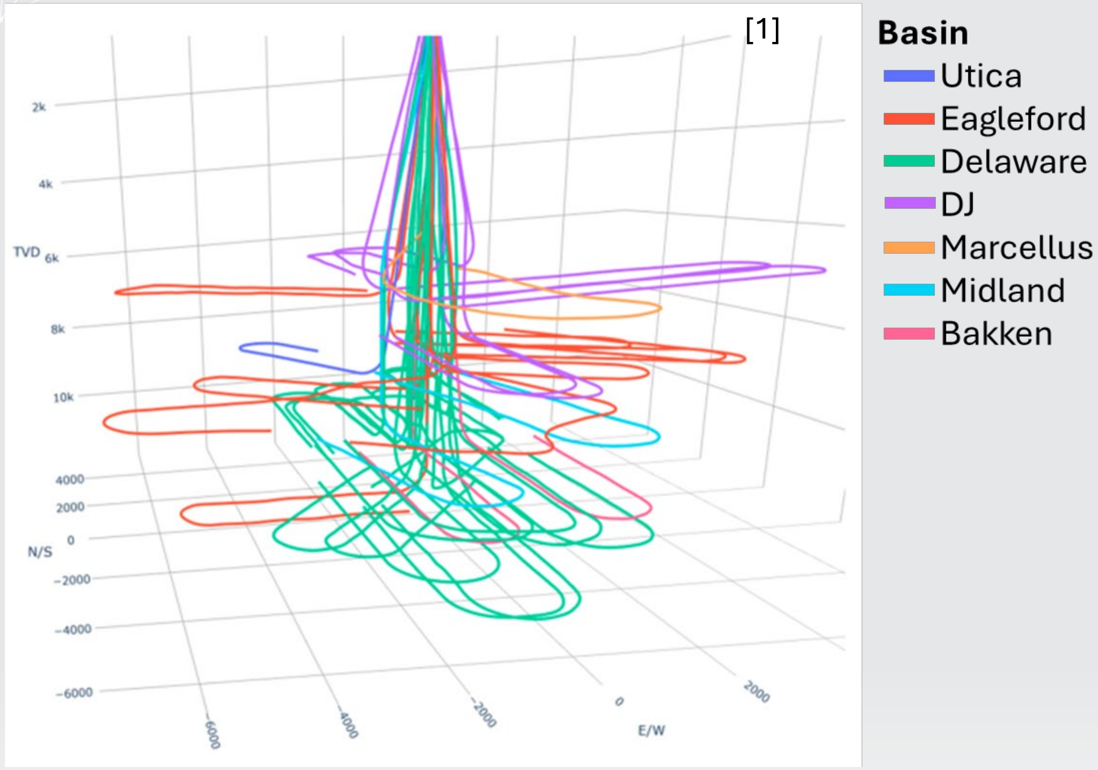
[1] Ouadi, 2024. doi: https://doi.org/10.3390/fuels6040084
[2] EPA. 2023. *Life Cycle Assessment Guidelines for Oil and Gas Operations*

Technical Challenges – Casing Lens

- High-curvature turn T&D + buckling sensitivity
  - Primary design constraint [2]
- Wellbore quality/tortuosity
  - Drives casing-running margins[3]

Mitigation methods

1. Mud conditioning
2. Flotation
3. Rotation
4. Axial vibration
5. Swivels



[1] Ouadi, 2024. doi: https://doi.org/10.3390/fuels6040084
[2] AADE-25-NTCE-050
[3] AADE-19-NTCE-077

Casing Considerations

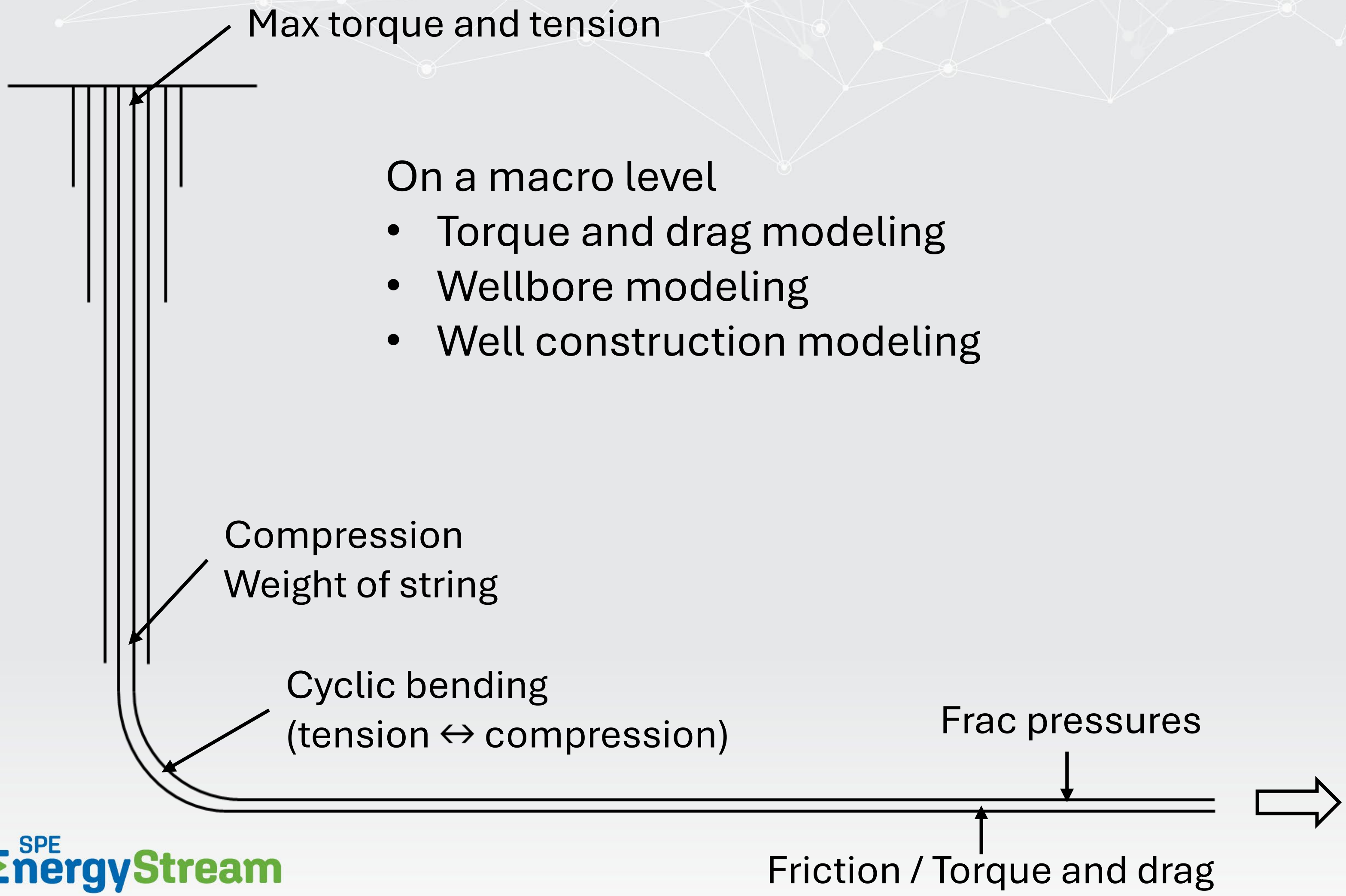
- Increased lateral lengths – increased T&D
  - Rotation mitigation
- Top-drive advancements
  - no longer the limiting factor

