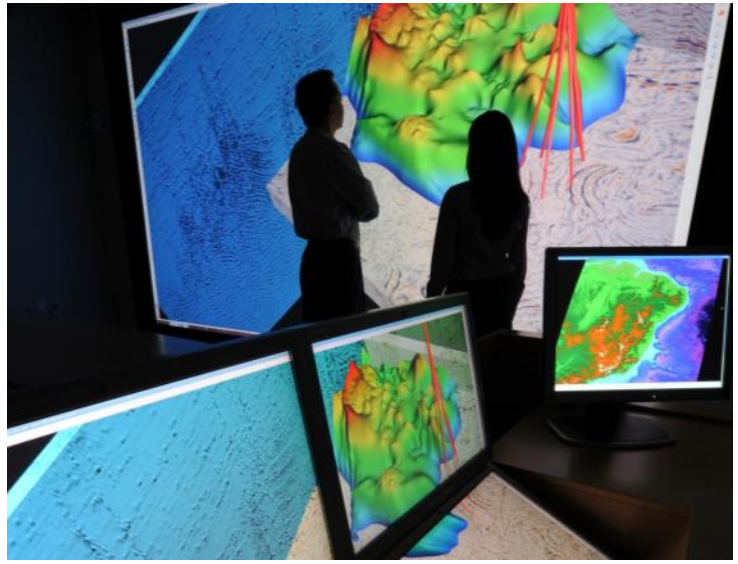
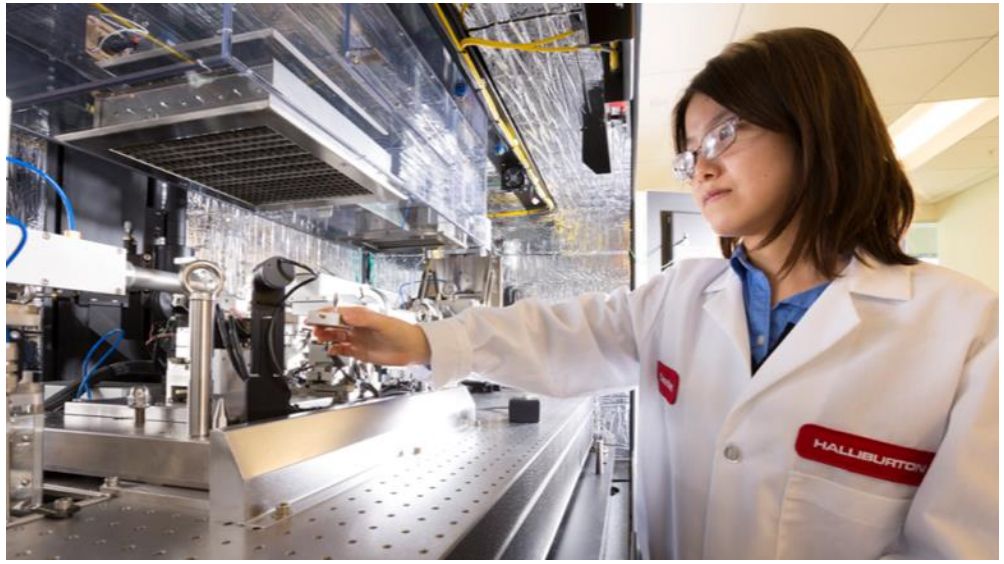




Performance Optimization Through Design & Execution

Amr Taher

October 26th, 2017

HALLIBURTON

Excellent Salt ROP

Drill Bits

CASE HISTORY

UNIQUE CUTTING STRUCTURE

OPTIMIZED SALT DRILLING

FASTEST ROP

LITTLE TO NO VIBRATIONS

OUTSTANDING DULL CONDITION

Garden Banks Block 998

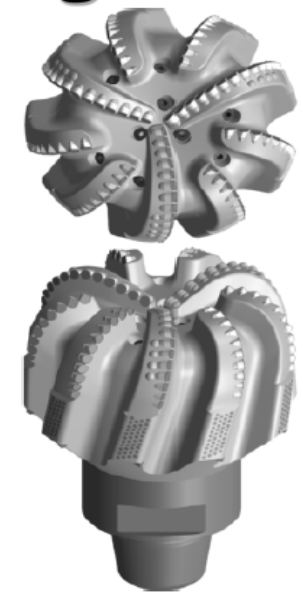
Deepwater Gulf of Mexico

Offshore Louisiana

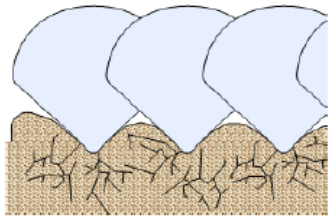
The **18 1/8" MM96** MegaForce™ Series PDC bit utilizes a unique cutting structure which incorporates both "Round" and "Scribe" SelectCutters™ PDC cutters. The MM96 was designed with customer collaboration utilizing the Halliburton proprietary DatCI™ (Design at the Customer Interface) bit optimization design process. The MM96, run along with a 21" reamer and a RSS combination, drilled 4,335 feet of salt with instantaneous ROPs of over 220 fph and an outstanding overall average ROP of 177 fph setting a new record in this application / hole size for this operator in all of Deepwater GOM. This run had little to no vibrations and the MM96 had an incredible dull condition with a dull grade of 0-0-NO-A-I-X-NO-TD.

Scribe™ PDC Cutter

MegaForce™



18 1/8" MM96



Scribe™ PDC Cutting Action provides higher point loading, pre-fracturing of brittle salt formations, and adds restorative forces to prevent bit whirl.

CHALLENGE

- Drill and Enlarge 18 1/8" x 21" in Salt
- Drill entire interval with one BHA
- Maximize ROP

SOLUTION

- **Utilize DatCI process**
- 18 1/8" MM96 Drill Bit
- Proprietary cutting structure of Round and Scribe Cutters

RESULTS

- Successfully Drilled and Enlarged a Total of 4,335 ft of Salt.
- Minimal Vibrations, Excellent Dull Condition, No Service Quality Incidences
- Excellent Avg ROP of 177 ft/hr, and instantaneous over 220 ft/hr.

