

Technical Presentation Softtorque



Angel Catena

Technical Presentation Softtorque

Topics

- Short introduction of ENGIE Electroproject bv.
- Performance improvement by Stick Slip mitigation
- Electroproject involvement in Softtorque technology.
- low CAPEX ElectroProject SoftTorque (EPST) Controls Hardware
- Installed base.

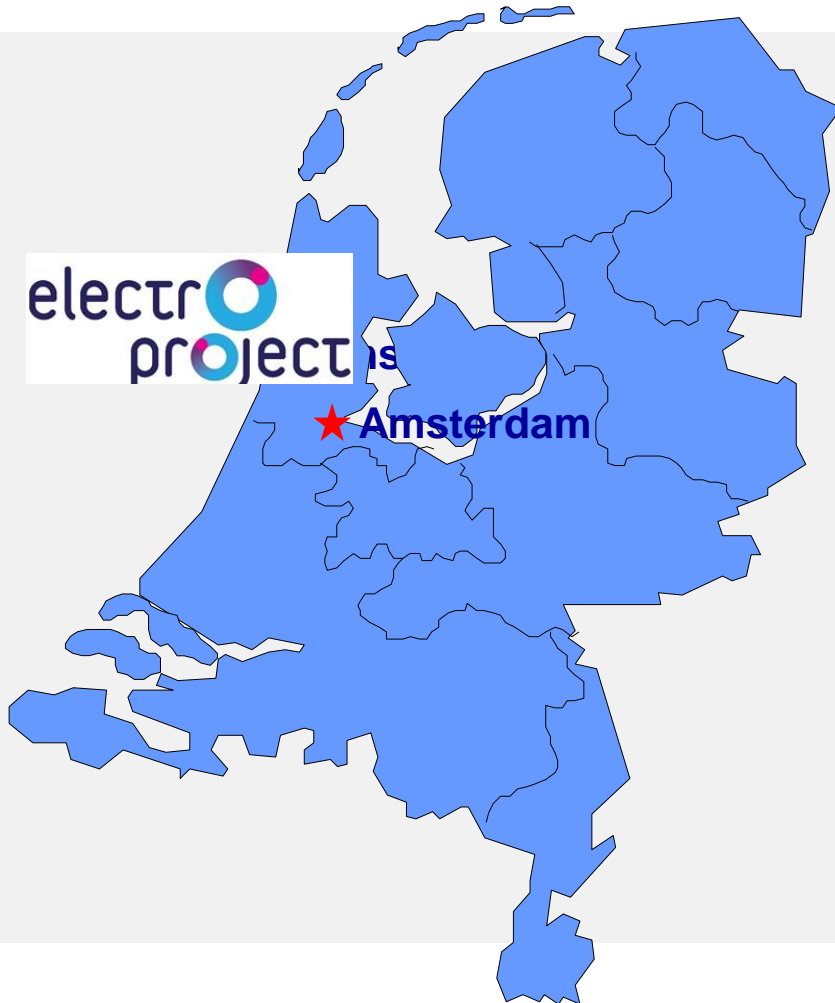
ENGIE Electroproject bv



A global energy player
and an expert operator in
the three businesses of :

- Electricity,
- Natural gas
- Energy Services

ENGIE Electroproject bv



Drives and controls



ENGIE Electroproject bv



Marine and Off-shore



Water



Heave and transport



Industrie



HVAC



Roller coasters



Industrial components



**Service and
Maintenance**

Engie Electropoint involvement in softtorque technology

- 80s Shell introduces Softtorque Rotary Systems .
- 90s problems with the use of the technology.
- 2009 Shell starts a rejuvenation project with Electropoint in a leading rol.
- 2011 AST (Advanced Softtorque) is patented as an independent technology.
- 2013 AutoTune for Softtorque systems is introduced.
- 2014 Down hole observer is introduced.
- 2014 Working with Shell on Ztorque technology

Last 5 years focus on the influence of Softtorque technology on drill string behavior.



Technical Presentation Softtorque

Topics

- Stick Slip behavior.
- Softtorque theoretical background.
- Softtorque in practice.
- Softtorque working envelop.



Softtorque in practice

**Movie showing softtorque performance
from drillers perspective.**

Softtorque in practice

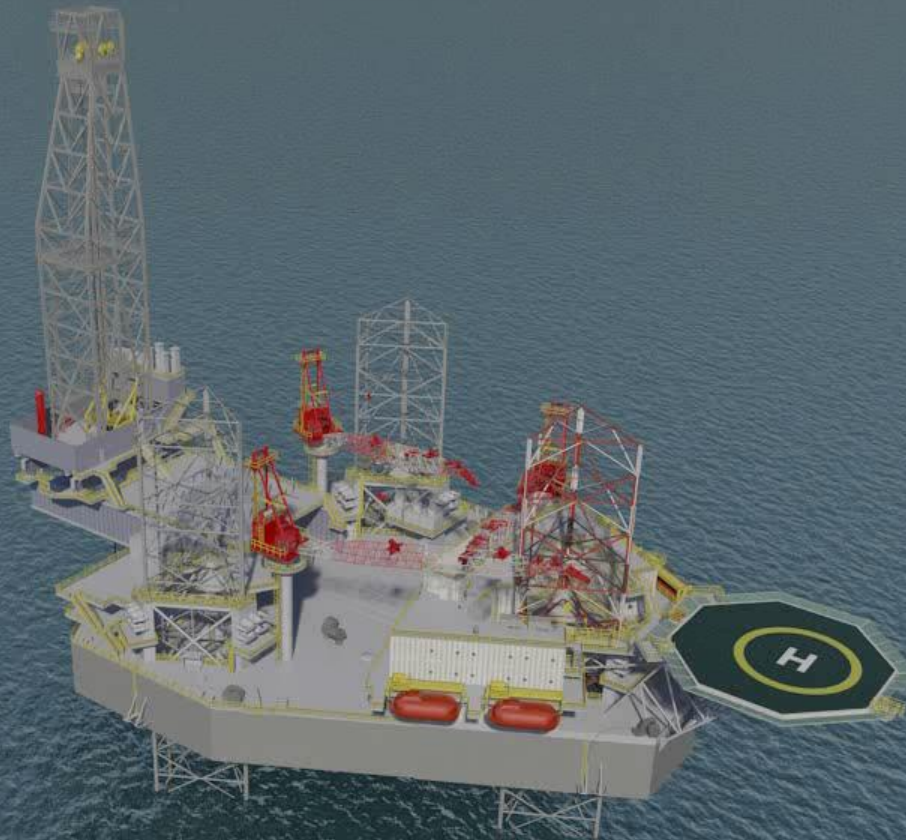


Softtorque in practice

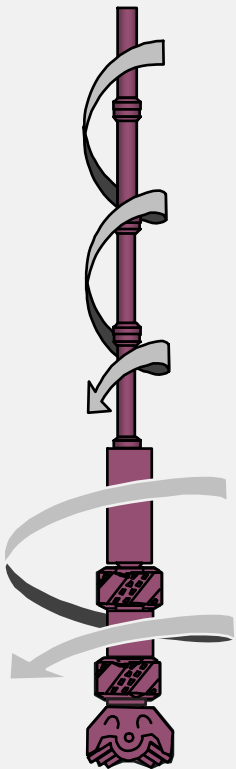
stick-slip behaviour

.

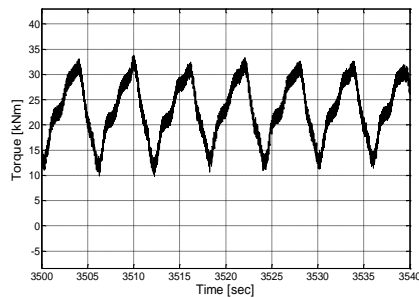
Softtorque in practice



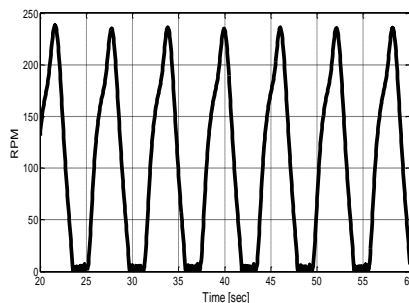
Stick-slip behavior



Surface torque



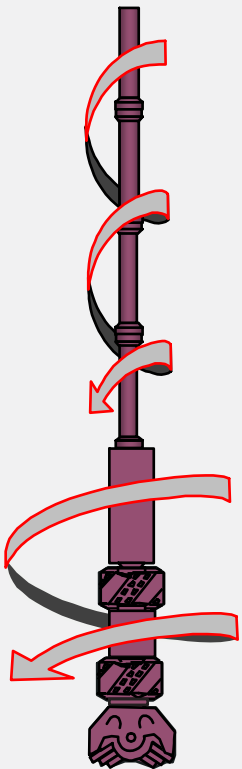
Down hole RPM



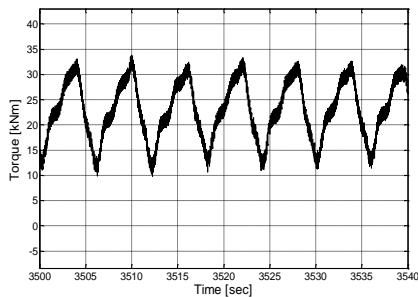
Cyclic, heavy torsional vibrations

- 3-10 second period
- BHA comes to a complete stop in “stick phase”
- BHA accelerates up to 5x surface speed in “slip phase”
- Can occur 50% of on bottom time (!)

