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# **Inaccessible Drilling Targets and Completions Operation Made Possible by the Alleviation of Excessive Torque and Drag**

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# Introduction

- John McCormick: WFT
  - Applications Engineer
- Melissa Frilot: WFT
  - Applications Engineer
- Tim Long: Chevron
  - Completions Engineer



# Presentation Overview

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- I. General Torque and Drag Reduction Methods
- II. Well Descriptions
  1. Offshore: Gulf of Mexico (GoM)
  2. Land rig: Texas, USA
  3. Offshore: West Africa
- III. Application and Results
- IV. Mechanical Friction Reduction Tools
  - Casing wear, Drag, and Torque Reduction

## Section I

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# General Torque and Drag Reduction Methods

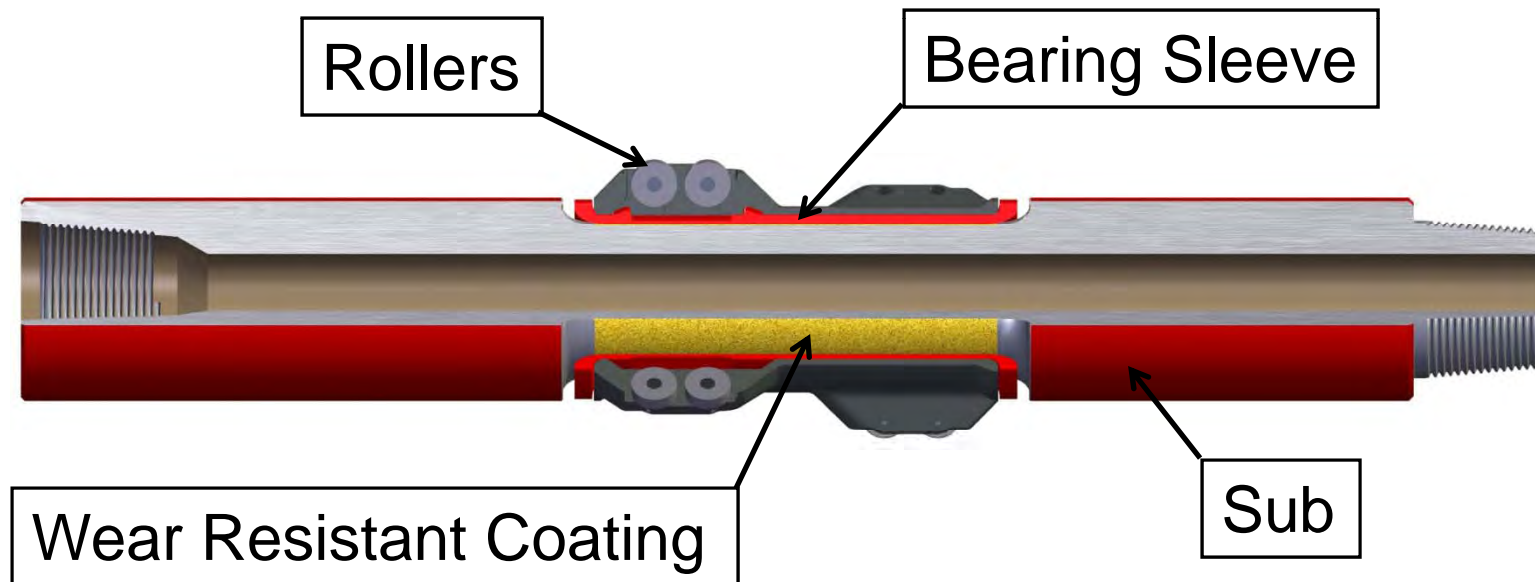
# Torque and Drag Reduction Methods

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- Engineered Wellpath
- Operational Practices
  - Hole Cleaning, Smooth wellpath
- Lubricants
  - Well #1 (GoM) and #3 (W Africa)
- Mechanical Friction Reduction Tools
- Lightweight String Components
  - Aluminum, Titanium, Thin-walled Steel

# Mechanical Friction Reduction Tool (MFRT)

- Sub-based Mechanical Friction Reduction Tool
- Expected 50% Local Friction Reduction



## Section II

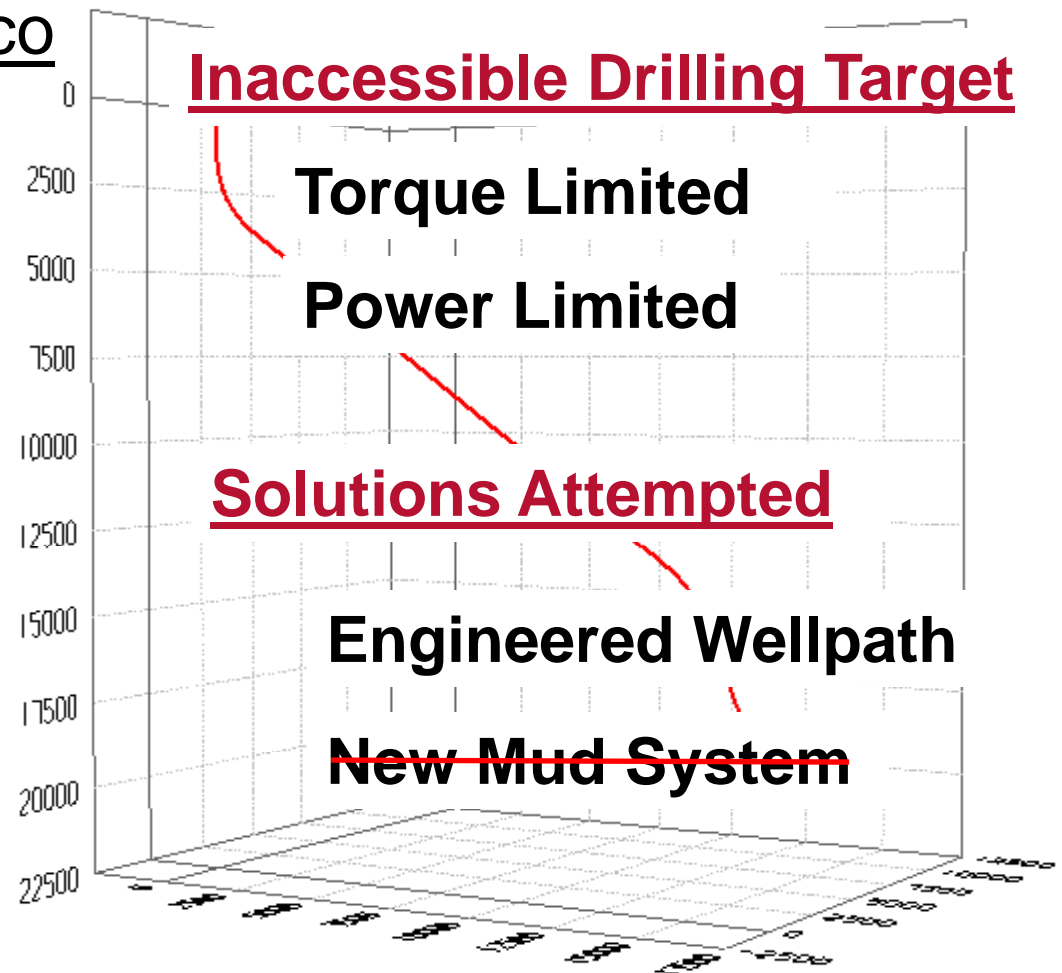
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# Well Descriptions

# Well Description: Well #1

## Offshore Gulf of Mexico

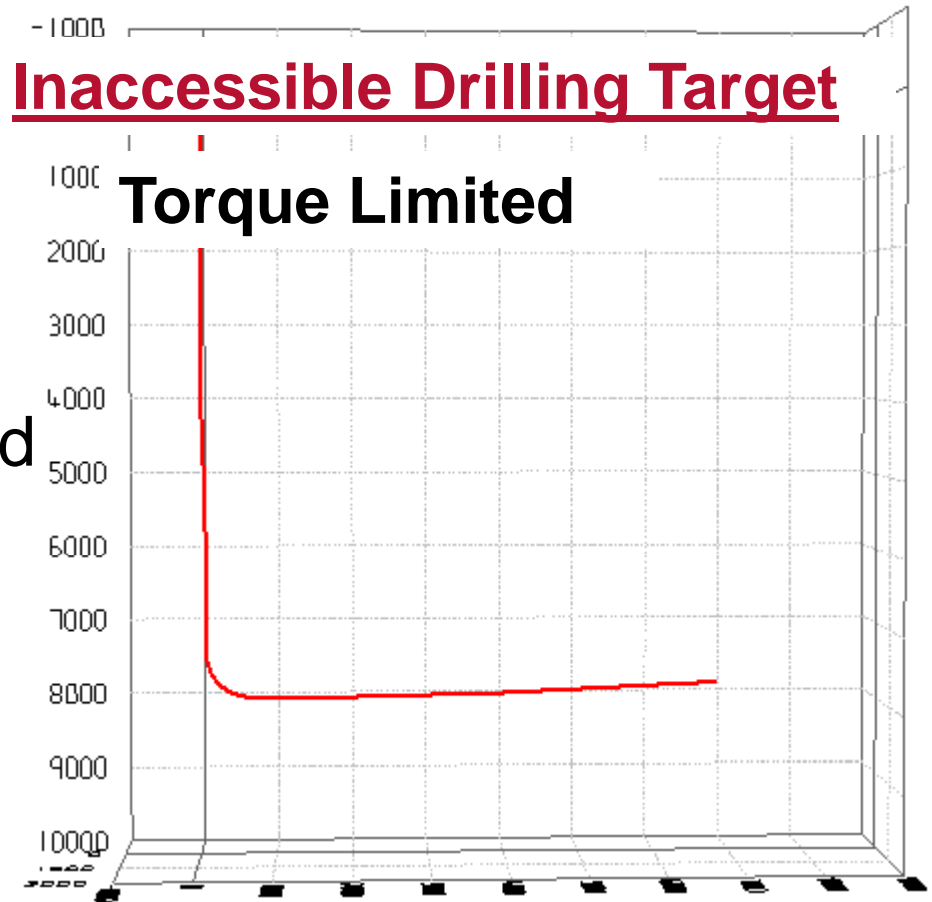
- 485 ft water
- 50° inclination
- TD: 26,400 ft MD
- 8 ½" hole
- 42,000 ft-lbs torque
  - at 23,000 ft MD