Next Weakest Link → Casing Connections

- Rotate through the bend (plural bends now)
- Clearance constraints (vs drill pipe)
- New combination of load conditions

Split coupling field failure

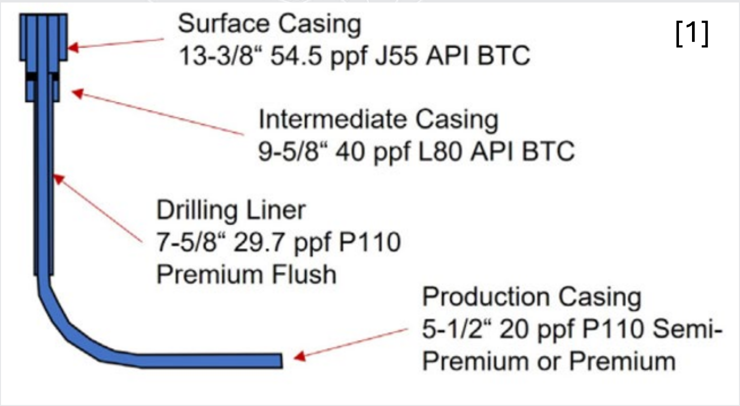
Load State Along a Horizontal Well

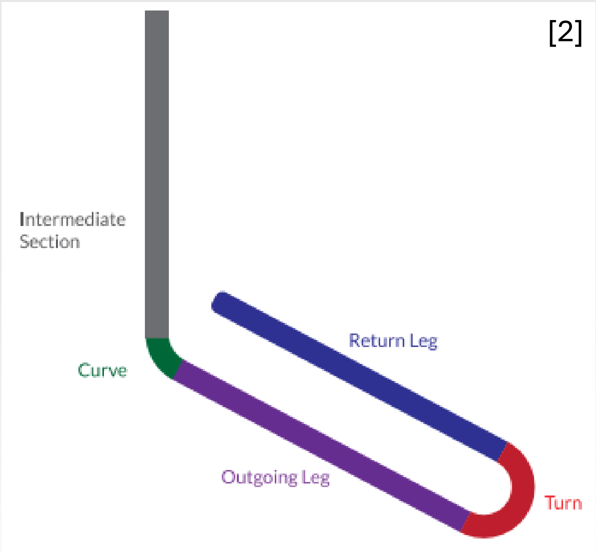


On a macro level

- Torque and drag modeling
- Wellbore modeling
- Well construction modeling

Midland Example





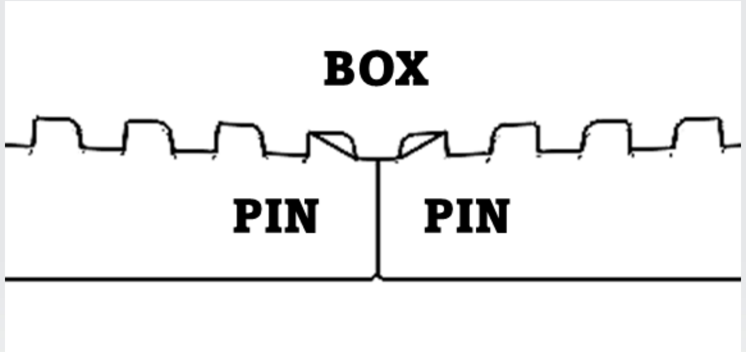
[1] Teodoriu, 2022. doi: https://doi.org/10.1016/B978-0-323-90185-7.00018-2
[2] AADE-25-NTCE-050

Zoomed-In Load State

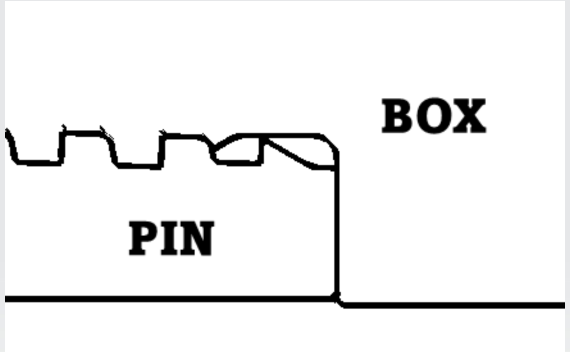
The load considerations are well understood on the macro-level modeling

Load considerations missed at the connection level

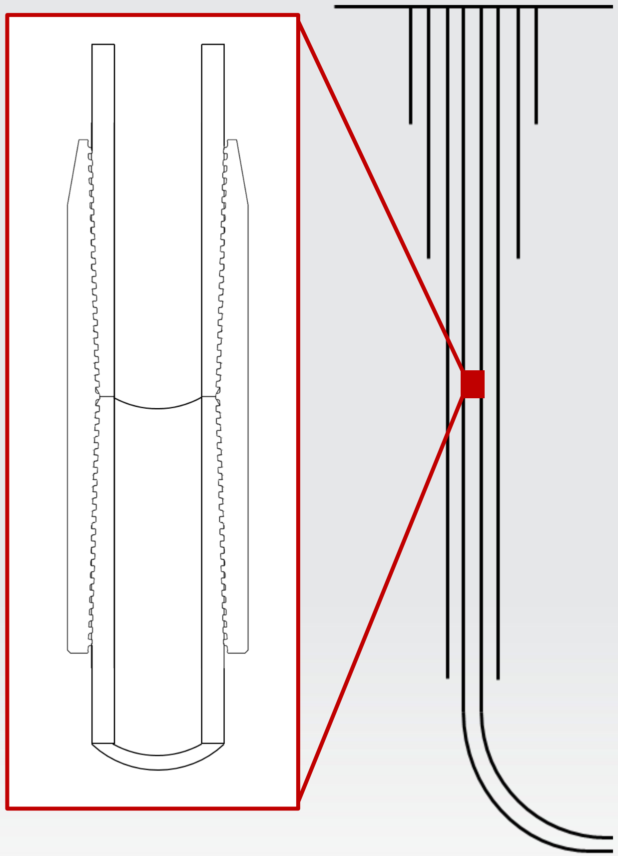
- Buttress compatible (BTC) is standard widely used connection
- Higher torque compatible options rely on a shoulder vs interference