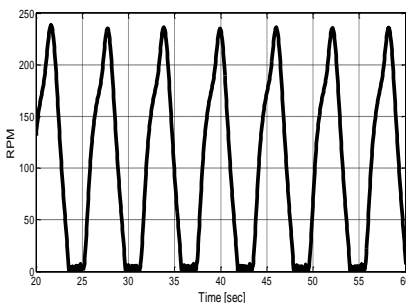
Stick-slip behavior



Surface torque



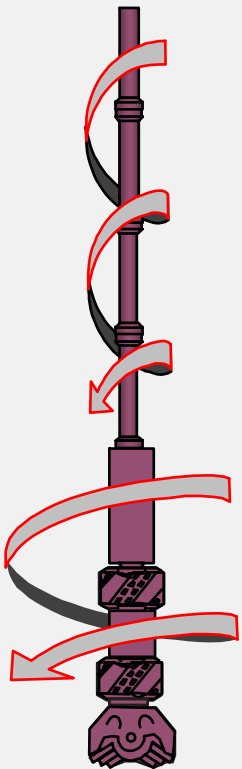
Down hole RPM



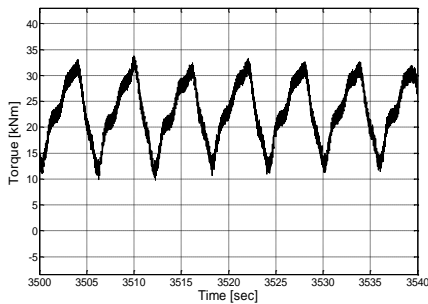
Heavy torsional vibrations lead to:

- **Reduced ROP,**
- **Heavy vibrations down hole, motor failures,**
- **Additional bit wear and bit damage**
- **Potential lateral vibrations that may damage the wellbore.**
- **Can cause problems on TD equipment**
- **Can lead to well integrity problems (!)**

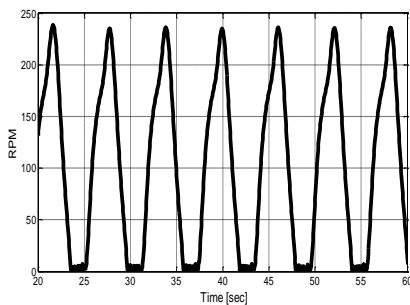
Stick-slip behavior



Surface torque



Down hole RPM

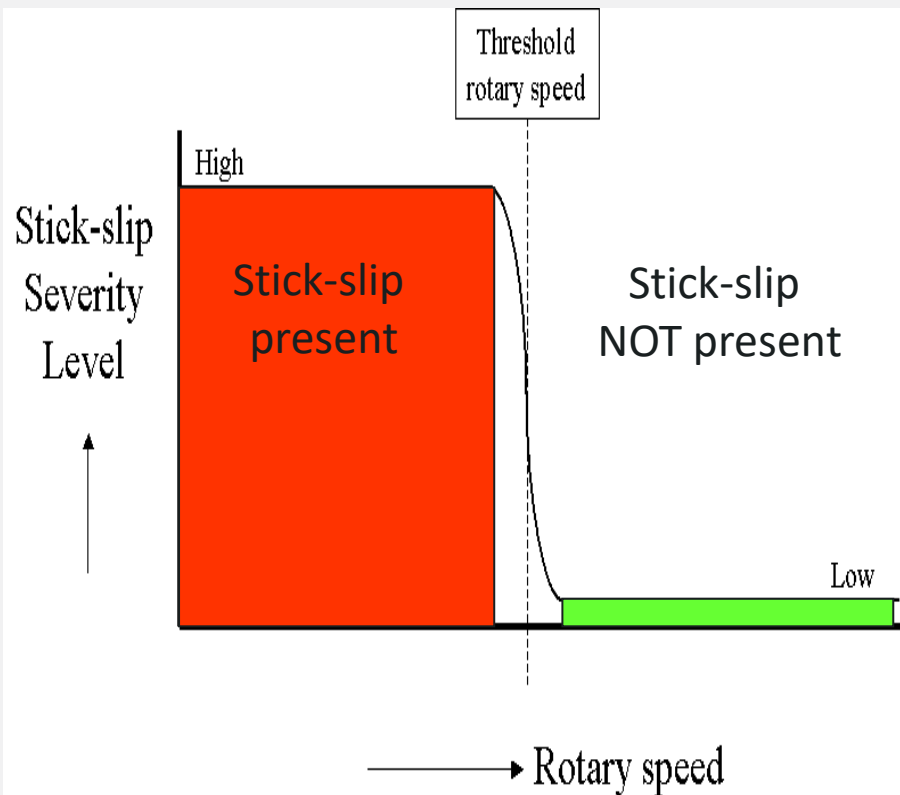


Mitigating stick slip:

- Increases ROP.
- Lead to longer bit runs. Saving tripping time.
- Saves on tool wear out.
- Less issues during coring.

Stick-slip behavior

Stick-slip is a threshold phenomenon.



Value of the threshold speed is difficult to predict but increases with:

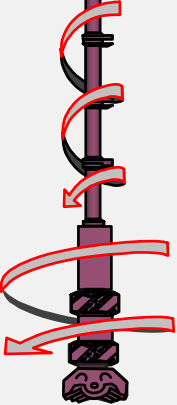
- Larger WOB
- Reduced DP size
- Increasing MD

Theoretical background for stick-slip mitigation.

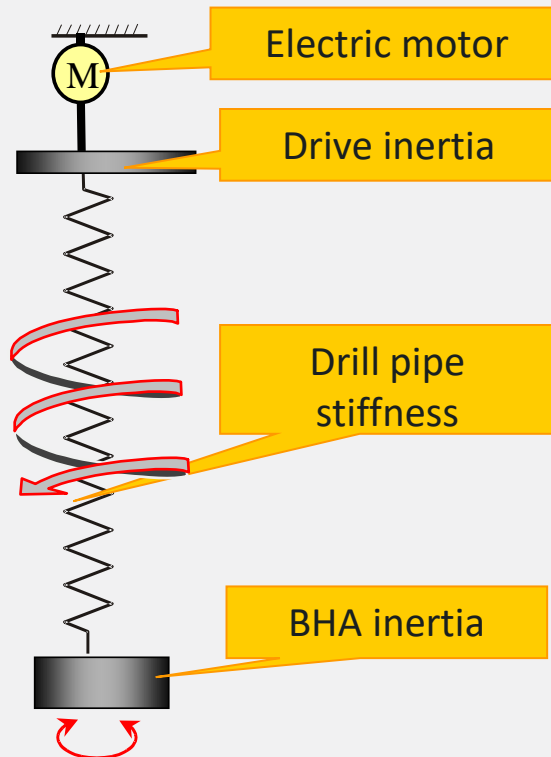
Two different technologies

1. Traditional Softtorque (STRS/EPST)
2. Advanced Softtorque (AST)

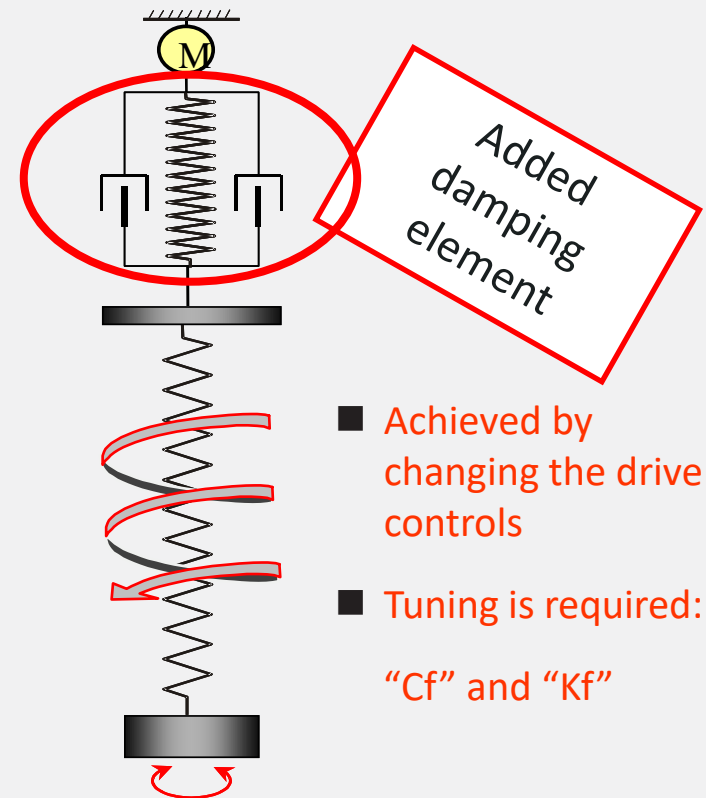
1. Softtorque theoretical background (STRS)