# Well Description: Well #2

## Land Rig, Texas USA

- TD: 14,500 ft MD
- 6,150 ft horizontal section
- DLS avg 10°/100 ft in build
- Inclination up to 92.87°
- 13,000 ft-lbs torque
  - at 12,164 ft MD

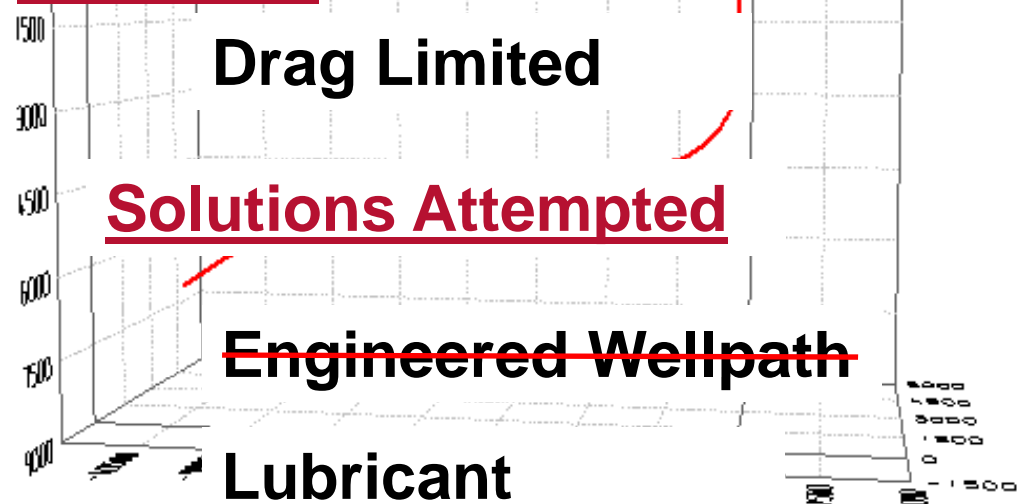


# Well Description: Well #3

## Offshore West Africa

- 1,727 ft water
- 76° inclination
- Unplanned 86° kink
- Gravel pack operation
  - 80,000 lbs needed

## Inaccessible Completions Operation

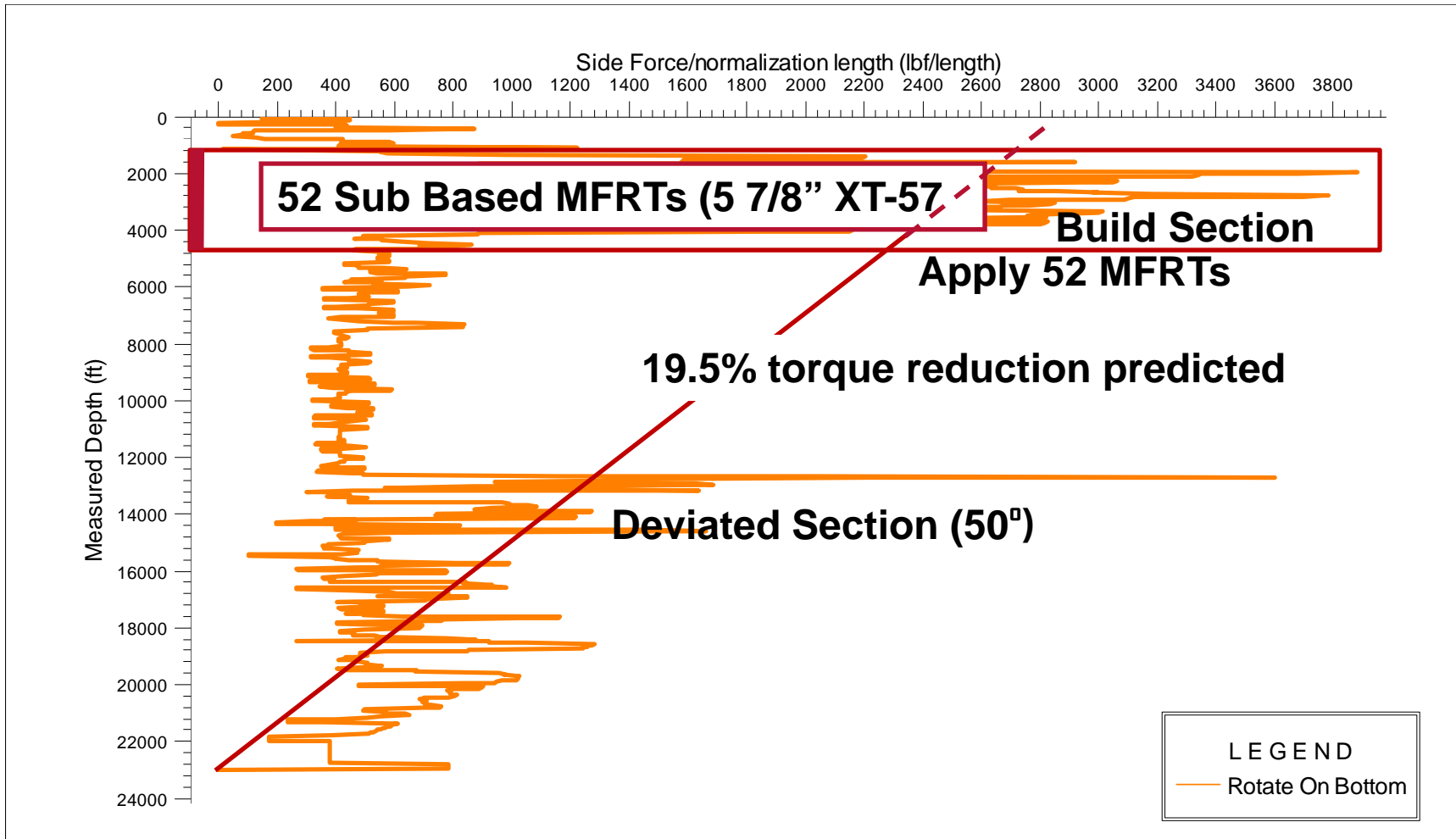


## Section III

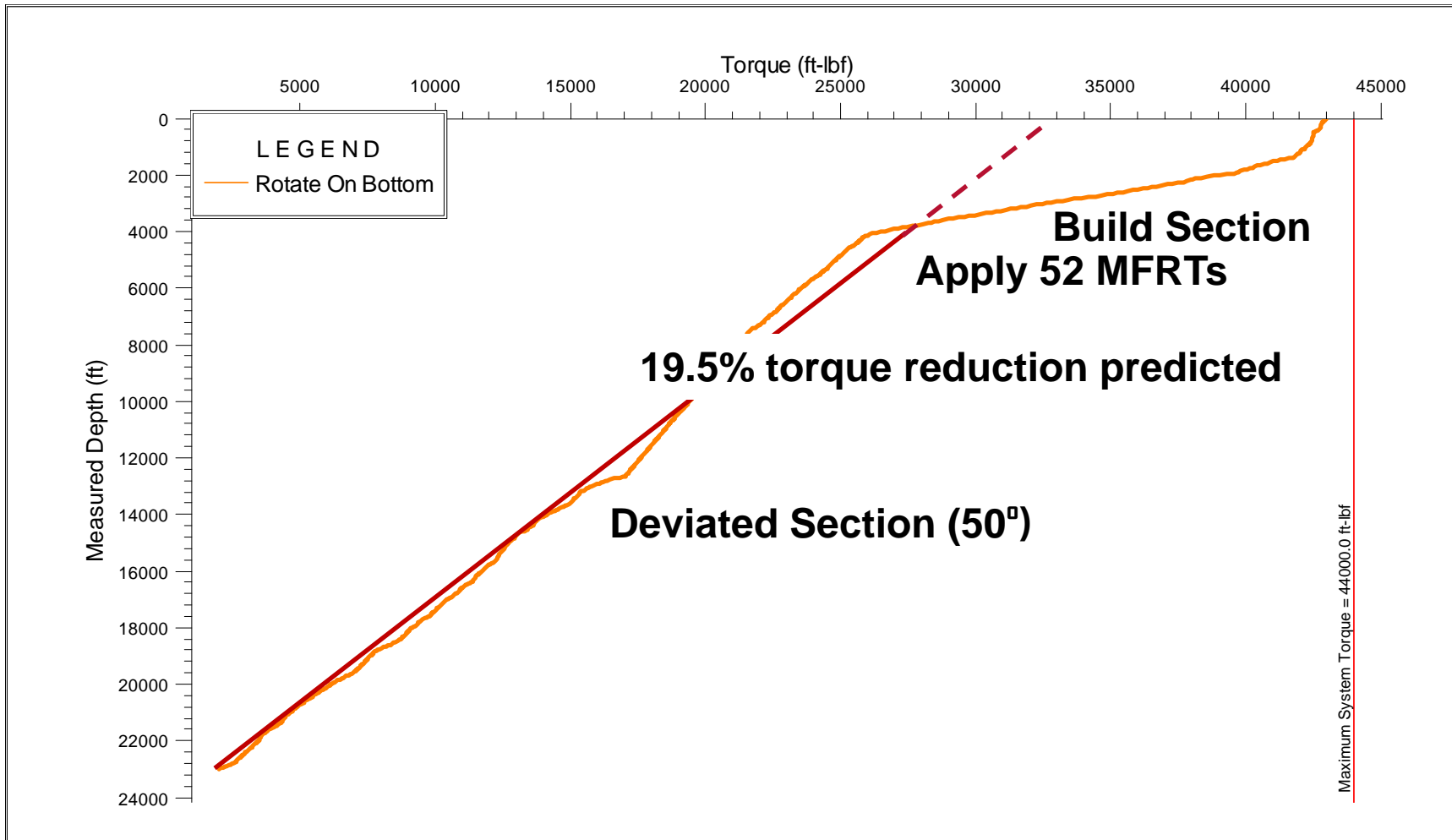
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# Application and Results