BTC Pin-to-pin Shoulder



BTC Shouldered



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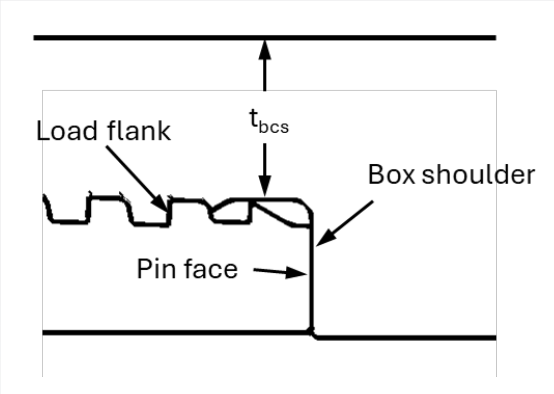
Connection Load State

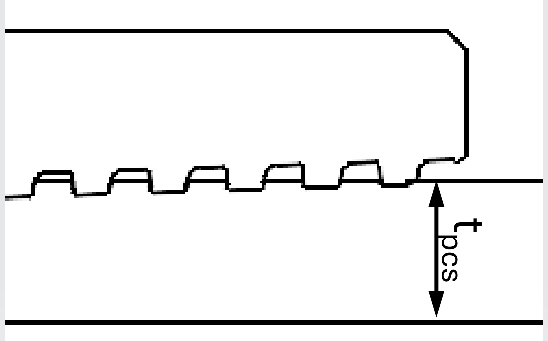
Connection terminology

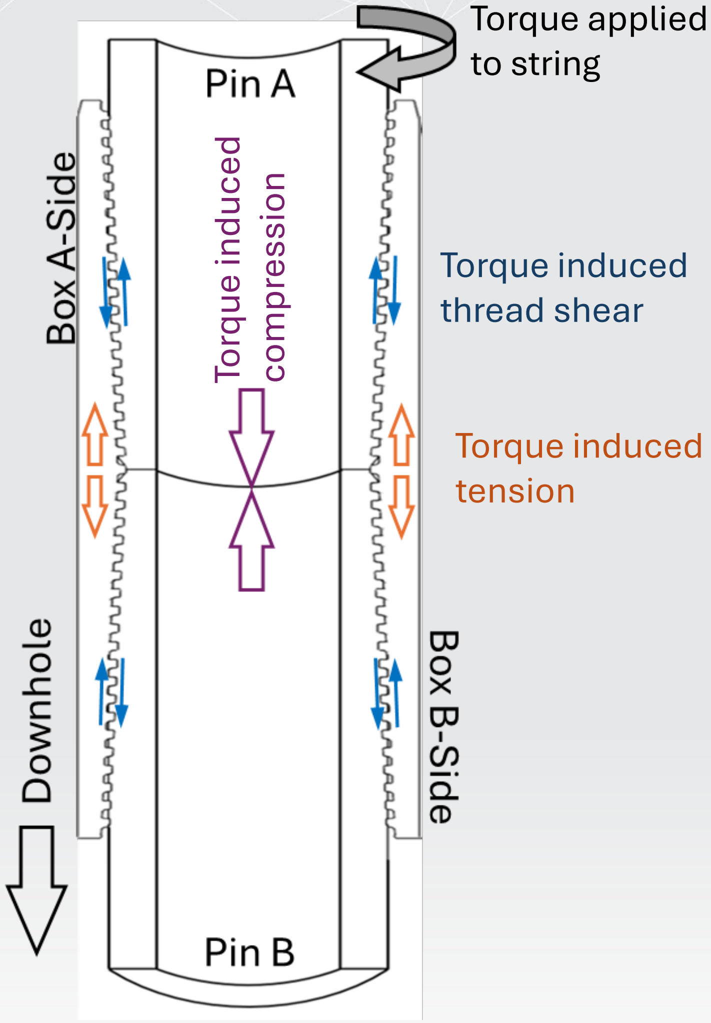
As a shouldered connection is rotated down-hole it will enact a tension load on the couplings critical cross-sectional area

