Rotary Snubbing Technology Option for Long Reach Horizontal Completions

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Presentation Overview

- Completion Program & Well Data
- Case History
- Underbalanced Rotary Equipment Technology
- Accomplishments
- Results
- Safe Practices
- Summary

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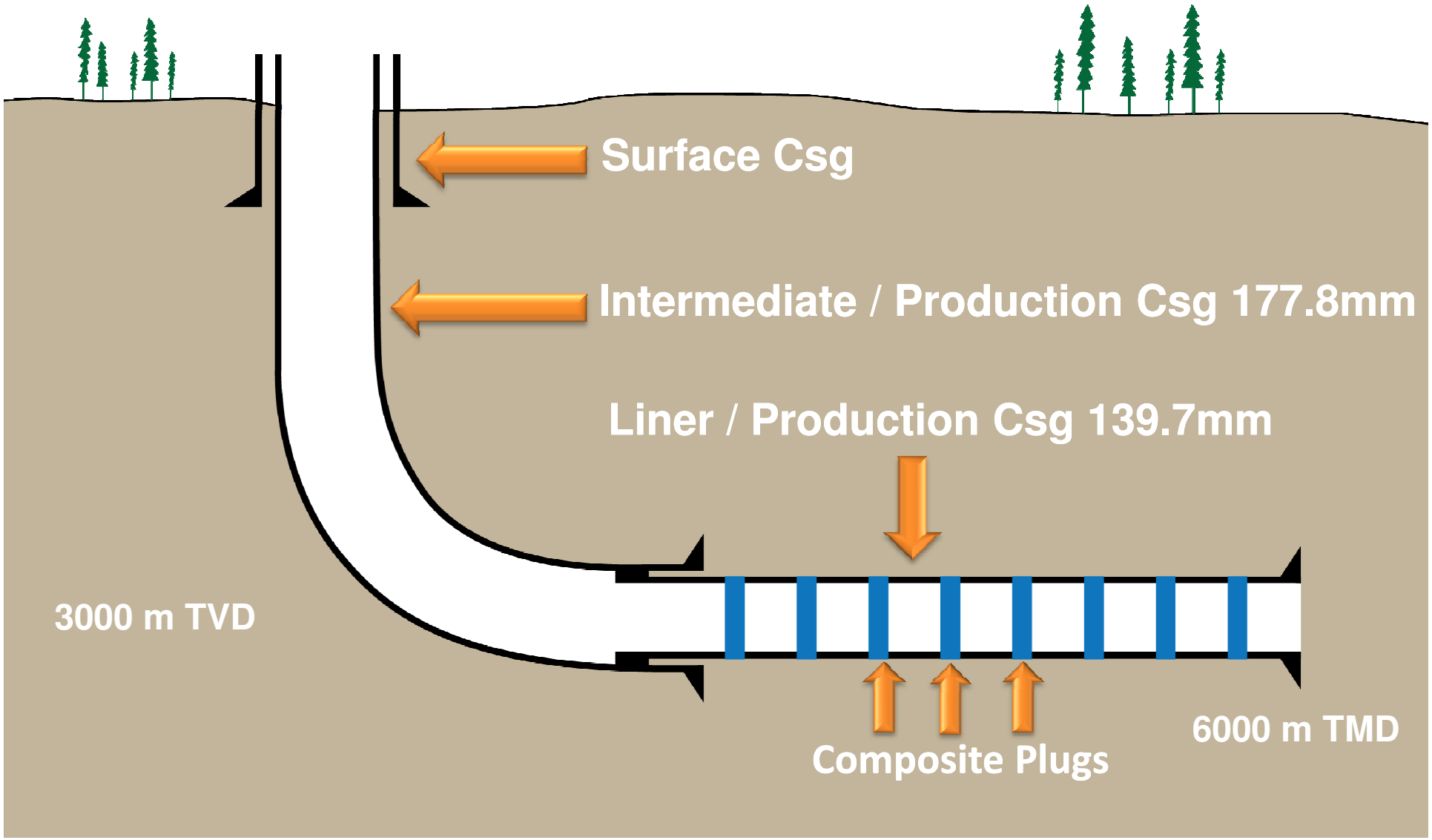
Wellbore diagram



Program

- Rotary drill 20-30 composite plugs in horizontal section with jointed pipe
- Bottom Hole Pressure (≈ 50 MPa)
- Bottom Hole Temp (≈ 140°C)
- T.M.D: ≈ 6300 m
- T.V.D: ≈ 3000 m
- Snub production tbg

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Case History

- 7 well horizontal pad in Northern BC
- TMD: >6000 m
- Total Lateral Section: 3000 m w/ 20-30 composite plugs
- BHA: Tooth bit, floats, jars (No D.C, No HWDP)
- DP: 73 mm SL H-90, 10.4 lbs/ft
- BOP: 10K Primary Class III
- Drill Fluid: Water, FR with 2-5 m3 gel sweeps
- D.P Pump Pressures: 16-25 MPa with FFR
- Csg return Pressures: 9-15 MPa with FFR