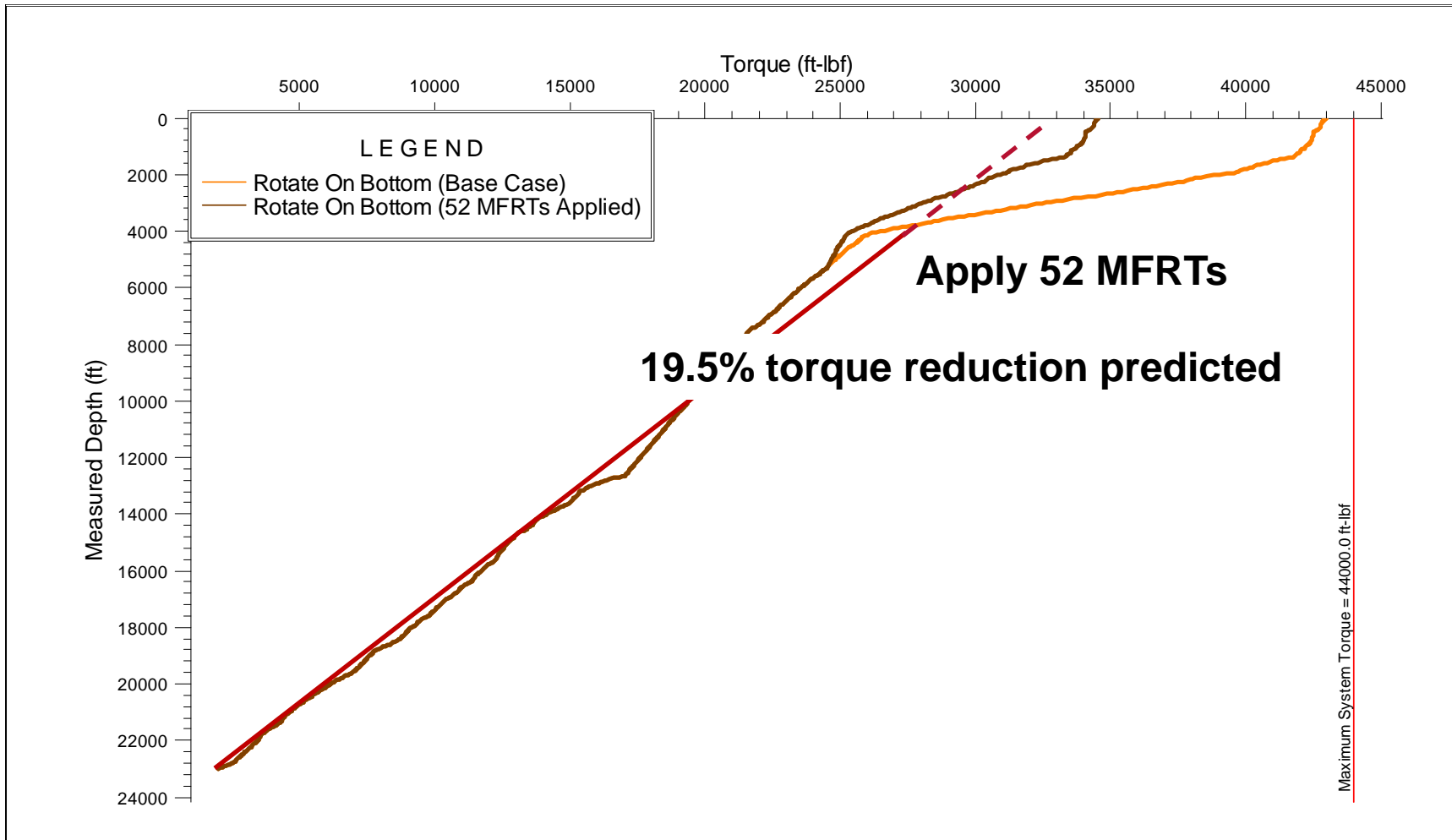
# T&D Modeling: Well #1 (GoM)



# T&D Modeling: Well #1 (GoM)



# T&D Modeling: Well #1 (GoM)



# MFRT Application

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- MFRTs Applied

- Well #1: 52 subs w/XT-57 connections (5 7/8")
- Well #2: 18 subs w/XT-39 connections (4")
- Well #3: 100 subs w/XT-57 connections (5 7/8")

- Expected Results

- Well #1: **19.5 %** torque reduction
- Well #2: **10.5 %** torque reduction
- Well #3: alleviate helical buckling

# Results: Well #1 and 2

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- Actual Results

- well #1: 19.0 % torque reduction (19.5 % expected)
- well #2: 35.0 % torque reduction (10.5 % expected)

- Possible Differences in the Model vs. Reality

- ~~model is not calibrated (incorrect friction factors)~~
- ~~incorrect inputs~~
- physical realities not captured by the T&D model
  - doglegs between survey points

# Results: Well #1 and 2

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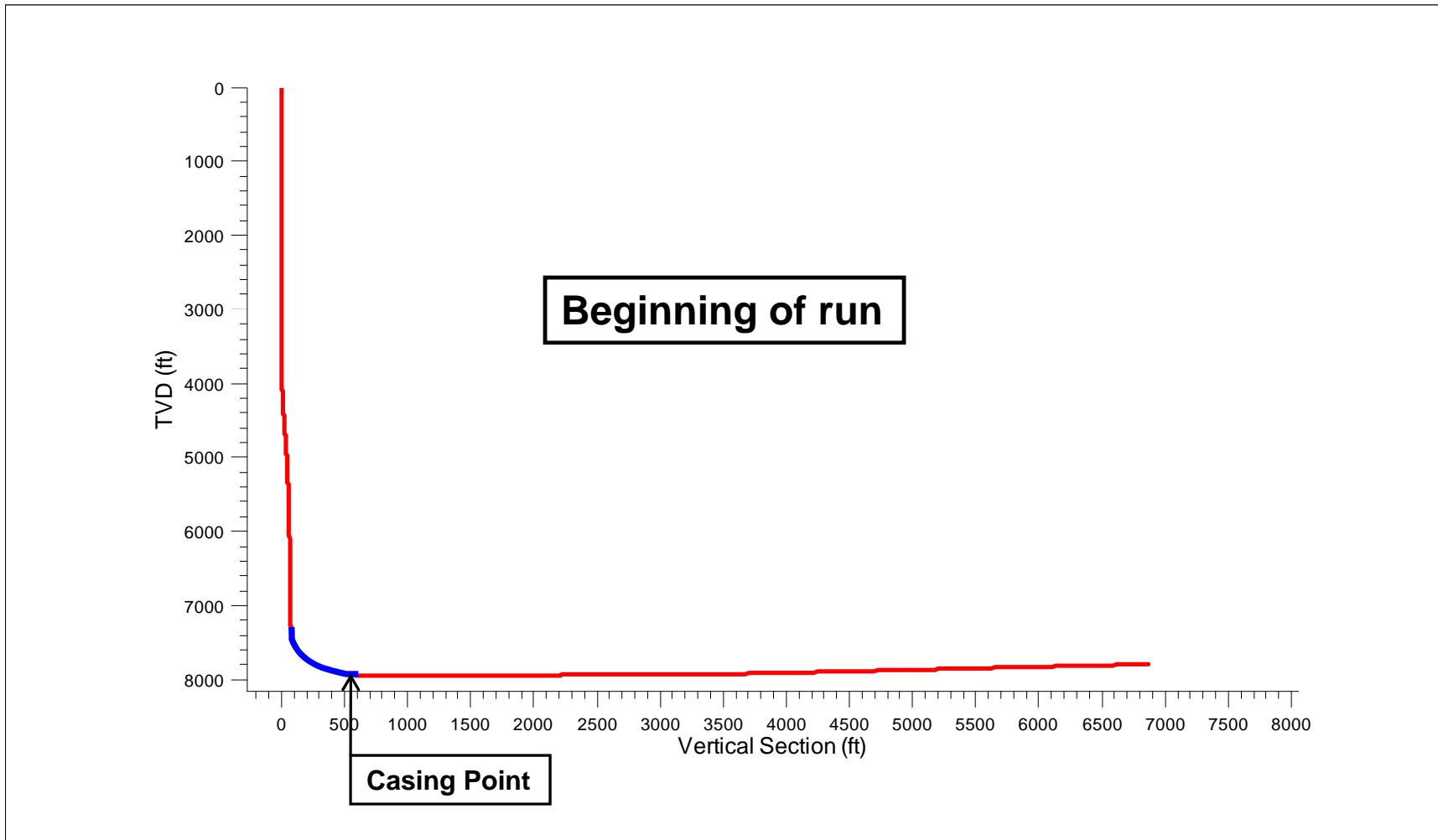
- Actual Results