Box critical cross-section

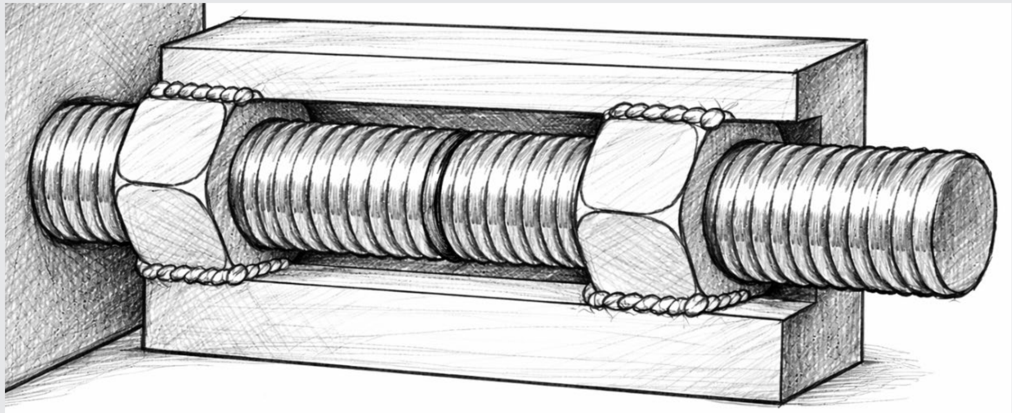


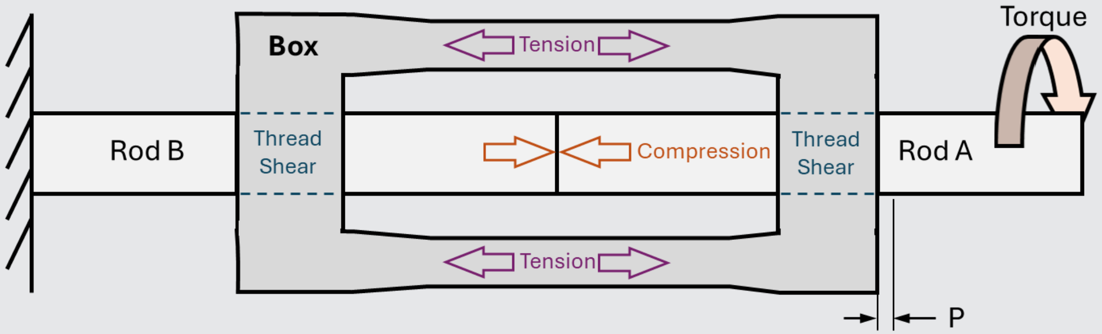
Pin critical cross-section





Understanding the Screw-Jack





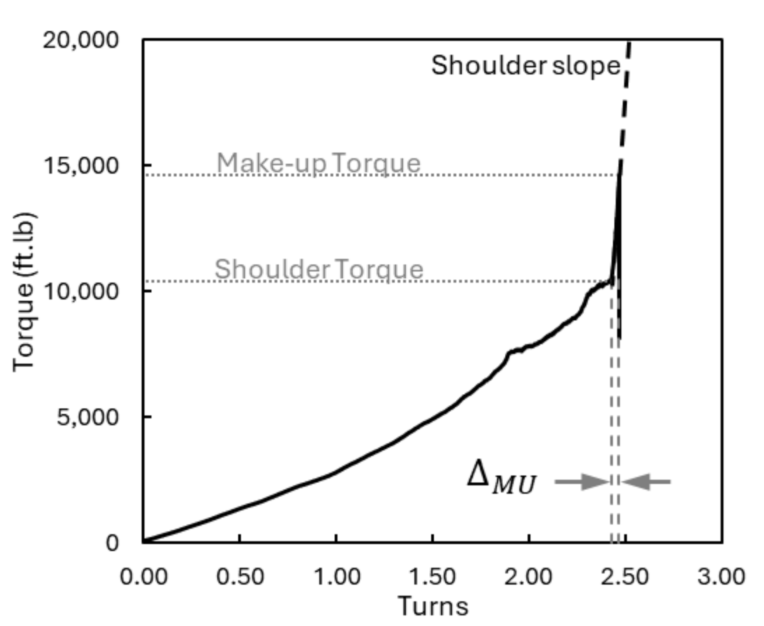
Torque – Turn Behavior in the Field

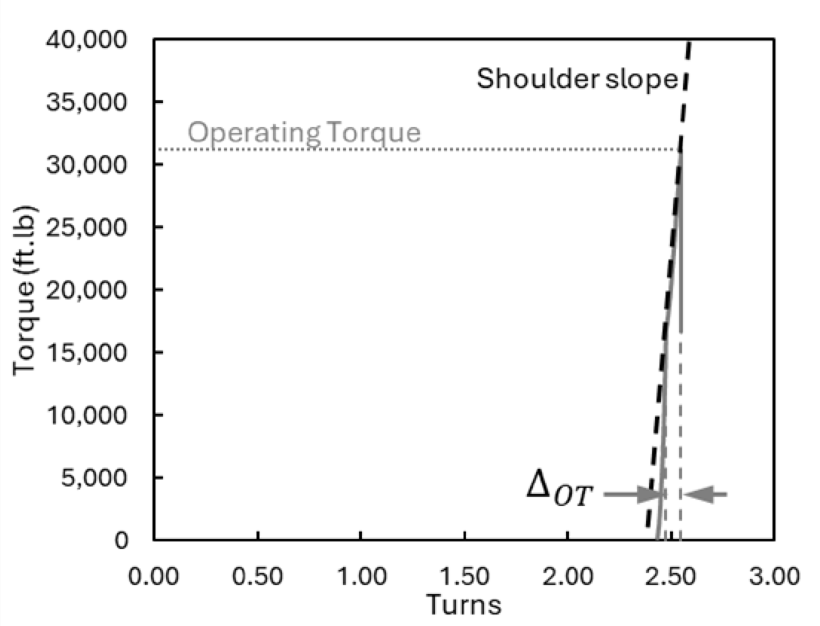
Example make-up:

- **5.5in 20# P110 BTC**

Axial movement:

$$L_{OT} = (\Delta_{MU} + \Delta_{OT}) \times LFL$$





Connection data sheet (CDS) values:

Make-up Torque	
Maximum	**16,600** ft. lbs
Optimum	**14,400** ft. lbs
Minimum	**12,200** ft. lbs

Torque Limits	
Yield Torque	**34,000** ft. lbs
Operating Torque	**30,600** ft. lbs

Torque vs Tension

Two primary considerations

- Torsion – API RP 7G Recommended Practice for Drill String Design and Operating Limits

A.8.2 TORSION AND TENSION

$$Q_T = \frac{0.096167J}{D}\sqrt{Y_m^2 - \frac{P^2}{A^2}} \qquad \text{(A.15)}$$

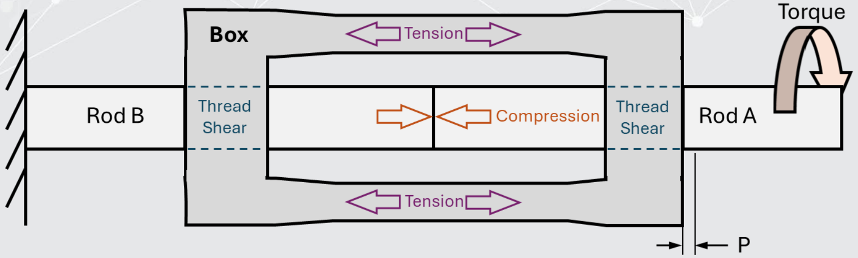
- Screw-jack

$$F_{TQ} = \frac{\delta \cdot E \cdot BCCS_{Area}}{L_B}$$

Strain (δ)

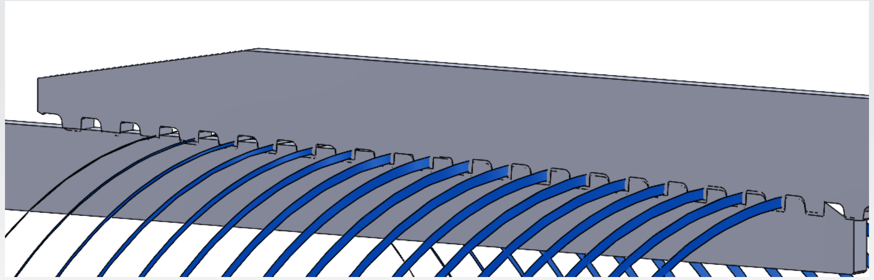
Load on box critical cross section (F_{TQ})

Coupling Length (L_B)



Strain component derived from axial movement resisted by:

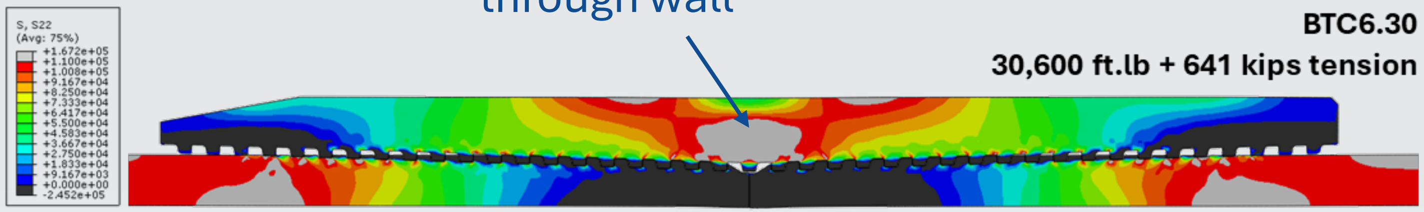
- Pin face area in contact
- Box critical cross-sectional area ($BCCS_{Area}$)
- Load flank helical area