Drill string represented
as torsional spring

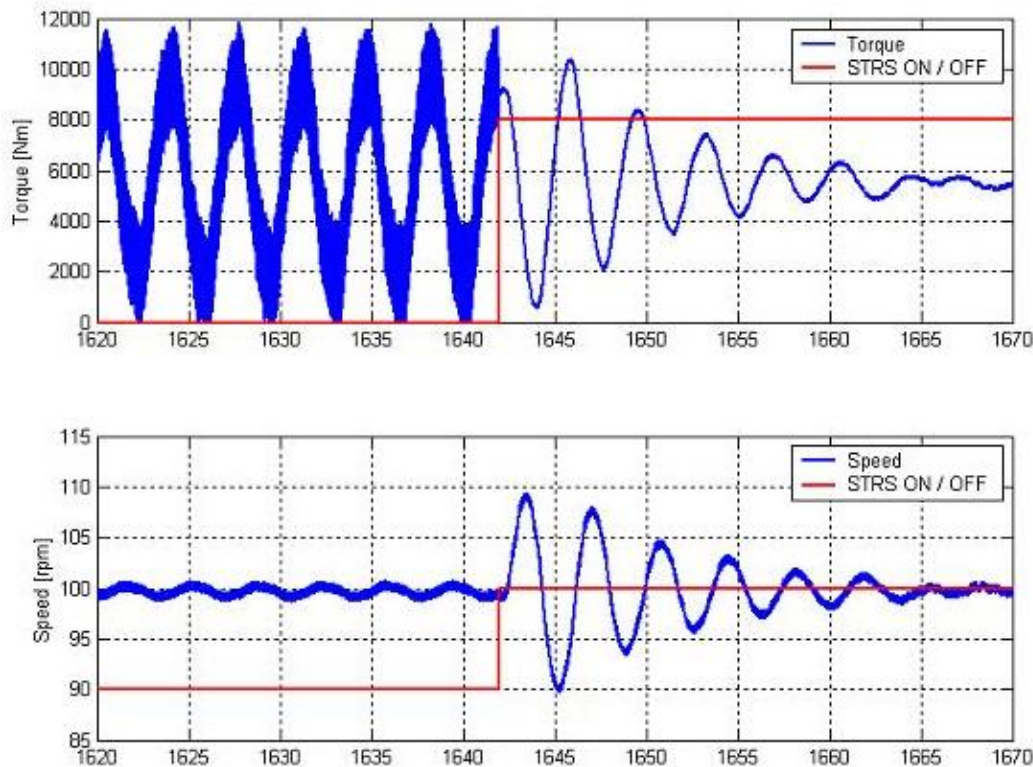


TD motor & controls
represented as torsional
spring and damper



1. Softtorque theoretical background

Example of stick-slip mitigation with EPST

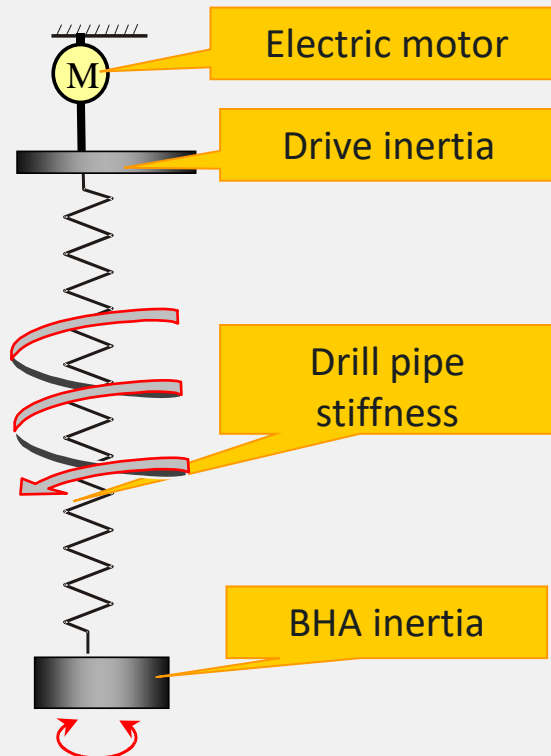
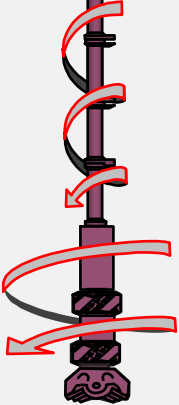


■ Torque steady

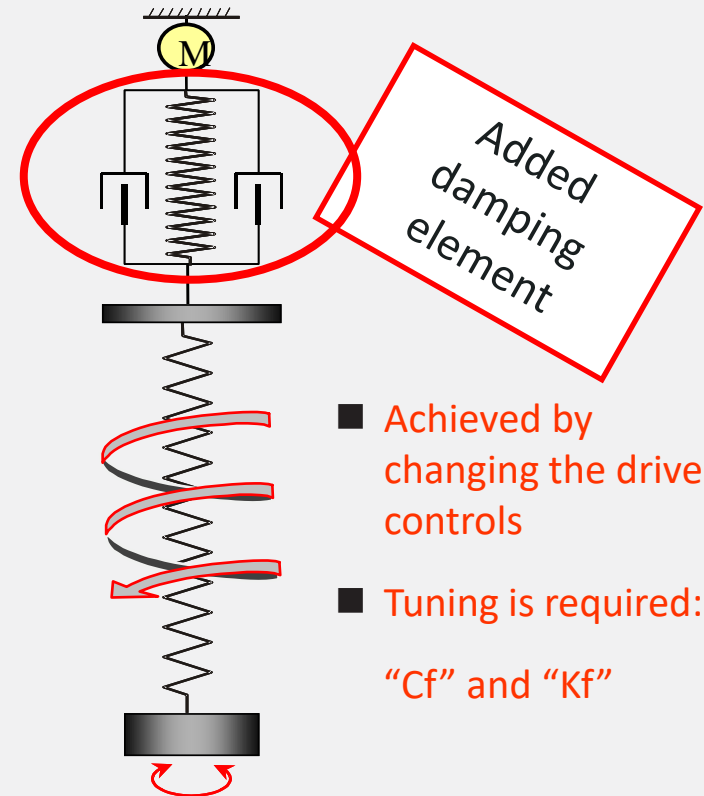
■ RPM variations

1. Softtorque Tuning

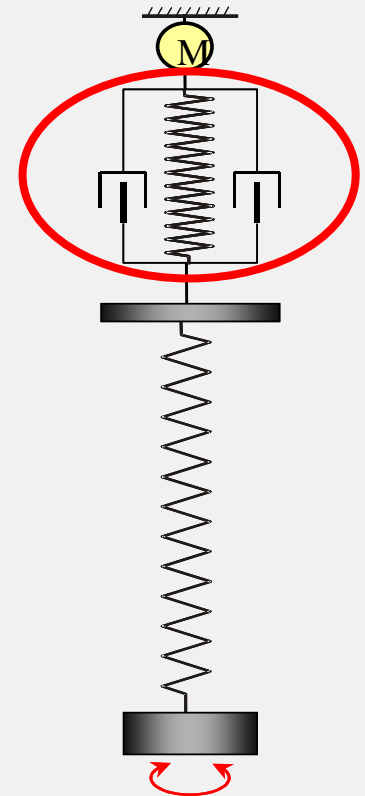
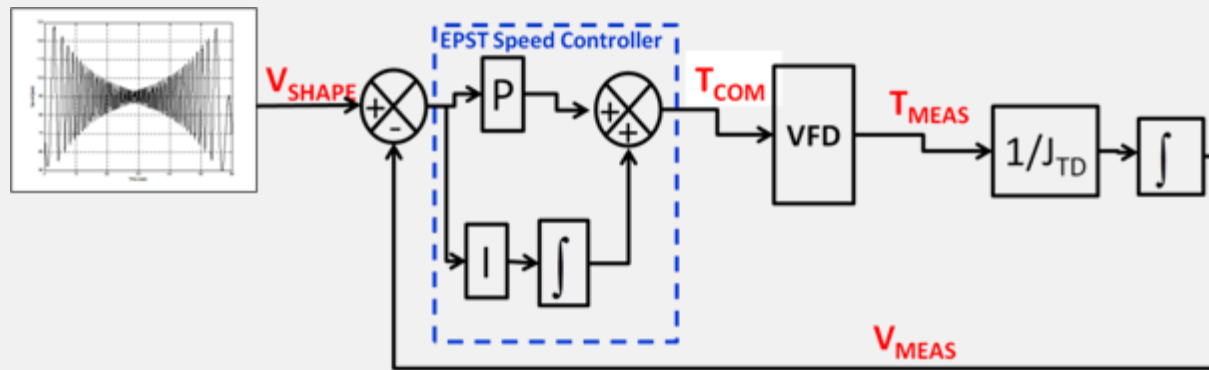
Drill string represented
as torsional spring



TD motor & controls
represented as torsional
spring and damper



Softtorque AutoTune



- First in the world, while drilling identification of softtorque tuning parameters
- Only software update for EPST controller.

1. Softtorque Tuning

Manually input of Kf and Cf (MHI Home screen)

Total Measured Depth (along hole)	Tuned values	
Total MD	Kf	Cf
m	Nm/rad	Nms/rad
1800	6188	2523
1829	6046	2508
1857	5909	2493
1886	5776	2478
1914	5649	2464
1943	5525	2449
1971	5406	2435
2000	5290	2422
2028	5178	2408
2057	5070	2395
2085	4965	2382
2114	4863	2369

Calculation with integrated BHA and drill string configuration.

Warning if fishing

ElectroProject Soft Torque
MIMIC: Drill Pipe Entries

ElectroProject aandrijfstechniek

No	Pipe name	ID	One stand [ft]	Length [ft]
3	No pipe	0	0.00	0.00
2	No pipe	0	0.00	0.00
1	5 1/2" DP - 21.90 lb/ft - FH	11	27.00	1027.00

Bottom hole

Calculate

Calculated values:

Kf: 89506
Cf: 5955

Transfer

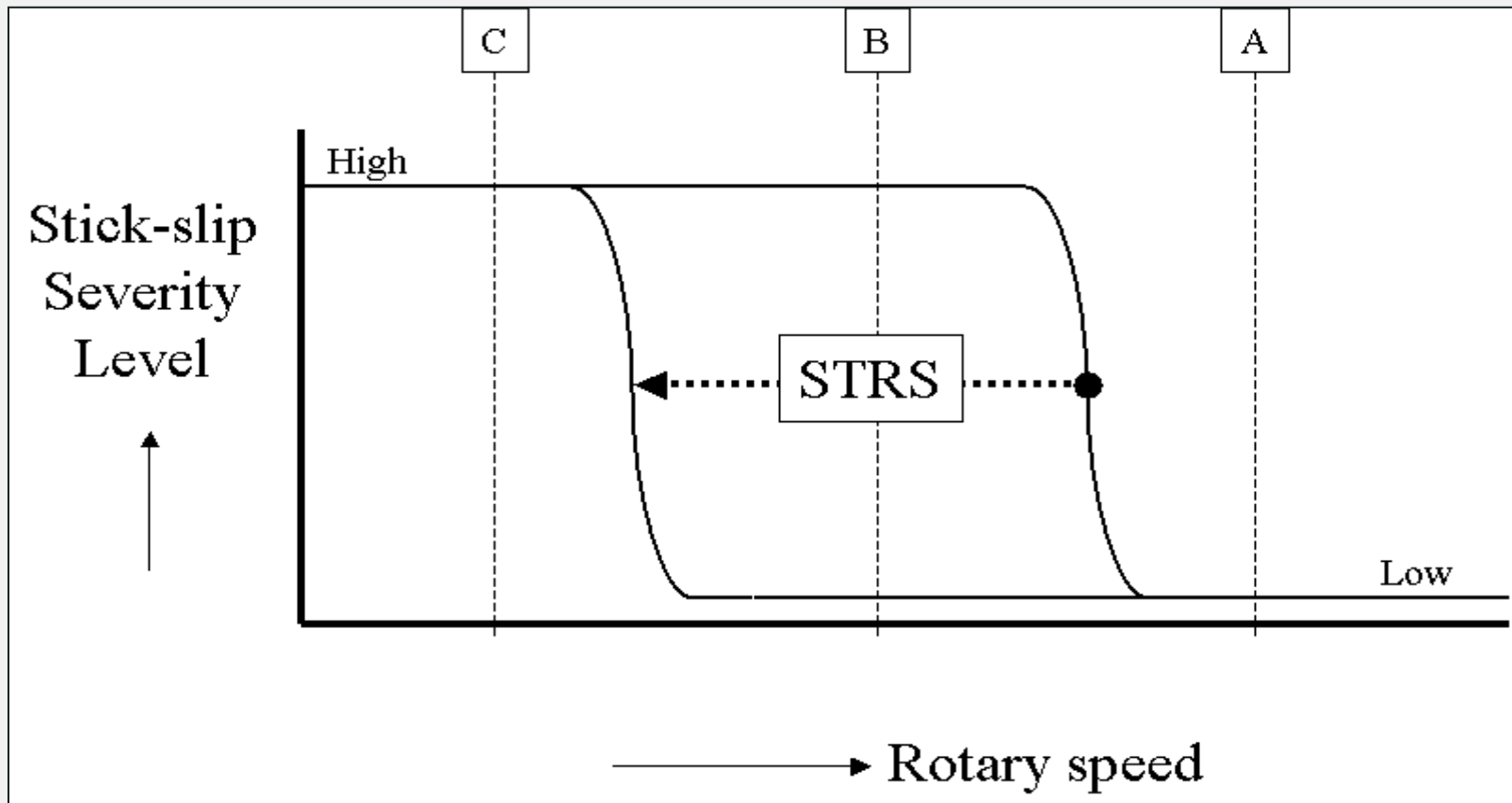
Current values:

