Alcoa Oil & Gas, Inc.

IADC --DEC Technology Forum

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Extending the Reach—with FarReach Drill Pipe Yields Significant Cost Savings

- Alcoa Oil & Gas, Inc.
- Directional Mud Motor
- Vertical Rigs

Alcoa at a glance

- Founded in 1888
- 200+ locations in 31 countries
- $25B in 2013 revenue
- Invented the Modern Aluminum Industry
- *Fortune* magazine's #1 "Most Admired" metals company[1]
- 125 years of metallics technical leadership including the original aluminum process
- Alcoa has invented 95% of the aluminum alloys that are in flight today

Number of Employees (2013)	
U.S.	26,000
Europe	17,000
Other Americas	11,000
Pacific	7,000
	61,000

Alcoa Oil and Gas (AOG) business unit

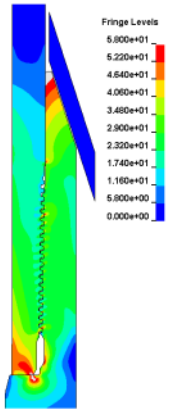
- Located in The Woodlands, TX (North of Houston)
- Independent business unit of Alcoa
  - A division of Alcoa Engineered Products and Solutions
- Cross functional team
  - Metals & O&G industries
  - Manufacturing, quality, technology
- Mission to grow oil and gas market for aluminum alloy solutions and sub systems
  - Riser
  - Drill pipe
  - Casing
  - Forgings, casting, tubing, sheet & plate

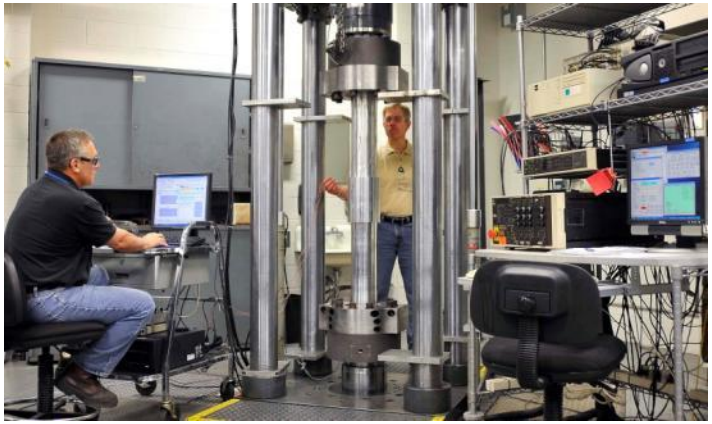
Houston, TX

Targeted O&G Investment in R&D

- Alloy Development
  - Leveraging aerospace
  - Microstructure-process-performance
- Corrosion
  - Seawater & CP System
  - Internal fluids
- Coatings
  - Corrosion mitigation
  - Wear
- Design, Analysis & Testing
  - Drill Pipe
  - Mechanical Connections
- Manufacturing
  - Fusion & Solid State Welding

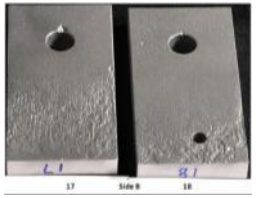
$10m+ Investment



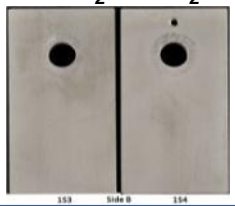


Drilling Mud 230F

Non-Sour- CO_2



Sour H_2S / CO_2



Epoxy Coatings Carboguard 890

Seawater Exposure

No CP ***With CP***

Benefits with Directional Mud Motors

- **Why Using Aluminum DP?**
- **Torque & Drag Basics**
  - Friction & Contact Forces
  - Weight / Buoyancy
  - Stiffness
- **Case Study**
- **BHA & Drillstring Design**
- **Results**
- **Conclusion**

Ryan Directional and Alcoa Oil & Gas

Why Using Aluminum DP?

- **Problematic**

  Torque & Drag & Buckling is a concern in long horizontal wells because of cumulative **Friction Forces** that lead to

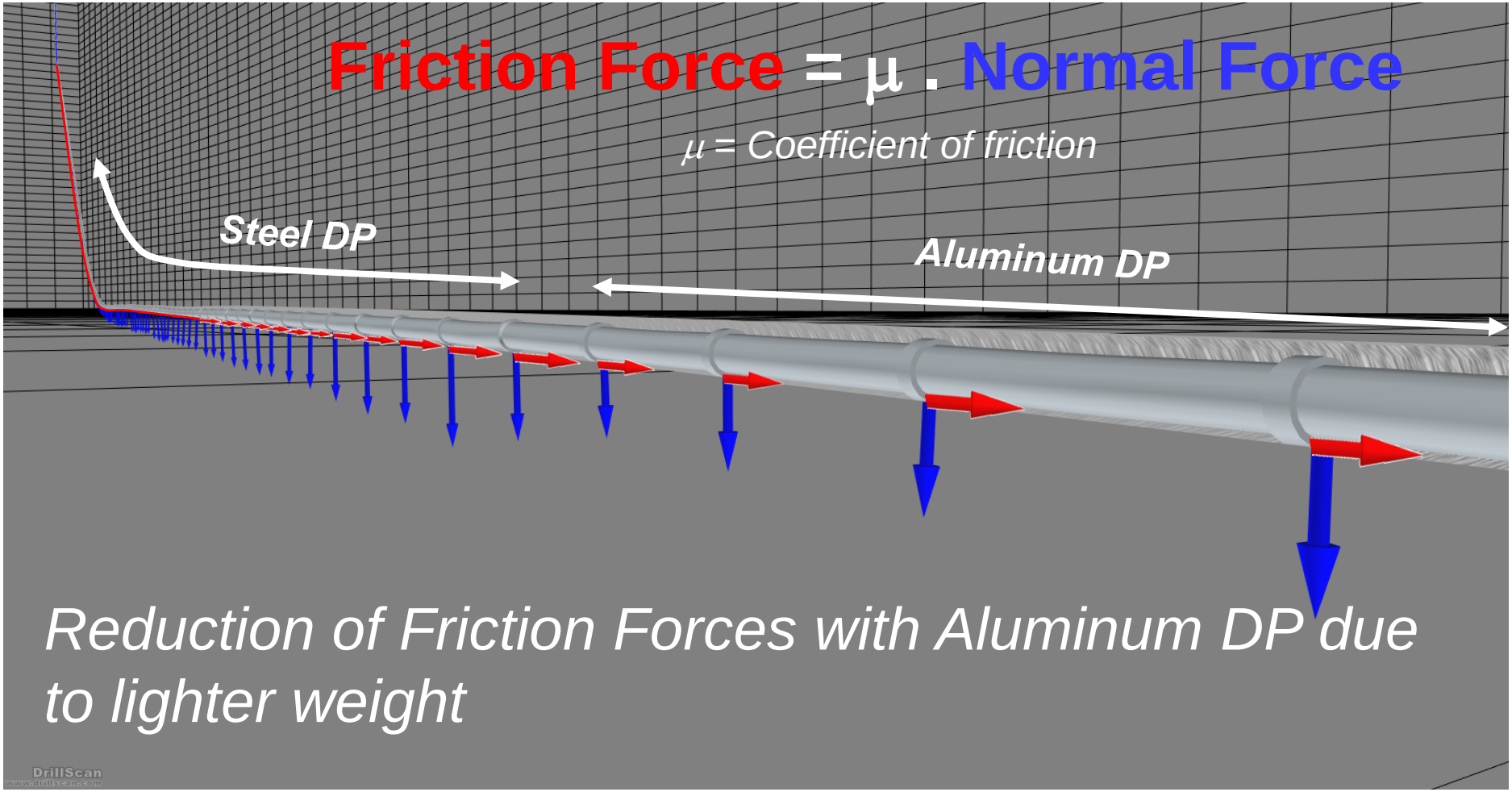
  - Excessive Torque
  - Compression & Buckling (poor WOB Transfer in sliding mode)
  - Limitation of the lateral extension of the well