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Case History Continued…

- D.P Fluid Rates: 450-550 L/m
- Csg Fluid Rates: 450-550 L/m
- WT on BA: 1-2 Decs
- Rotary Torques: 2000-4000 ft./lbs.
- Rotary RPM: 50-60
- Connection time: 3-5 min per joint
- POOH (with toe to heel gel sweeps)
- All wells drilled and cleaned out with one bit run per well
- Snub in production tbg

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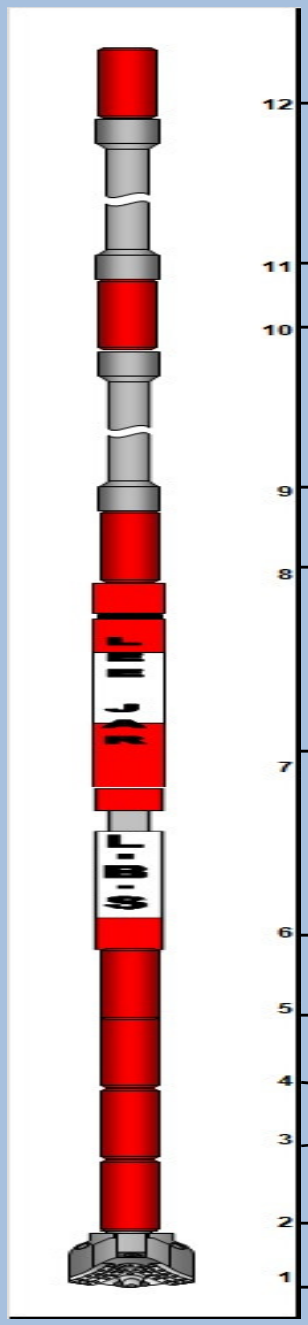
Bottom Hole Assembly



Float Sub

Drill Pipe

Float Sub

Drill Pipe

Crossover Sub

Hydraulic Jars

Bumper Sub

Crossover Sub

Float Subs

Bit Sub

JZ Bit

Note: *No Bit Release*

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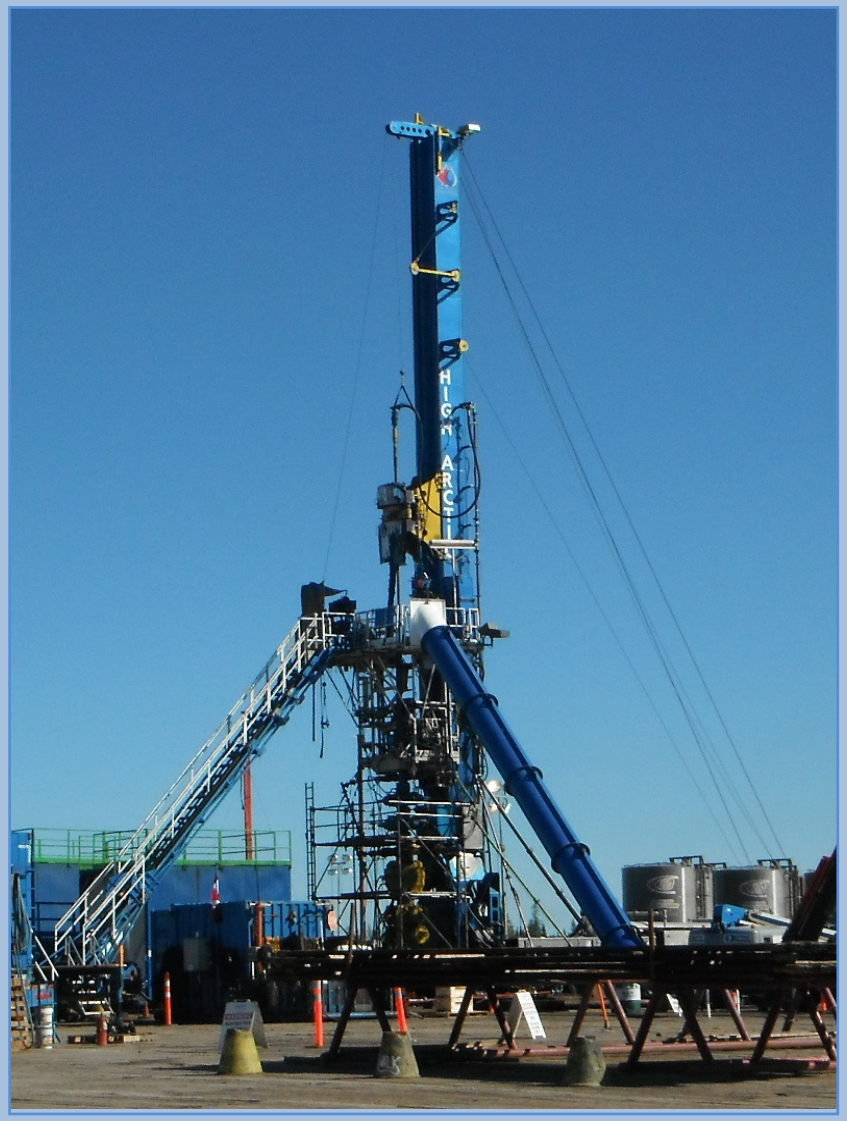
250K Rotary Underbalanced Rig Package