- well #1: 19.0 % torque reduction (19.5 % expected)
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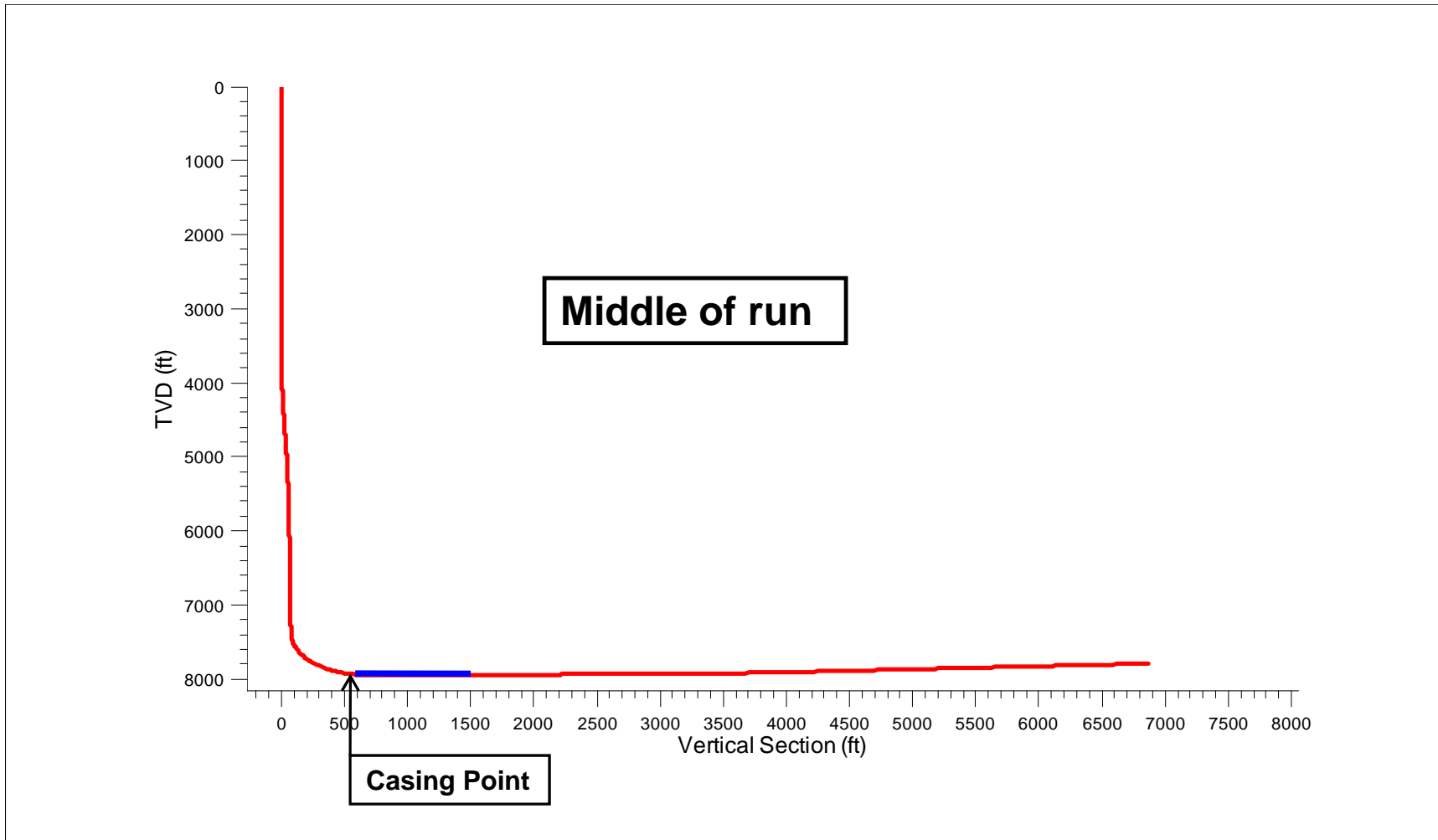
- Possible Differences in the Model vs. Reality

- The more severe the application, ~~(reduction factors)~~  
the better MFRTs will perform
- Sub-based MFRTs are very robust
- physical realities not captured by the T&D model
  - doglegs between survey points

