DrillEdge: Application of Case-Base Reasoning*

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Search and Discovery Article #70098 (2011)
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*Adapted from presentation at AAPG Geoscience Technology Workshop, "Success in the Marcellus and Utica Shales: Case Studies and New Developments," Baltimore, Maryland, May 23-25, 2011

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Comments

New problem	>	Old problem
Solution to new problem	<	Solution to old problem

"Testing with DrillEdge technology demonstrated that unscheduled events don't happen immediately; there are predictable and repeatable symptoms in advance of each event -- on the order of hours, or sometimes even days"--Eric van Oort (Shell).

Case Study:Twist-off Analysis

Example well was in Middle East; test well was in Haynesville play, Louisiana.
Scripts were built on max torque, erratic torque and string stall.
These were used to detect events leading up to a twist-off and to provide actions to mitigate these events.
Testing shows that a drilling engineer using DrillEdge could have detected an impending twist-off in advance – with enough time to relay this information to the rig team in order to make an informed decision about how to proceed.

References

Watson, Ian, 1997, Applying Case-Based Reasoning: Techniques for Enterprise Systems: Morgan Kaufmann Publishers, Inc., San Francisco, California, 289 p.

Van Oort, E., and K. Brady, 2011, Case-based reasoning system predicts twist-off in Louisiana well based on Mideast Analog: World Oil, April, 2011, v. 232/4, p. 41-43, 45.

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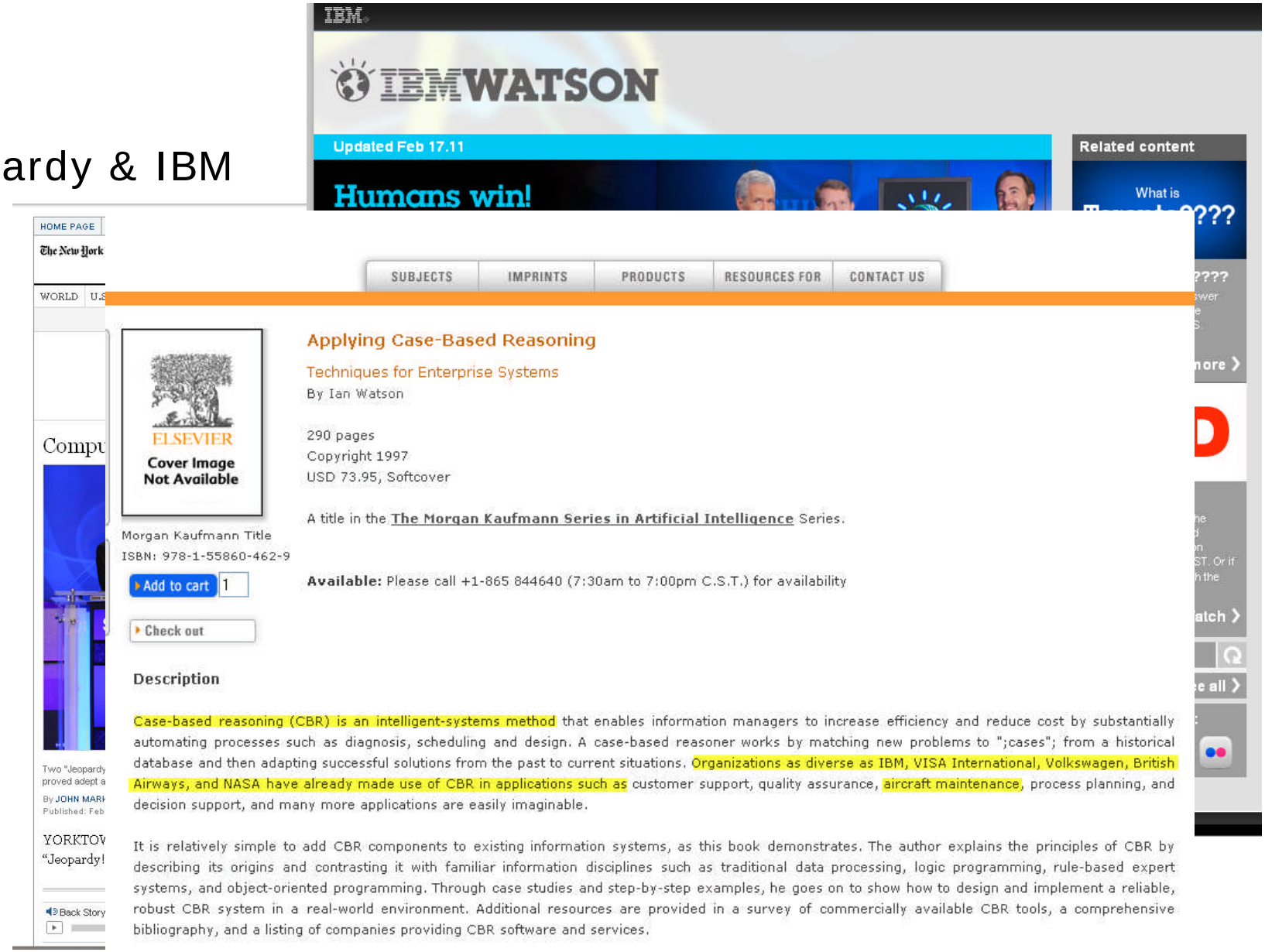
AAPG GTW, Baltimore, May 23 – 25, 2001