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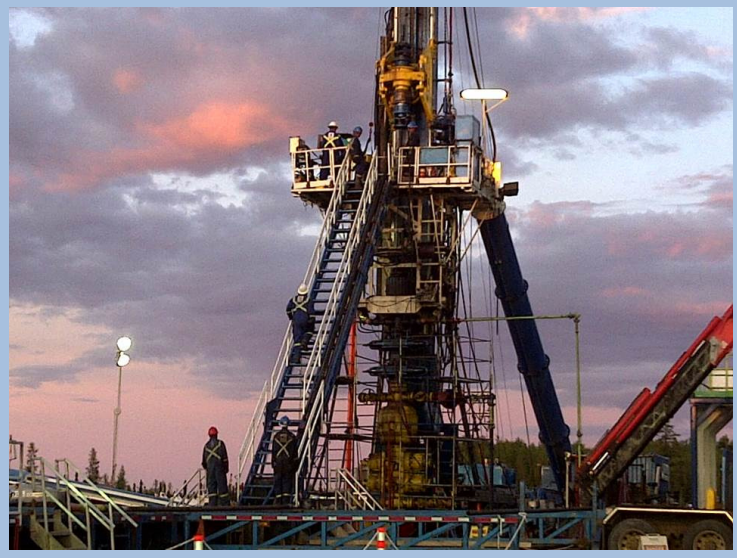
250K Rig Specifications

- Mobile carrier/mast
- Free Standing
- Hydraulically operated
- 250,000 lb. lifting capacity
- 125,000 lb. snub force
- Full stroke 24 m traveling hoisting assembly accommodate variety of BOP's
- 3 - 5 ton hydraulic winches c/w boom
- Rack & pinion mast with rotary hoisting assembly
- Escape Egress Slide System



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PLC Controls

- Controls can be set for the operating parameters of the well
- Emergency Stop Loop

Travelling Rotary Head

- 80 RPM @ 12,000 ft. lbs.
- Rotary drilling head built into traveling hoist assembly
- Rotate to drill through secondary annular
- Additional flow diverter not required

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Pipe Handler with Class III Accumulator System

- Fully mobile
- Winch controlled pipe skate for delivery of pipe to floor level
- Dual-sided swing out pipe racks with hydraulic jack system

- Separate Accumulator for primary BOPs. Sufficient capacity for 5K, 10 & 15k BOP stacks and shear blinds
- Secondary snubbing BOPs mounted on rig carrier and independently operated

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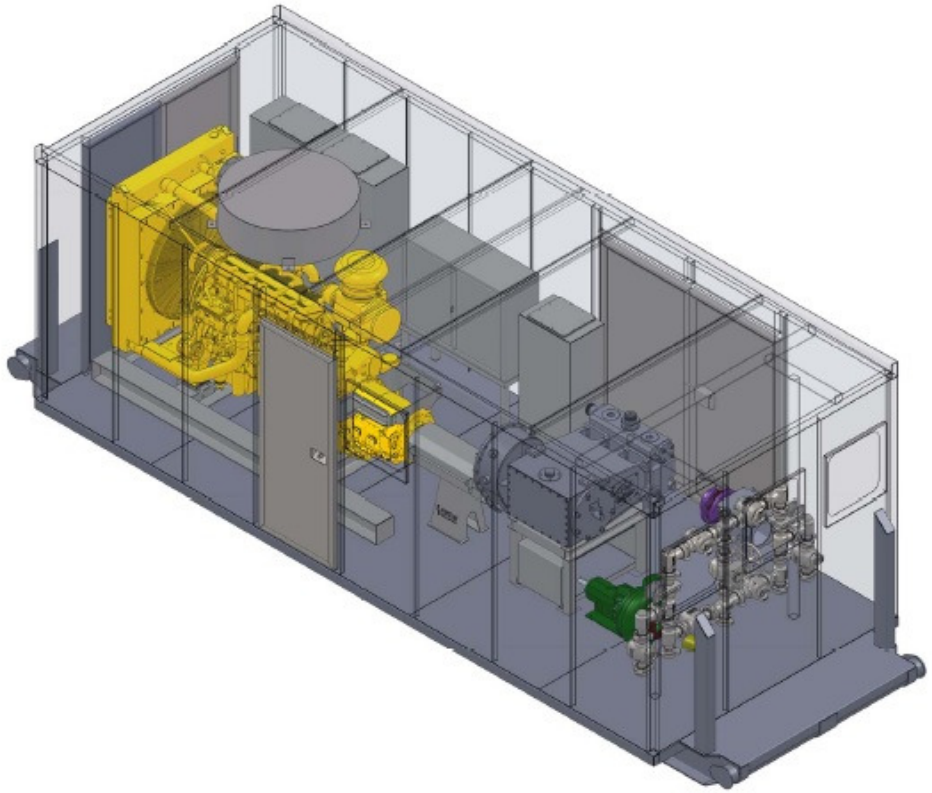
Main Pump