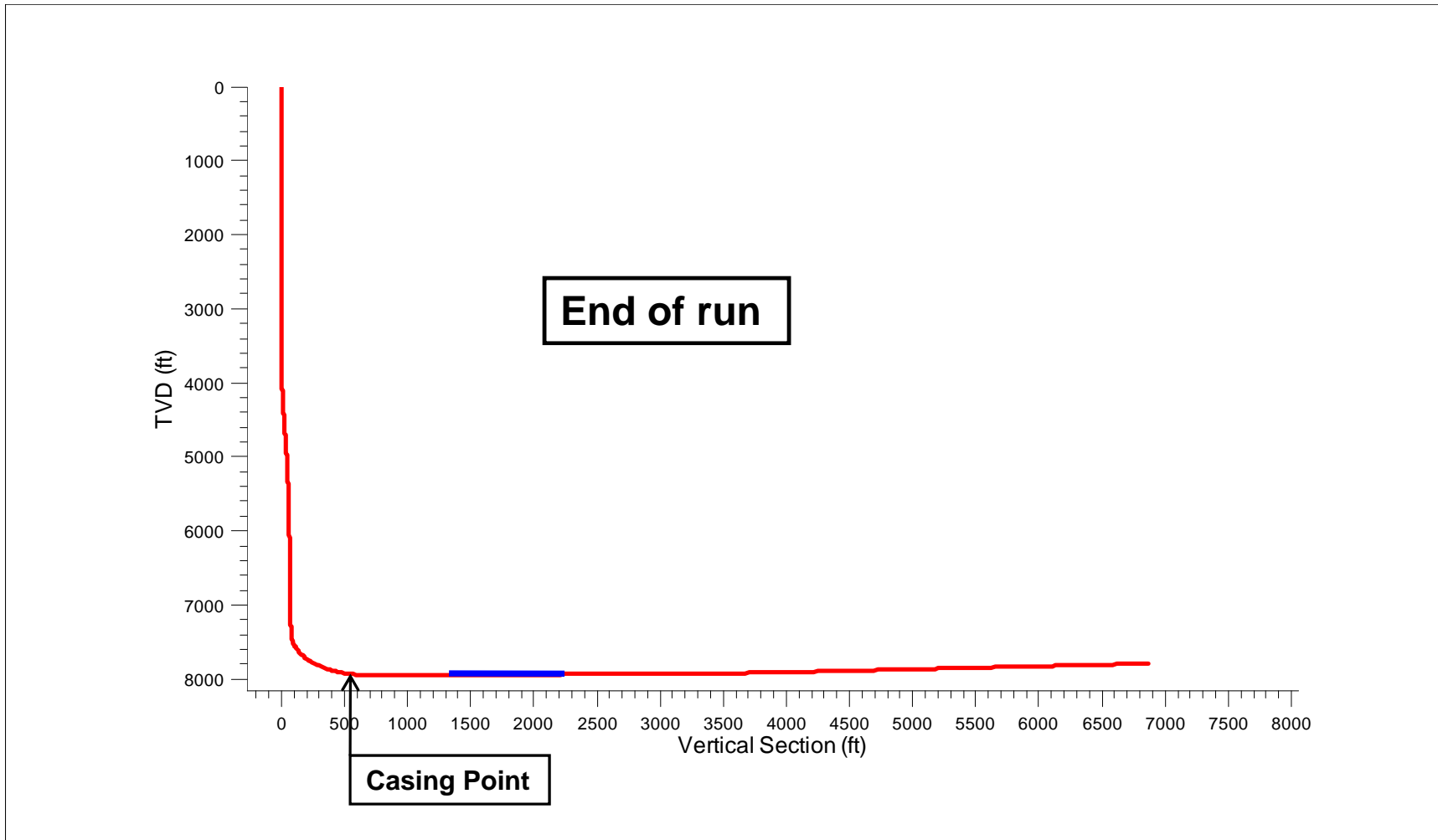
# Application: Well #2



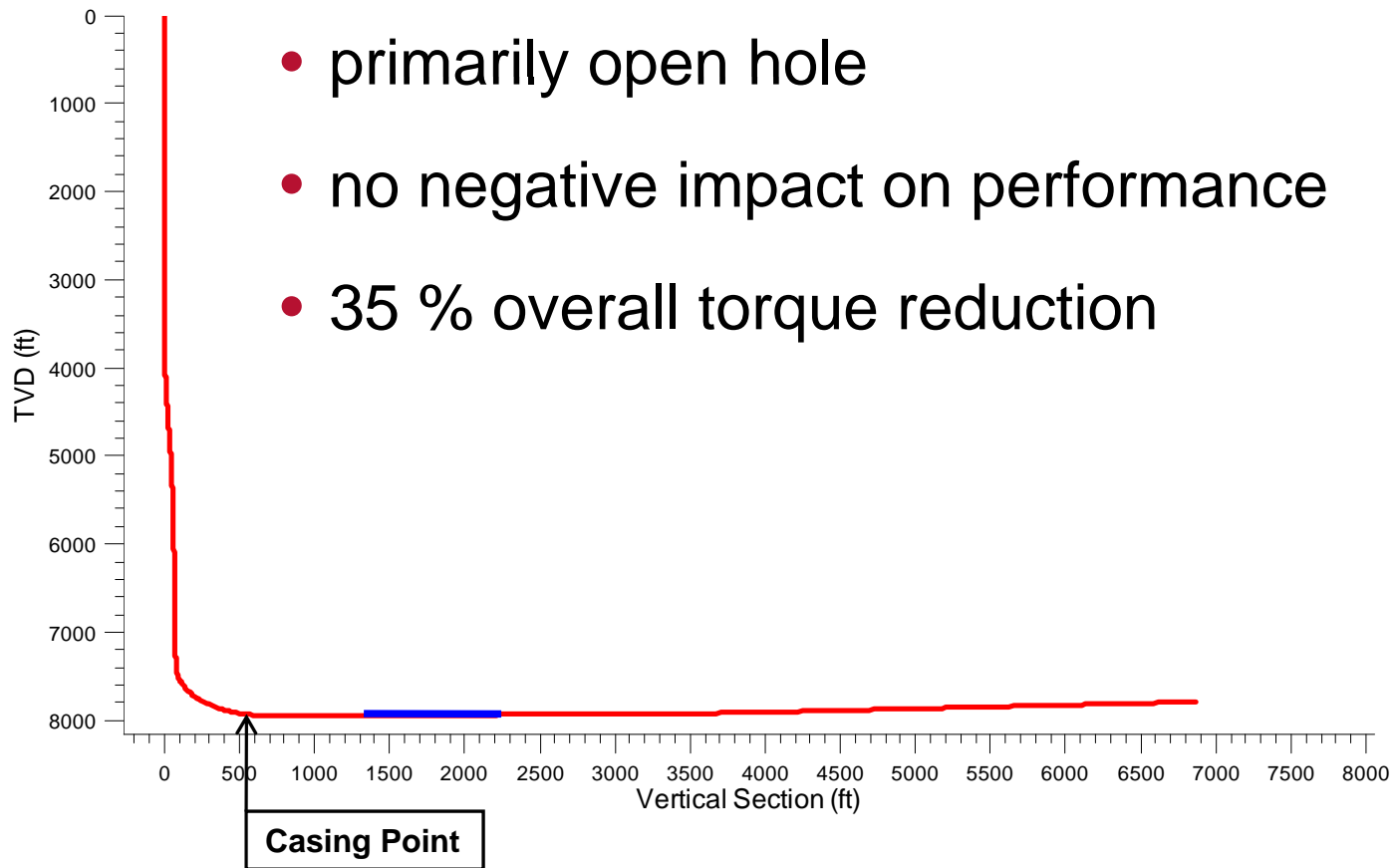
# Application: Well #2



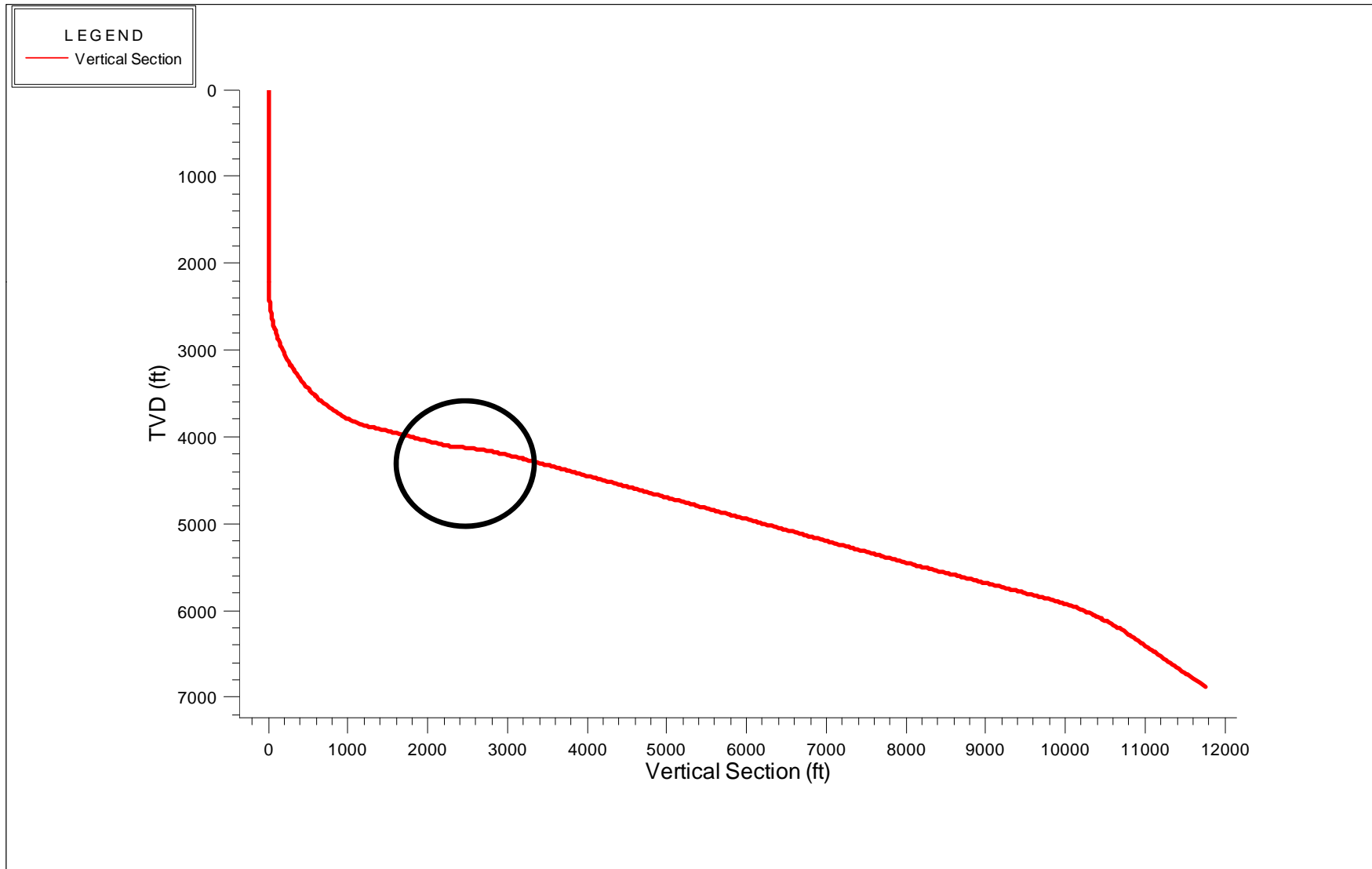
# Application: Well #2



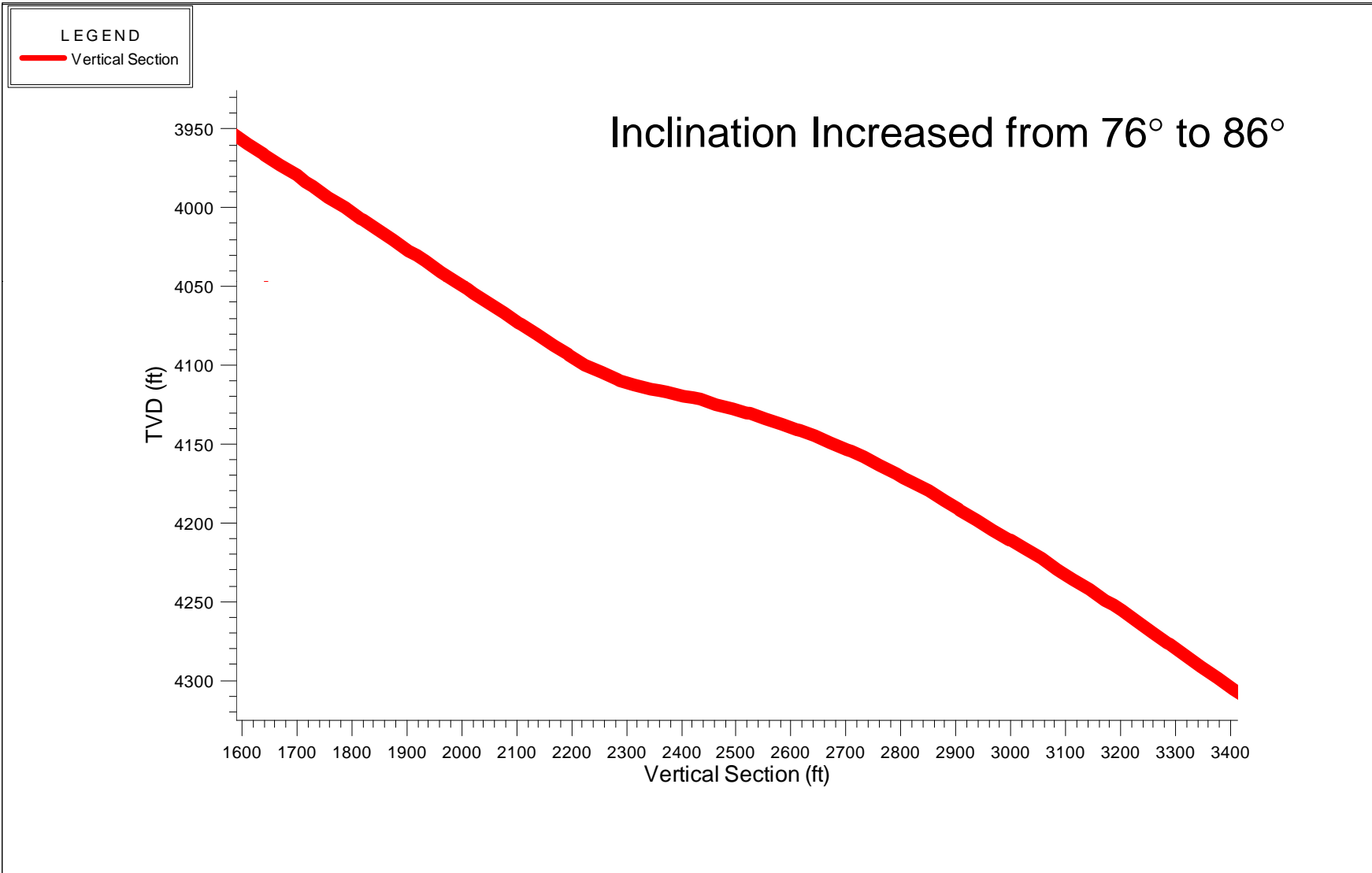
# Application: Well #2



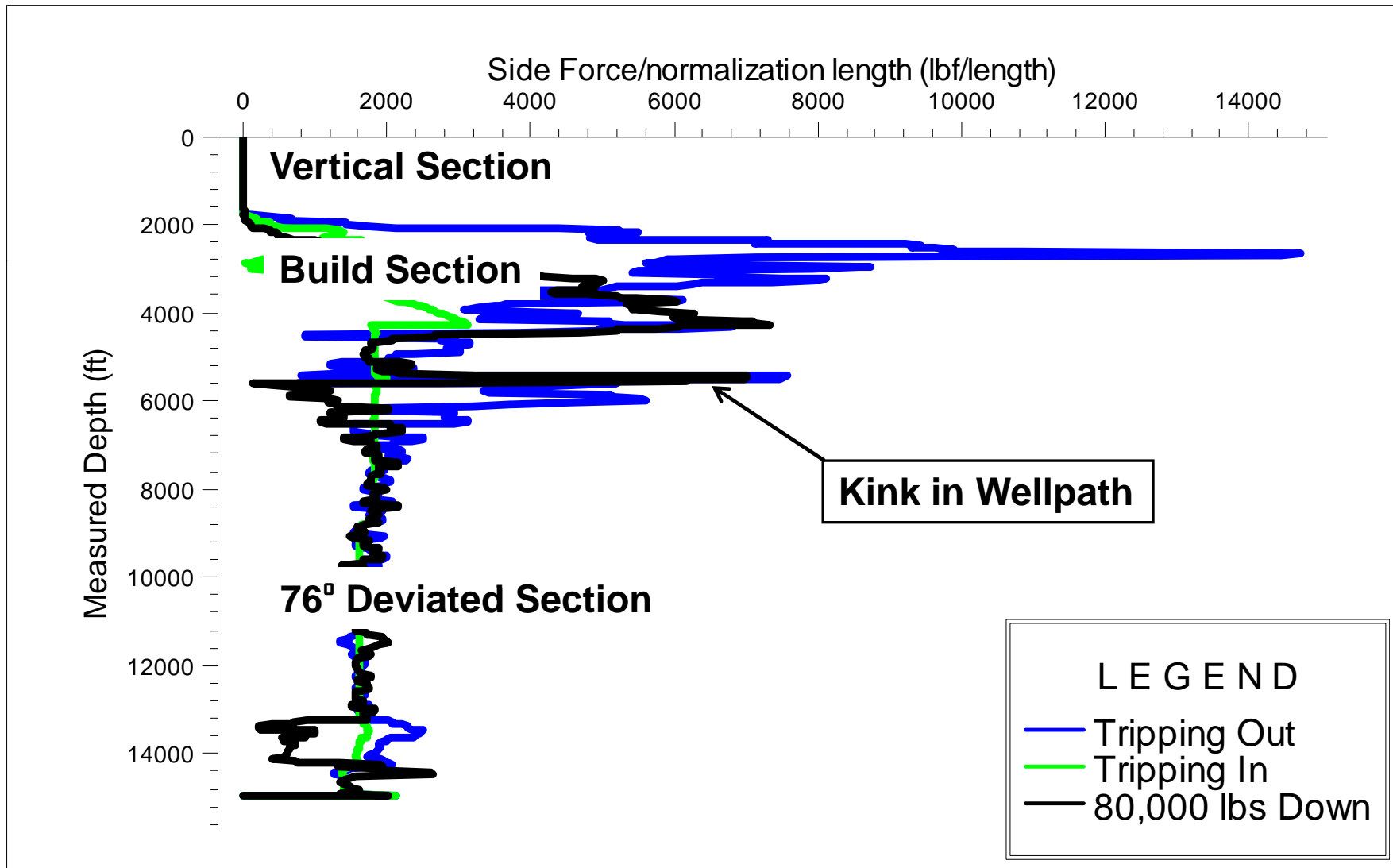
# Well #3: Excessive Drag



# Well #3: Excessive Drag