Marcellus and Uttica Shales

VERDANDE™
TECHNOLOGY

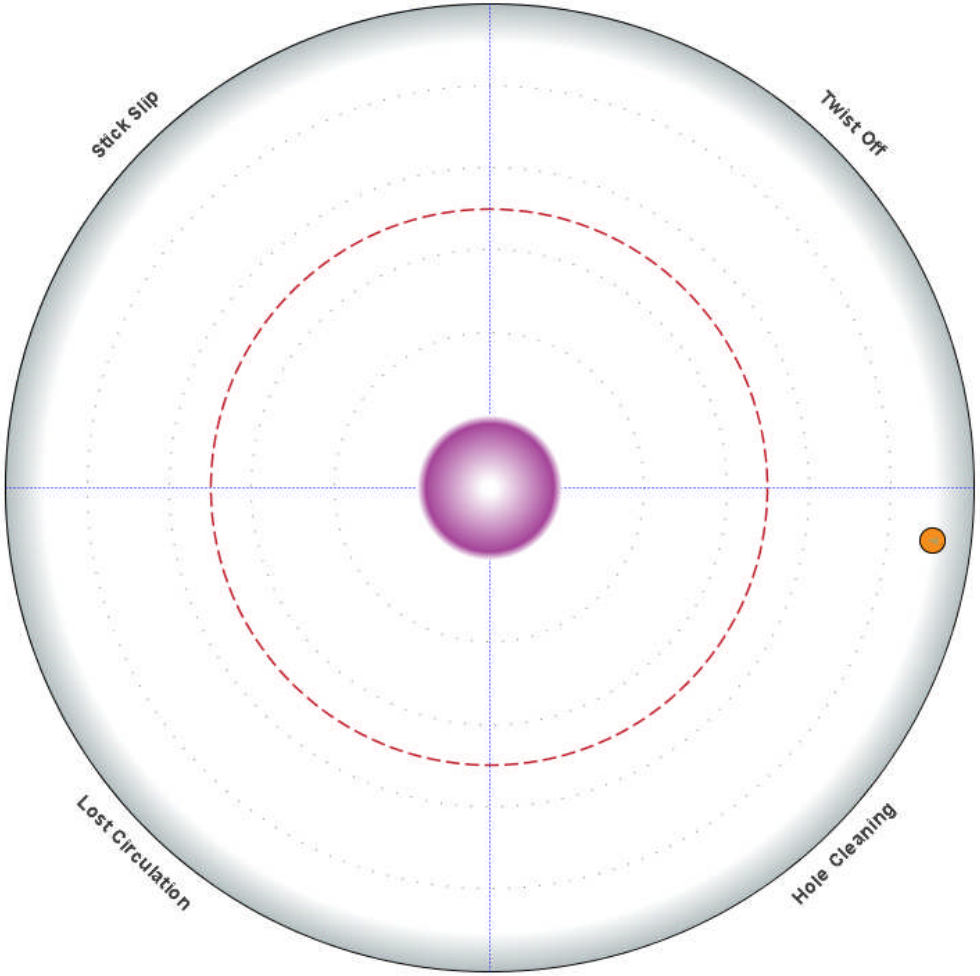
Jeopardy & IBM



Case based Reasoning

(CBR)

The Radar



"Our testing with DrillEdge technology produced compelling results and ***demonstrated that unscheduled events don't happen immediately.*** *We learned that there are predictable and* ***repeatable symptoms in advance of each event on the order of hours, or sometimes even days****."*

- Eric van Oort
Shell -Well Performance Improvement Manager

Reprinted from:
World Oil
April 2011 issue, pages 41-45. Used with permission.

Frode Sørmo, Chief Technology Officer, accepting Harts E&P Meritorious Engineering Award at this month's OTC conference

SPECIAL FOCUS: DRILLING TECHNOLOGY

Case-based reasoning system predicts twist-off in Louisiana well based on Mideast analog

THE AMERICAN OIL & GAS REPORTER
JANUARY 2011
The "Better Business" Publication Serving the Exploration / Drilling / Production Industry

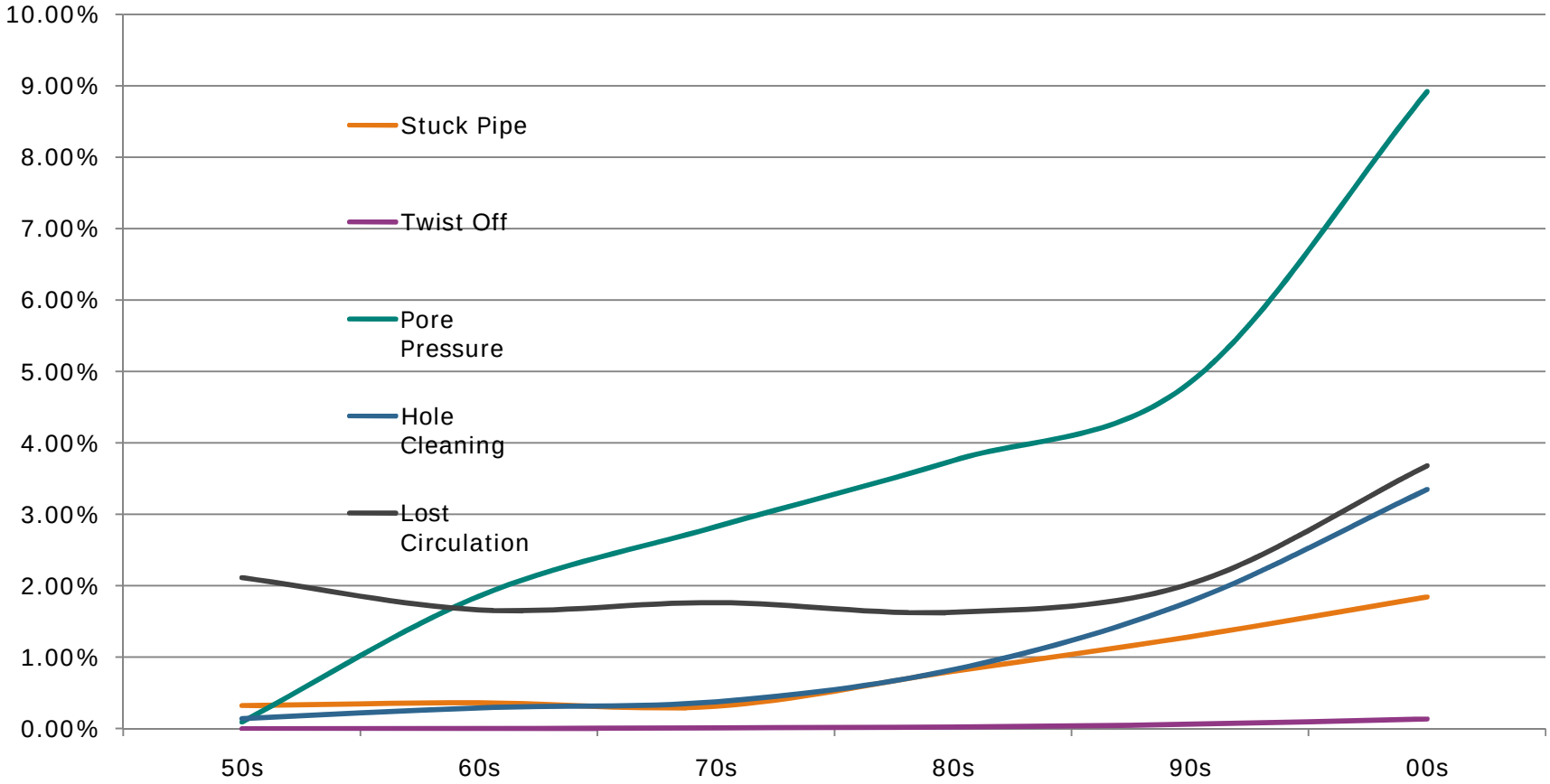
Well Test Highlights Benefits Of Real-Time Infrastructure In Land Drilling Operations

By John F. Jones, Steve Tucker and Tim Sheehy

HOUSTON–The land drilling industry's ability to capture lessons learned in drilling previous wells often exceeds its ability to effectively apply those lessons in real time at the well site. Volumes of carefully collected information too frequently end up in a "black box," where its utility to ongoing drilling operations is marginalized.