- 1000 HP
- 70 Mpa manifold
- 5 X 6 charge pump
- 12V 2000 850 HP Engine
- 15K- 2” 1502 Line Pipe

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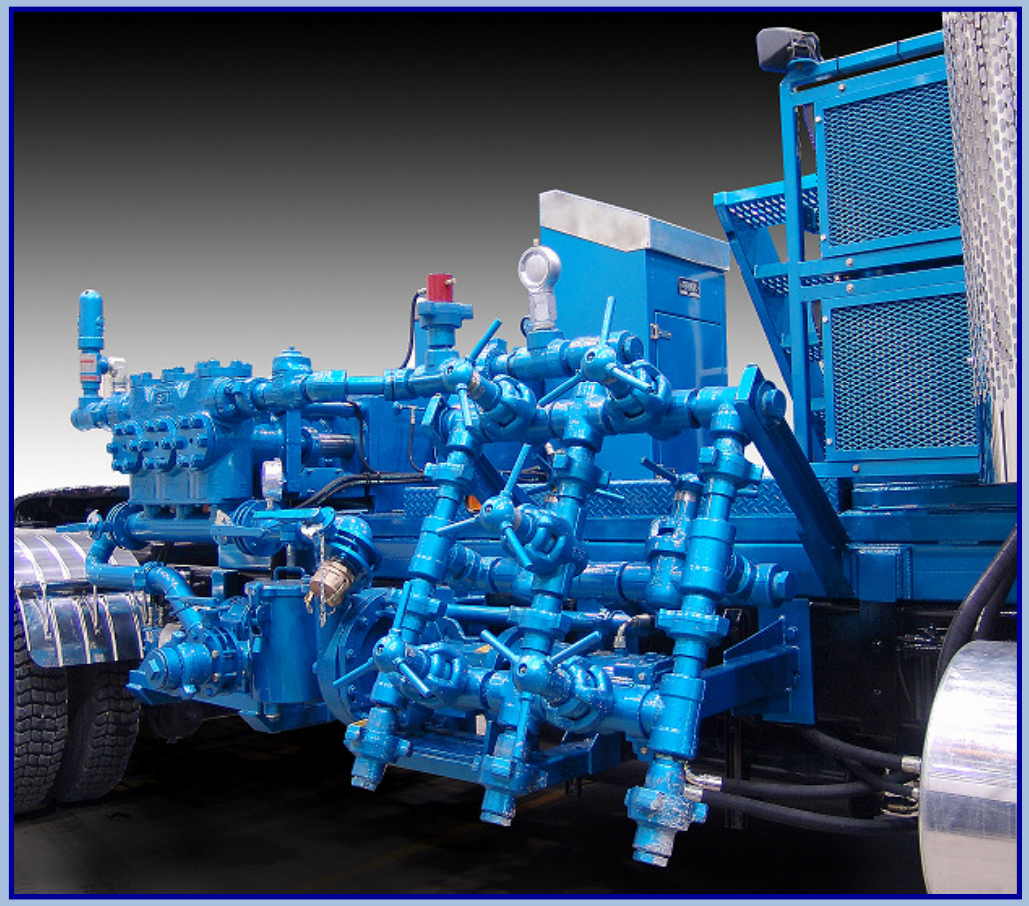
Additional Spare Pump

- Mobile Truck mounted
- 4.5 X 6 Triplex pump
- 5 valve 35 MPa manifold
- Mission and Bowie boost pumps for precharge and suction
- 1502 Line pipe