HALLIBURTON

Fastest ROP – 24 hrs record

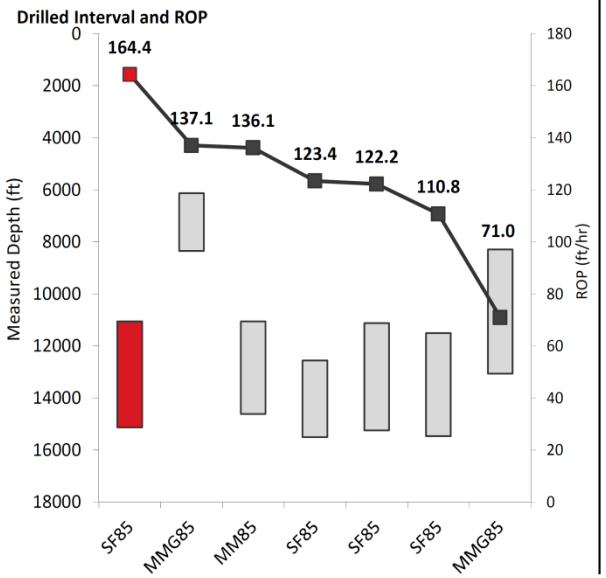
Drill Bits

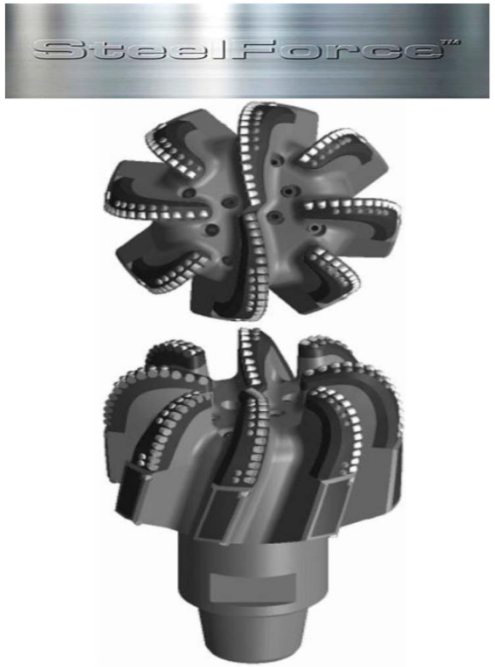
CASE HISTORY

OUTSTANDING PERFORMANCE
HIGHEST ROP
EXCELLENT DULL CONDITION

East GOM - Deep Water

The 18 1/8" SF85 SteelForce™ Series PDC drilled 4075 feet from 11050 ftMD to 15125 ftMD with an average ROP of 164 ft/hr. The interval was drilled with synthetic based mud. The 18 1/8" SF85 had an ROP that was 41% faster than the average of the offset runs and drilled an interval that was 13% longer than the average drilled interval of the offset runs. Drilling was stopped due to total depth being reached and the bit showed minimal wearing, with a dull grade of 1-1-CT-N-X-X-X-I-NO-TD.





18 1/8" SF85

Bit Type	MD In (ft)	MD Out (ft)	Run Length	ROP
SF85	11050.0	15125.0	4075.0	164.4
MMG85	6130.0	8345.0	2215.0	137.1
MM85	11057.0	14609.0	3552.0	136.1
SF85	12558.0	15502.0	2944.0	123.4
SF85	11125.0	15240.0	4115.0	122.2
SF85	11500.0	15460.0	3960.0	110.8
MMG85	8286.0	13058.0	4772.0	71.0

CHALLENGE

- Drill and Enlarge 18 1/8” x 21” in Sediments
- Drill entire interval with one BHA
- Maximize ROP
- Manage Transitional Zones, expected abrasive sands.

SOLUTION

- **Utilize DatCI process**
- 18 1/8” SF85 Drill Bit
- Superior steel body and abrasion resistance PDC cutters, with managed depth of cut.

RESULTS

- Drilled and enlarged 4075 ft in 24 hrs setting a record for the fastest ROP for the interval with an avg ROP of 164.4 ft/hr.

HALLIBURTON

Operator Hole Section Record

Hole Enlargement

CASE HISTORY

HALLIBURTON DELIVERS RECORD RUN FOR MAJOR GOM OPERATOR

XR™Reamer and MegaForce™ Bit drills 2,295' in less than 17 hours!

Green Canyon Block 859
Deep Water, Gulf of Mexico
Sand/Shale formations

A Halliburton BHA consisting of 18 ⅛" MMG85 MegaForce Series PDC , a XR1800 x 22" XR Reamer from Halliburton Drill Bits and Services, and a GeoPilot® Rotary Steerable from Sperry Drilling was successfully used to drill and ream from 9,185' MD to 11,480' MD in a vertical hole. This BHA drilled 2,295' reaching section TD in a record setting 16¾ hours with instantaneous ROP's as high 198'/hr. The reamer was subsequently deactivated for hole conditioning and casing was successfully run to bottom.

At Deepwater spread rates close to a million dollars per day the XR™ Reamer and MegaForce™ Bit delivered substantial cost savings to this customer!

18 ⅛" MMG85

0-1-WT-S-X-I-NO-TD

XR 1800 Reamer x 22"

0-1-CT-S-X-I-NO-TD

CHALLENGE

- Drill and Enlarge 18.125" x 22.000" vertical hole
- Soft Sediment section with High ROP
- Low Vibration

SOLUTION

- **Utilize Halliburton's Total System Approach**
- 18.125" MMG85 Drill Bit and XR1800 x 22.000" Reamer
- Geo Pilot RSS Assembly

RESULTS

- Successfully Drilled and Enlarged 2297 ft.
- Instantaneous ROP's of 198 ft/hr.
- Section drilled in 16.75 hr.
- Minimal Vibrations, Excellent Dull Condition, No Service Interruptions