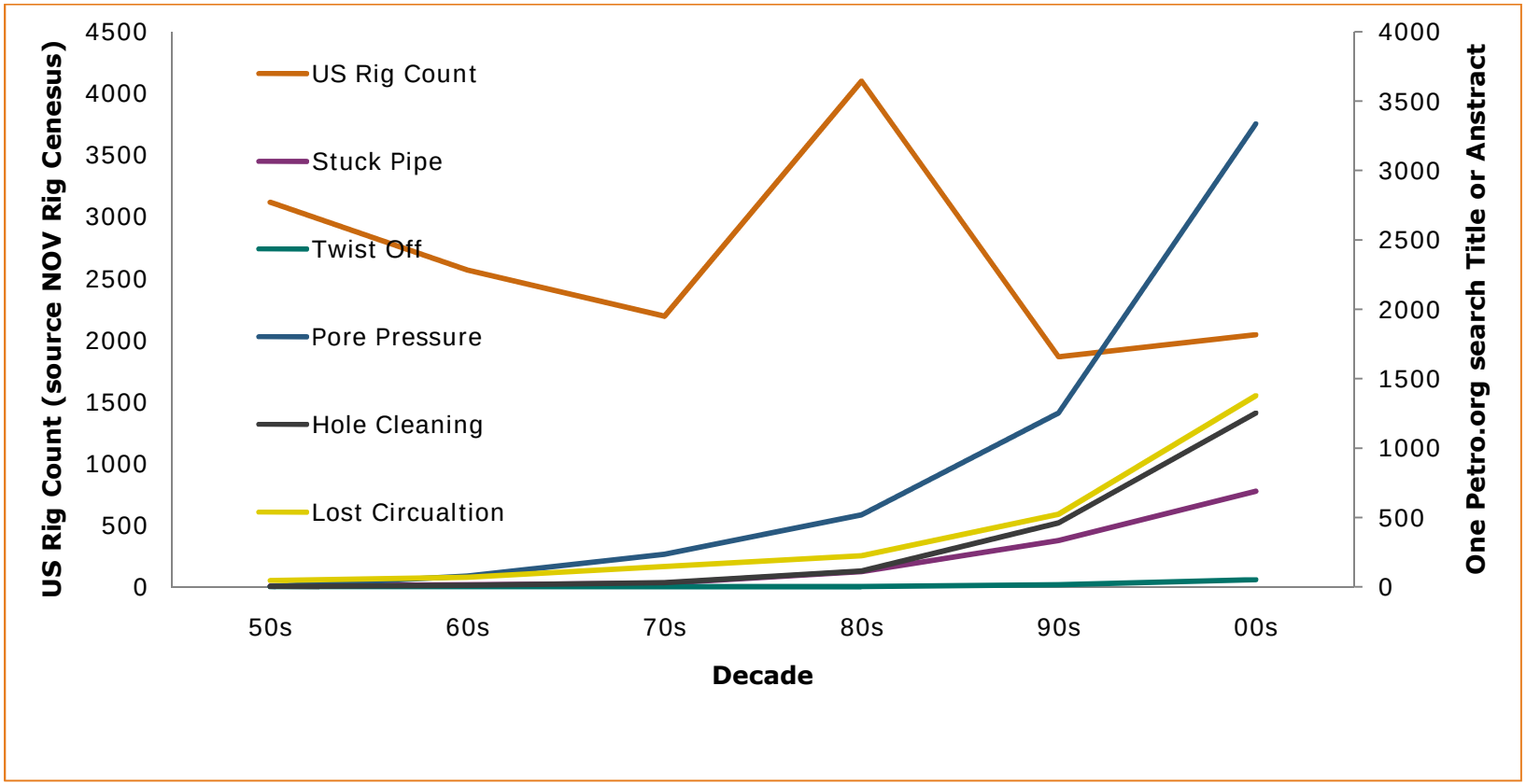
Percentage of papers on OnePetro by Key Word Search

Many people (claim they) don't have problems with Hole Cleaning, Stuck Pipe, Lost Circulation etc.

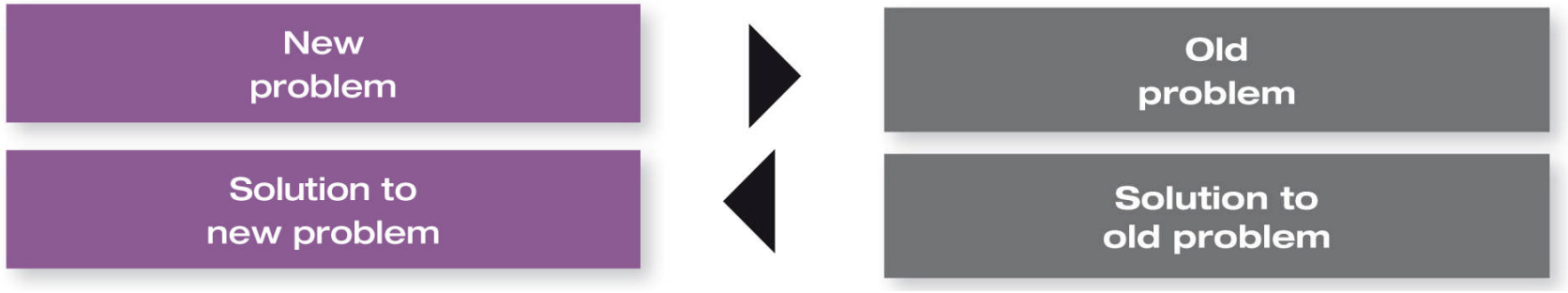


Decades, 1950-59 thru 2000-2009

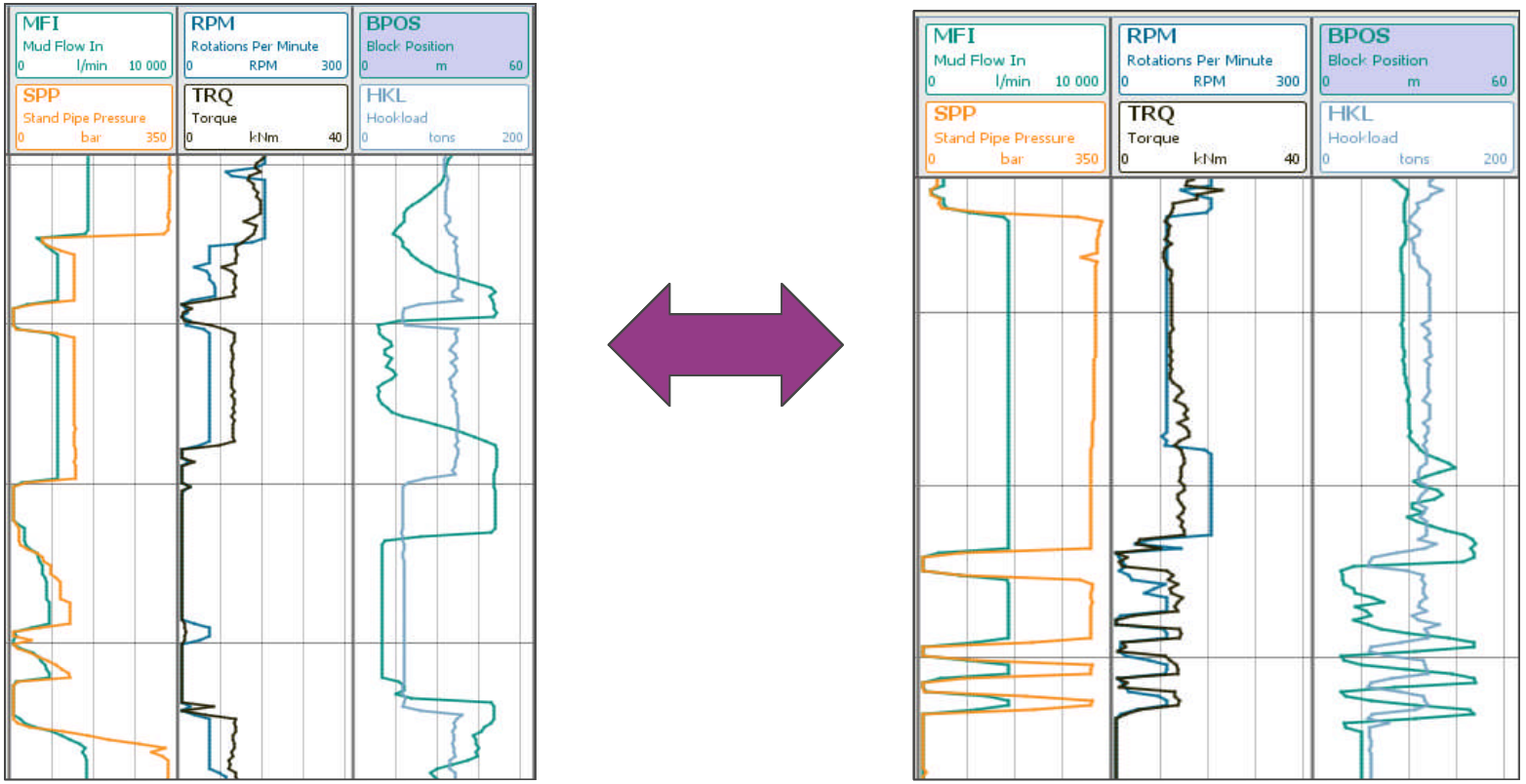
Individually in specific areas this is probably true, but as an industry apparently not ..... last slide global, this specific to US