- **Solution**

  Reducing **Friction Forces** with light weight Aluminum DP

Torque & Drag Basics

Contact Forces



SPE170255 • Successful Use of Mixed Aluminum-Steel Drill Pipe String In Complex Horizontal Wells: Case Study • Stephane Menand

Torque & Drag Basics

Weight & Buoyancy

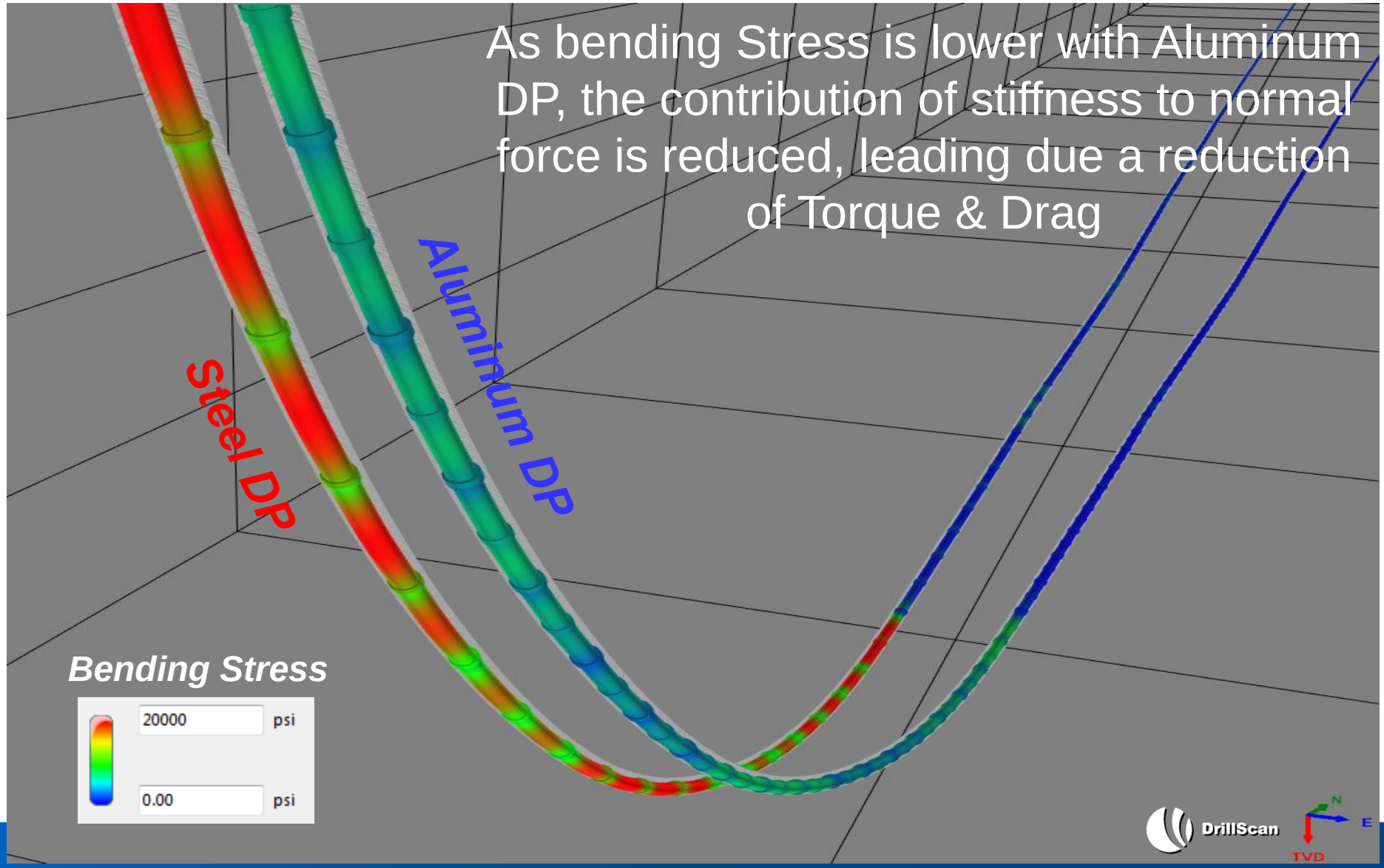
Pipe	Density	Weight in Air (lb/ft)	Weight in 10 ppg Mud (lb/ft)
5 7/8 in. Aluminum DP	2.80	16.6	9.5
5 in. Steel DP	7.85	23.6	20.0
Difference		**-30%**	**- 52 %**

Reduced Weight & Higher Buoyancy

SPE170255 • Successful Use of Mixed Aluminum-Steel Drill Pipe String In Complex Horizontal Wells: Case Study • Stephane Menand