HALLIBURTON

Excellent Salt ROP

Case History

Hole Enlargement

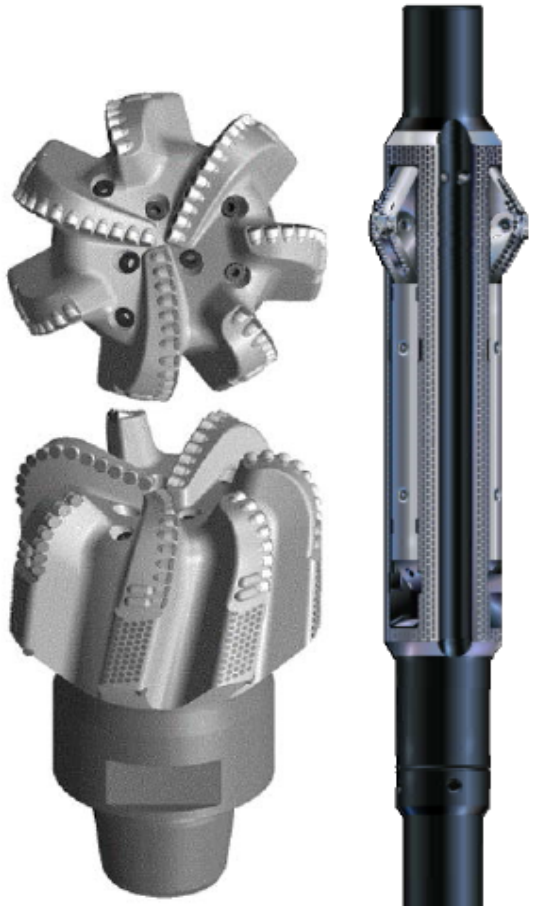
HALLIBURTON'S TOTAL SYSTEM APPROACH

EXCELLENT SALT RUN ROP
MINIMAL VIBRATIONS
ZERO NPT

Salt Formation
Green Canyon Area
Deep Water, Gulf of Mexico

The assembly combination of the 14 1/2" MM75 PDC Bit and XR1400 x 17" Reamer from Halliburton was utilized to drill from 16,261 feet to 22,908 feet. The assembly drilled and enlarged 6,647 feet at an excellent ROP of 118 fph for the entire section. There was little to no vibration from the MM75 / XR1400 assembly to help result in zero NPT and no downhole tool failures. The MM75 bit (1-2-CT) and the XR1400 reamer (1-1-TD) had excellent dull grades.

XR1400 x 17" Cutter Arms Post Run Photo



14 1/2" MM75

XR1400 x 17"

CHALLENGE

- Drill and Enlarge 14 1/2" x 17 in Salt
- Drill entire interval with one BHA
- Maximize ROP

SOLUTION

- **Utilize Halliburton's Total System Approach**
- 14 ½" MM75 Drill Bit
- Geo Pilot RSS Assembly
- XR1400 x 17" Reamer

RESULTS

- Successfully Drilled and Enlarged a Total of 6,647 ft of Salt.
- Minimal Vibrations, Excellent Dull Condition, No Service Quality Incidences
- Excellent ROP of 110 ft/hr

HALLIBURTON

Drill and Enlarge Hole – De-Activate – Drill to Total Depth

Case History

Hole Enlargement

SO QUIET YOU COULD HEAR ITS JAWS DROP

SUCCESSFUL TOOL DEACTIVATION
MINIMAL VIBRATIONS
ZERO NPT

Wilcox Formation
Green Canyon Area
Deep Water, Gulf of Mexico

The assembly combination of the **12 1/4" FXG74R** PDC Bit and **XR1200 x 14 ½" Reamer** from Halliburton was utilized to drill a total of 4,040 feet. The assembly drilled and enlarged 596 feet to KOP and then drilled and enlarged an additional 2,039 feet while building to 30 degrees prior to deactivation. With the contingency liner option eliminated the reamer was deactivated. Drilling continued another 1405 feet to core point. The ROP for the entire section averaged **36.3 fph**. There was little to no vibration from the FXG74R / XR1200 assembly to help result in zero NPT and no downhole tool failures. The FXG74R bit (1-2-CT) and the XR1200 reamer (1-1-TD) had excellent dull grades.

XR1200 x 14 ½" Cutter Arms Post Run Photo

12 ¼" FXG74R

XR1200 x 14 1/2"

CHALLENGE

- Drill and Enlarge 12 ¼" x 14 ½", Build Angle to 30 degrees
- After Successfully Passing Contingency Casing Point De-Activate
- Drill to TD

SOLUTION

- **Utilize Halliburton's Total System Approach**
- 12 ¼" FXG74R Drill Bit and XR1200 x 14 ½" Reamer
- Geo Pilot RSS Assembly

RESULTS

- Successfully Drilled and Enlarged a Total of 4,042 ft of Wilcox While Building to 30 degrees.
- Successfully De-Activated Reamer After Passing Contingency Casing Point
- Minimal Vibrations, Excellent Dull Condition, No Service Quality Incidences

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XR Reamer Reliability Summary 2014 - 2017 (Q2)

HALLIBURTON
Drill Bits & Services

Reamer Type/Size	Total Ftg. Enlarged	Total No. of Runs	No. of Successful Activation	No. of Successful Deactivation	No. of Successful Runs
XR800	34,063	18	18/18	2/3	17/18
XR1000	60,467	16	16/16	1/1	16/16
XR1200	115,372	35	35/35	11/11	35/35
XR1400	37,152	15	14/15	4/4	14/15
XR1600	52,513	30	29/30	8/8	29/30
XR1800	32,377	12	12/12	8/8	12/12
Summary	331,944	126	124/126 (98%)	34/35 (97%)	123/126 (98%)