Case Based Reasoning



Comparing Drilling Situations



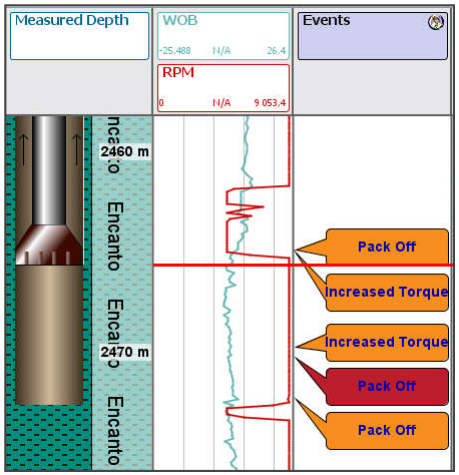
Comparing Drilling Situations

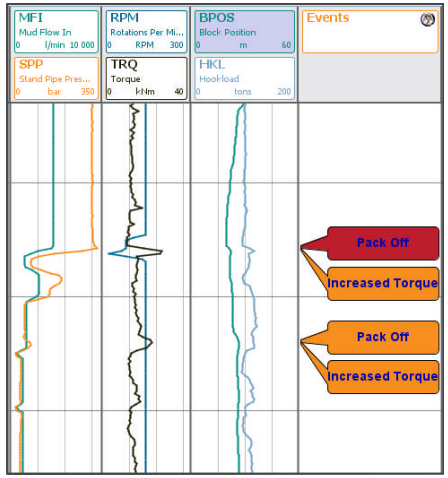
Components of any case

Drilling Fluid	
Mud Weight:	1.6
Type:	OBM
pV:	36
Yp:	25

Well Geometry	
Section start:	4280 MD
Target depth:	6310 MD
Bit Type:	PDC

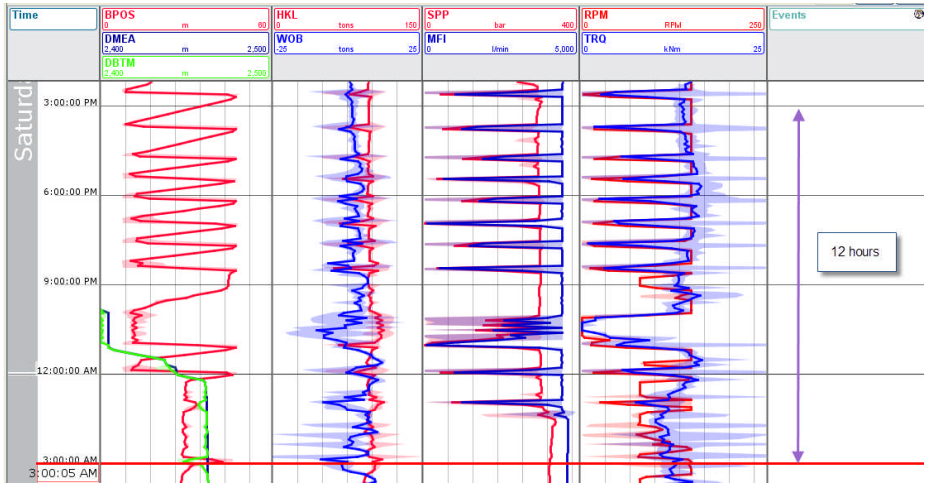
BHA	
Length:	90
Stabilizers:	2
Bit Type:	PDC