Torque & Drag Basics

Stiffness



Torque & Drag Basics

Aluminum DP

Reduced Stiffness

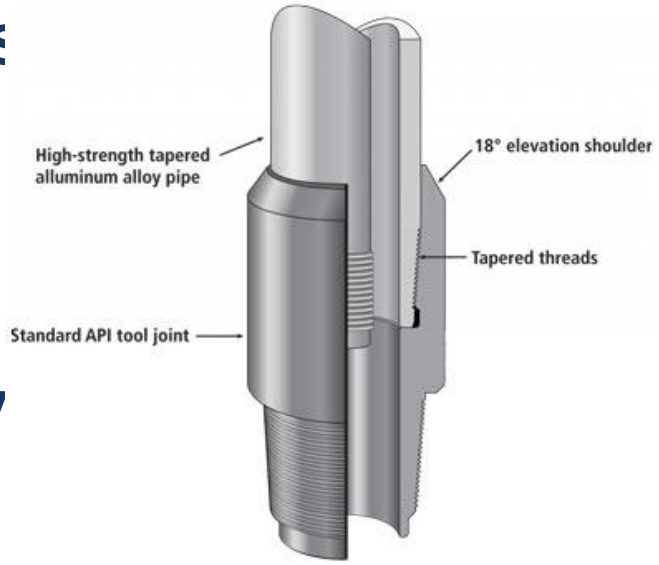
+

Lighter Material

+

Higher Buoyancy

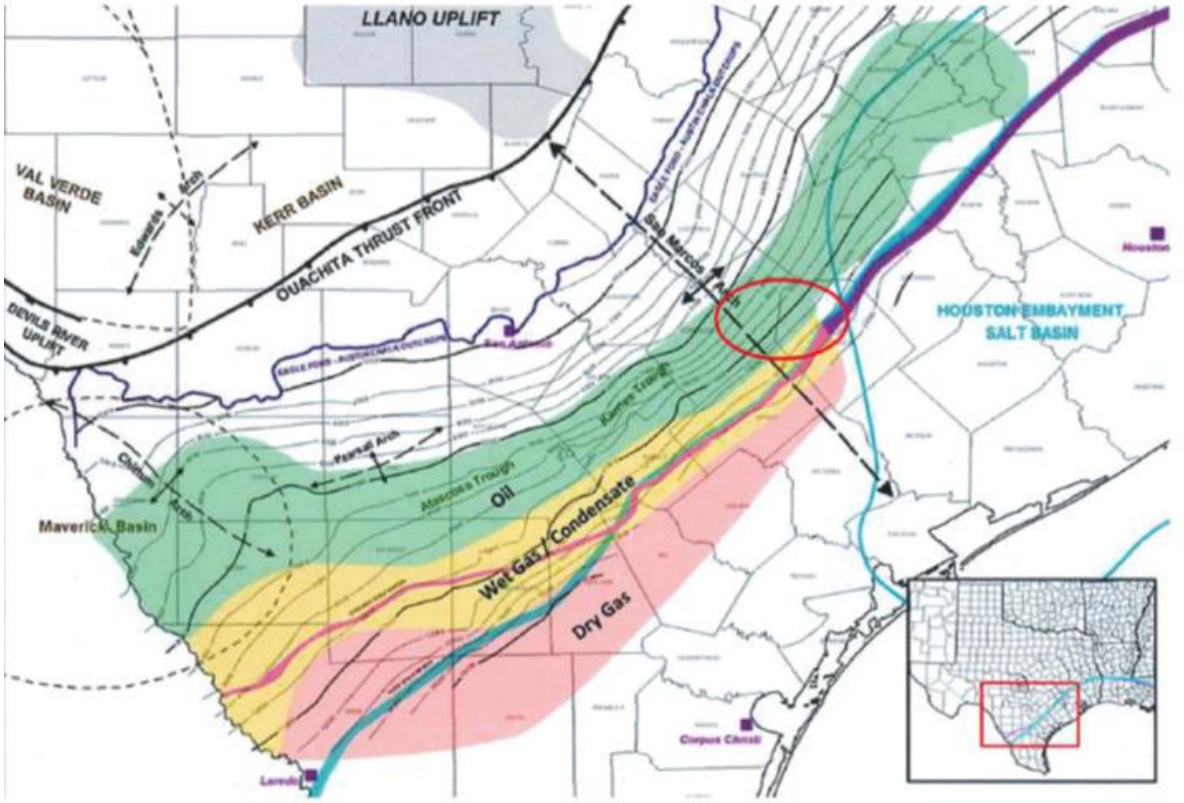
=



Less Torque & Drag

Better WOB transfer (Higher ROP)

Case Study in Shale Play

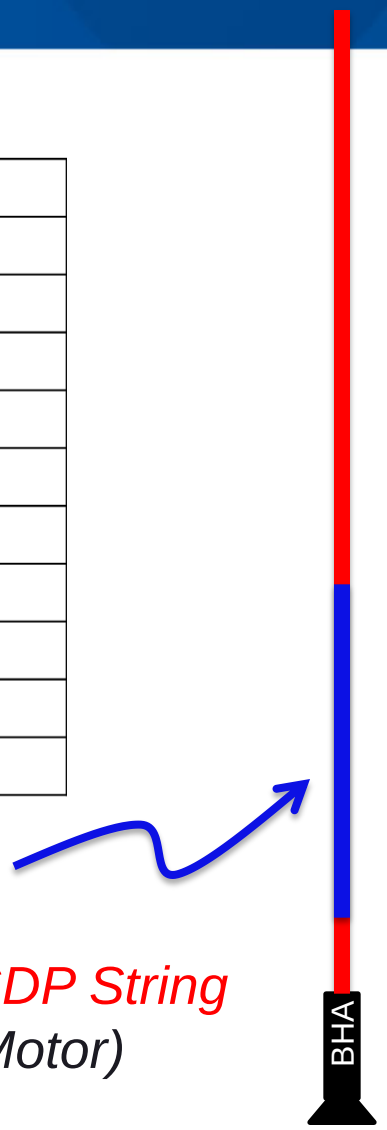


Case Study in Shale Play

BHA & Drill Pipes

	5" Steel SDP	5 7/8" ADP
OD (in.)	5	5.743
ID (in.)	4.28	4.68
ID Tool Joint (in.)	3 ¾	4.68
OD Tool Joint (in.)	6 5/8	7 3/8
Wear Pad OD (in.)	-	6 1/8
Grade	S135	2014-T6
Make up torque (ft.lbs)	38,044	51,100
Tensile Yield (klbs)	712.0	505.0
Torsional Yield (klbs)	74,100	58,000
Linear Mass (lb/ft)	23.40	16.60

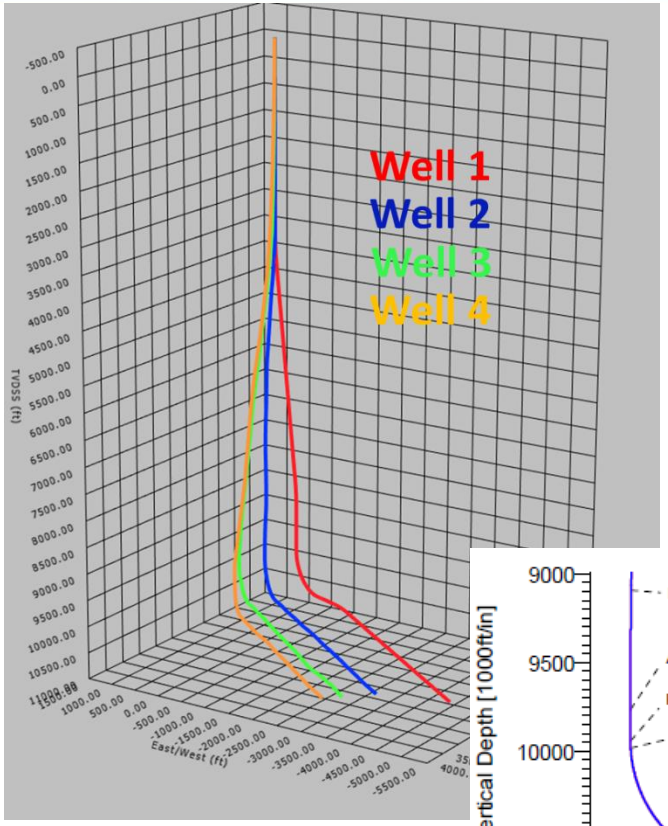
180 joints of ADP (~ 30% of the total length)



Comparison between Mixed SDP-ADP string and SDP String
***Same** PDC bit - **Same** BHA (Steerable Mud Motor)*