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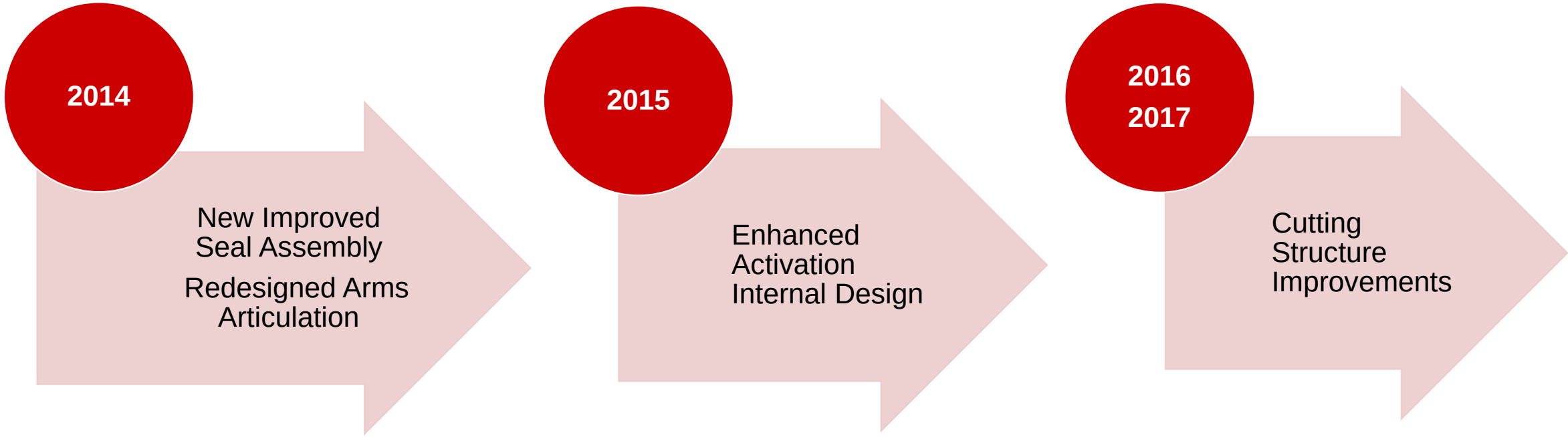
Technology Improvements



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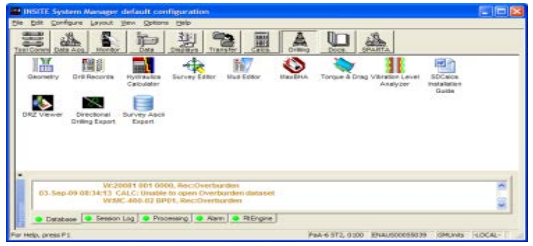
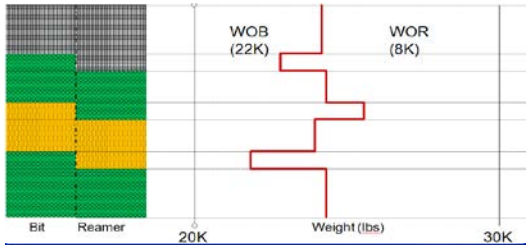
HDBS Toolbox

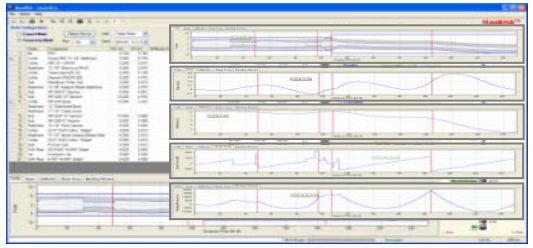
INSITE



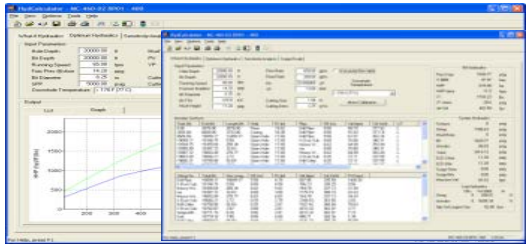
PBR



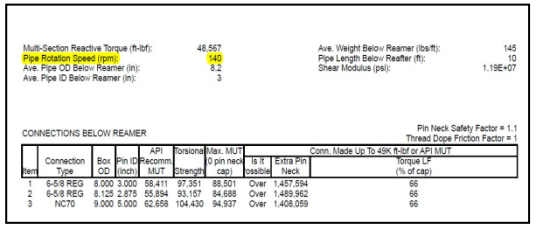
MaxBHA



HYDRAULICS



Reactive Torque Calculator



Multi-Section Reactive Torque (ft-lbf): 48,567
Pipe Rotation Speed (rpm): 140
Ave. Pipe OD Below Reamer (in): 8.2
Ave. Pipe ID Below Reamer (in): 3

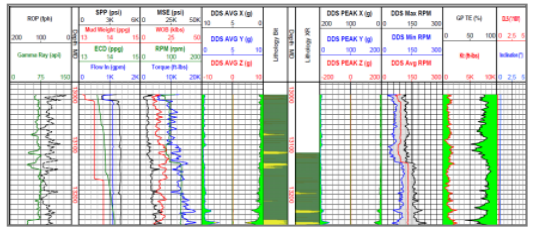
Ave. Weight Below Reamer (lbs/ft): 145
Pipe Length Below Reafter (ft): 10
Shear Modulus (psi): 1.19E+07

CONNECTIONS BELOW REAMER

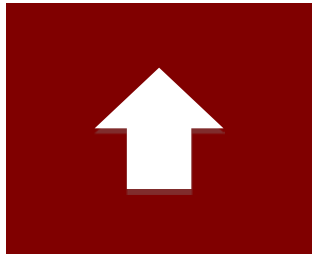
Pin Neck Safety Factor = 1.1
Thread Dope Friction Factor = 1

Item	Connection Type	Box OD	Pin ID (inch)	API Recomm MUT	Torsional Strength	Max. MUT (0 pin neck cap)	Is It possible	Extra Pin Neck	Conn. Made Up To 49K ft-lbf or API MUT Torque LP (% of cap)
1	6-5/8 REG	8.000	3.000	58,411	97,351	88,501	Over	1,457,594	66
2	6-5/8 REG	8.125	2.875	55,894	93,157	84,688	Over	1,489,962	66
3	NC70	9.000	5.000	62,658	104,430	94,937	Over	1,408,059	66