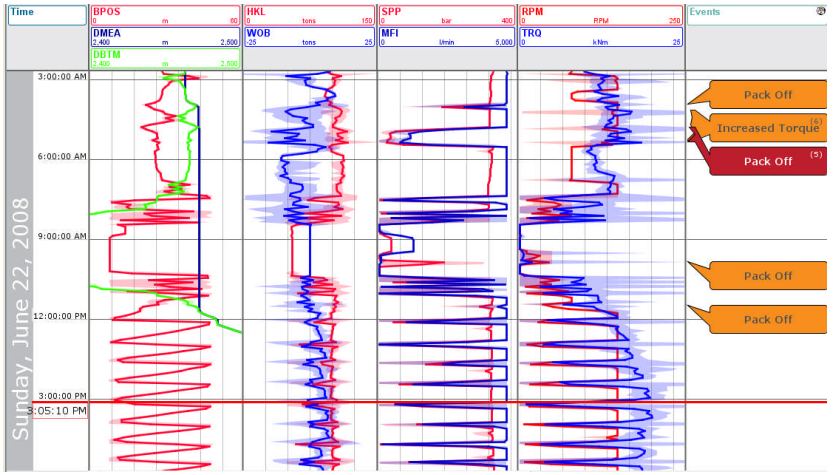


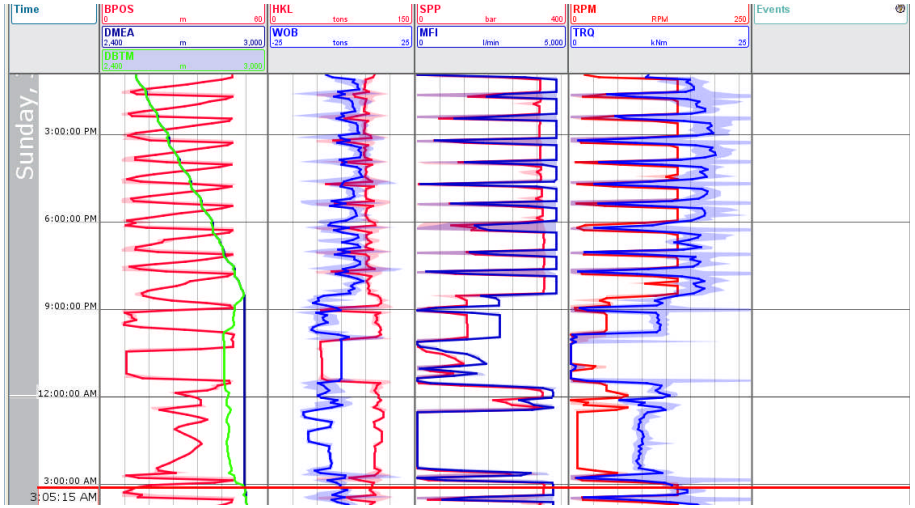


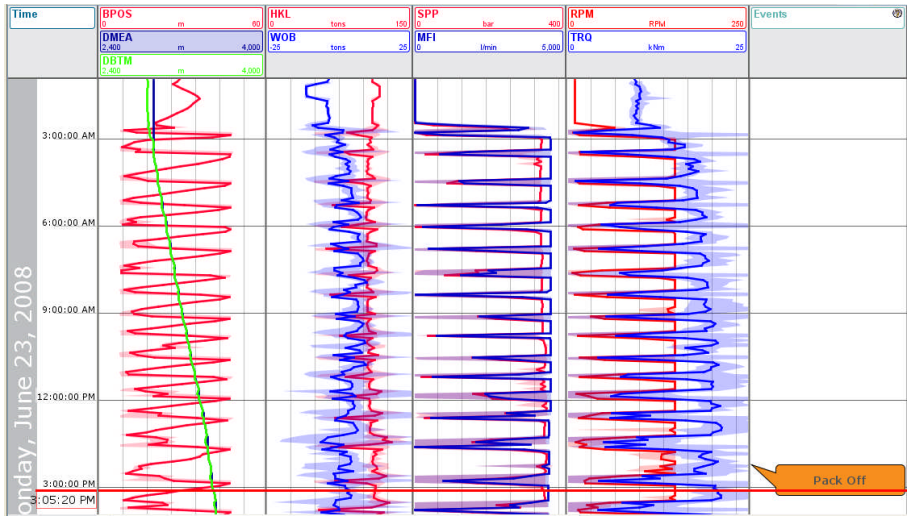

Drilling Fluid
...
BHA
...
Well Geometry
...
78%
52%
31%
86%
74%
64%
Drilling Fluid
...
BHA
...
Well Geometry
...
Pack Off
Increased Torque
Increased Torque
Pack Off
Pack Off
Pack Off
Increased Torque
Pack Off
Increased Torque
Increased Torque
Torque Vibration
Tight Spot
Pack Off
Increased Torque
Increased Torque


CHECK
ENGINE


Time
BPOS
HKL
SPP
RPM
DMEA
WOB
MFI
TRQ
DBTM
Events
Saturd
3:00:00 PM
6:00:00 PM
9:00:00 PM
12:00:00 AM
3:00:00 AM
3:00:05 AM
12 hours


Time
BPOS
HKL
SPP
RPM
DMEA
WOB
MFI
TRQ
DBTM
Events
Sunday, June 22, 2008
3:00:00 AM
6:00:00 AM
9:00:00 AM
12:00:00 PM
3:00:00 PM
3:05:10 PM
Pack Off
Increased Torque
Pack Off
Pack Off
Pack Off


Time
BPOS
HKL
SPP
RPM
DMEA
WOB
MFI
TRQ
DBTM
Events
Sunday,
3:00:00 PM
6:00:00 PM
9:00:00 PM
12:00:00 AM
3:00:00 AM
3:05:15 AM


Time
BPOS
HKL
SPP
RPM
DMEA
WOB
MFI
TRQ
DBTM
Events
onday, June 23, 2008
3:00:00 AM
6:00:00 AM
9:00:00 AM
12:00:00 PM
3:00:00 PM
3:05:20 PM
Pack Off

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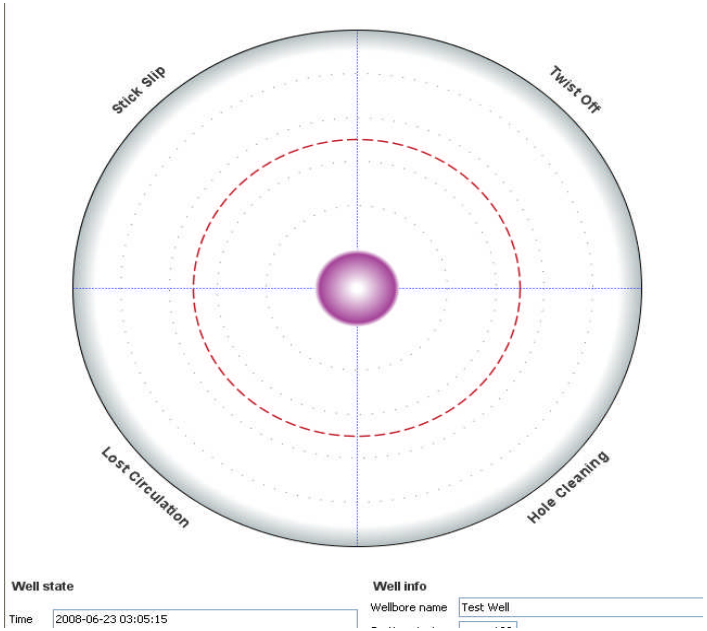
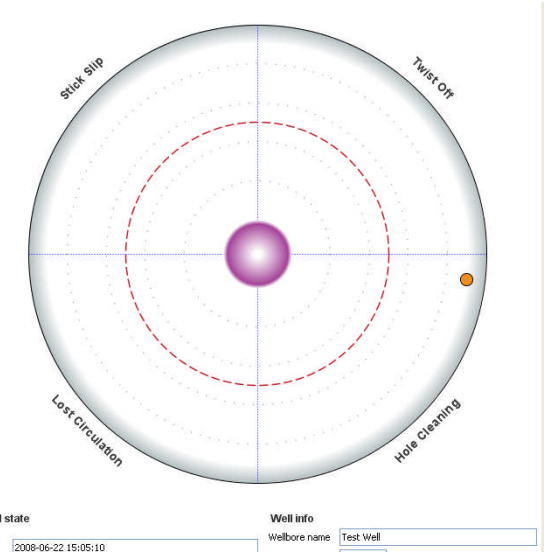
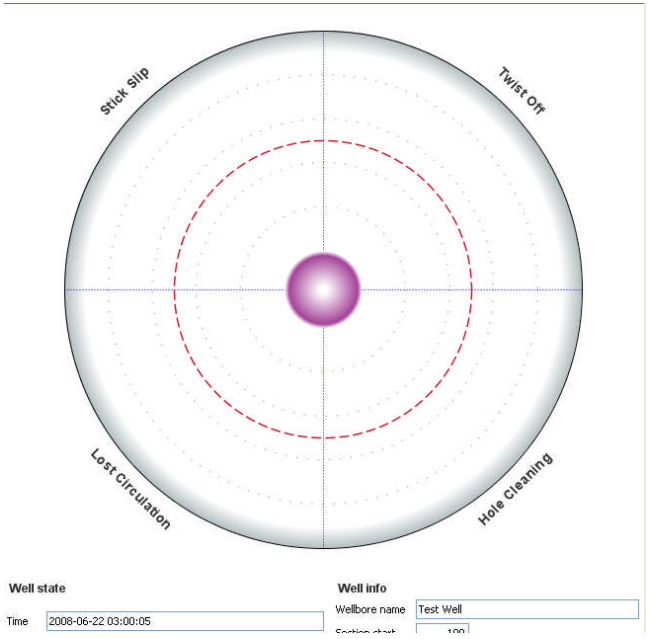