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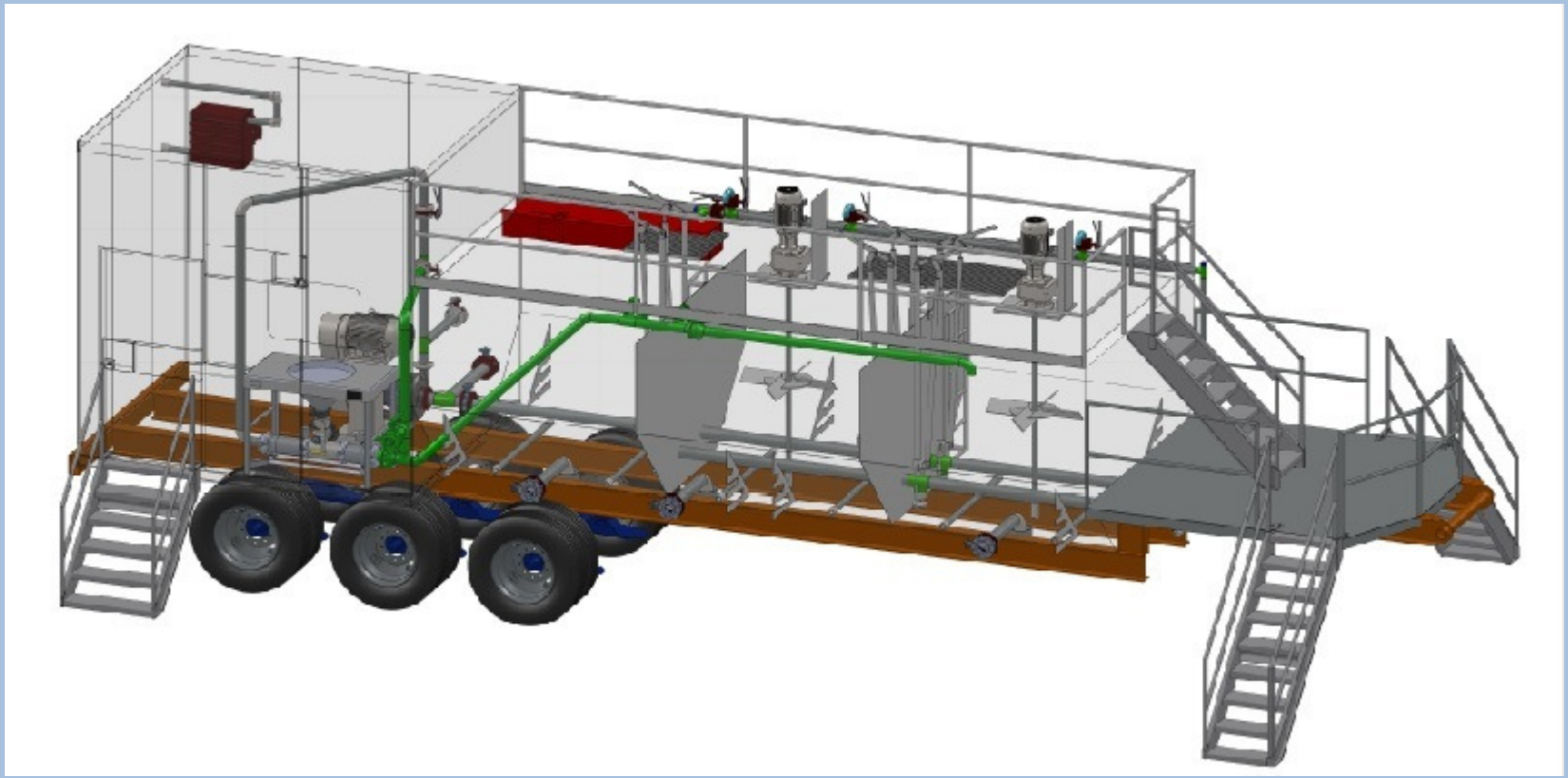
Mud Tank



- 30 m^3- 3 compartment tank
- 2 mixing tanks with agitators
- Mixing hopper with centrifuge pump

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Mobilization

- 1) Crane Carrier/Rig. 2) Accumulator Truck/Pipe Handler, 3) Pump Truck/Mud Tank, 4) Crane Truck/Doghouse/Tool Crib/Gen Set
- Additional loads required for hauling matting and boiler etc.
- 24 wheel trailer
- Ability to move at 100% road ban, with tractor and Jeep

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Accomplishments

- Rotary Drilled without mud motors
- Controlling wellbore annular flow back
- High B.H.T (m^3 in m^3 out method)
- Control D.P torque and drag with FFR
- Fluid System and Hole conditioning with gel sweeps
- TMDs > 6000m