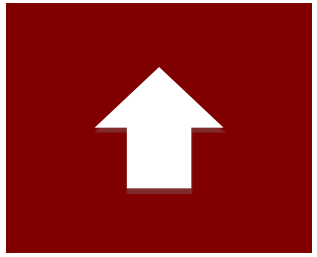
REAL-TIME INSITE



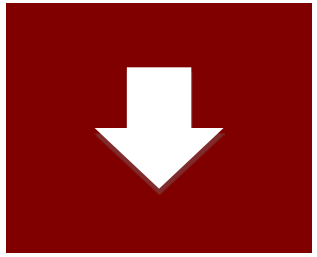
UTILIZING THE TOOLBOX



Service Quality



Tool Performance



NPT

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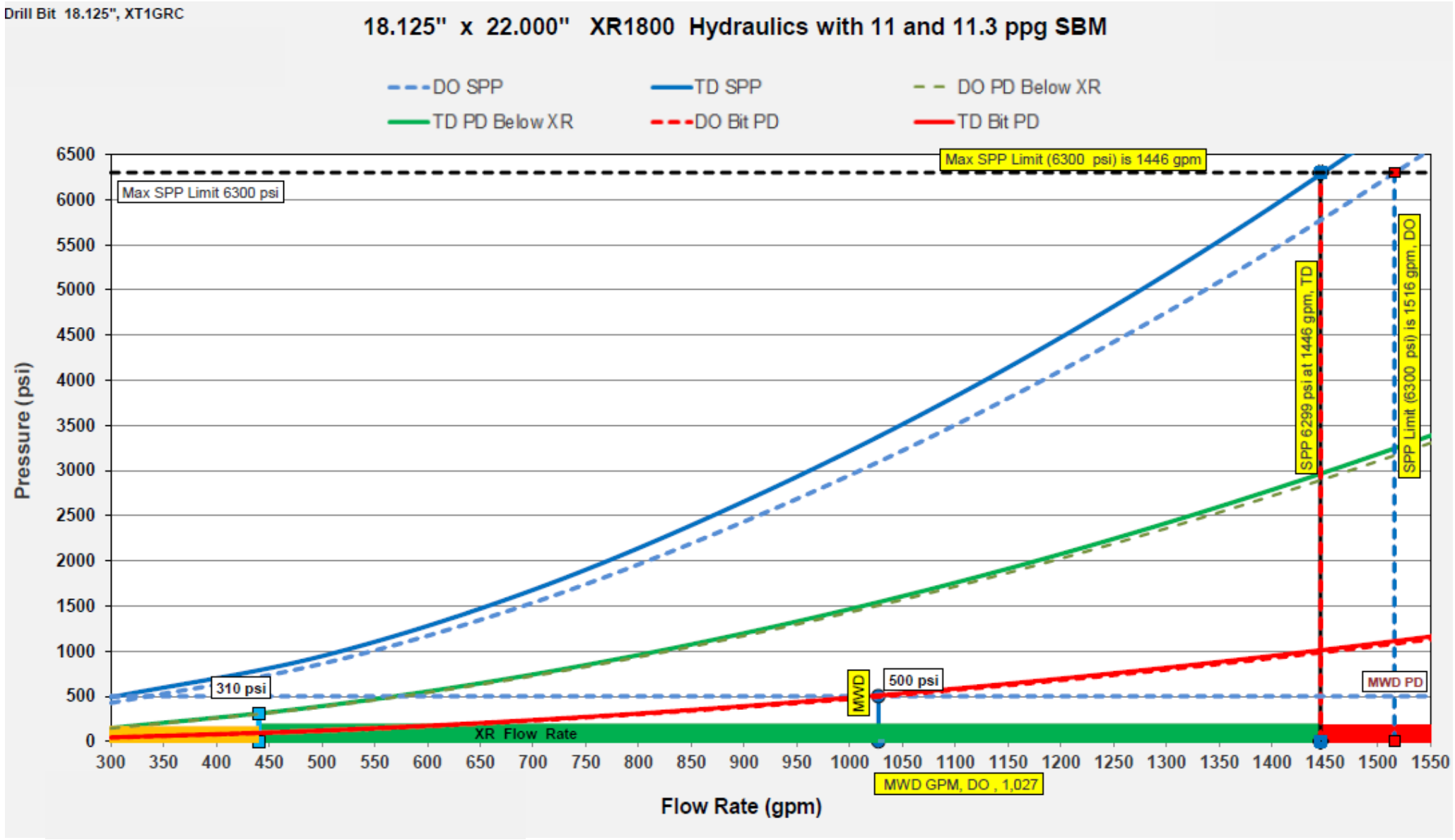
Hydraulics Analysis