Stick Slip
Twist Off
Lost Circulation
Hole Cleaning
Well state
Time
2008-06-23 03:05:15
Well info
Wellbore name
Test Well


Stick Slip
Twist Off
Lost Circulation
Hole Cleaning
Well state
Time
2008-06-22 15:05:10
Well info
Wellbore name
Test Well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Lost Circulation
Hole Cleaning
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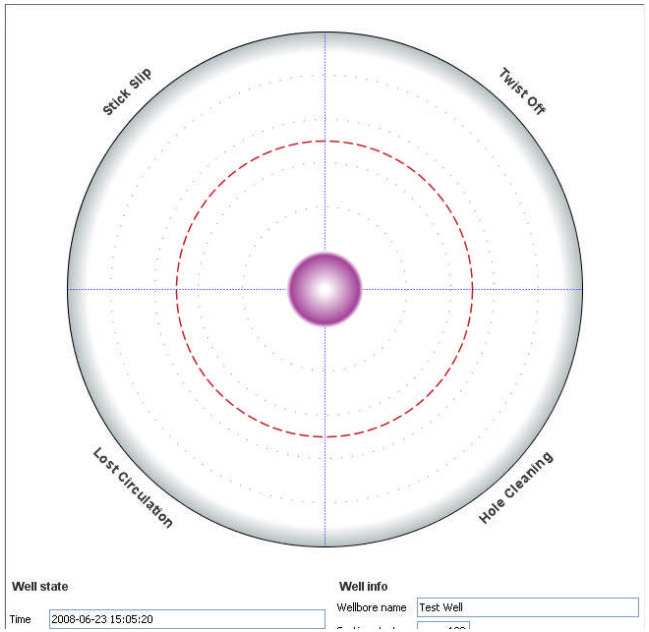
Well info
Wellbore name
Test Well

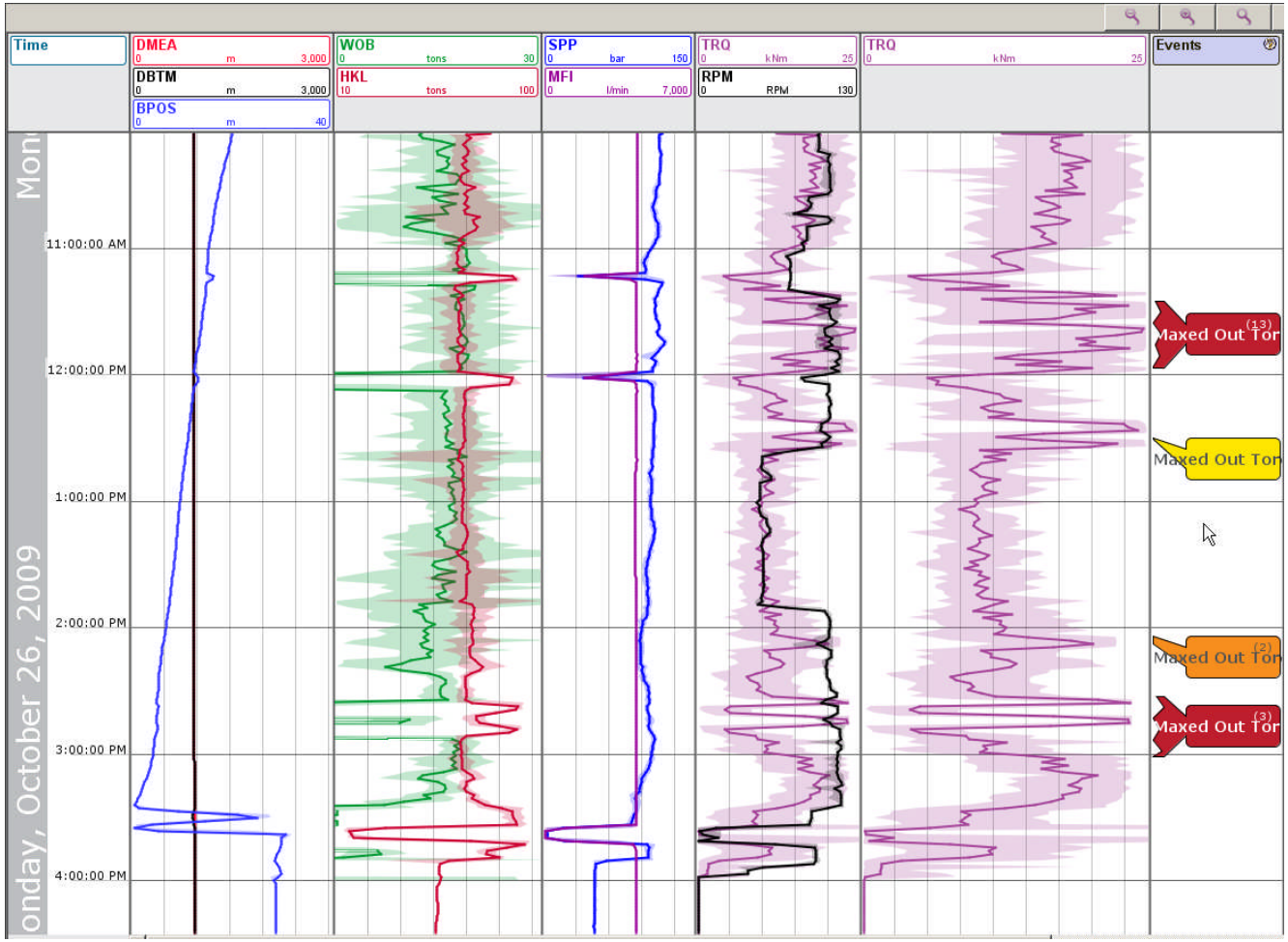

Stick Slip
Twist Off
Lost Circulation
Hole Cleaning
Well state
Time
2008-06-23 15:05:20
Well info
Wellbore name
Test Well

Case Study
(Middle East well & Haynesville well)