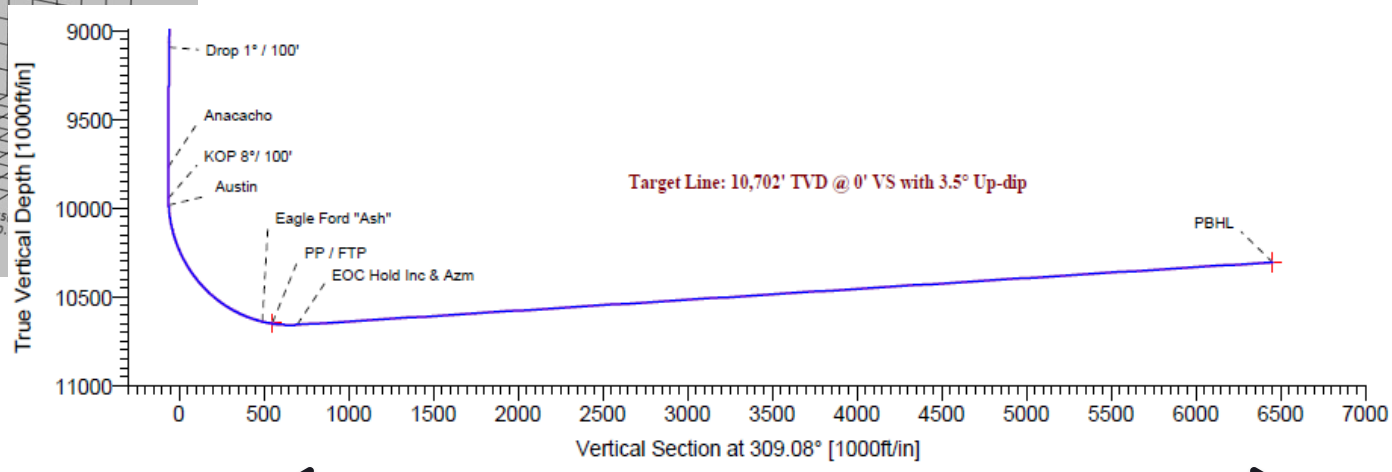
Case Study in Shale Play

Trajectory



Well 1
Steel DP String

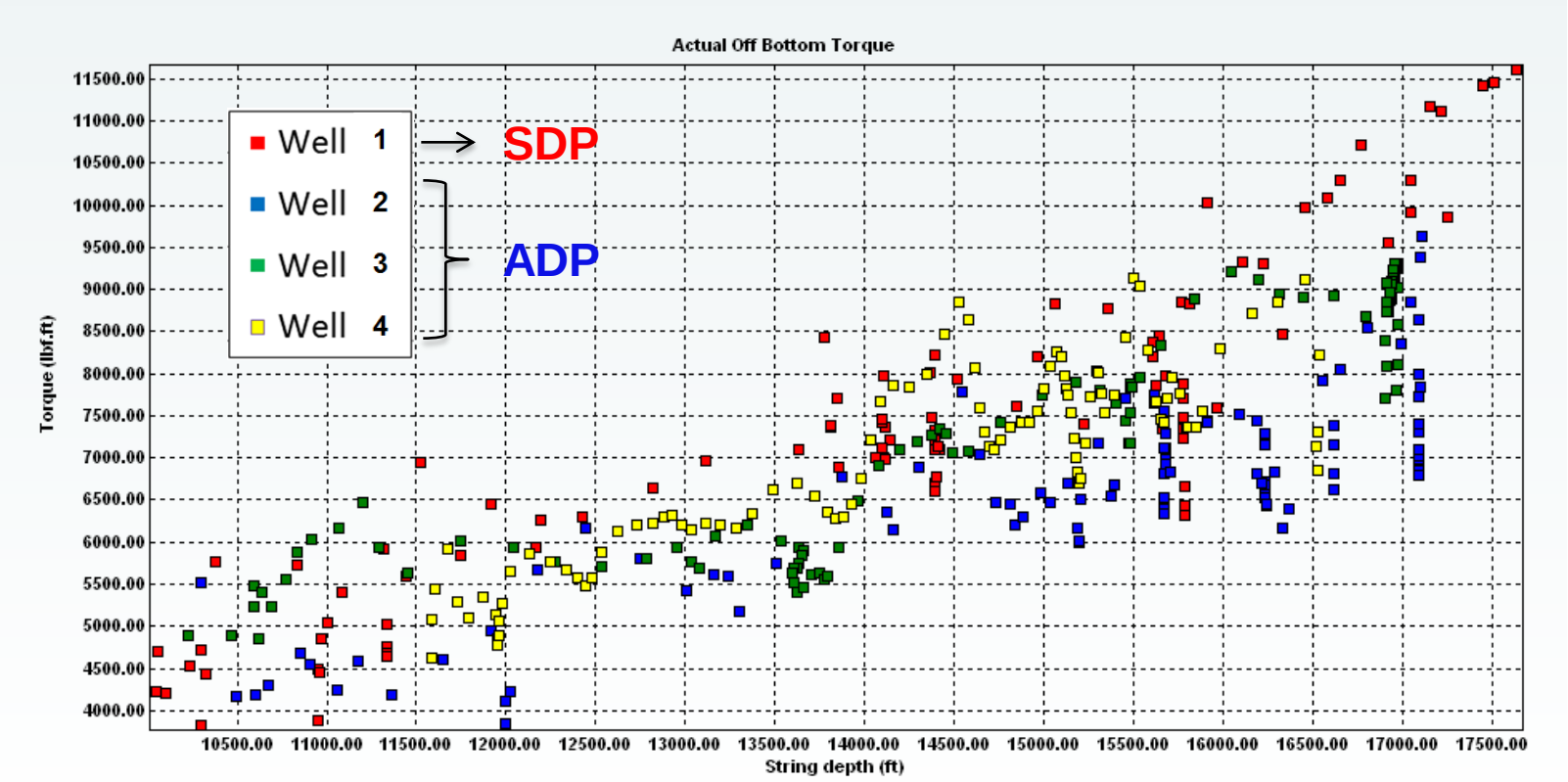
Well 2, 3, 4
Mixed Steel & Aluminum DP



Lateral length = ~ 6,000 – 6,500ft

Results

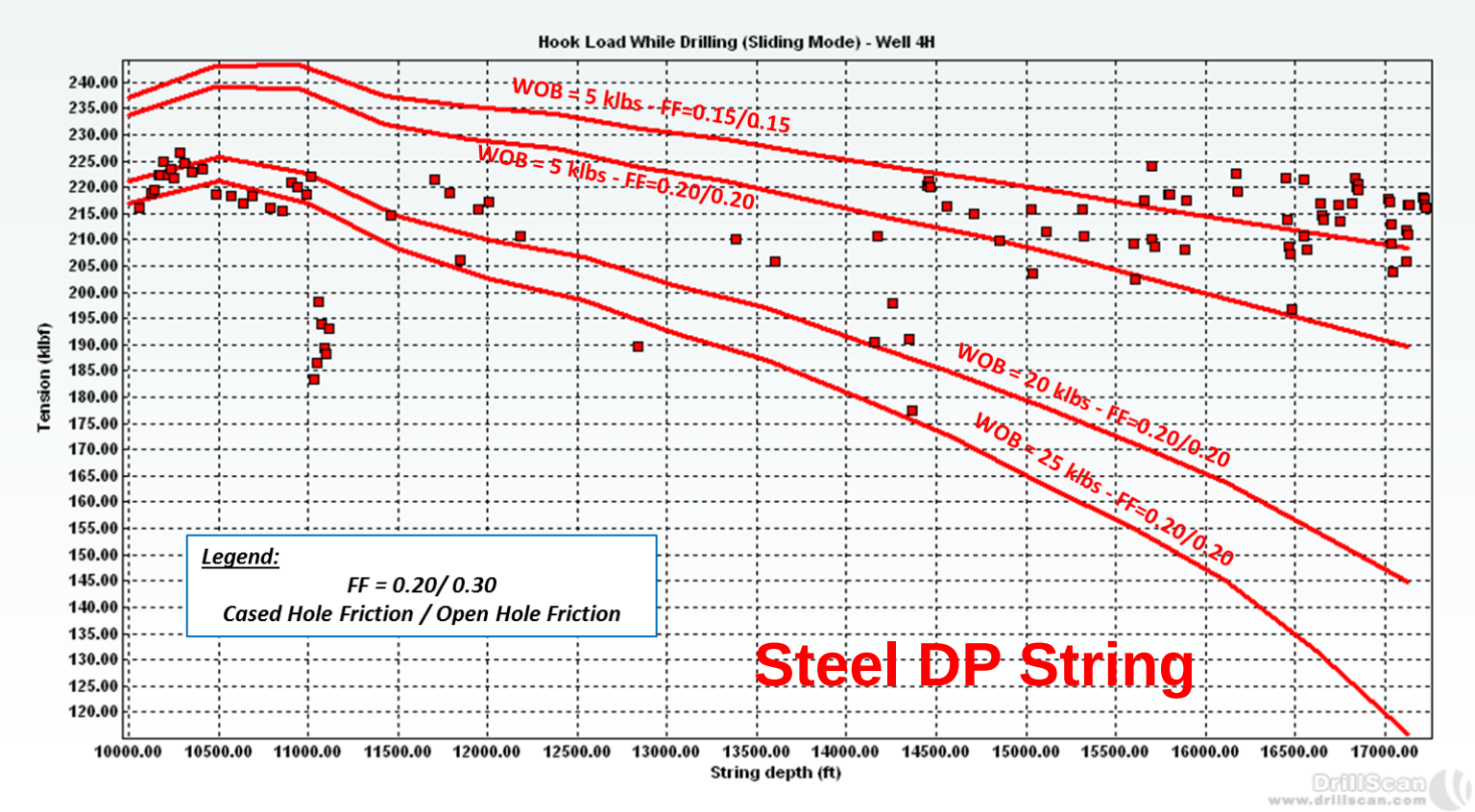
Torque off Bottom



Mean Torque Reduction = 25%

Results

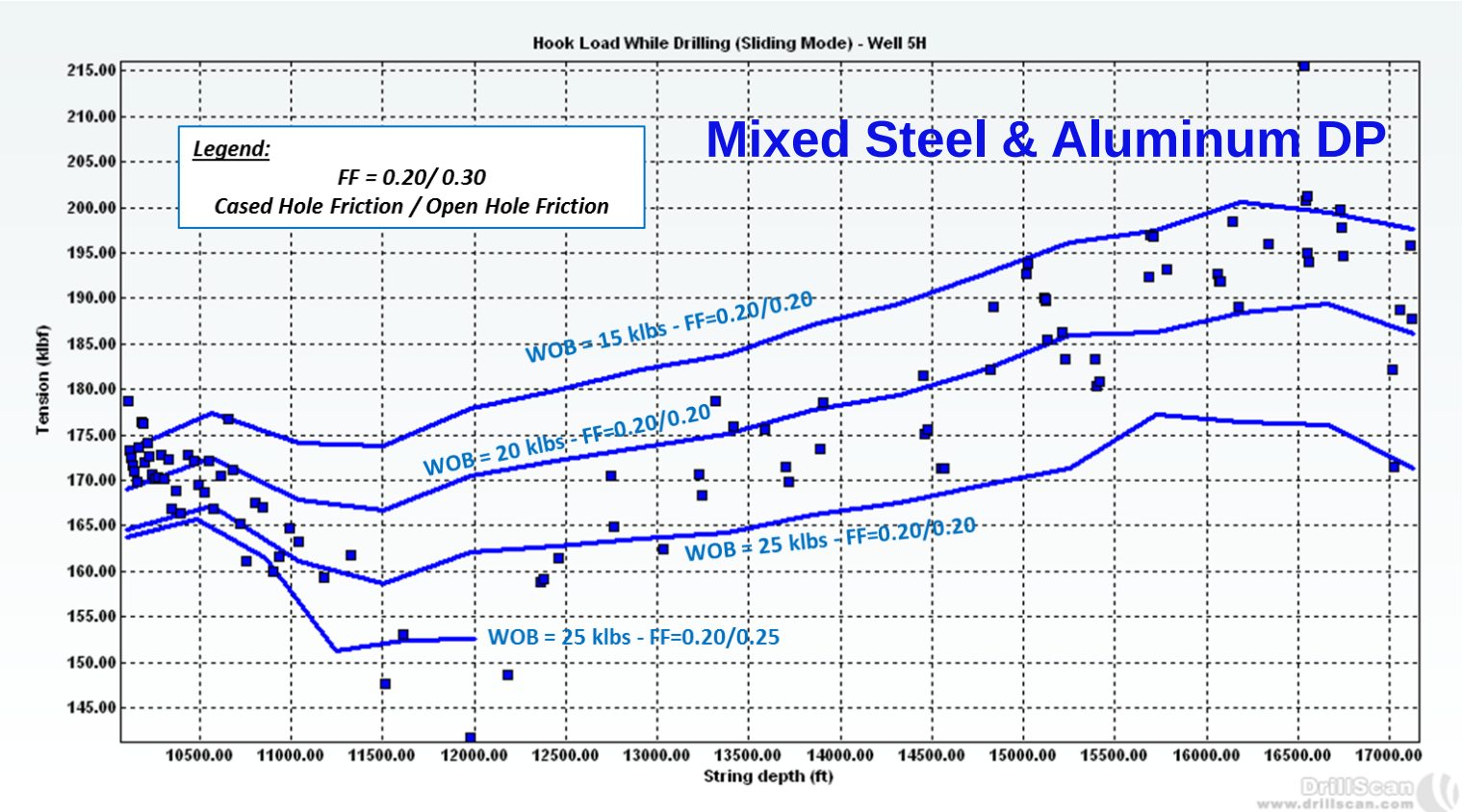
Hook Load While Sliding



Real WOB while sliding in the lateral section section = 5-10 klbs

Results

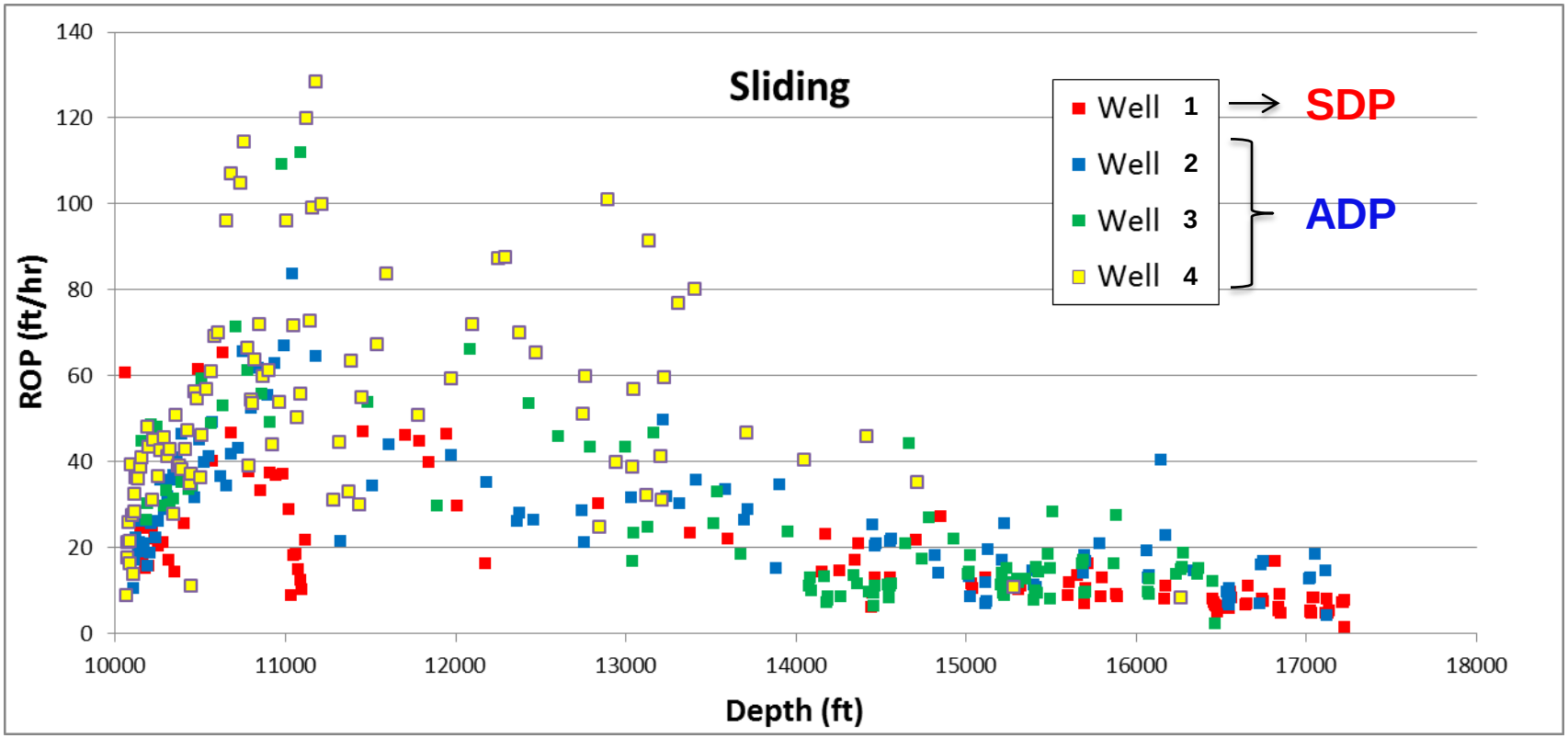
Hook Load While Sliding



Real WOB while sliding in the lateral section section = 15-20 klbs

Results

ROP

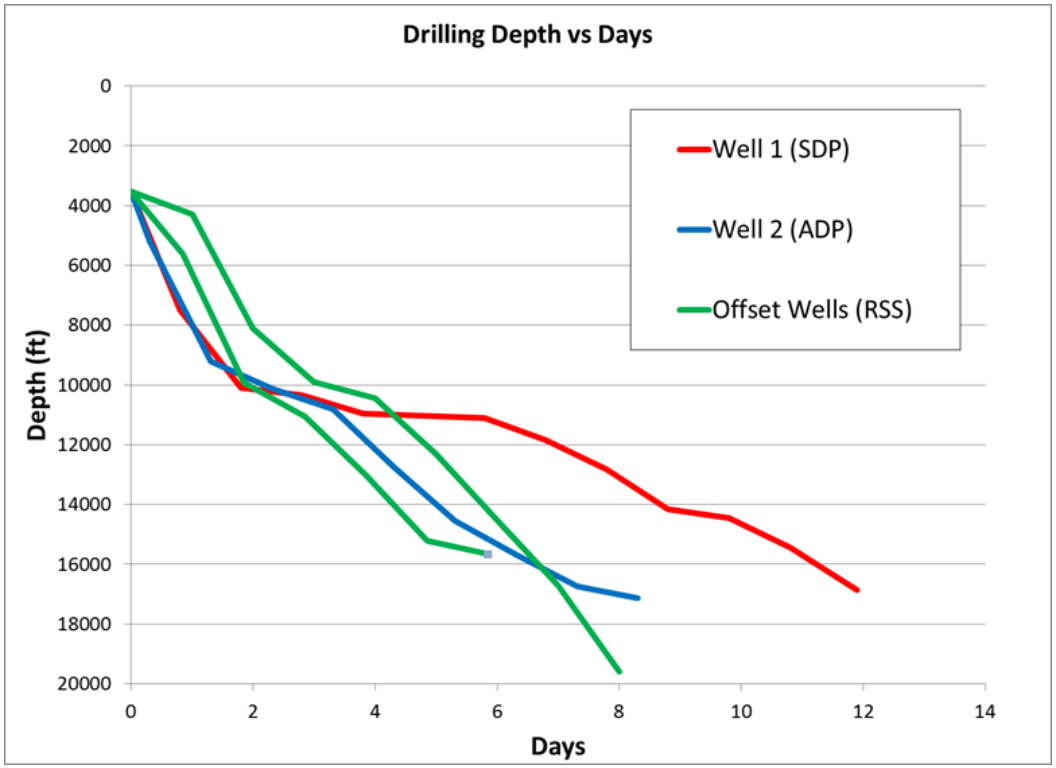


Mean ROP increase = *+43% (sliding)*