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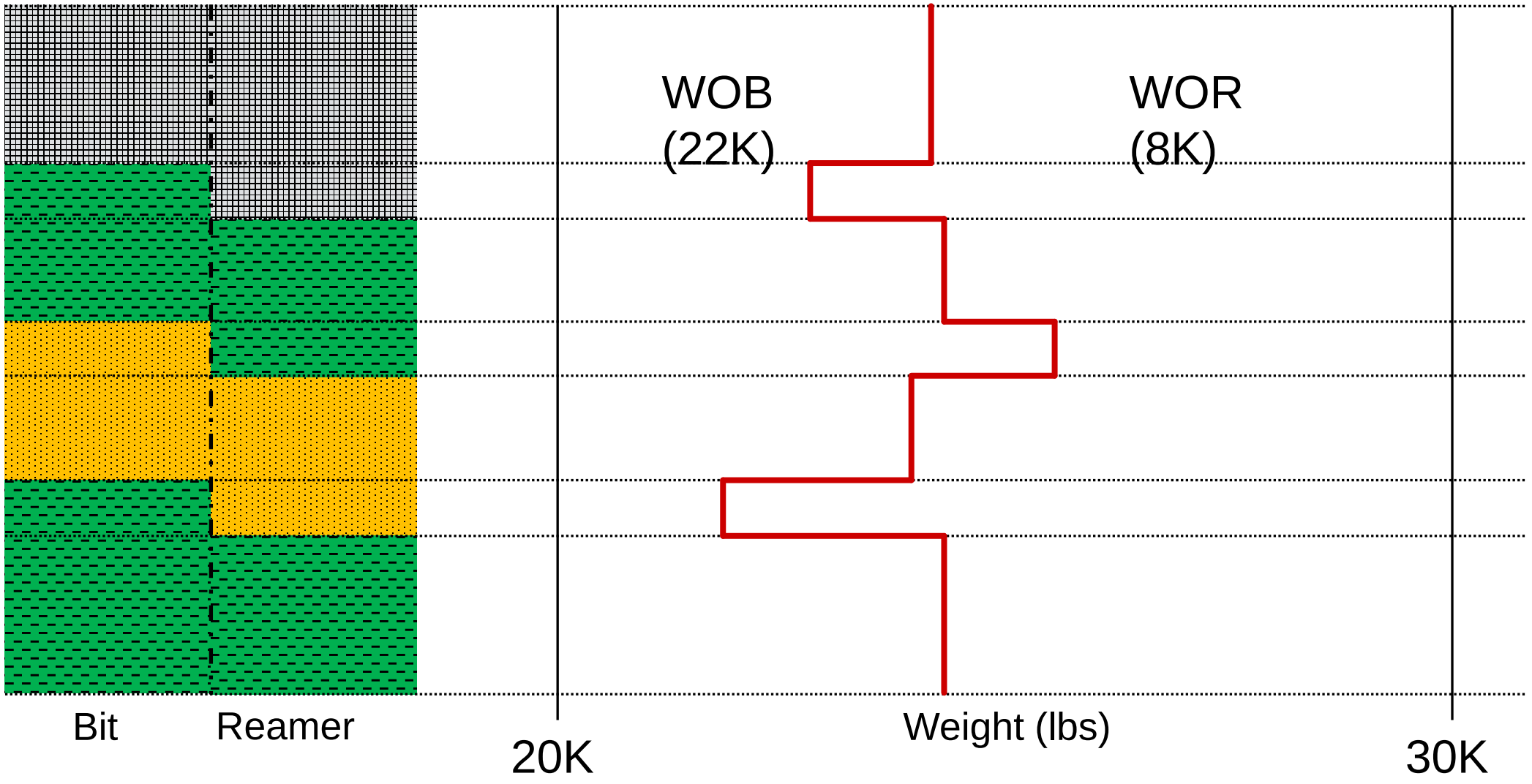
PBR Bit/Reamer Modeling – Weight distribution



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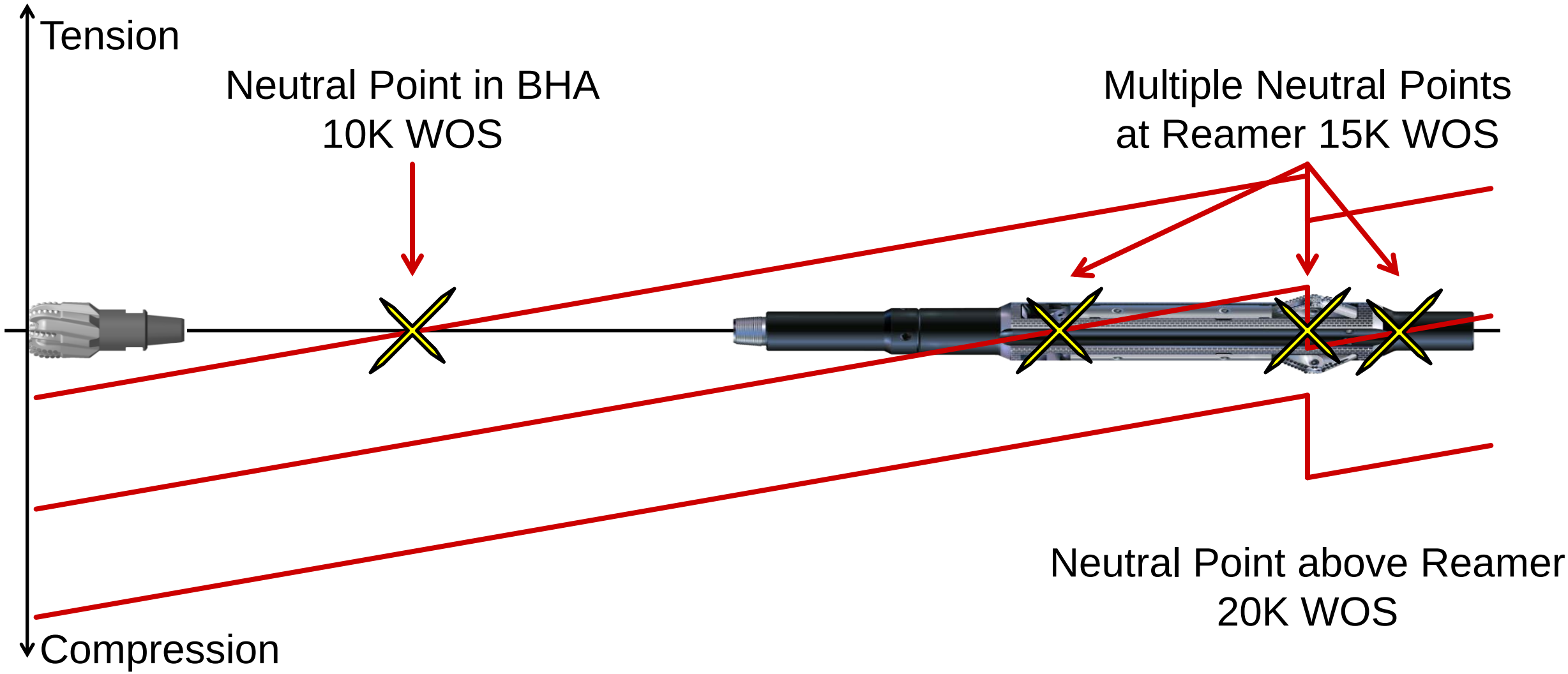
PBR Bit/Reamer Modeling – Neutral Point