Twist-off analysis

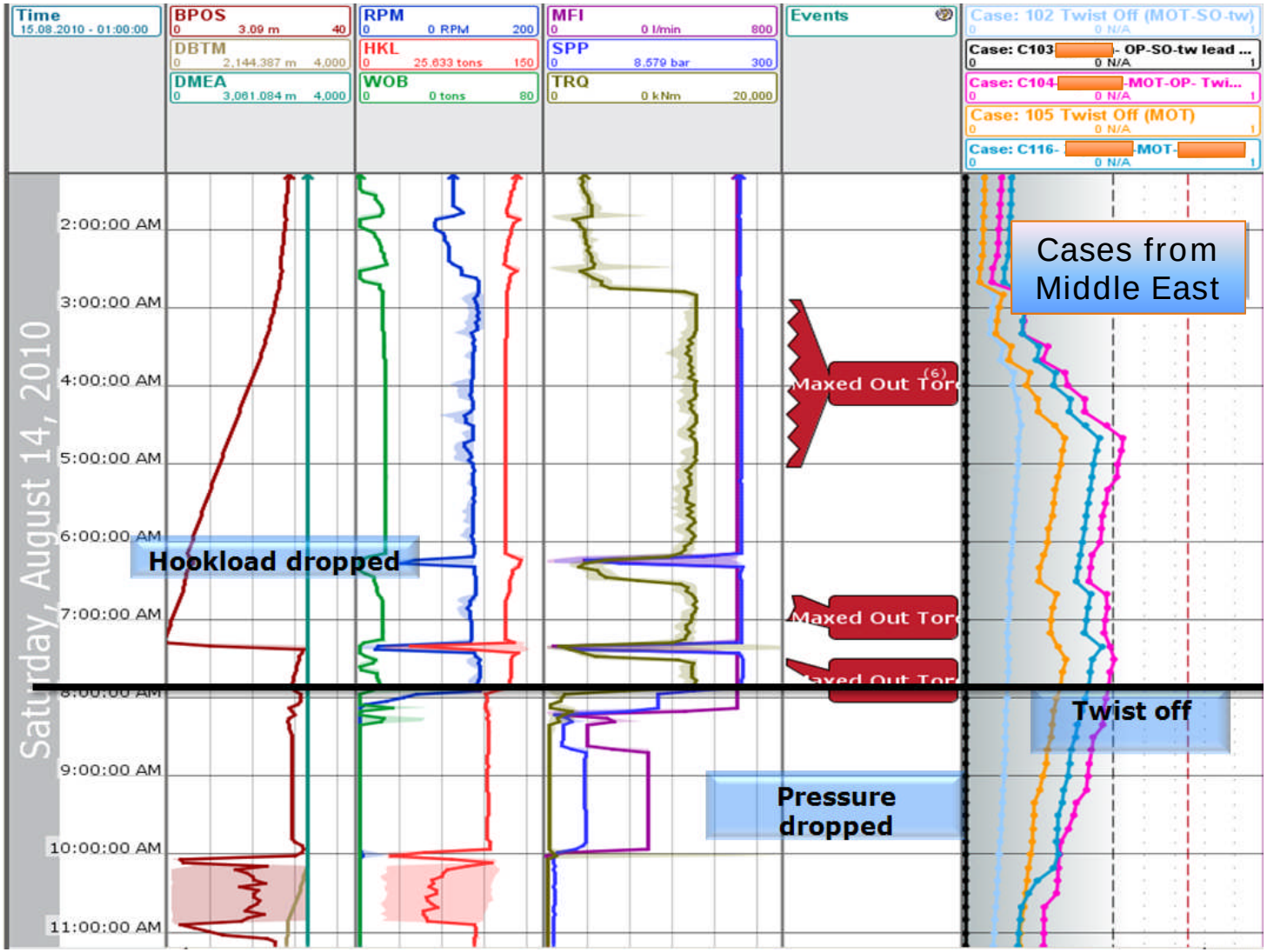
- Example well was in Middle East, test well was in Haynesville play, Louisiana.
- Scripts are built on max torque, erratic torque and string stall.
- Used to detect events leading up to a twist-off and to provide actions to mitigate these events.
- Testing shows that a drilling engineer using DrillEdge could have detected an impending twist-off in advance – with enough time to relay this information to the rig team in order to make an informed decision about how to proceed.

Example Well = Middle East Well



Twist-off analysis #1

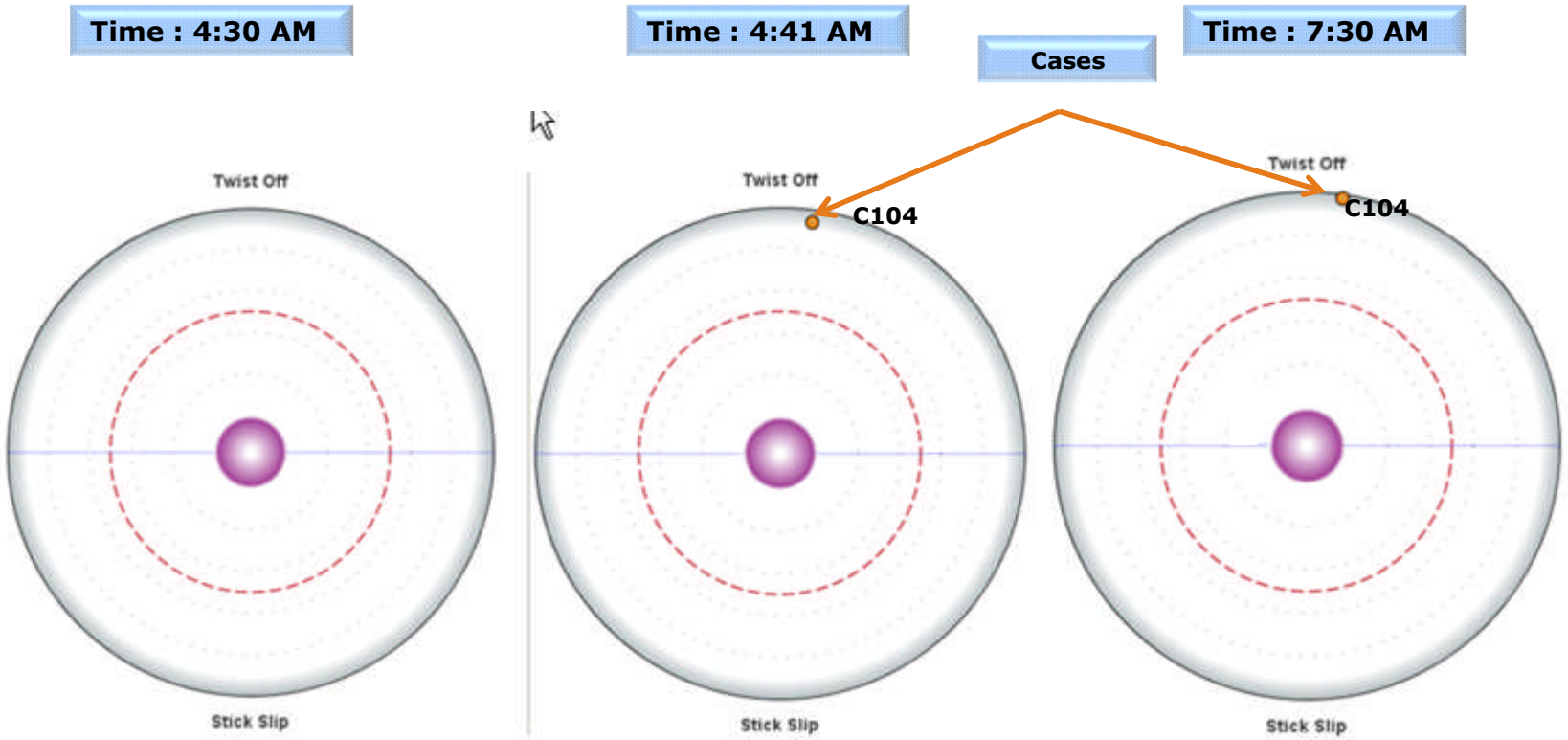
Time view showing case response before twist-off.



