Old rig with new technology
Z – Torque
AUTOMATION SYSTEMS — SOFT DRIVE

TORSIONAL VIBRATIONS DAMPING SYSTEM

- Soft drive
  - Research in this field since 2009
  - Based on Shell technology
    (known as: Soft torque, Z-torque)
IMPACT OF DRILLSTRING VIBRATIONS

- REDUCED RATE OF PENETRATION (ROP)
- EQUIPMENT FAILURES E.G.
  - Rotary Steerable System (RSS), Downhole motors
  - Measurements while drilling (MWD)
- BROKEN DRILL BIT CUTTERS
- DRILL PIPE FATIGUE FAILURE
- ESTIMATED TO OCCUR 50% OF ‘ON BOTTOM’ DRILLING TIME
OLD SOFT TORQUE ROTARY SYSTEM (STRS)

NO STRS

Electric motor

Drive inertia

Drill pipe stiffness

BHA inertia

With STRS

ACHIEVED BY CHANGING THE DRIVE CONTROLS

COULD BE SOFTWARE OR ELECTRONICS

TUNING IS REQUIRED:

“CF” AND “KF”

Added damping element
NEW Z-TORQUE TECHNOLOGY - STICK SLIP MITIGATION

LINE THEORY APPLIED TO DRILLSTRING

WITH INERTIA COMPENSATION/CORRECTION

TD CONTROL SYSTEM DESIGNED TO ABSORB ‘ALL’ TORSIONAL WAVES WHICH ‘ARRIVE’ AT THE TOP DRIVE

NO TUNING REQUIRED (FIXED SETTING PER DP SIZE/TYPE)
HOW TO ASSURE THAT Z-TORQUE WORKS?

MINIMUM SPEC IS DEFINED IN COMMISSIONING QA/QC PROTOCOL

MINIMUM CRITERIA CONFIRMING SYSTEM FUNCTIONALITY AS WHOLE

- Derived from Unloaded Top Drive testing during commissioning
- Can be confirmed with Drilling data
WHY Z-TORQUE?

SOFT TORQUE GAPS:

- TARGETS & ONLY TUNED TO THE FIRST ‘MODE’: THE LOWEST FREQUENCY
- MODEL REDUCTION ASSUMPTION: ONE LUMPED BHA MASS, AND ONE DRILL PIPE SPRING
- IT IGNORES PROPAGATION TIME DELAY: A 3 KM DRILL STRING, 3 KM/S...
- NEEDS TUNING, AND THAT’S PRONE TO HUMAN ERROR
- OPERATING ENVELOPE CONSTRAINTS: <4” DP AND >6 KM MD ARE A CHALLENGE
- NO GOOD SOLUTION YET FOR HYDRAULIC DRIVES
Z-TORQUE RESULTS

The diagram shows a graph with time on the x-axis, frequency, torque, and speed on the y-axis. The graph includes multiple lines indicating different parameters over time. The data points and lines are color-coded for clarity.

The graph includes a legend on the right side that explains the different line types and colors:
- Red: Motor Airgap
- Green: Inertia Torque
- Black: Pipe Torque
- Yellow: Measured
- Blue: Est
- Red dotted: Scatter/FO

The graph appears to be used for analyzing drilling operations, specifically focusing on the torque and frequency effects over time.
Z TORQUE MAIN IMPROVEMENTS

- HIGHER ROP
- LONGER BIT LIFE
- FEWER TRIPS FOR DOWNHOLE BREAKDOWNS...
- LOWER COSTS
ADDITIONAL Z TORQUE IMPROVEMENTS

- LIGHTER BHA
- SLIMMER DRILL PIPE
- FEWER MUD MOTORS
- LATERAL/WHIRL SOLVED BY ENABLING VERY LOW TD RPM
- DRILL STRING IMAGING
- NEAR SOLID STATE ROTARY STEERABLE: STEER WITH TD
IMPLEMENTATION REFERENCES
EGYPTIAN DRILLING COMPANY: Z-TORQUE IMPLEMENTATION

CLIENT: COOPERATION AGREEMENT BETWEEN SHELL, BAPETCO, EDC, HELB

EGYPT: RIG 52, HADS/ST SYSTEM

YEAR: 2015 - 2016

SCOPE OF WORKS:

- SOFT DRIVE - Active Damping System for Rotary Drilling String