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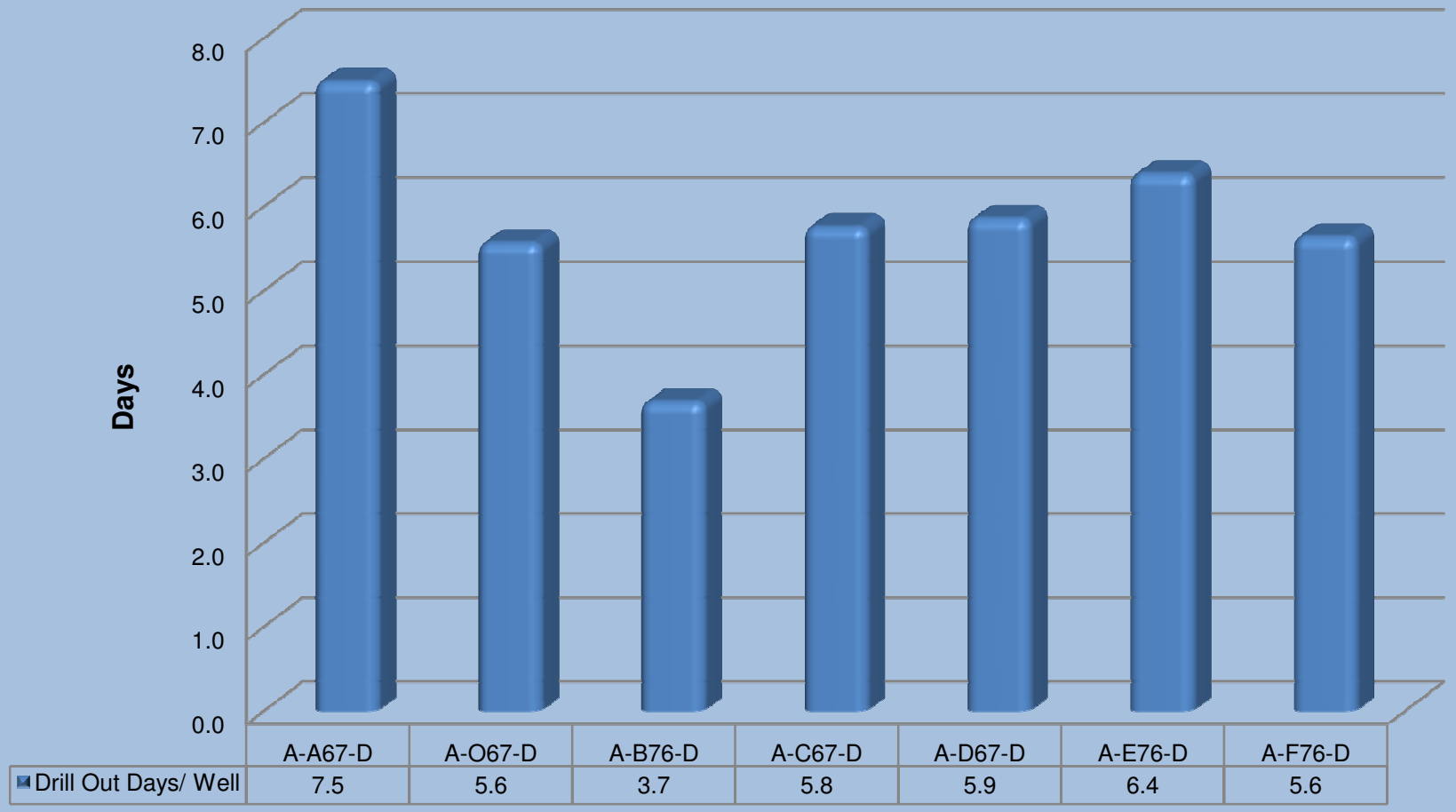
Drill Out Days Per Well



	A-A67-D	A-O67-D	A-B76-D	A-C67-D	A-D67-D	A-E76-D	A-F76-D
Drill Out Days/ Well	7.5	5.6	3.7	5.8	5.9	6.4	5.6

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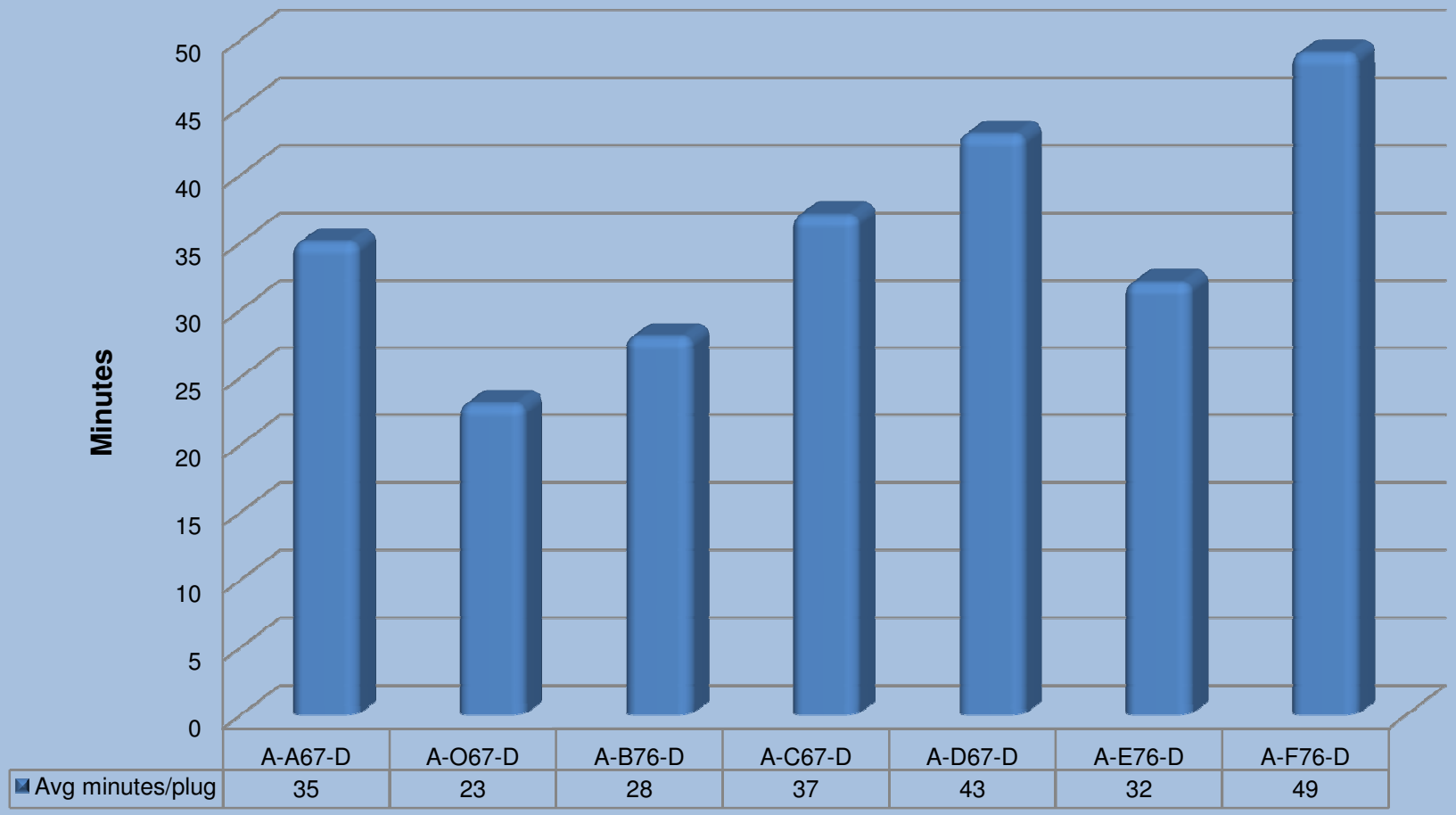
Average Minutes Per Plug