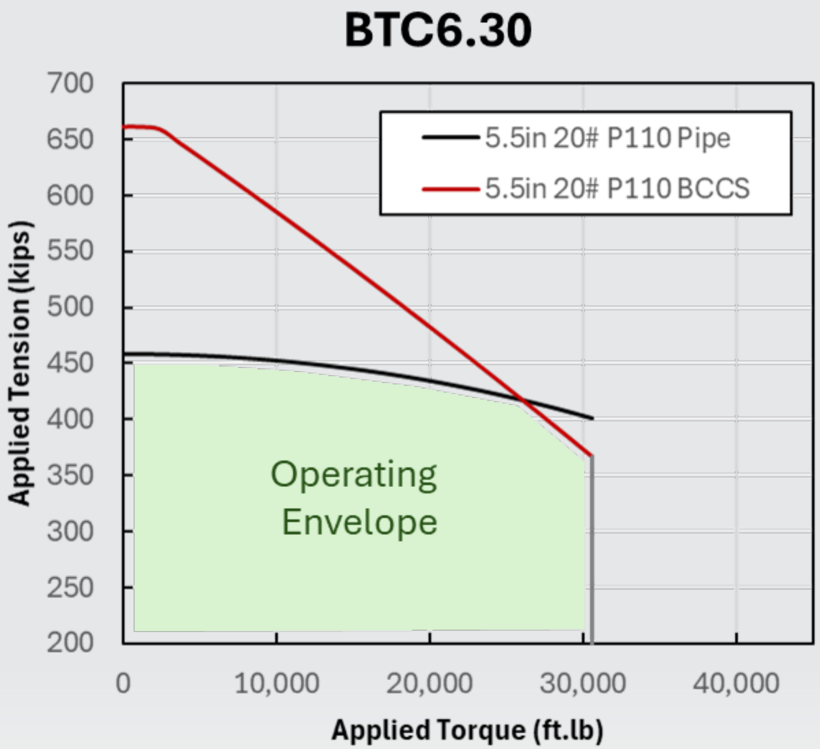
Torque-Tension Operating Envelope

For standard sized OD – the box critical cross-section area is so much larger vs the pipe that the it only limits near the operating limits of the connection.

High axial stresses not through wall

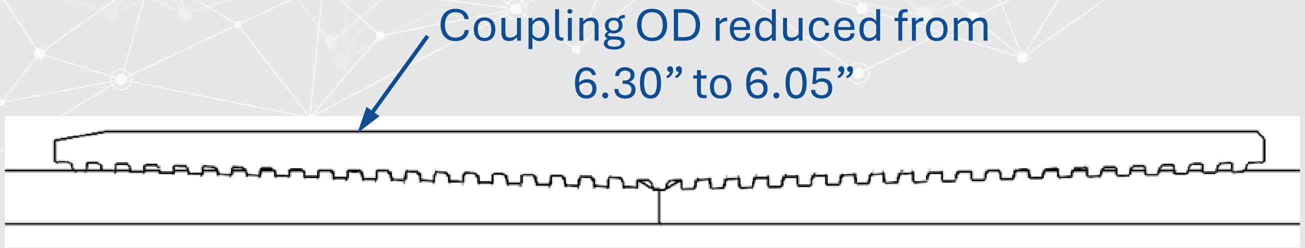


Axial Stresses at max rated torque + max rated tension

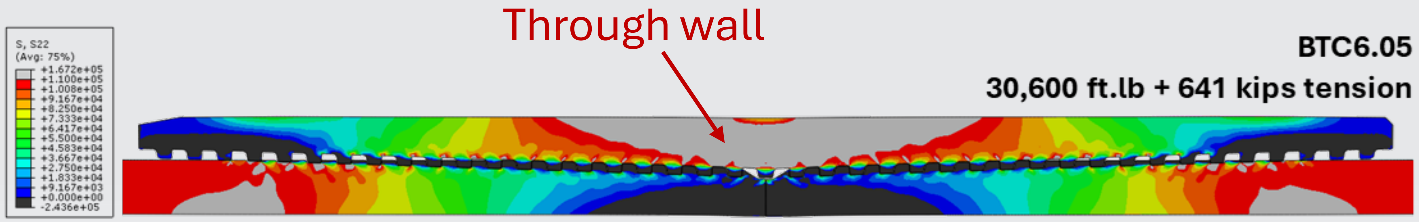


Enhanced Clearance: Why It's Dangerous

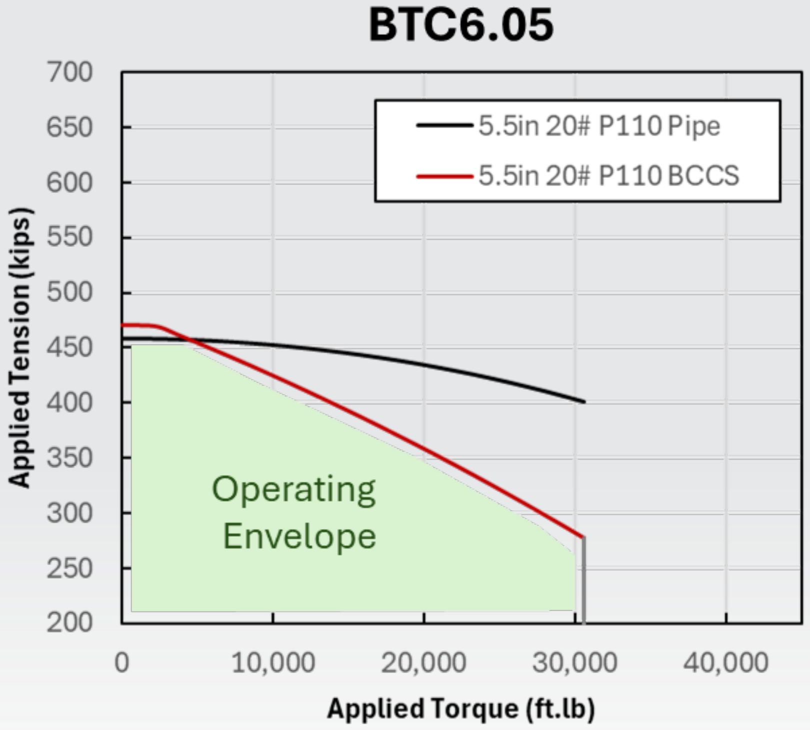
Enhanced clearance drivers
1. Improved cement
2. Regulator requirement



Torque-tension combined loading
- The box becomes the weak-link at even low torques
- Even with tension safety factors a coupling has high risk of failure



Axial Stresses at max rated torque + max rated tension



[1] Liu 2021 doi: 10.1016/C2019-0-02251-4
[2] BLM 43 FR Part 3160
[3] API Spec 5CT