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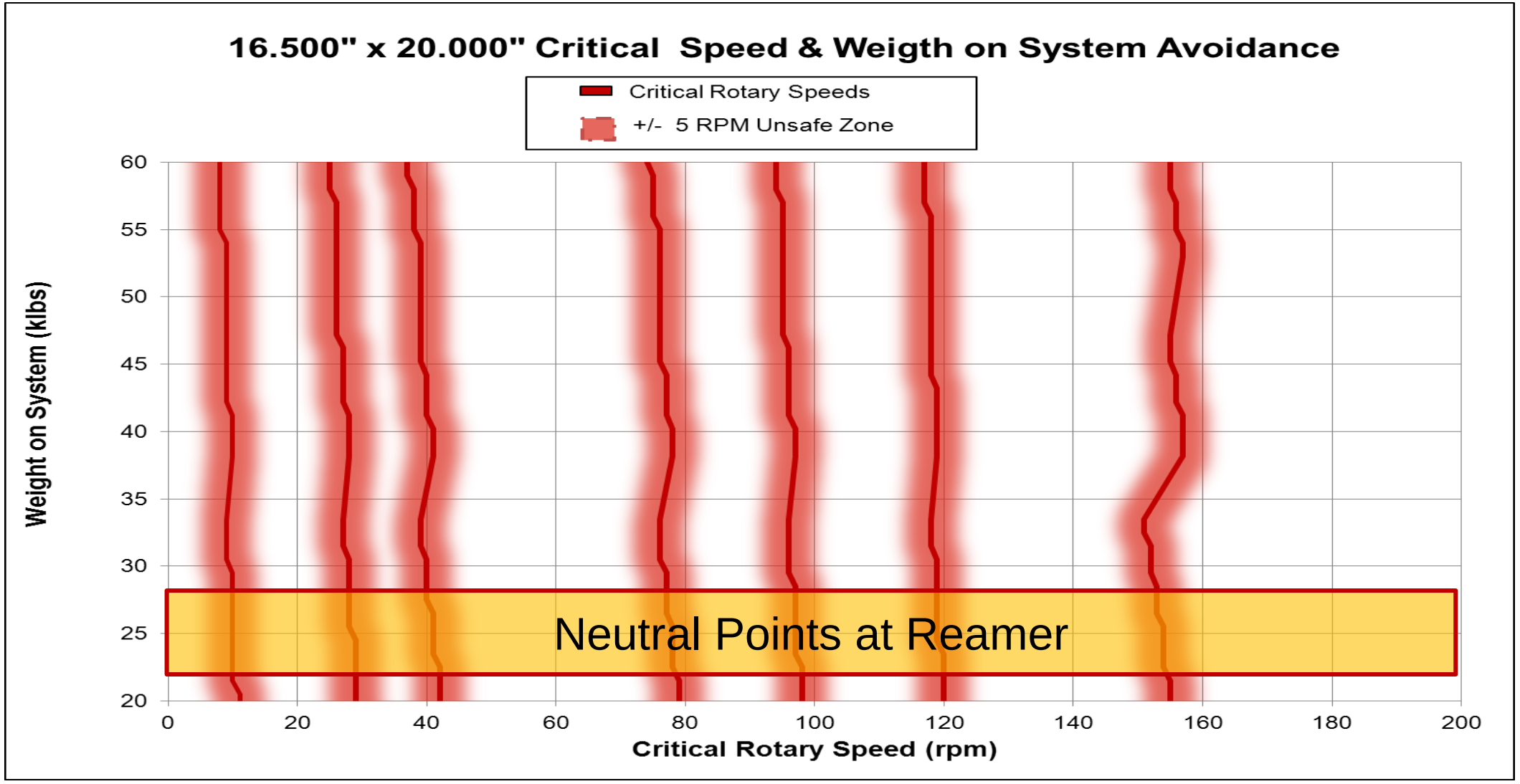
Reaming BHA Whirl Output



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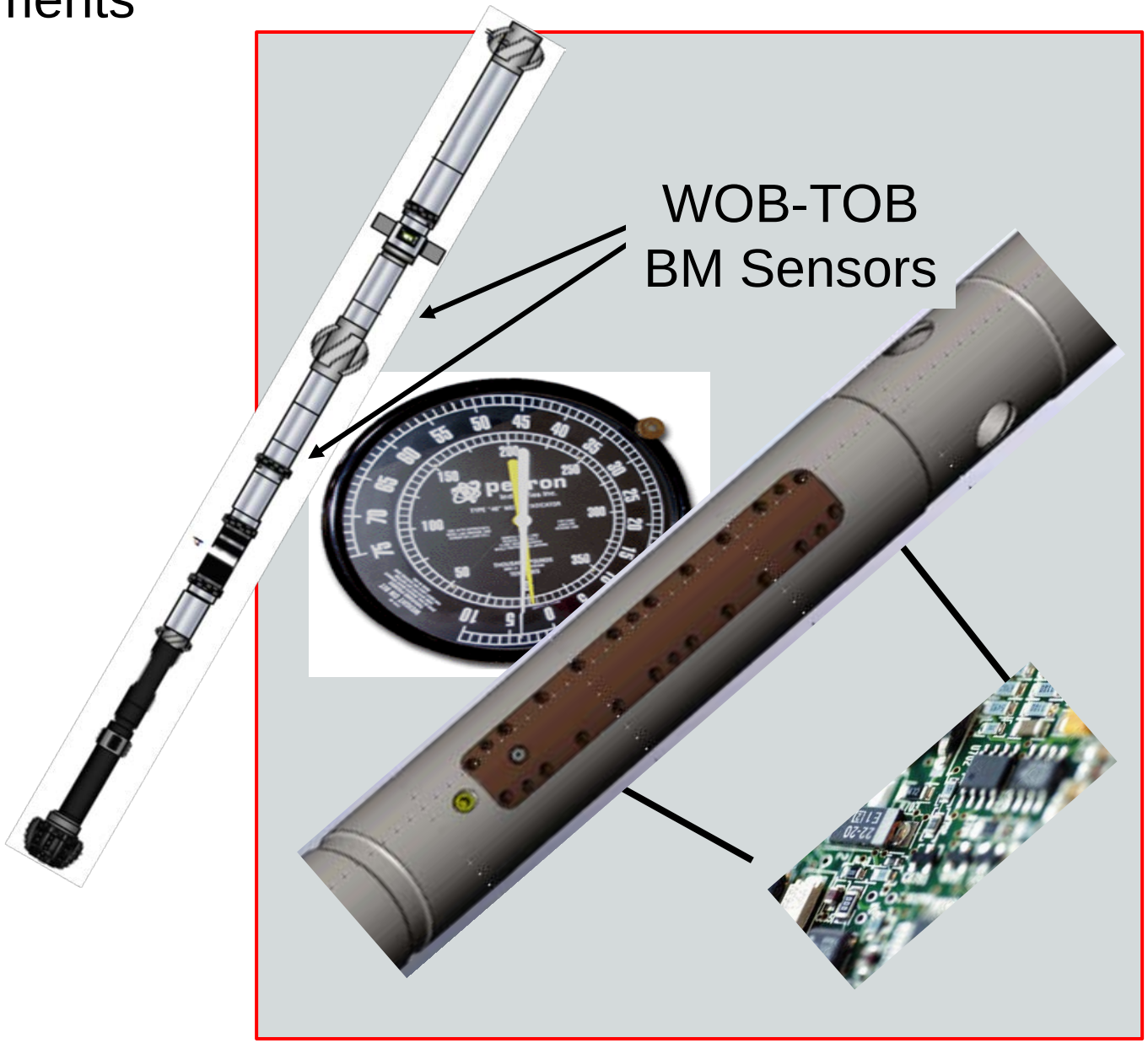
Downhole Drilling Dynamics Measurements