	A-A67-D	A-O67-D	A-B76-D	A-C67-D	A-D67-D	A-E76-D	A-F76-D
Avg minutes/plug	35	23	28	37	43	32	49

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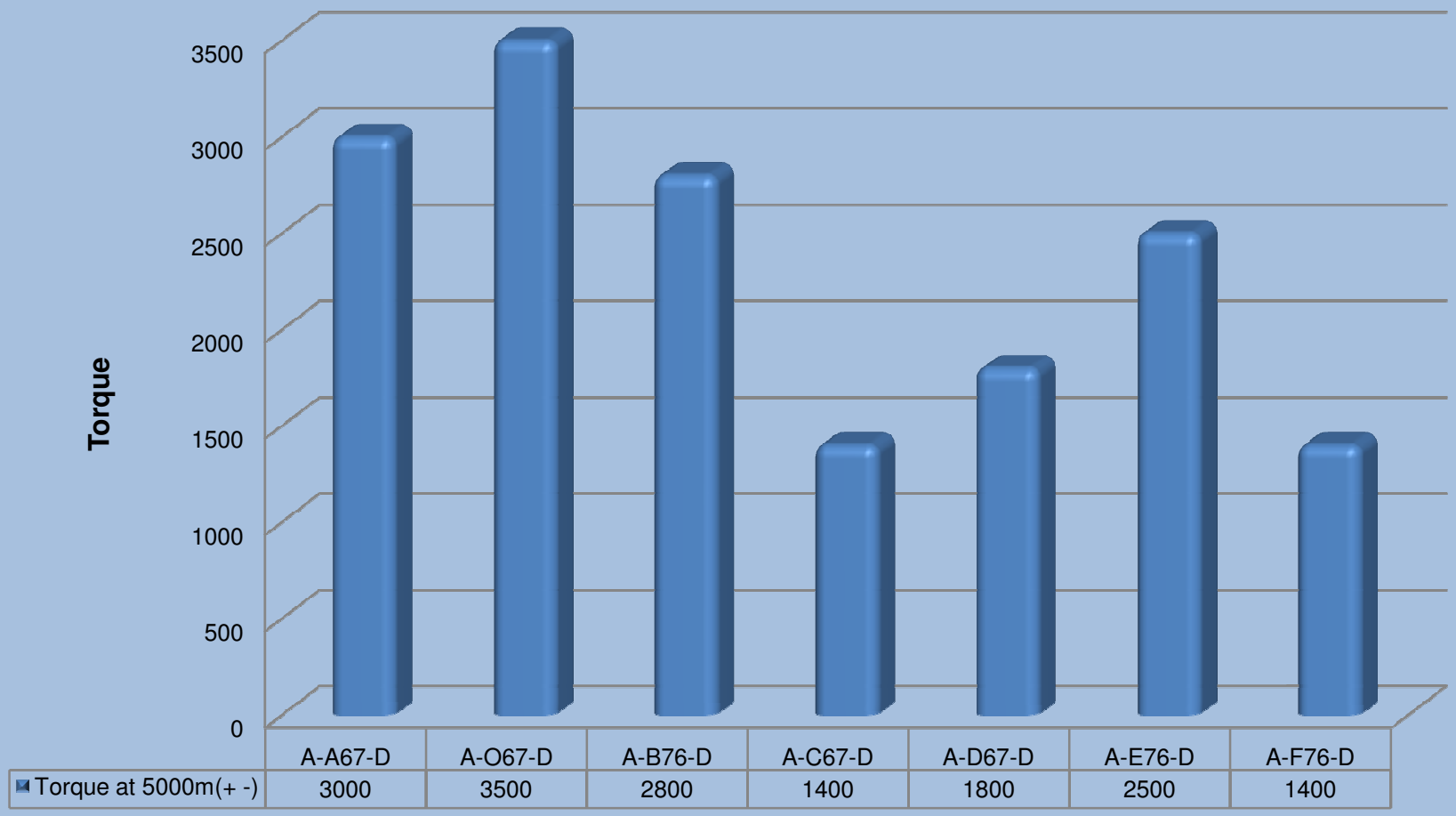
Average Torque