Field Example

Case

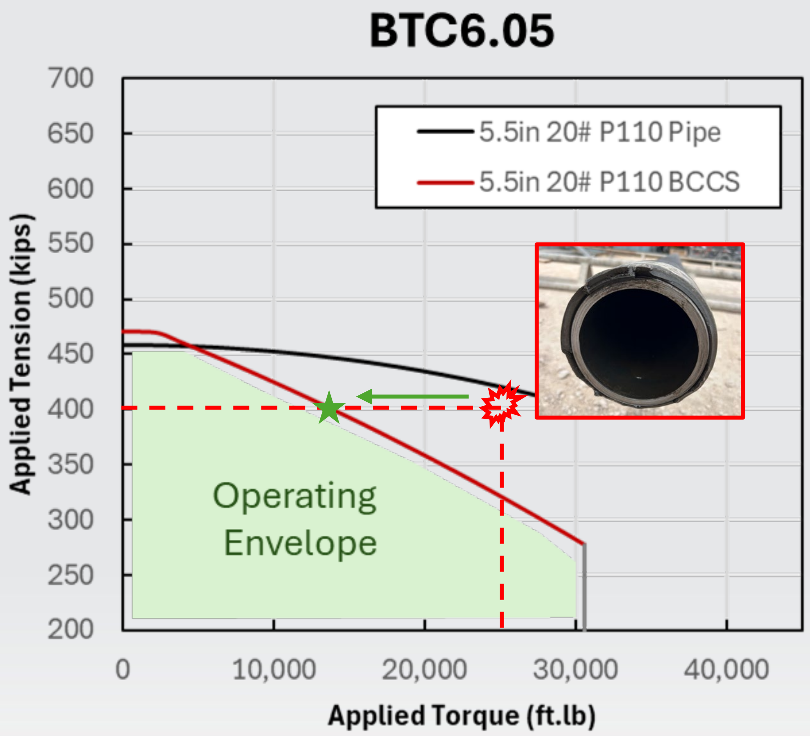
- 5.5in production casing with enhanced clearance run inside of 7-5/8in intermediate casing.
- 4-mile laterals (10K ft TVD)

Problem

- High torque was required to reach bottom.
- Coupling parted near surface.

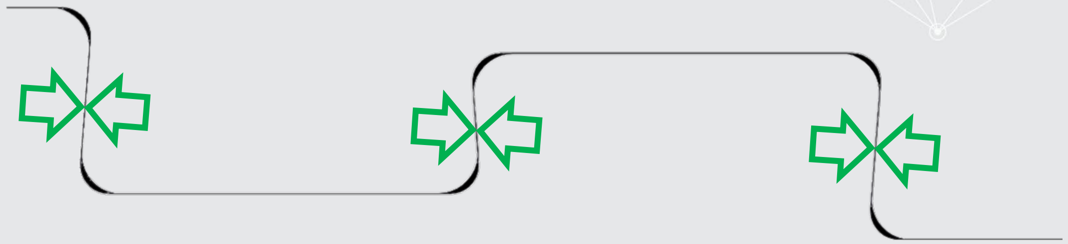
Mitigation

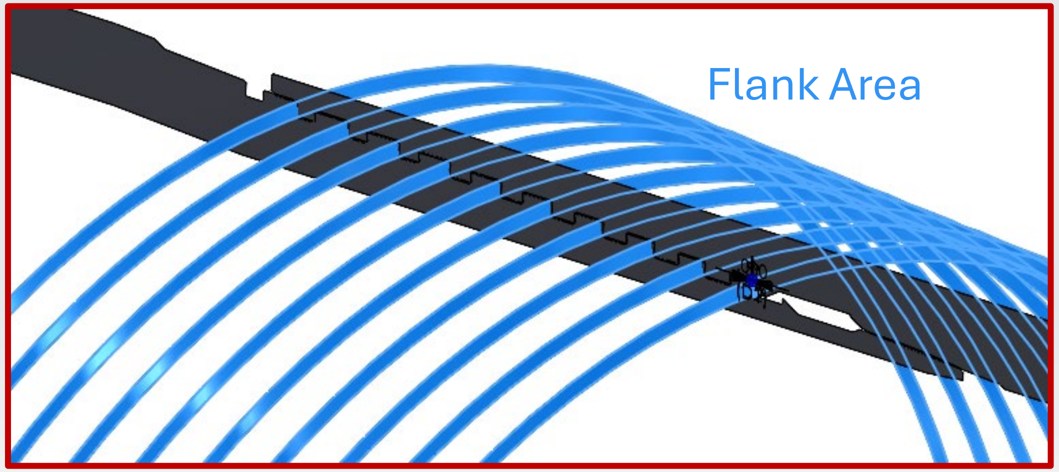
- Utilize operating envelope for remainder of casing
- Move to an alternate casing connection