Length: 1732.8[ft]
Kf: 89506
Cf: 5955

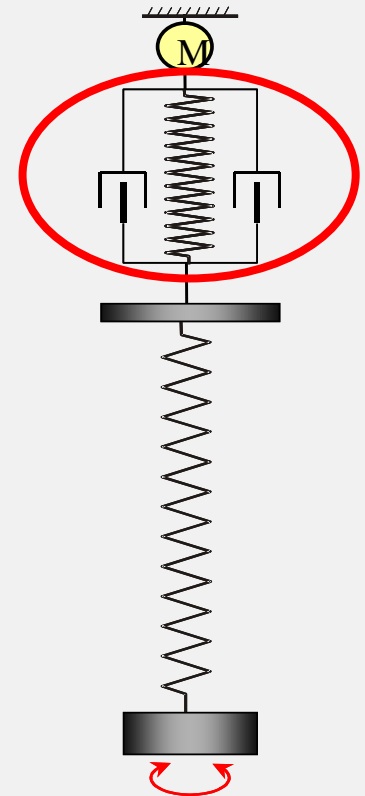
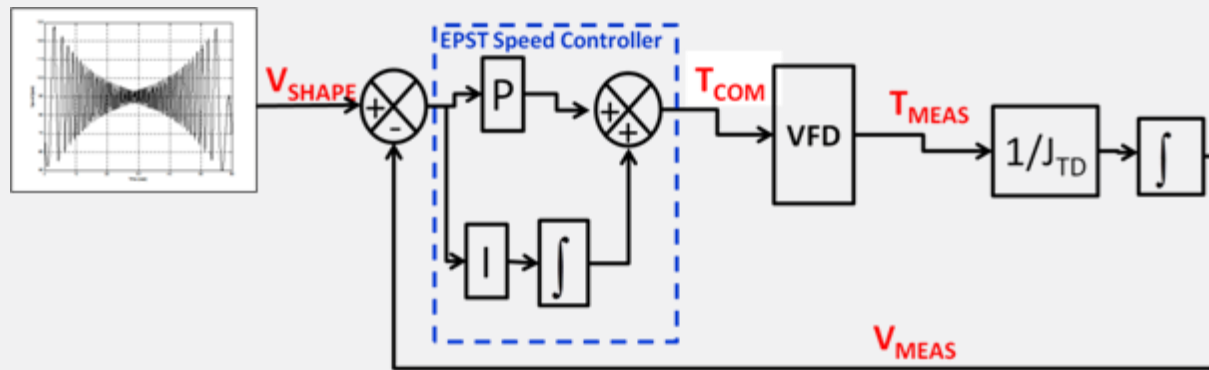
Home Trend BHA Entry Drill Pipe Entry Messages Settings System

EPST BHA/drill pipe entry screen

1. Softtorque working envelop



1. Softtorque AutoTune



- First in the world, while drilling identification of softtorque tuning parameters
- Only software update for EPST controller.

1. Traditional Softtorque (STRS)

Technology Resume: Traditional Softtorque (STRS) technology.

- Suitable for vertical well operations.
- Drill pipe size from 5" up.
- Drill depth up to around 5000 m.
- Standard STRS technology needs continues tuning while drilling.
- Electropoint EPST system can be upgraded with Autotune module
- Suitable for DC TD's.



Softtorque new technology

Electroproject Advanced Softtorque AST



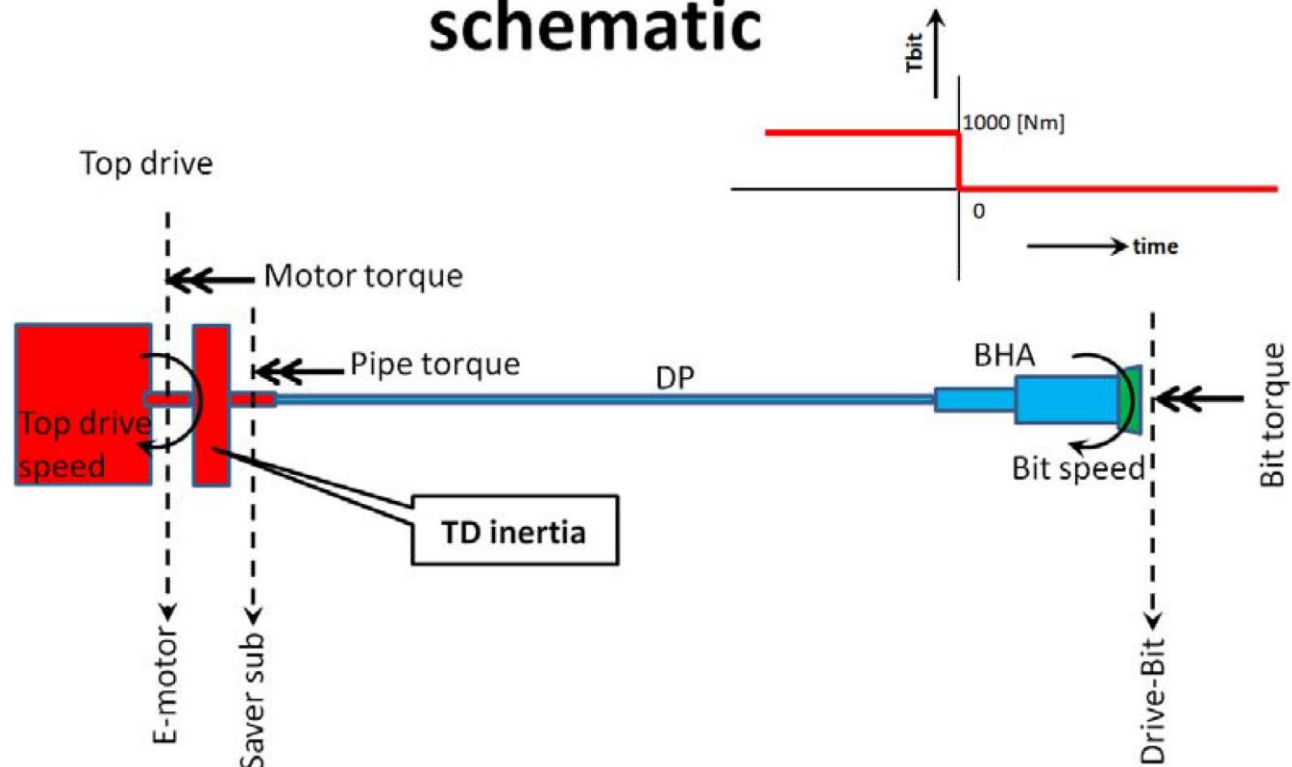
Technical Presentation softtorque

AST technology minimize drill bit speed variations caused by bit torque disturbance, delivering :

- a “wider” working envelop for stick-slip mitigation allowing for larger WOB
- Better performance when drilling with “thin” pipe
- Better performance a greater depth.
- Better performance in horizontal wells and lighter BHA.

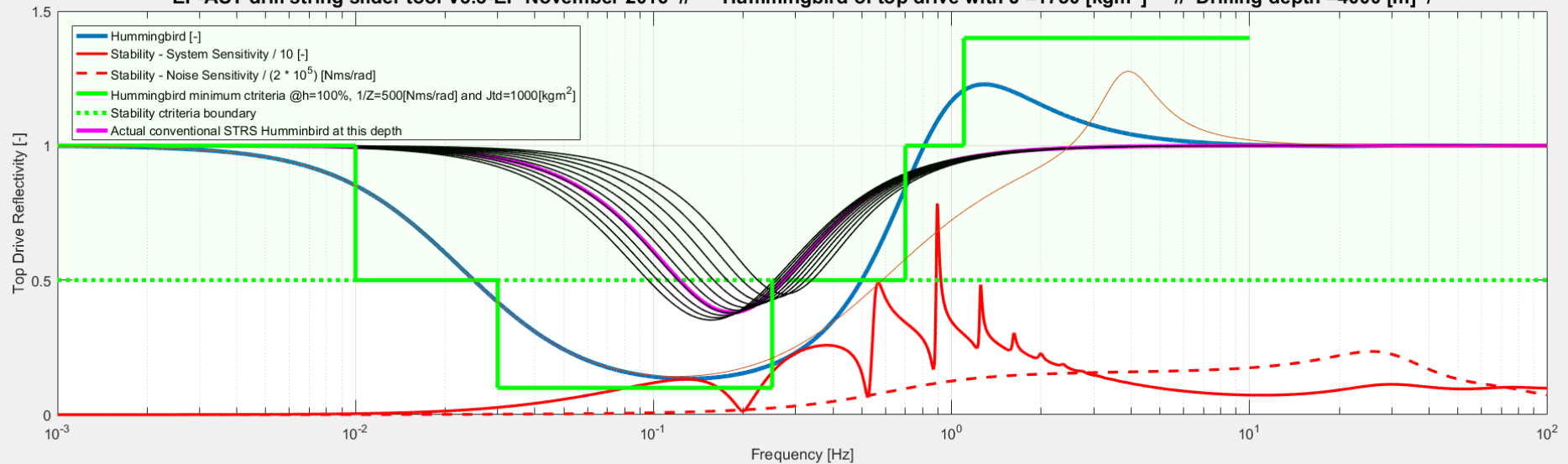
New technology: Advanced Softtorque

Top drive – drill string – bit schematic



TTA5 – 12 ¼" hole – 13kft MD / Top drive inertia = 1750 [kgm²]