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Results

- One bit trip per well
- Drill plugs
- One trip out per well
- Snubbed production tbg in each well
- No bit issues
- Minimum repair/maintenance cost on drill string after 7 wells
- Exceeded Historical TMD's drilling plugs

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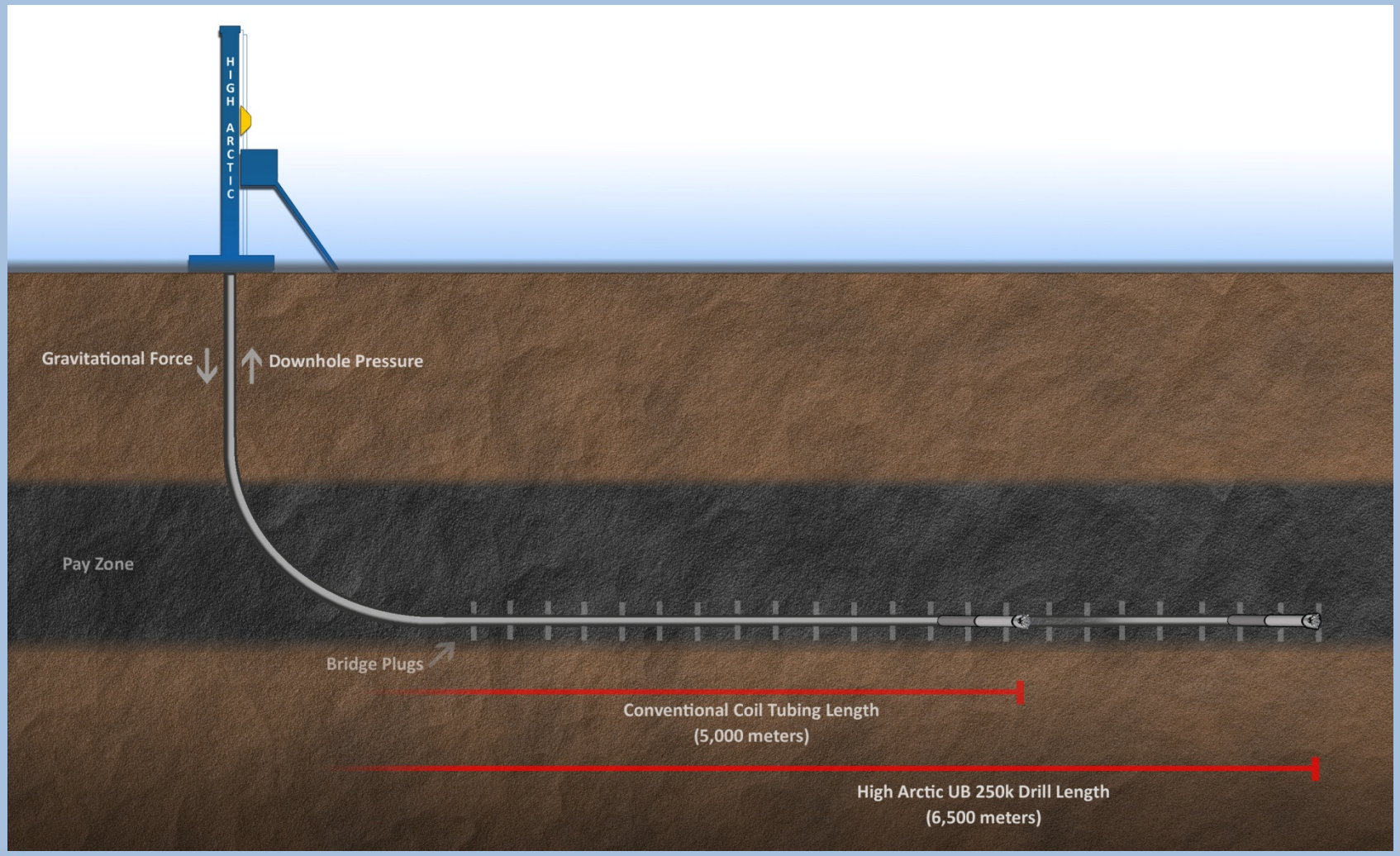
Jointed Pipe vs. Coil Tubing Length



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Safe Snubbing Practices

- A shear ram installed on wells that are deemed critical
- If **SCIP > 21mpa** a **5K ram to ram package** utilized in order to safely stage tubing couplings in/out of the hole.
- If **SCIP > 28mpa** or 80% of the pressure rating of the secondary BOPs on the snubbing stack a **10K ram to ram package** is utilized.

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Thank You!

Questions??

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