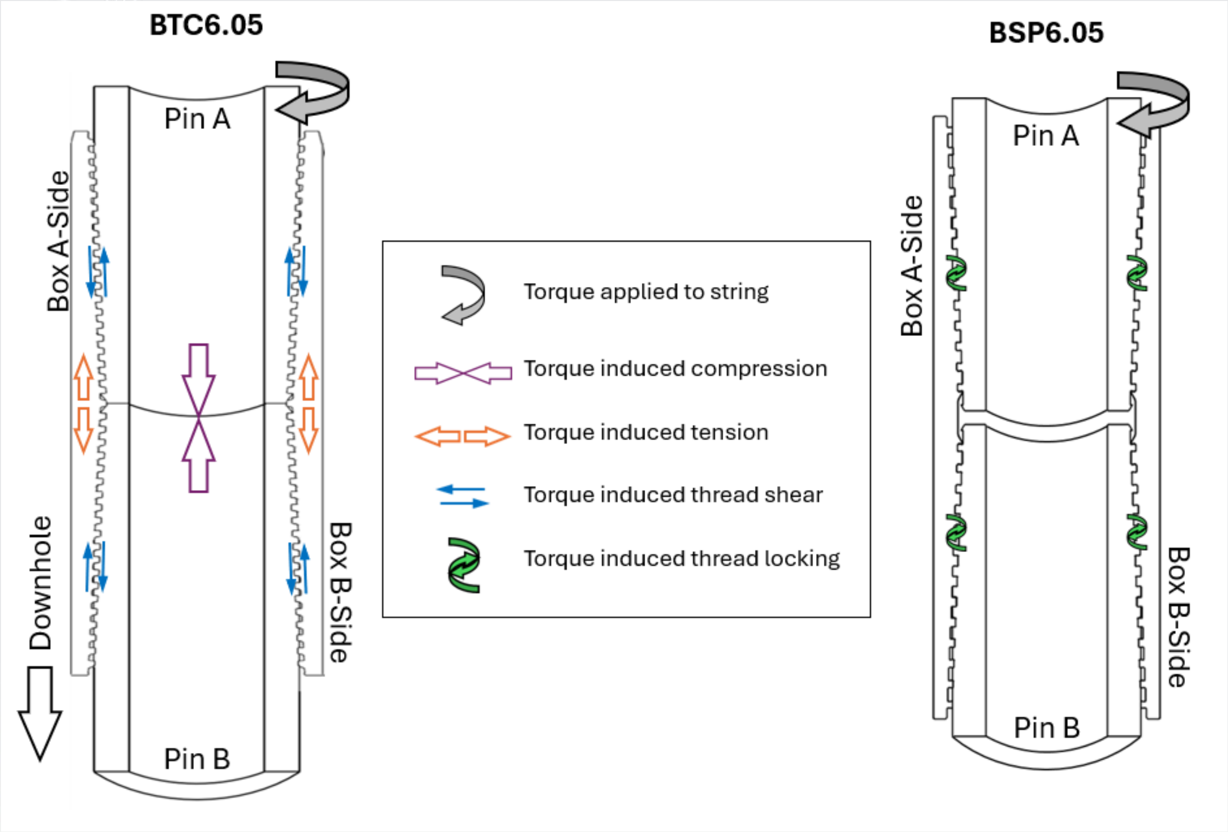


Wedge Threads: Different Physics

How to balance torque / tension / clearance



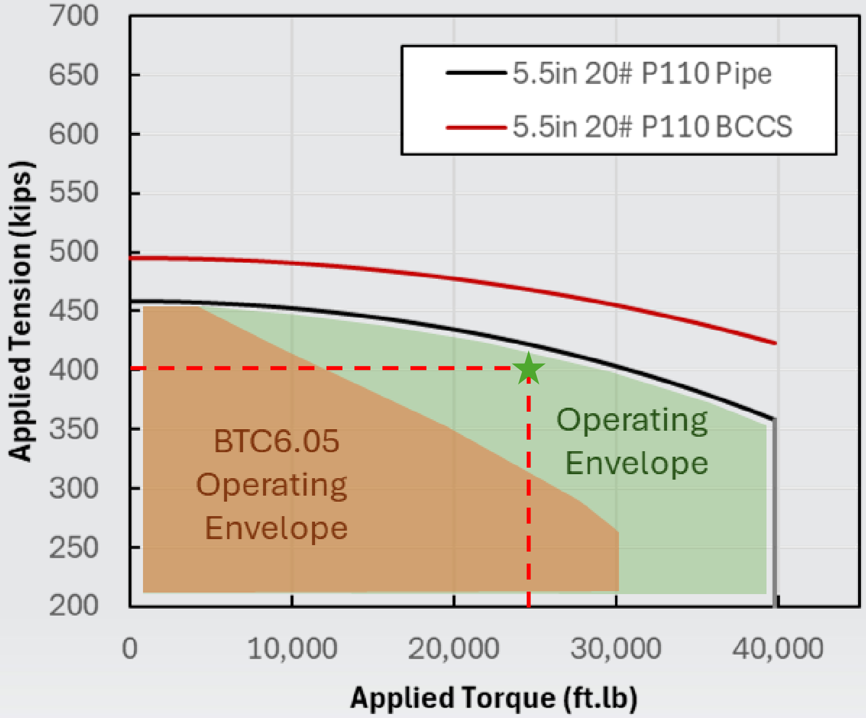


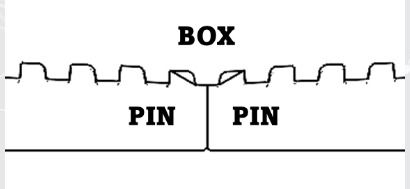


Proprietary wedge-thread example (BSP6.05)

Wedge Threads vs Shouldered

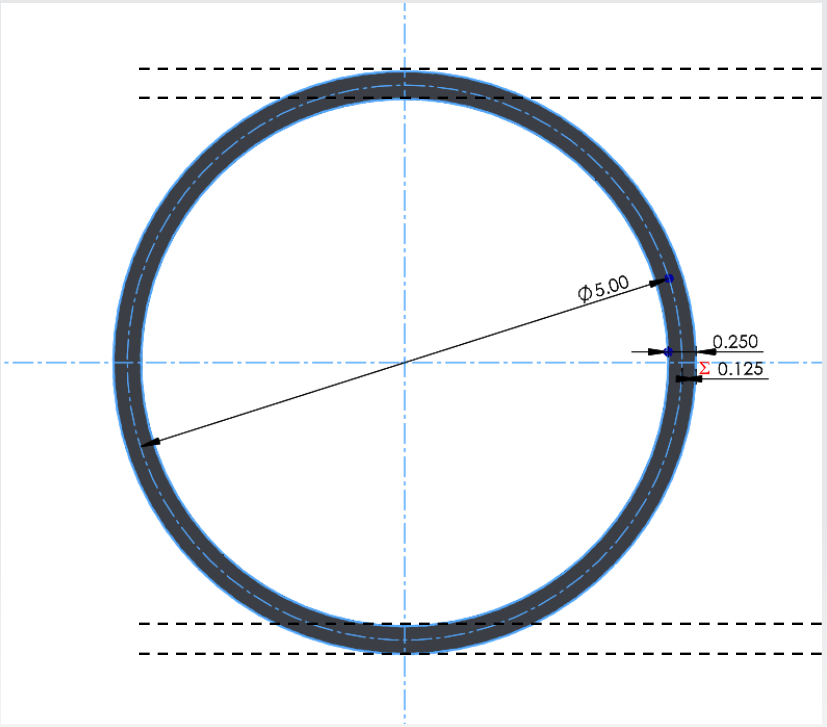
BSP6.05





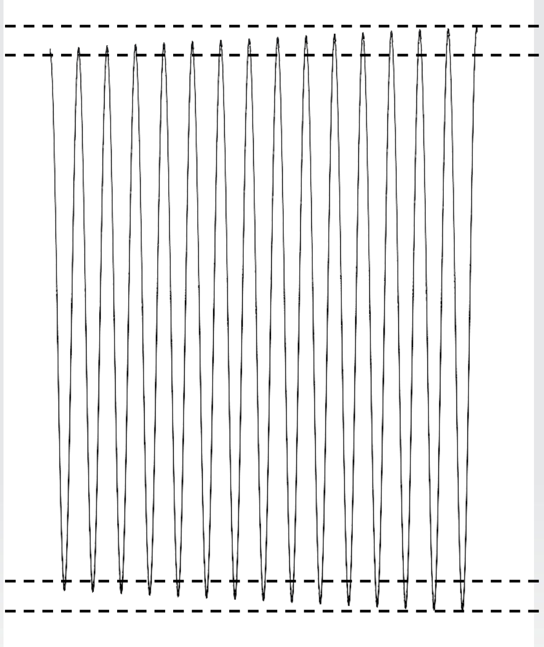
Over the same wall the stab flank area is **3 times larger** than the shoulder area