EP-AST drill string slider tool V3.3-EP November 2016 // Hummingbird of top drive with J =1750 [kgm²] // Drilling depth =4000 [m] /



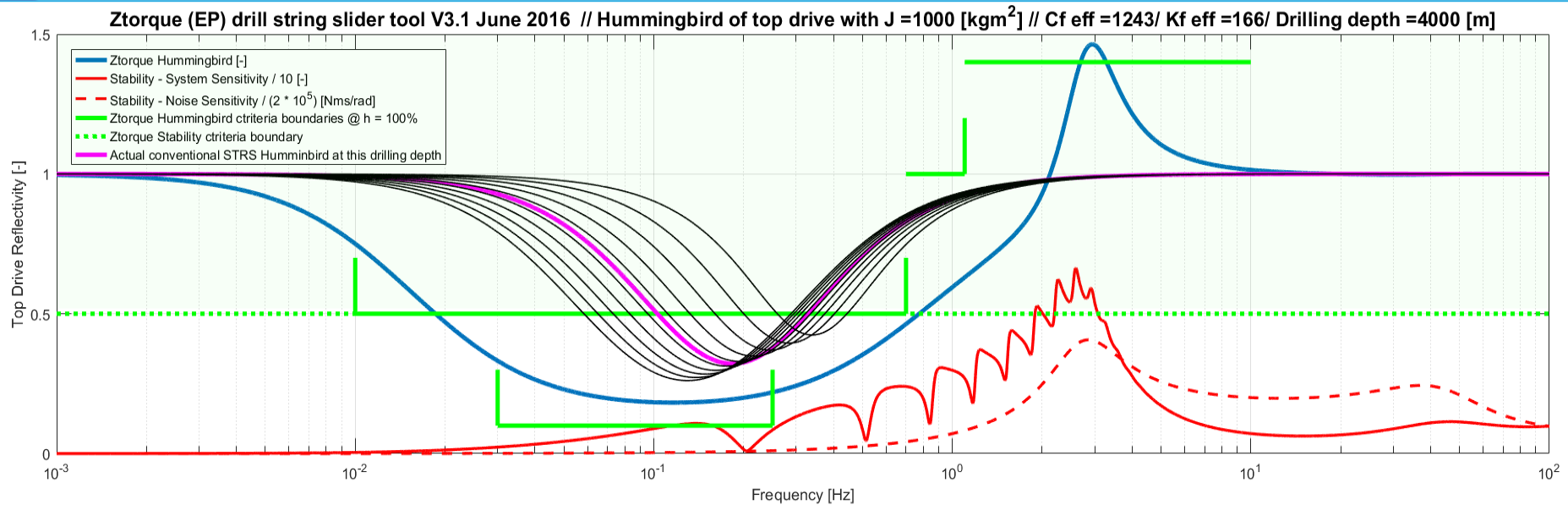
Variable	Min	Max	Selected	Units
h hybrid	0.0	100.0	45	[%]
1/Z DP	100	1000	632.616	[Nms/rad]
Jtd	250	6000	1750	[kgm ²]
VFD LP	0.001	0.01	0.008	[s]
VFD delay	0	0.05	0.02	[s]
k	0	1.0	0.7	[-]
SL time	0.1	20	5	[s]
C1 LP	0.0	0.050	0.004	[s]
C3 LP	0.0	0.20	0.016	[s]
X-shift	1	5	1	[-]
K wall	0	10	3	[Ns/m ³]
delta	0	5e8	2e+08	[Ns/m ²]
J bit	0	500	0	[kgm ²]
Y bit	-500	500	0	[Nms/rad]
C vw	1	100	15	[rpm]
Depth	2467.9656	4815.84	4000	[m]

DRILL STRING : STRS_Tuning_V81_NAGA6_TTA5_12-25inchsection_8097-15800ft.xls

☒ EP-AST ON ☐ EPST ON ☐ SoftTorque OFF

Prepared by: Dr. Ir. Ivo Stulemeijer, Consultant, November 2016

New technology: Advance Softtorque



AST properties:

- Shape of reflectivity curve is adaptable on operation.
- Stability algorithms take the drill string property's into account.
- Higher modi damping up to 3 Hz.
- Low TD excitation with minimum drill bit speed disturbance.

Technical Presentation AST

What brings makes AST unique:

- Proved and recognized SoftTorque system.
- Designed to be embedded in all electrical TD's (AC and DC) (DC systems to be executed with encoder feedback).
- Widest control spectrum. Stick slip mitigation for higher modi.
- Low speed incursions while controlling. Not violent reacting TD.
- Highest crossover frequency. Immune for higher modi oscillations.
- Capability to investigate performance using expert tools to advice improvements.