# MFRT Application: Well #3

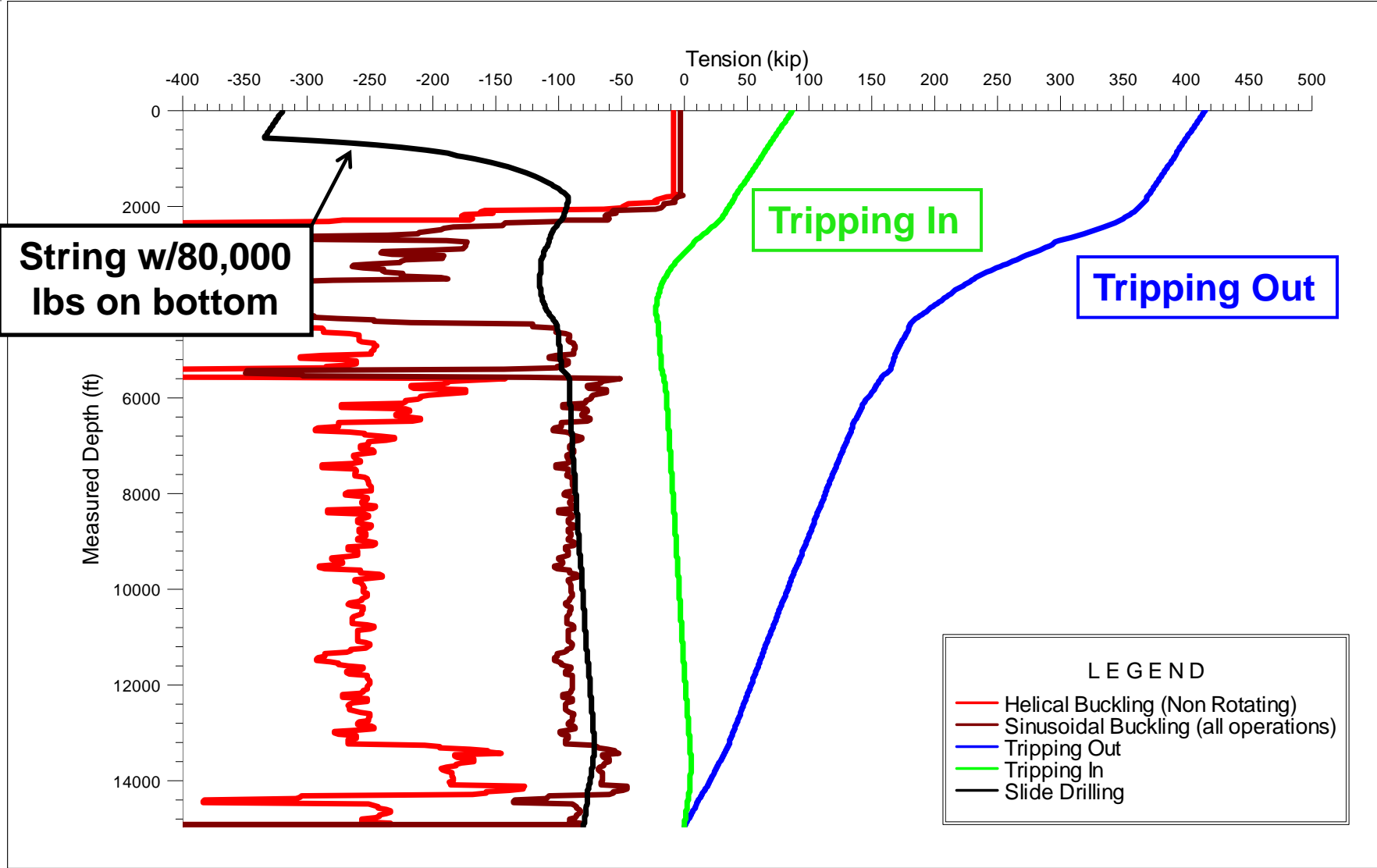


# T&D Modeling

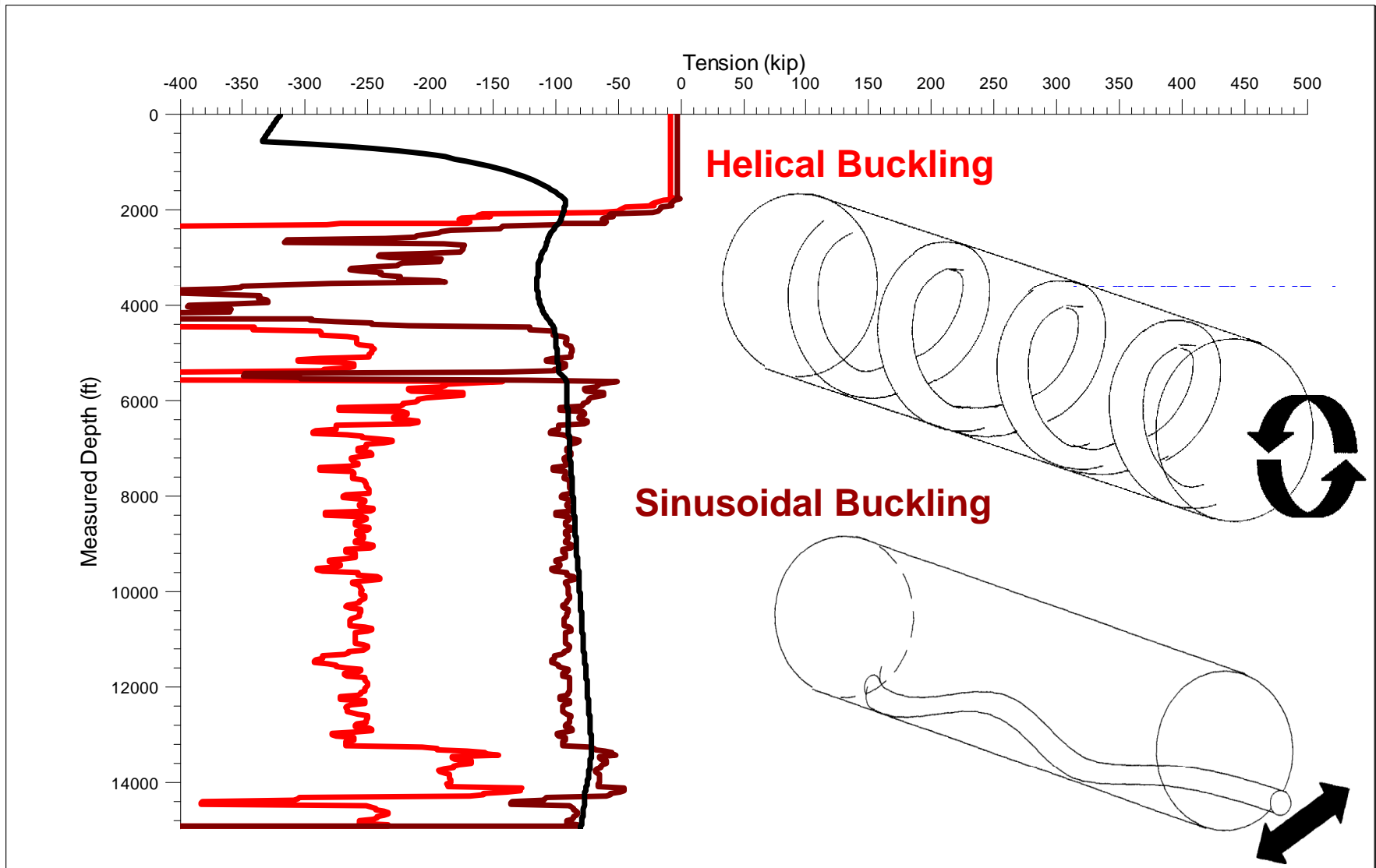
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- Operation: Gravel Pack
- Concern: Ensure the string does not unseat while fracturing
- 80,000 lbs on bottom desired
  - 30,000 lbs on the packer
  - 50,000 lbs max. up-force during frac