Shouldered Connection



Shoulder area = 3.9 in^2

Wedge



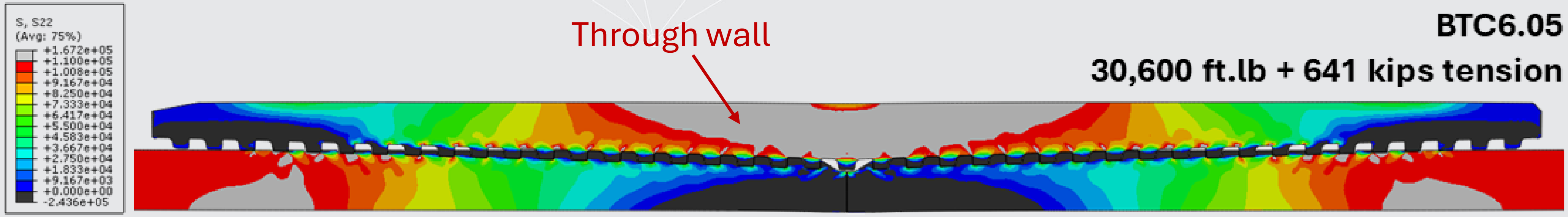
Flank area = 12.0 in^2

Wedge vs Shouldered

Through wall

BTC6.05

30,600 ft.lb + 641 kips tension

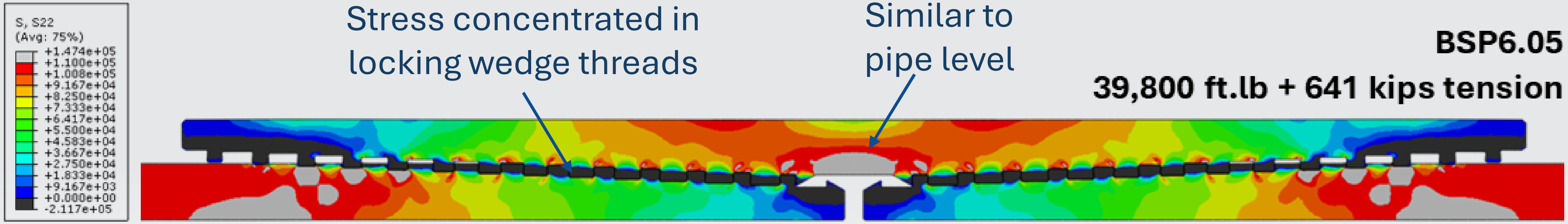


Stress concentrated in locking wedge threads

Similar to pipe level

BSP6.05

39,800 ft.lb + 641 kips tension

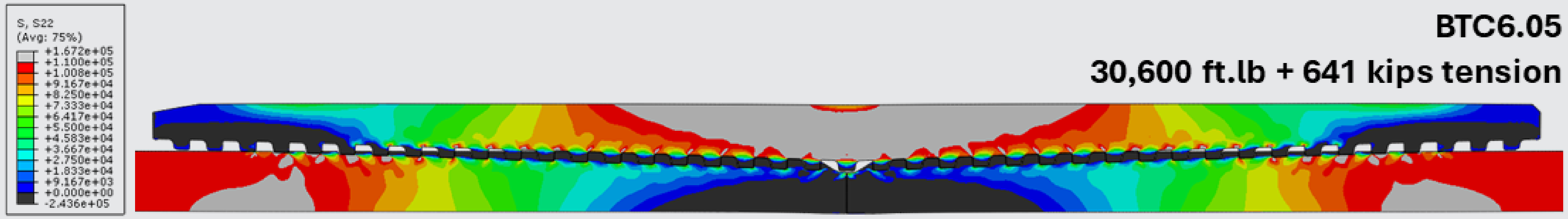


Regulatory Challenge Example

Running 5.5in 20# pipe inside of 7.625in 29.7#

Max coupling OD of 5.9in to meet the 0.422in radial clearance required in BLM 43 FR Part 3160

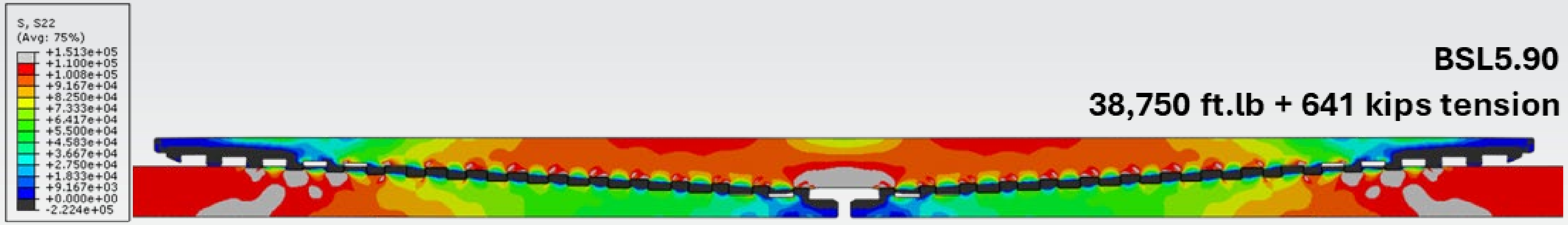
- **Slim-line version of BTC would be even more restrictive**



BTC6.05

30,600 ft.lb + 641 kips tension

- **Slim-line version of the wedge connection has no additional restrictions**



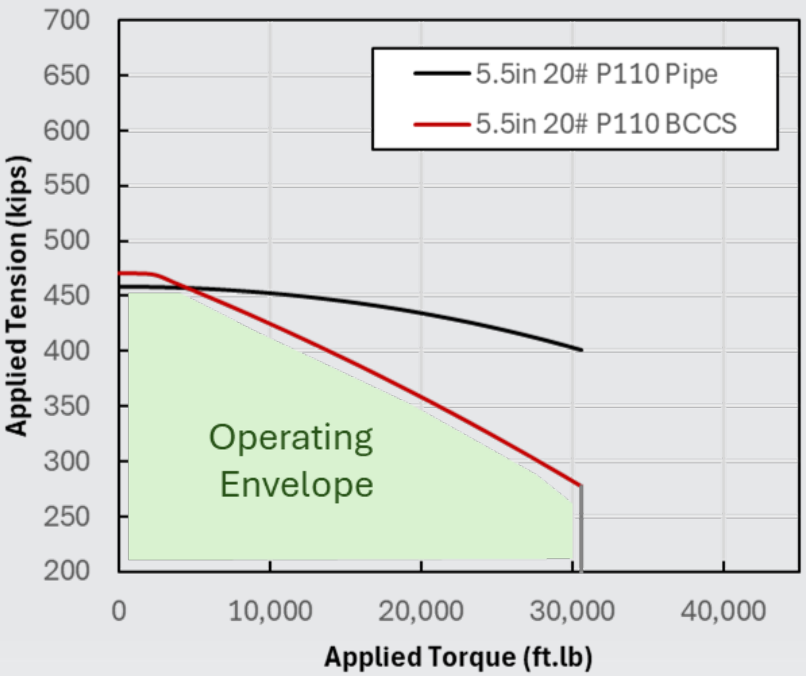
BSL5.90

38,750 ft.lb + 641 kips tension

Key Takeaways

- Top drives are no longer the limiting factor for ERD
- Know the torque-tension envelope for the connection you are running
  - Do not rely solely on Connection Data Sheet ratings
- Match the right connection for the application
  - If you can not compromise - move to a connection that does not have the screw jack mechanism

Torque Tension Envelope



Questions?

THANK YOU