+ 8% (rotary)

Conclusion

- **Successful Use of Mixed ADP-SDP String In Complex Horizontal Wells**
- **Field results and simulations show that:**
  - Torque was reduced by 25%
  - WOB transfer was better (about +10 klbs at the bit) while sliding
  - ROP was increased by 43%

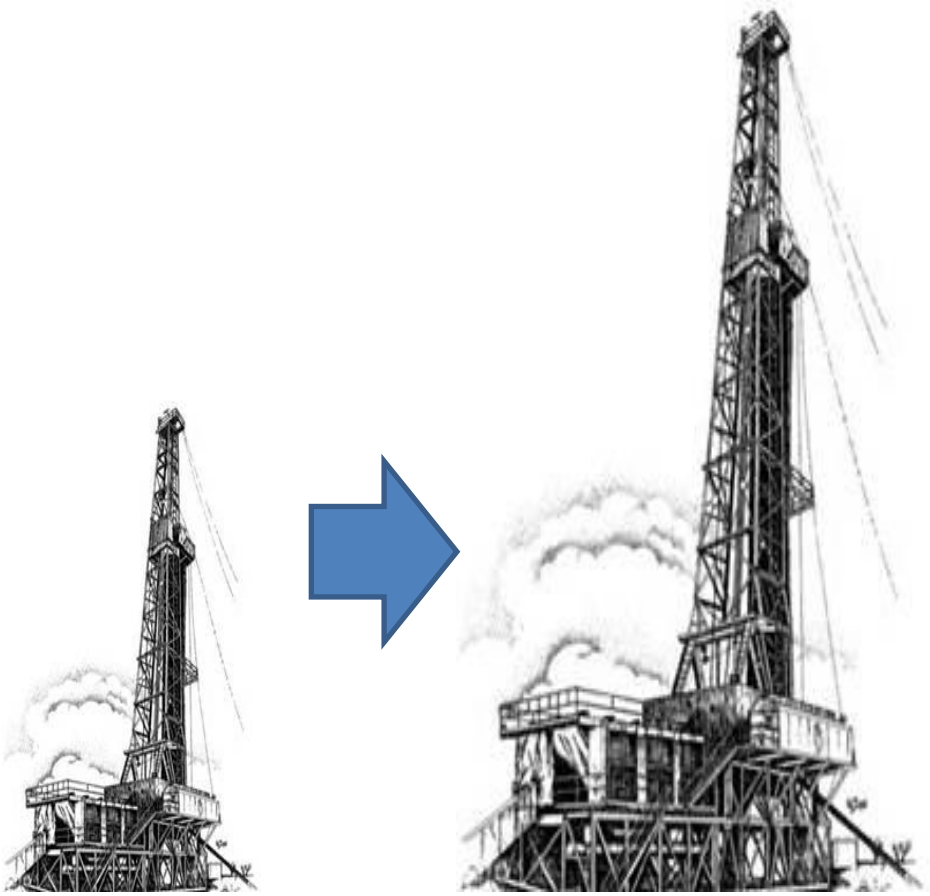
Conclusion



ADP associated with a steerable mud motor could be an economically and technically viable solution to compete with RSS in shale gas plays

The Problem: Can't Achieve your Goal without a Bigger Rig

- You need to drill farther to reach your goal…
- The traditional answer….bring in or create a bigger rig (if you can). The Result….
- Your costs rise rapidly…