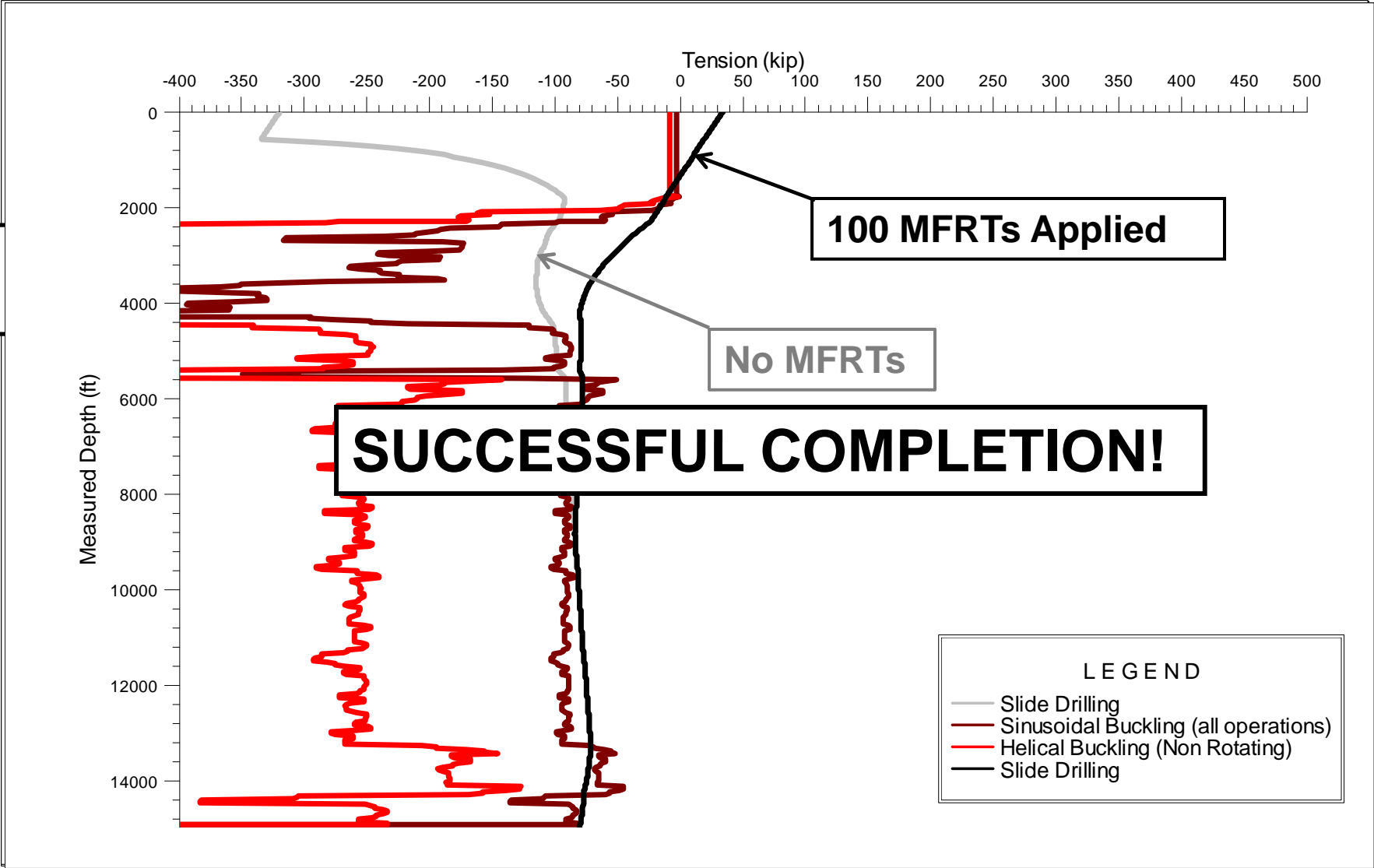
# T&D Modeling



# T&D Modeling



# T&D Modeling



## Section IV

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# Mechanical Friction Reduction Tools

# Casing Wear Reduction

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**Rotary Friction**

**Tool Joint**

**Wall of Hole**

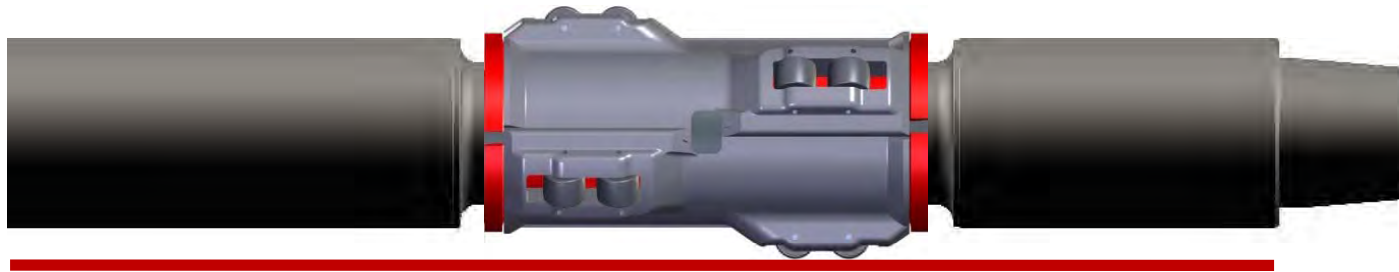
**Axial Friction**

**Tool Joint**

**Wall of Hole**

# Casing Wear Reduction

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## Rotary Friction

**MFRT Sub**

**Bearing Sleeve**

## Axial Friction

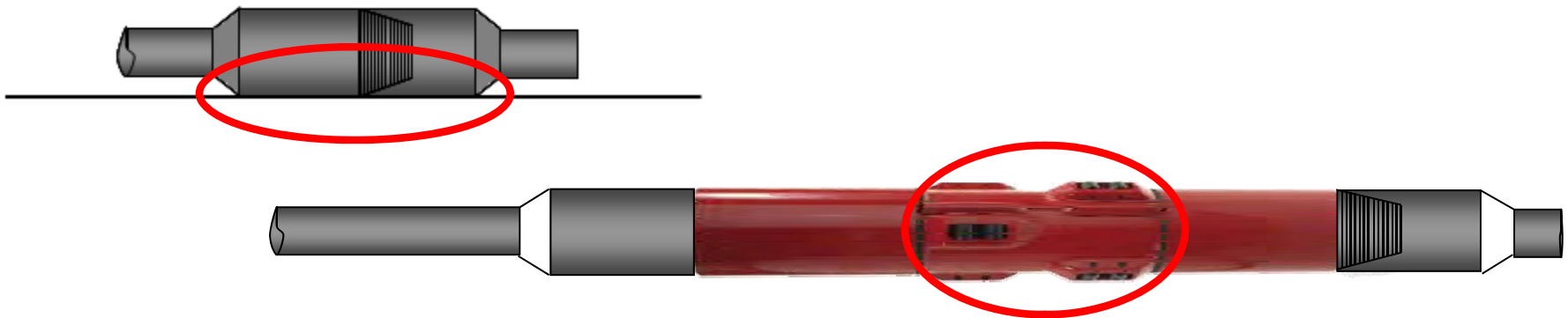
**Axle**

**Roller**

# Drag Reduction

$$F_D = F_N \times \mu \times \frac{|T|}{|V|}$$

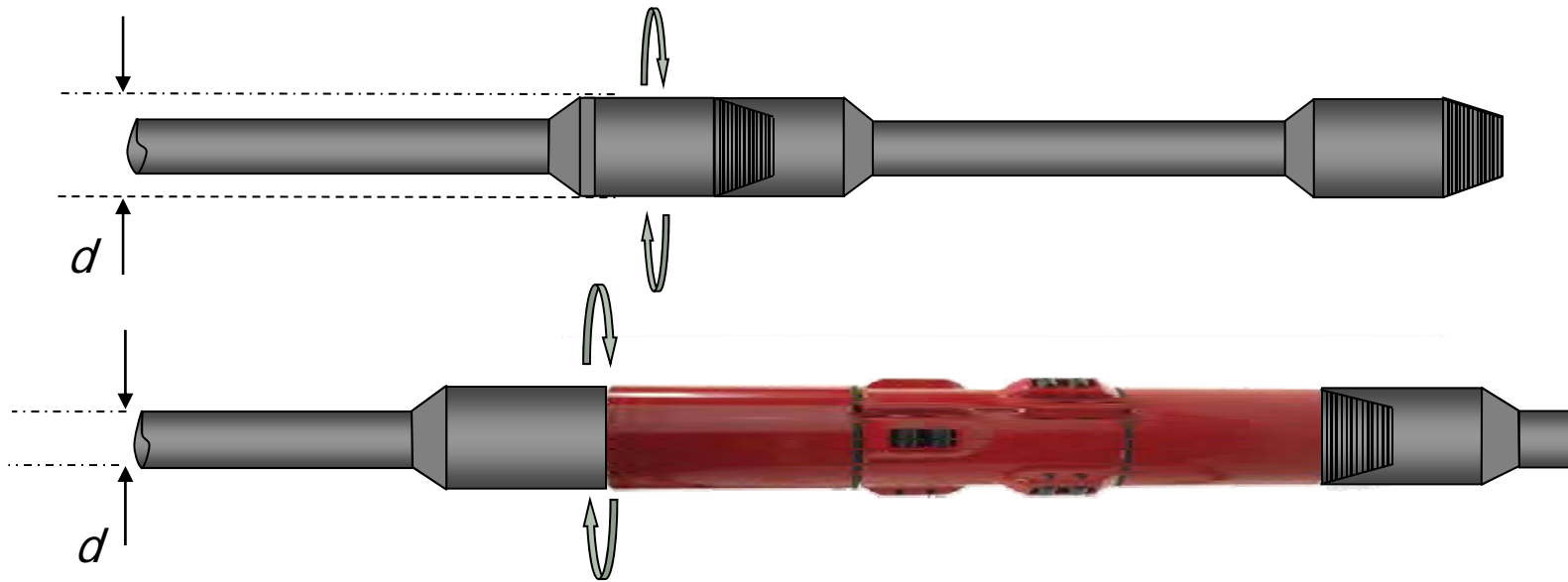
Drag Force      Normal Force      Coefficient of Friction      Pipe Movement