(WOB-TOB-BOB)

- **Measures**
  - Axial force (tension, compression)
  - Bend and direction
  - Torsional force
  - Vibration/Shock 3-axis
  - Whirl
- Operate above RSS



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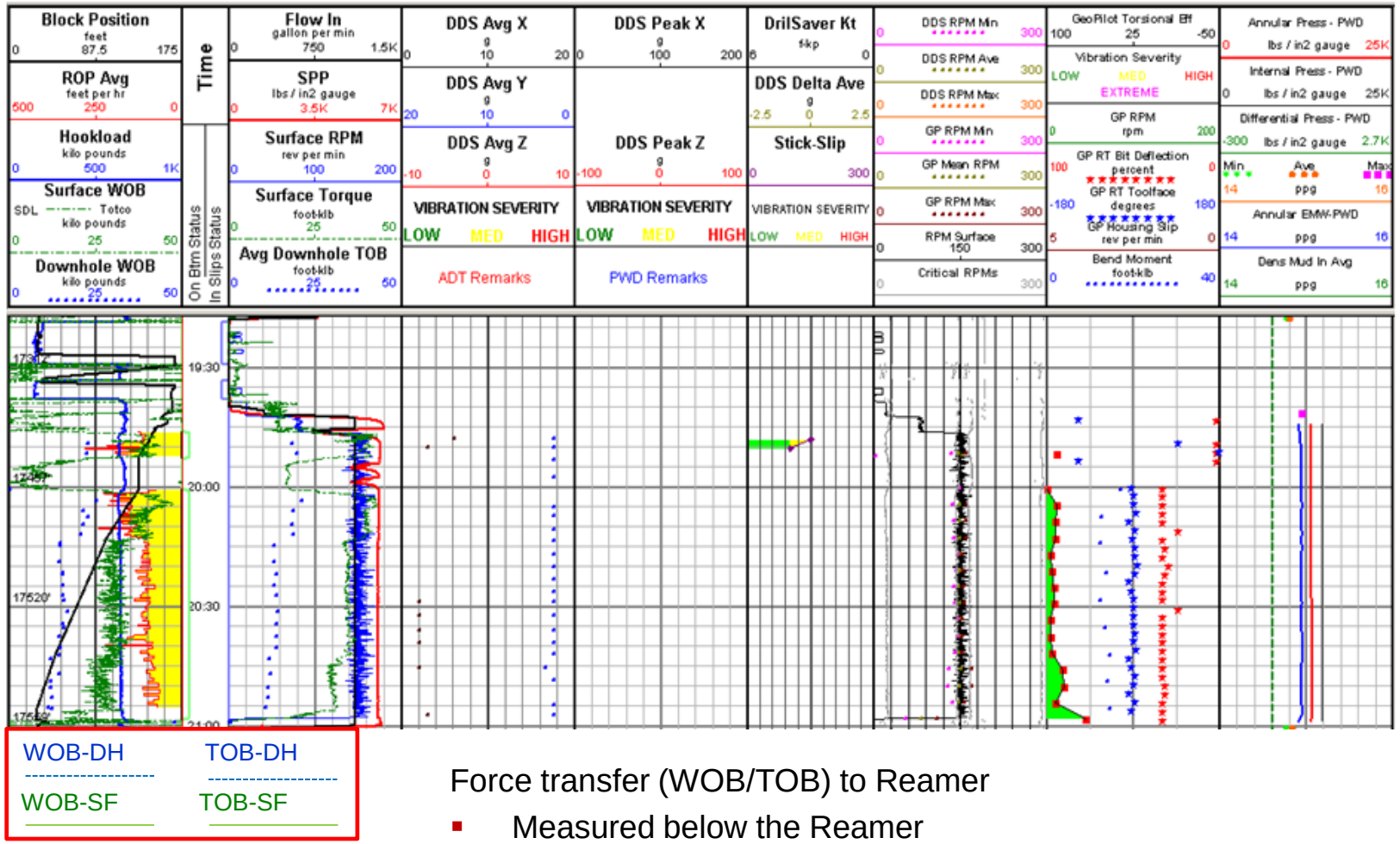
Downhole Drilling Optimization System



Force transfer (WOB/TOB) to Reamer

- Measured below the Reamer
  - Downhole WOB @ 50% surface
  - Downhole TOB @ 50% surface

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Value Proposition

We **COLLABORATE** to **DELIVER**
ENGINEERED DRILLING SOLUTIONS
and **RESERVOIR INSIGHT**
to **MAXIMIZE ASSET VALUE**

MAXIMIZE ASSET VALUE

Drill to produce | Enhance reservoir understanding | Reduce well time

COLLABORATE

Listen for value drivers | Solution-based designs | Integrate for value

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THANK YOU