  - Capital
  - Operating Costs
- Your footprint increases…
  - Permitting fees go up
  - More land space
  - More impact on roads, environment
  - Transport costs rise
  - More energy costs
  - Larger crews



What if…the answer was not a bigger rig?

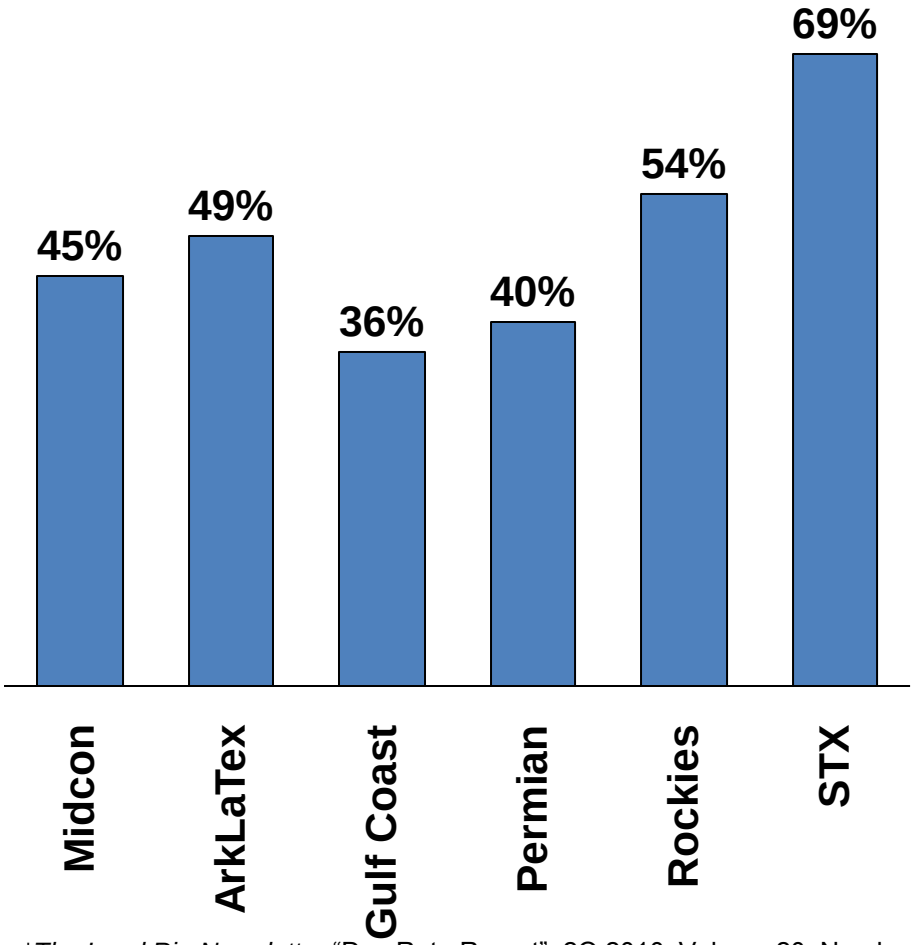
- What if:
  - You could use the same rig that you are currently but reach 30%-40% farther?
  - You could go to a smaller rig and achieve the same as the big rig?
  - You can't bring in a bigger rig but, using the existing rig, could now achieve your goal?
- If you could, you would:
  - Save Money
  - Save Time
  - Lower your environmental footprint
  - Produce hydrocarbons previously not accessible