Softtorque new technology

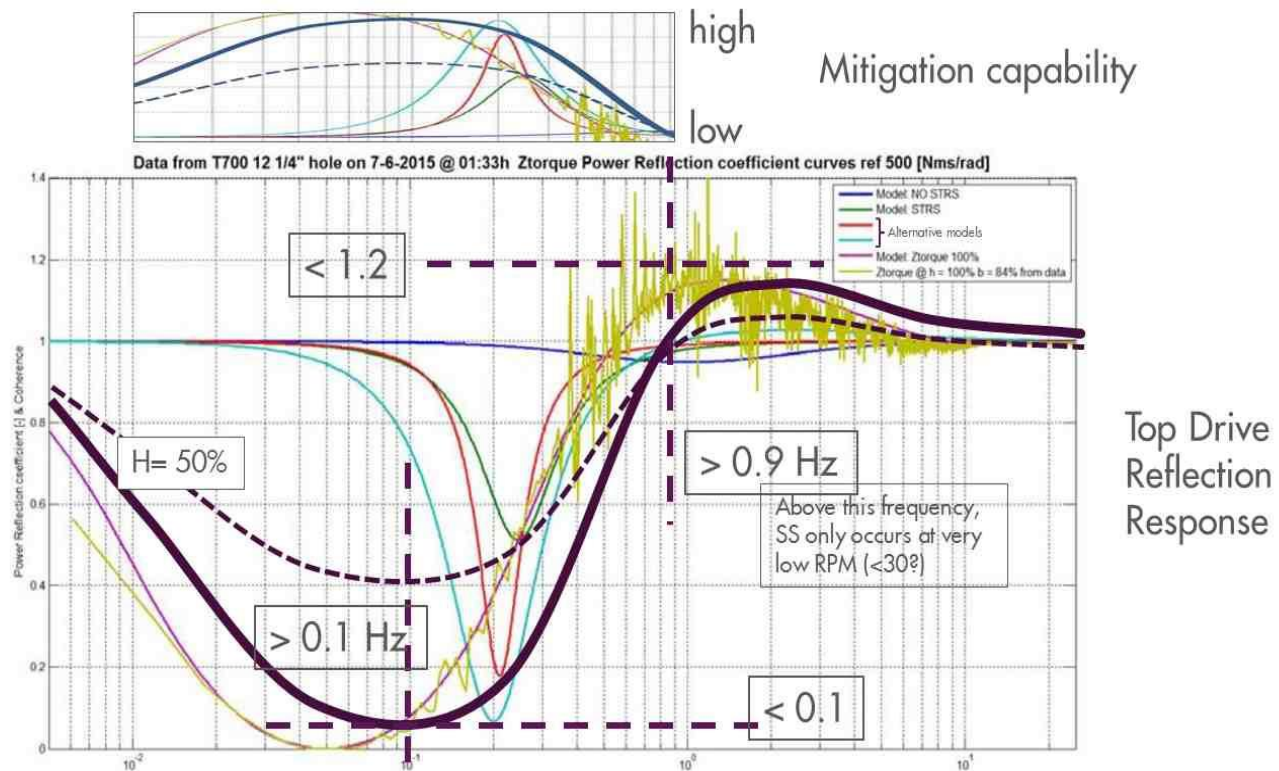
Electroproject Ztorque

Technical Presentation softtorque

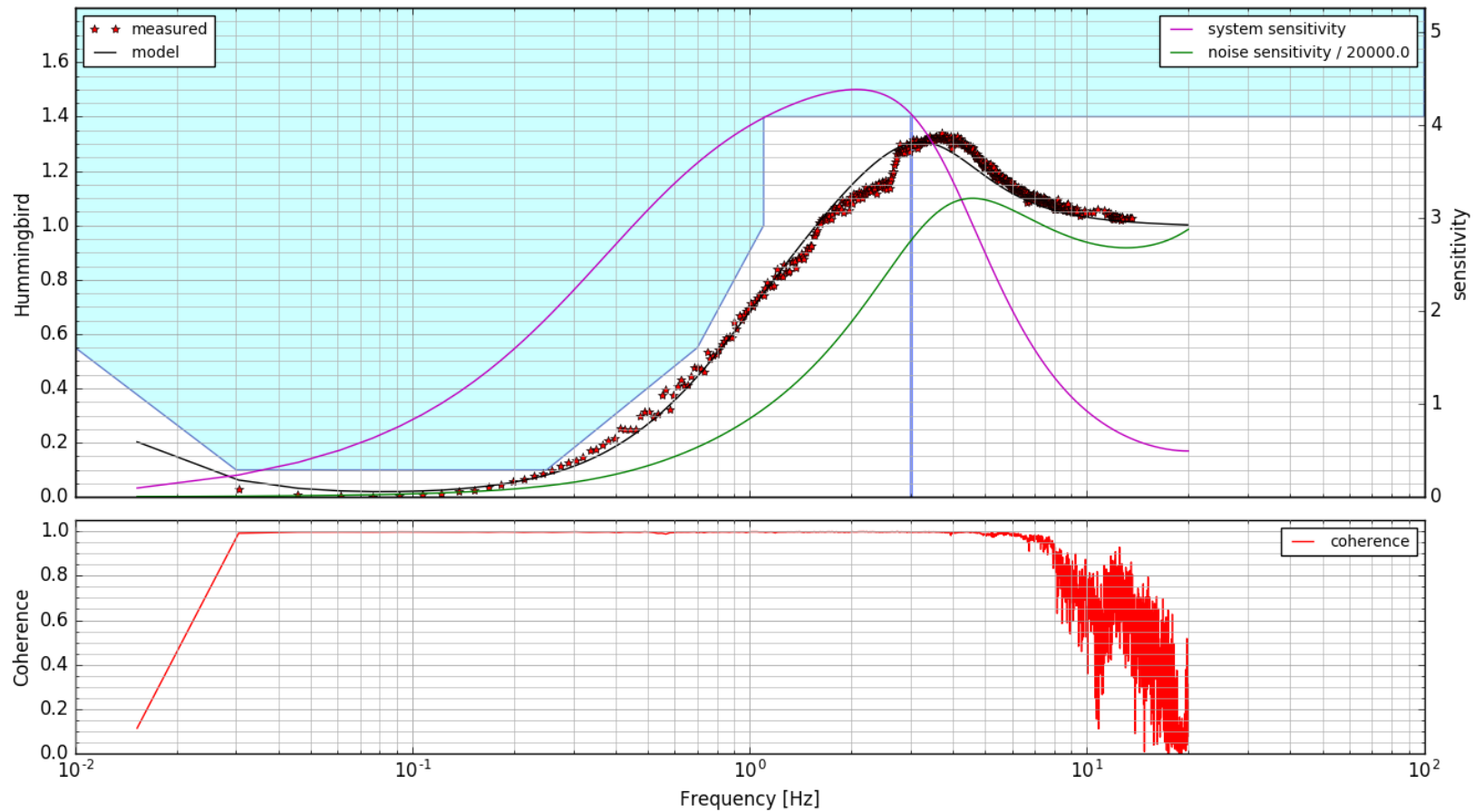
Ztorque (Zt) is designed as a wide band impedance (Z) matching concept. The technology is based on transmission line theory with underlying ambition to absorb all torque waves arriving at the TD, delivering :

- a “wider” working envelop for stick-slip mitigation allowing for larger WOB
- Better performance when drilling with “thin” pipe
- Better performance a greater depth.
- Better performance in horizontal wells and lighter BHA.

Ztorque QA/QC criteria



Hummingbird plot unloaded
 EPST 1016082 Rig279 Oman Wed Mar 01 20:09:00 2017 UTC+1 (5 min) H=1.00, T0=12.00, Comp=74



Prepared by: Dr. Ir. Ivo Stulemeijer, Consultant, November 2016

GDI-8 Ztorque implementation

PERFORMING BETTER

QATAR: IMPLEMENTATION OF Z-TORQUE ON NF-12 IN QATAR



Z torque has been successfully installed on GDI-8 to suppress stick slip by maximizing the top drives ability to catch the torque waves travelling through the drill string from the bit. This is a different approach compared to SoftTorque which treats the complete drill string as a mass-spring-dampener. Z-Torque increases the mobility of the top drive and counteract torque variations with velocity swings, absorbing the torque waves at the saver sub and preventing them from bouncing back to the bit. This levels the speed and reduces or eliminates stick slip.

GDI-8 is the first drill rig where ElectroProject has implemented Z torque according to Shell's patent in the top drive VFD. A fast bus is installed to allow communicating quickly enough to analyze and counteract with speed correction from controller. The theoretically mobility of the Z-torque without time delays is very good, and thus the requirement for the fast bus. The Z-torque systems widens the window for stick-slip free drilling and is more user friendly as it does not need constant re-tuning against actual drillstring length. Simply turn it on!

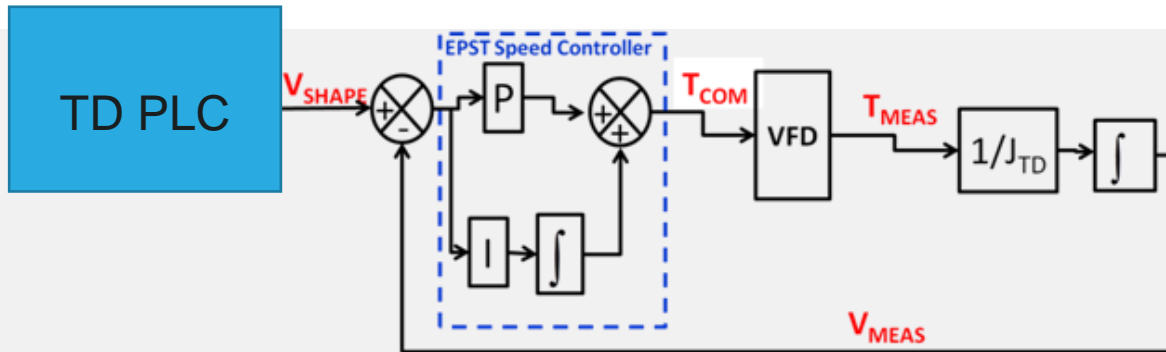
For more information, contact QSSC-Onshore-Perf-AA@shell.com (A&A Performance Team)



Technical Presentation softtorque

Hardware implementation.