# Torque Reduction

$$\tau = F_N \times r \times \mu \times \frac{|A|}{|V|}$$

Torque      Normal Force      Radius of Rotation      Coefficient of Friction      Pipe Movement



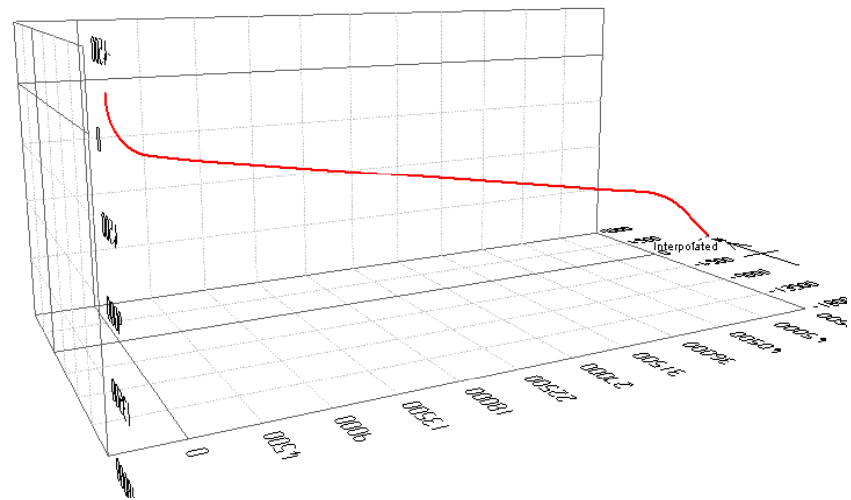
# Roller Tool Additional Applications

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- Casing Exits
- Rotating Liners (Cementing)
- Slide Drilling
- Running Liners and Sand Screens
- Casing and Drill Pipe Wear

# Conclusions

- Despite planning and best practices, some wells will have significant torque and drag issues
- Torque and drag can render a drilling target inaccessible
- MFRTs are a viable solution to torque and drag problems



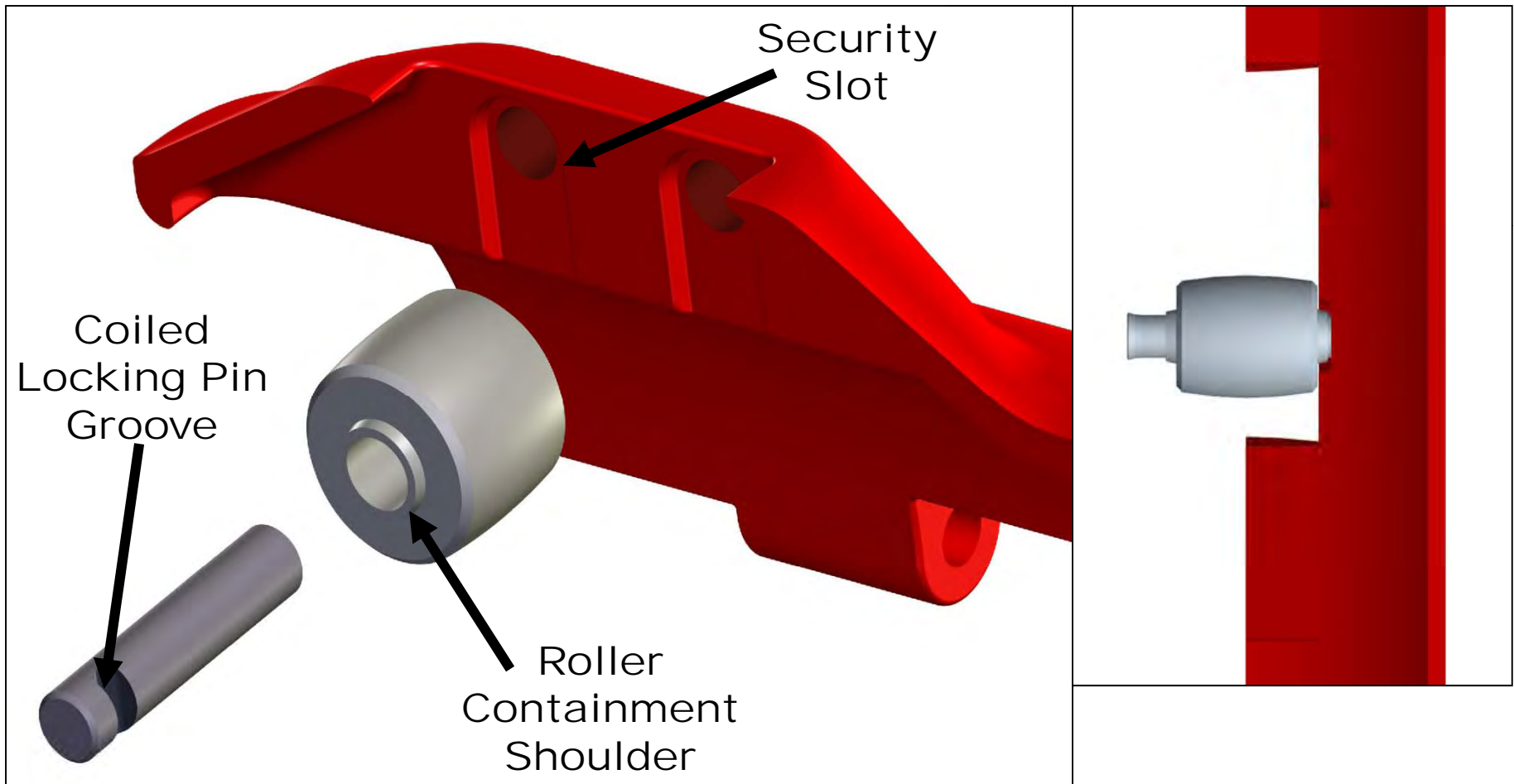
# Questions

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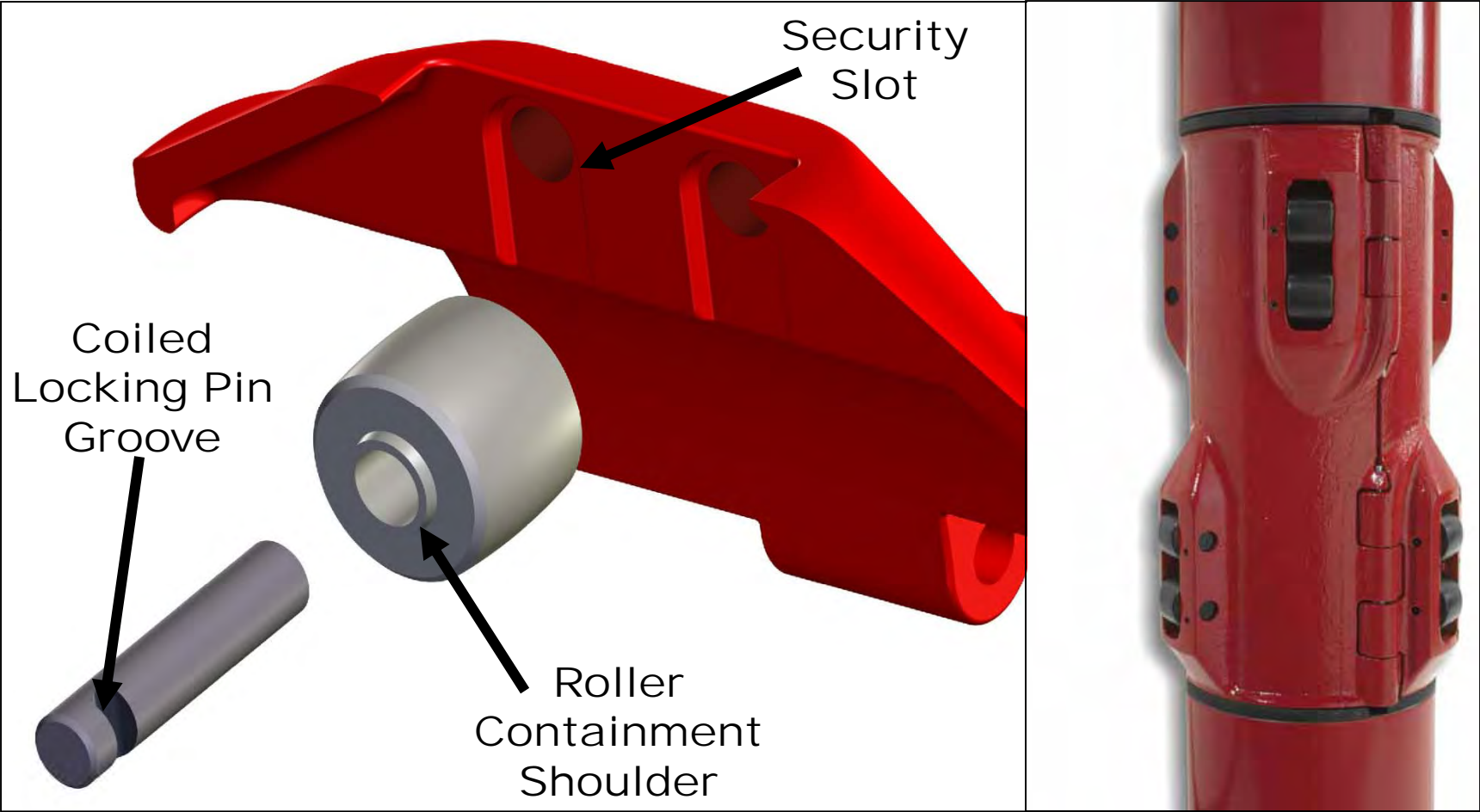
- Thank you for your attention.



# MFRT Roller Containment Features



# MFRT Roller Containment Features



# MFRT Operational Handling