The Cost of THE BIGGER RIG

Q2 2010 US Land

% Increase in Rig Cost

750 HP Rig -> 1500 HP Rig



**The Land Rig Newsletter* "Day Rate Report", 2Q 2010, Volume 20, Number 2

- Example:
  - **+$75000 additional cost -**10 Day Well using a larger rig in South Texas:

Case Study: Eclipse
Vertical Air Drilling

AlTiSS Aluminum Drill Pipe
RENTAL · SALES · SERVICE

Rig: Schramm T200XD Carrier Mounted Rig

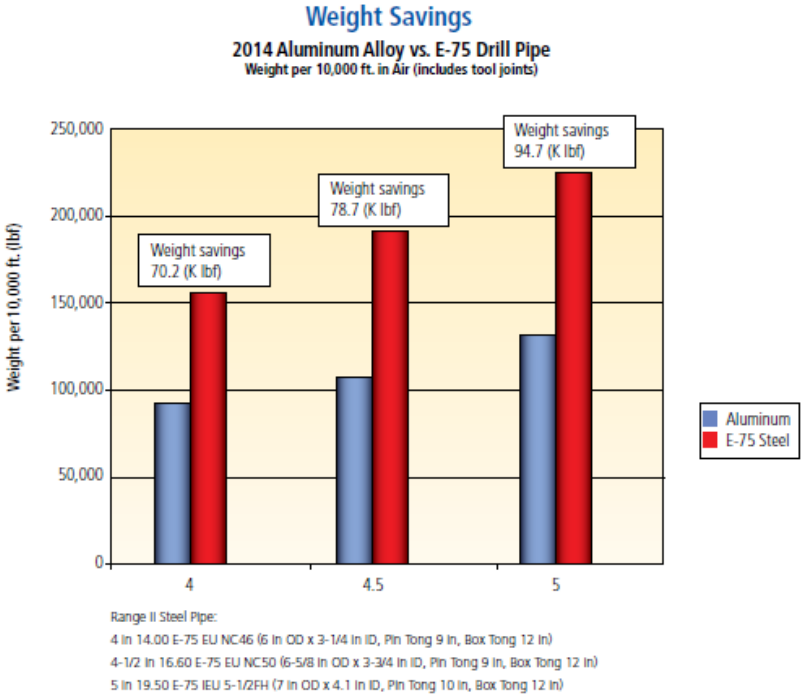
Hookload: 200,000#

Limitation:

- ❑BHA & 4.5” SDP 19.5#/ft,
- ❑Typically 5800’ in straight vertical
- ❑Hookload was maxed out
- ❑15 degree angle

Objective: Drill to 6410’

Solution: 3100’ of 4.5” steel pipe and adding 3300’ aluminum drill pipe



Benefits:

- ❑Reached TD of 6410’
- ❑Achieved 50,000’ overpull margin
- ❑Half from weight reduction of pipe
- ❑Half from reduced side load in deviated well
- ❑$150,000 cost savings per well

Conclusion

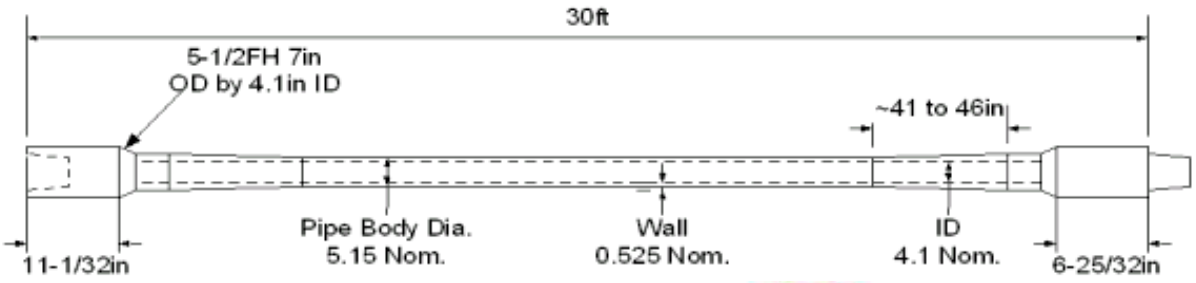
- **Significant opportunities to save money**
- **Rapidly gaining acceptance**

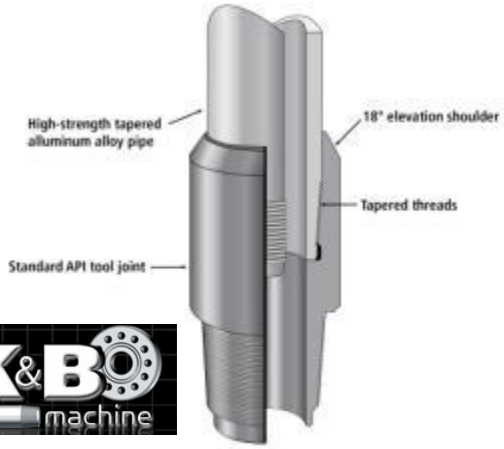
- Contact:
  - Jeffry Lehner
  - Technology GM
  - 281-292-3310

  - Abdias Alcantara
  - Business Development
  - 281-292-8325

Alcoa Aluminum Drill Pipe - AADP®

- Optimized tube geometry
  - Tapered upset tube
  - Strength-to-weight
  - Mechanical processing
  - Range 2/3 (long length)
- Connection you can trust
  - Thermal/interference fit
  - Pressure tight 5000 psi
  - Proven in the field 30+ yrs
  - Reynolds/Reed/Baker lineage
- Proven Alloy/Temper
  - T6 Peak strength temper
  - 2014 High strength 58 YTS
  - Good corrosion resistance
  - Good fatigue resistance
  - Reynolds lineage