EPST Hardware implementation for STRS and AST

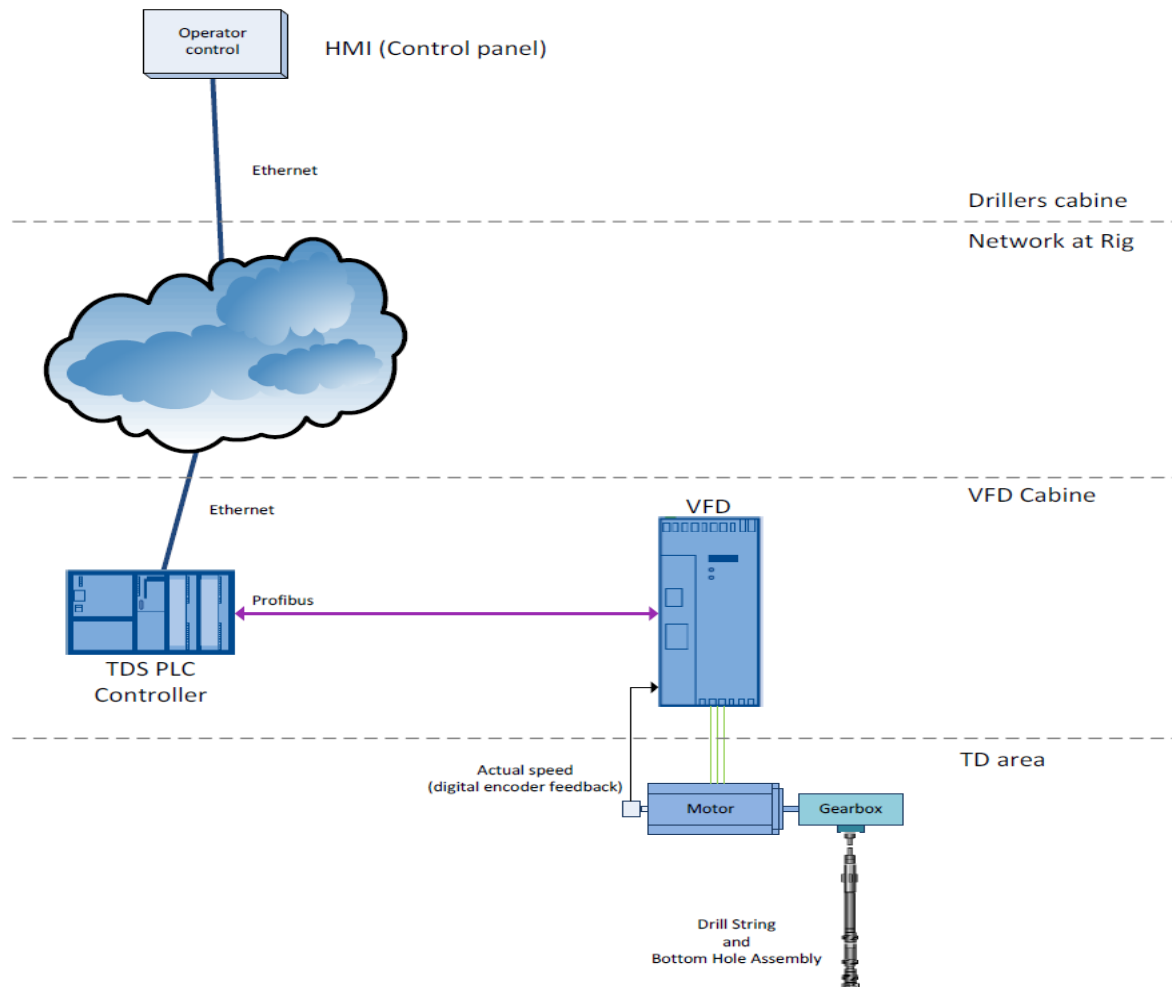


HMI Control panel

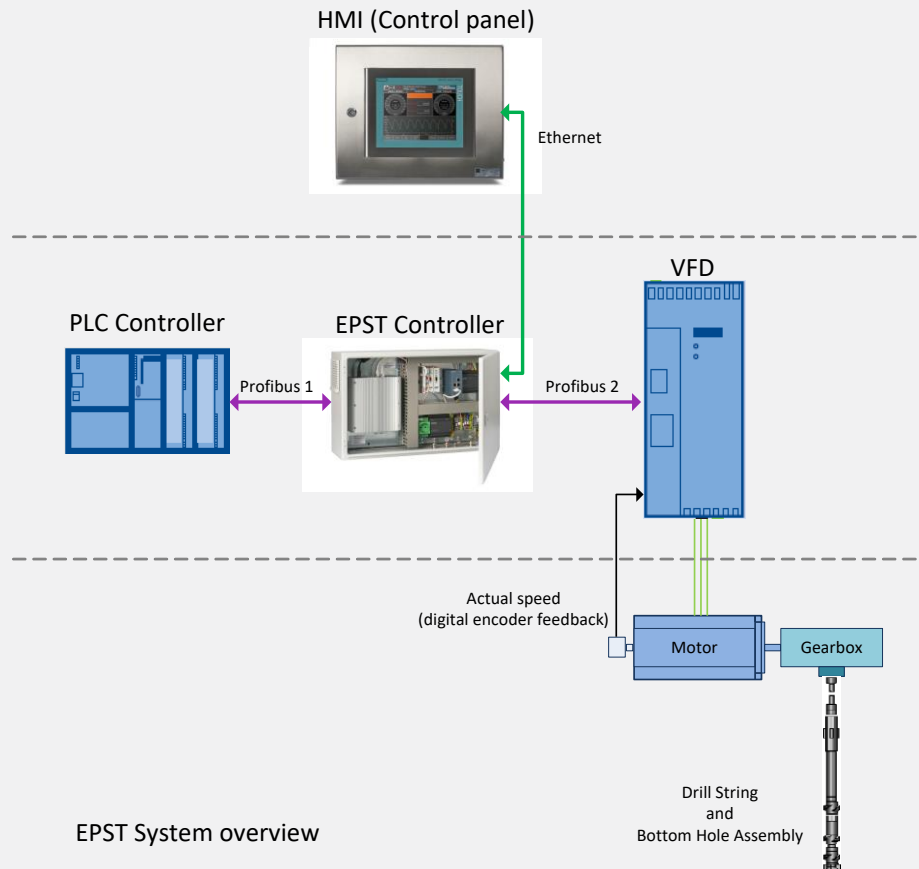


EPST Control cabinet

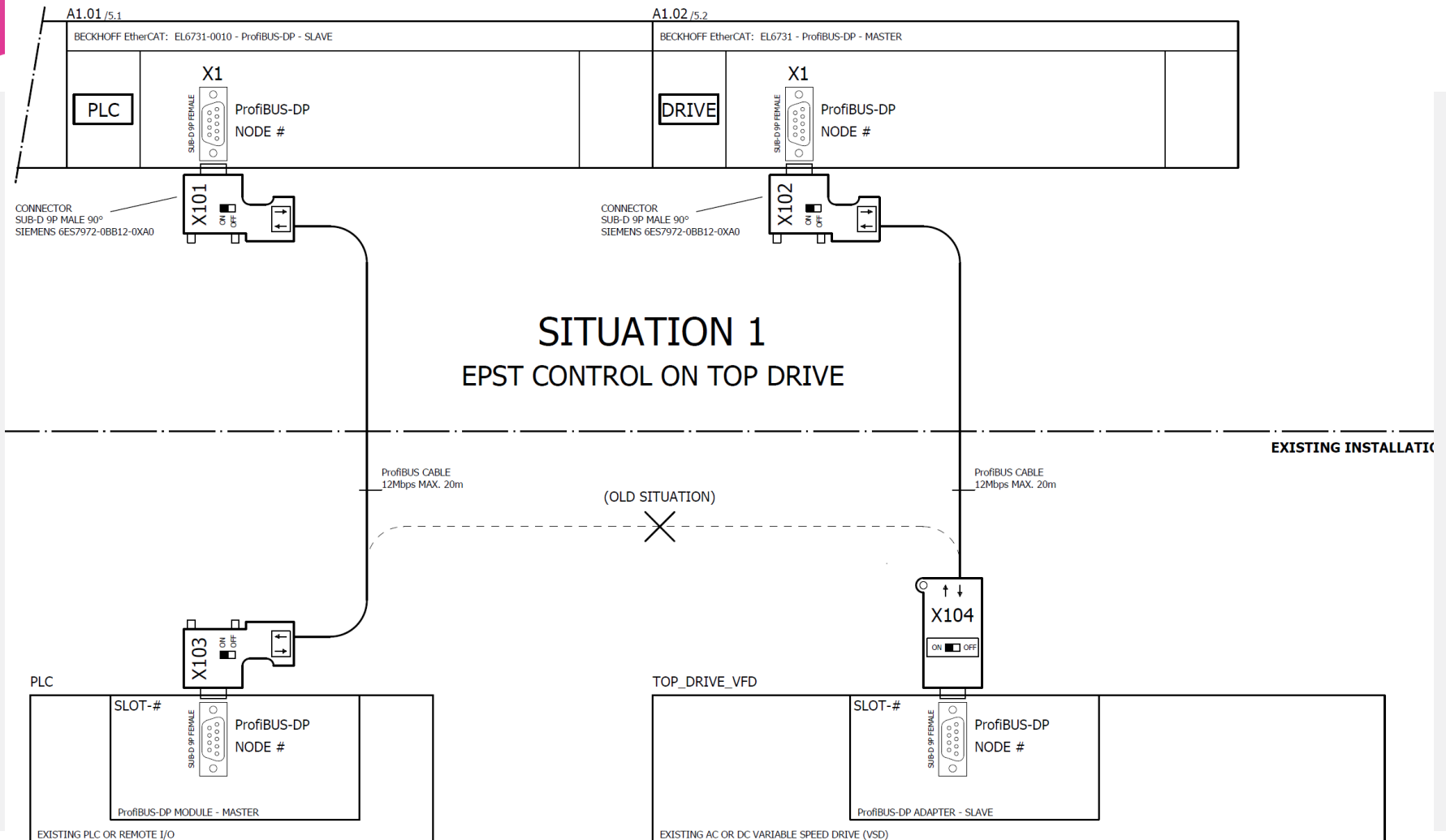
EPST Hardware implementation for STRS and AST



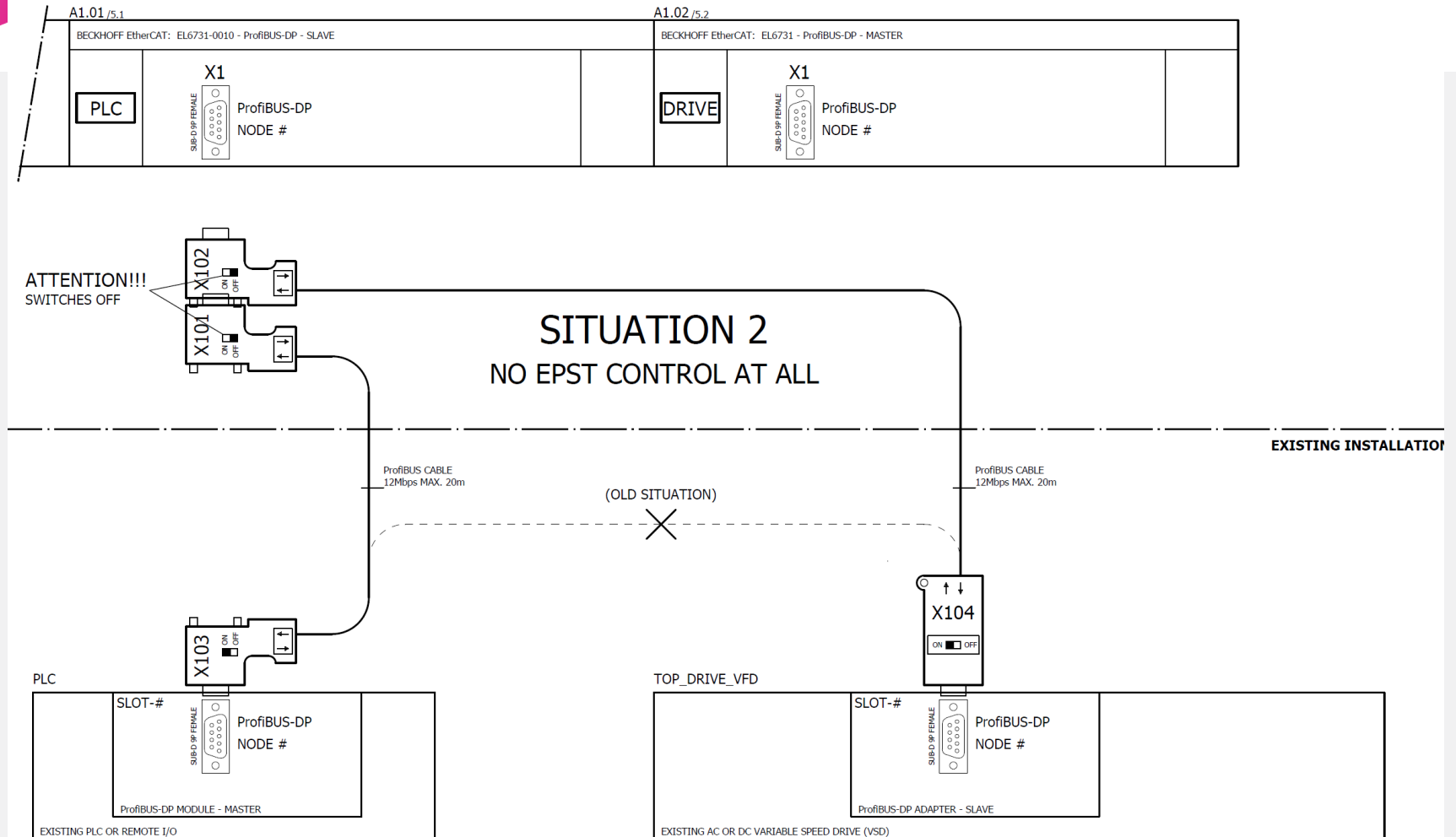
EPST Hardware implementation for STRS and AST



EPST Hardware implementation for STRS and AST



EPST Hardware implementation for STRS and AST





Technical Presentation softtorque

Installed base.



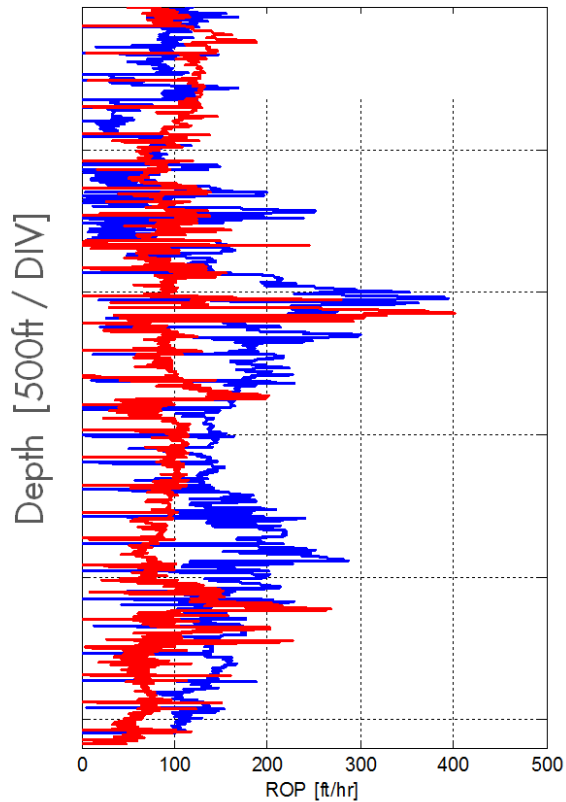
Technical Presentation softtorque

What brings ElectroProject SoftTorque to the table:

- Proved and recognized SoftTorque system.
- Designed to be embedded in all electrical TD's (AC and DC)
- AutoTune functionality
- Advanced SoftTorque (AST)
- Capability to investigate performance using expert tools to advice improvements.

Performance reports

Middle East



- Middle East
- BATCH DRILLING
- ELECTROPROJECT EPST
- **~40 % ROP IMPROVEMENT SINCE EPST; compared against best offset**
- **REDUCED BIT DAMAGE**



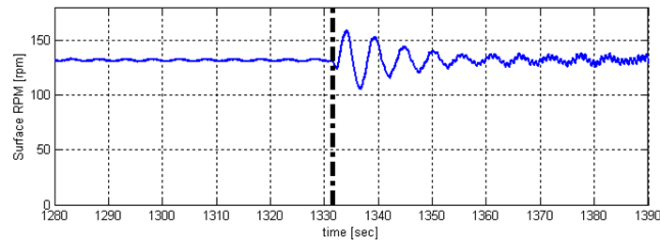
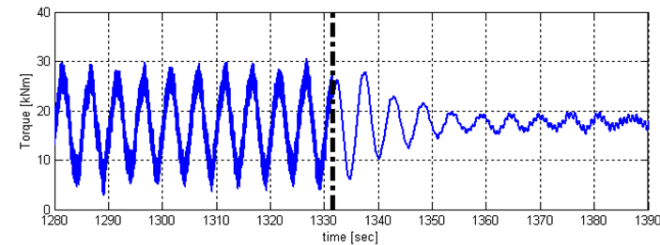
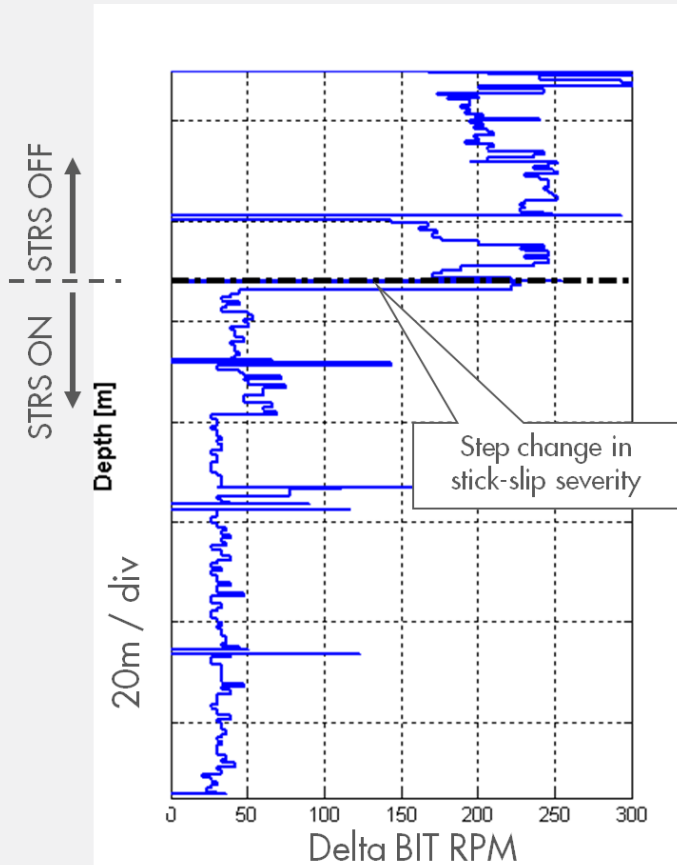
NO EPST



WITH EPST

Performance reports

Noble Hans Deul North Sea



- ELIMINATED STICK-SLIP VIBRATIONS
- REDUCED FAILURES
- INCREASED ROP 10%

The impact of Soft Torque Technology on Drilling Performance

Mike Lukyanov
Well Engineer

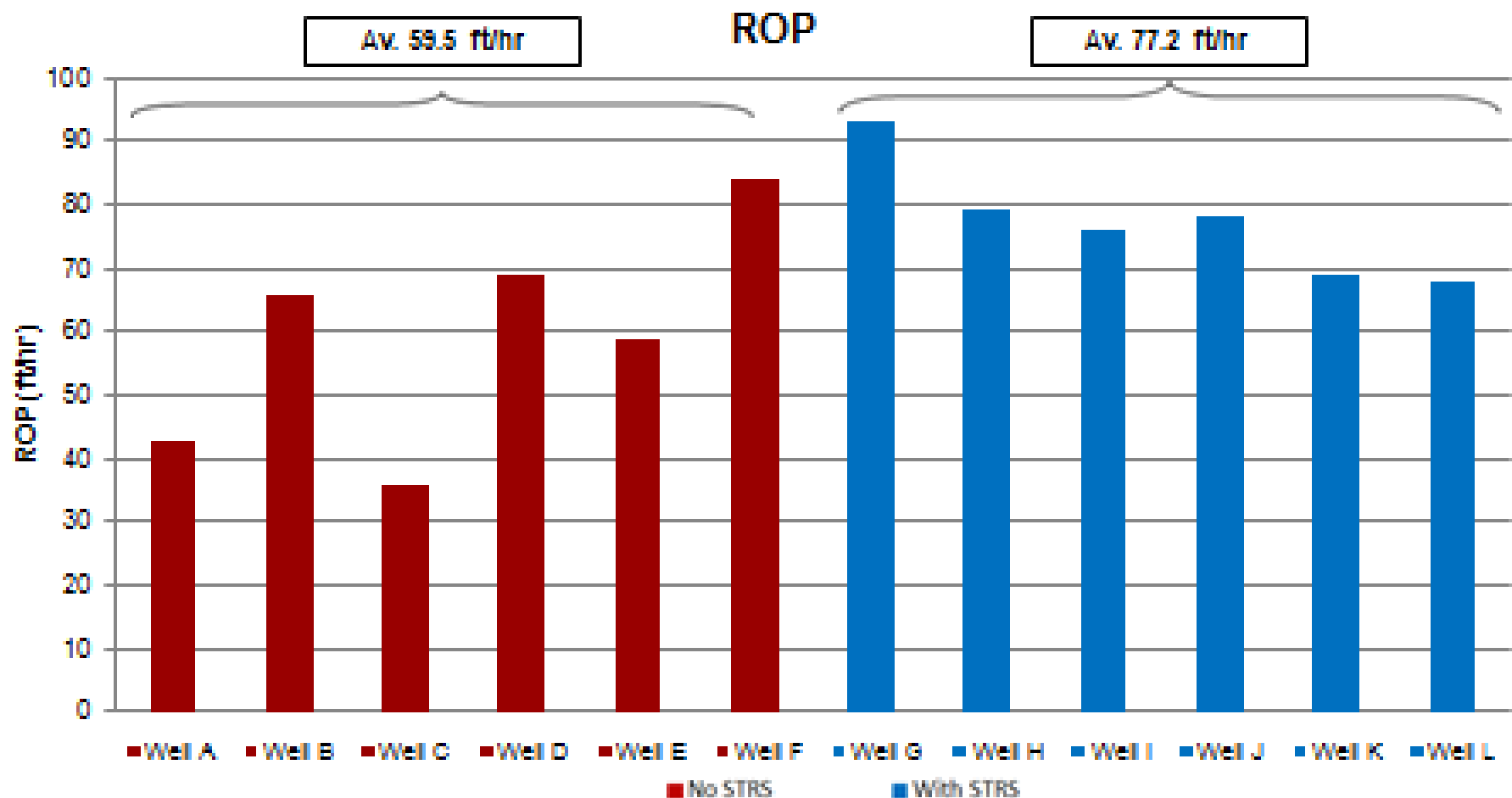
Odion Ikhajiagbe
Well Engineer



Conclusions:

- Stick slip is damaging both for equipment and for cores
- STRS aided Shell in:
 - Reducing stick slip by 40%
 - Increasing ROP by 30%
 - Reducing bit wear
 - Good quality cores
- STRS is easy to implement and has shown good results

Pearl Wells Application:



Pearl Wells Application:

- Improvements in bit performance were observed
- Less bit wear and more footage drilled per bit
- IADC bit dull grading was used and same crew applied it
- Weighted average with respect to footage drilled was taken

	feet/bit	Bit Wear	
		Inner Teeth	Outer Teeth
With-Out STRS	2371.9	1.5	3.2
With STRS	2567.6	1.0	2.0
% Improvement	8.2	34.2	37.1

Advanced Softtorque

Van: Martin Sanderson [mailto:MSander@slb.com]
Verzonden: woensdag 7 november 2018 9:37
Aan: CATENA Angel (ENGIE Electroproject B.V.) <acatena@electroproject.nl>
CC: avreman@einenterprise.com
Onderwerp: RE: [Ext] Evidence of good performance for rigs 42 and 57.

Angel
I can confirm that two advanced soft-torque systems were installed on KDC-57 and 42.

For the installation on KDC-57, a success flyer was made. Comments made by the Senior Well Engineer

“Advanced soft torque was installed in KDC-57, the stick slip was dramatically reduced and the ROP was improved especially in the 6 1/8” section.”

Secti on	Average ROP m/hr	OB ROP m/hr SA- 0677	Time saving hrs	Actual saving \$
12 ¼	28.71	42.09	13.02	27127.5
8 ½	24.71	41.94	16.89	35191.4
6 1/8	60.46	77.01	10.19	21238.3
Total Saving				83557

Regards
Martin



Thanks for your attention !

Questions ?

Angel Catena

acatena@electroproject.nl

Tel. 00 31 651400230