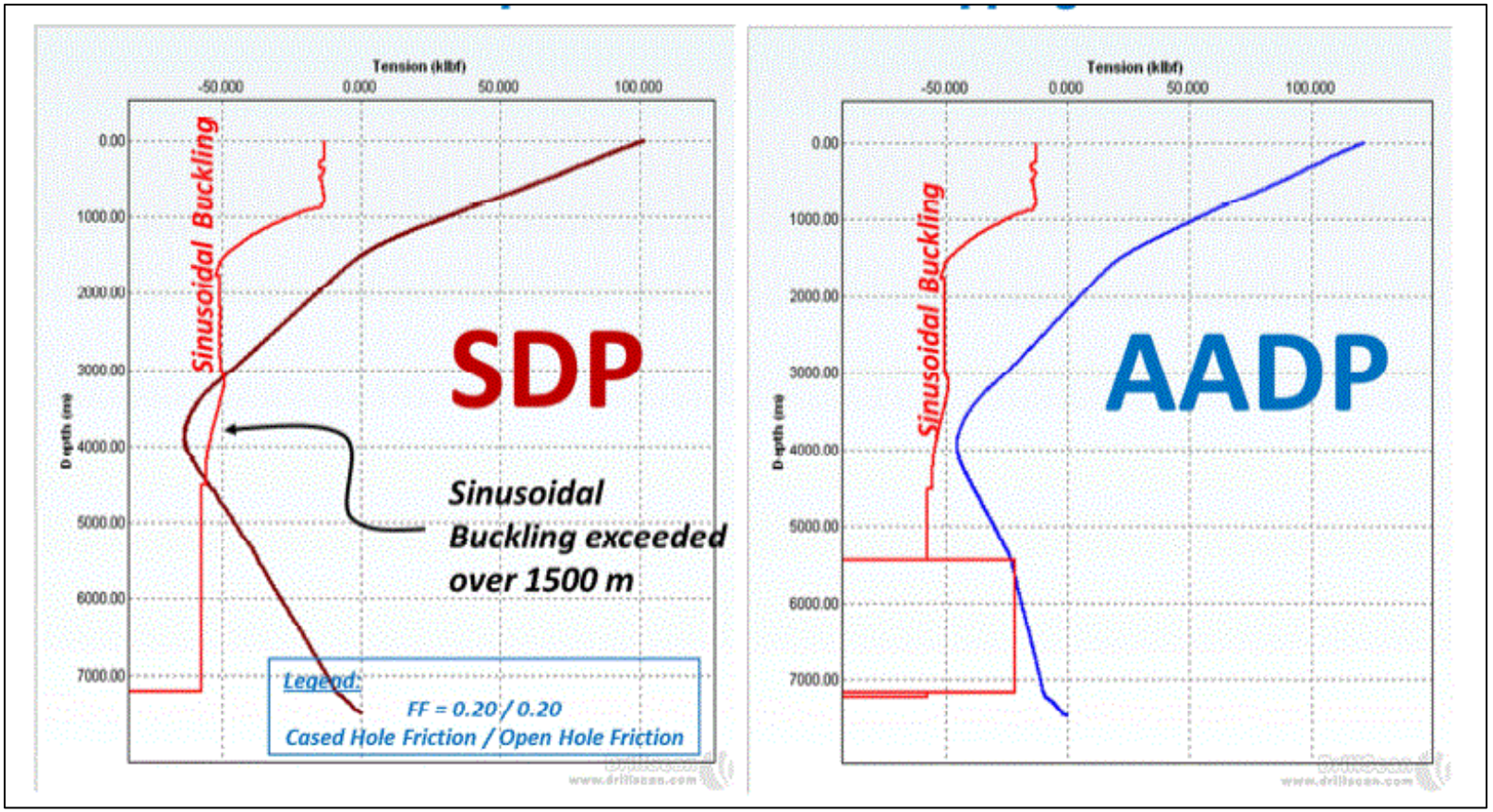
K&B machine

Shell

STRESS ENGINEERING SERVICES INC.

Strength Properties of 2014 Aluminum Alloy Drill Pipe	
Tensile Strength, minimum psi.	64,000
Yield Strength, minimum psi.	58,000

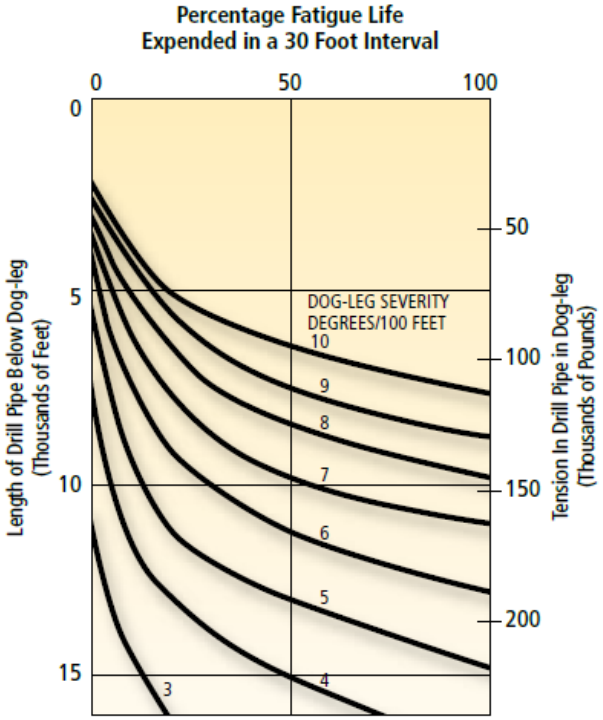
AADP can reduced tendency to buckling



In mixed string deployment the reduced weight & torque of AADP compliments steel pipe to reduce buckling tendency.

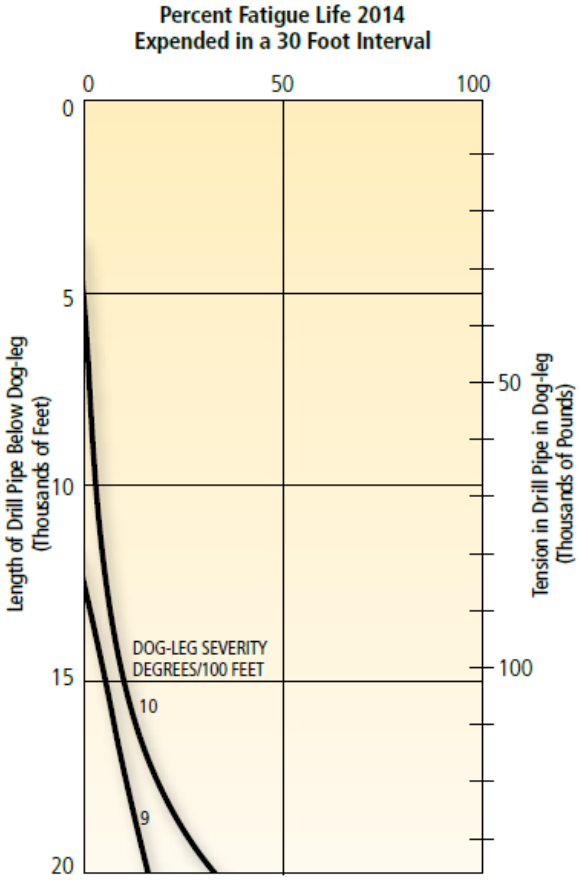
ADP Outperforms SDP in Fatigue!

Steel



*Fatigue Damage of 4-1/2" Grade E drill pipe in gradual dog-legs (non-corrosive environment: Rotary Speed, 100 RPM; drilling rate 10 ft./hr.; and mud, 10 lb./gal.)**

Aluminum Alloy



*Fatigue Damage of 4-1/2" aluminum drill pipe in gradual dog-legs (Rotary speed, 100 RPM; drilling rate 10 ft./hr.; and mud, 10 lb./gal.)**

Recent AADP customer reference list

- Shell Brunei Petroleum – Drill pipe, Offshore Brunei: Produced 10,000 ft of pipe for BSP for use offshore Iron Duke field in directional and horizontal ERD wells. Drilled May 2012 and December 2013
- STOS—Shell Todd New Zealand—completed ERD well from work over rig, extending reach of rig, 3435' added length, 30% less torque, drilled December 2013
- Eclipse—Ohio, extended vertical drilling reach of Schramm 200 rig by 3000', enabling lower cost rig to complete vertical section. Hook load reduction up to 50%
- Penn Virginia—Eagle Ford shale in south Texas. 30% improved ROP enabling use of lower cost mud motor directional steering as opposed to 3X more expensive RSS. May 2014
- Maersk—work over of 28,000' lateral, allowed extension of re-entry of uncased laterals, cementing and abandonment, allowing new parallel well to be drilled, and improving productive capacity of field. May 2014
- Fugro McClelland GeoSciences – Drill pipe, Offshore Brazil, Gulf of Mexico: Produced 6,000 ft of pipe for use in offshore survey work. Depths of 8,000 to 10,000 ft. Fugro has existing Alcoa (Reynolds design) pipe wth up to 20 year of service.