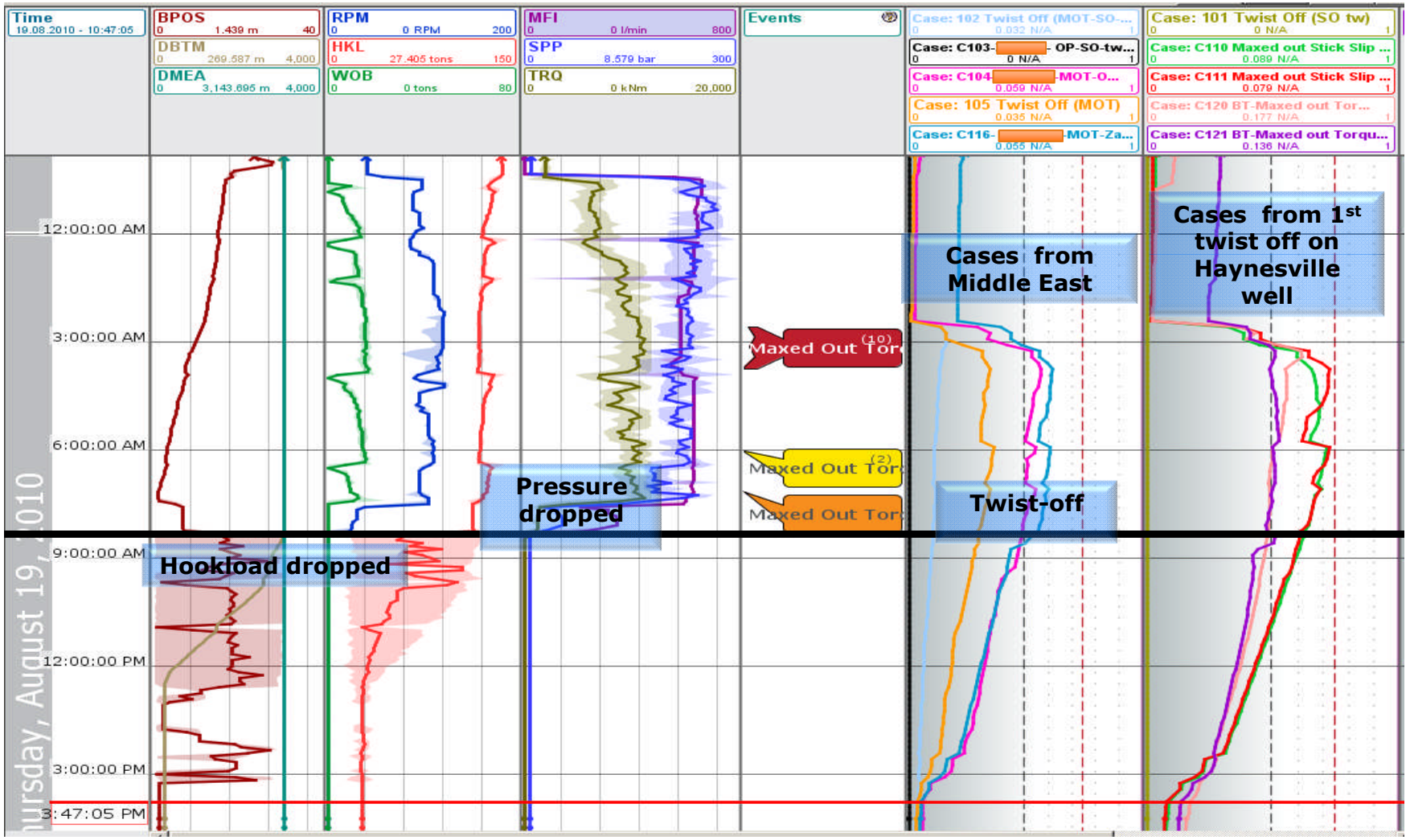
Twist-off analysis - #1

Twist-off occurs at 7:53 AM, at 3,060 m.

First case appears on the radar 3 hrs 12 minutes before the twist off



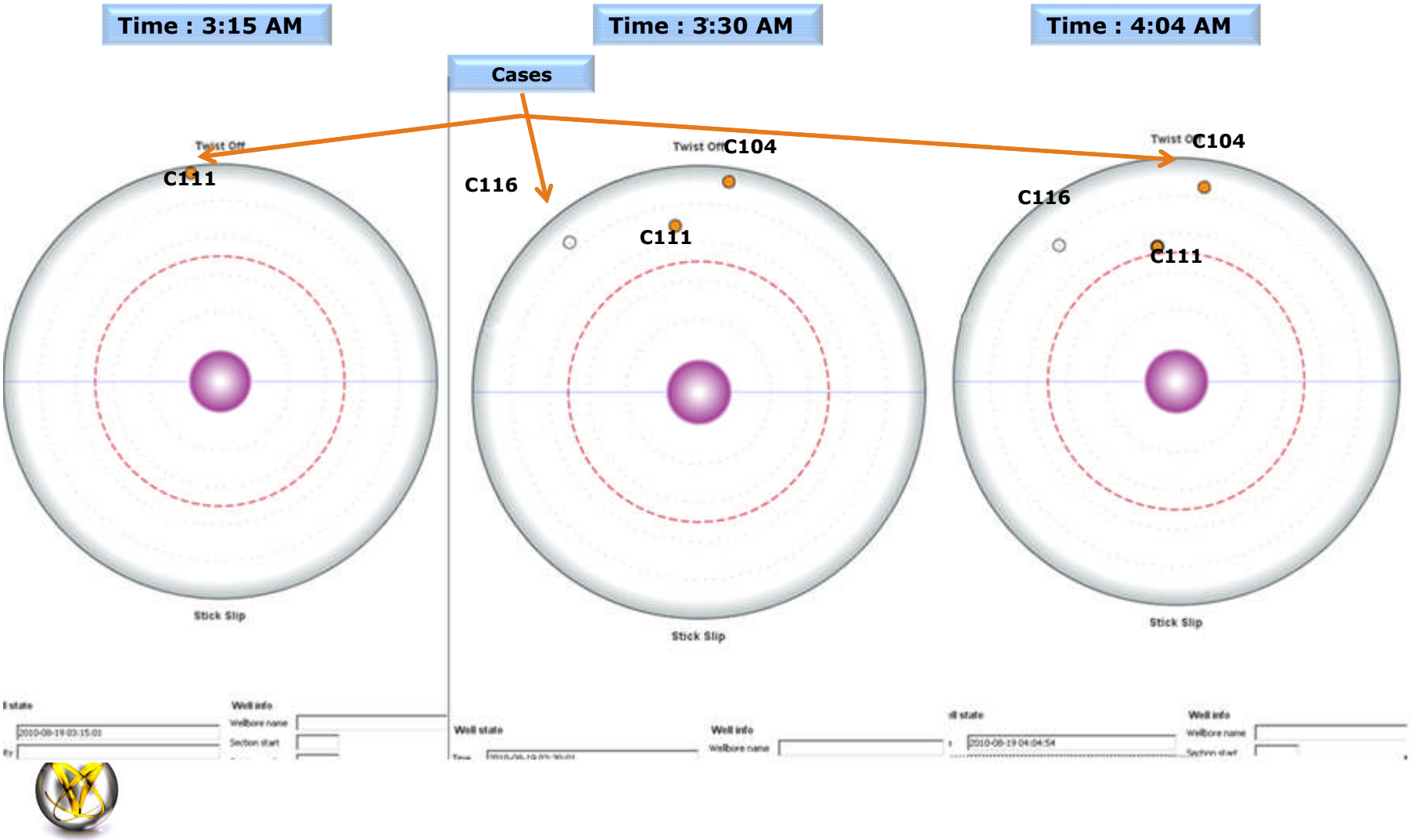
Time view showing case response immediately before twist-off #2



Twist-off analysis - #2

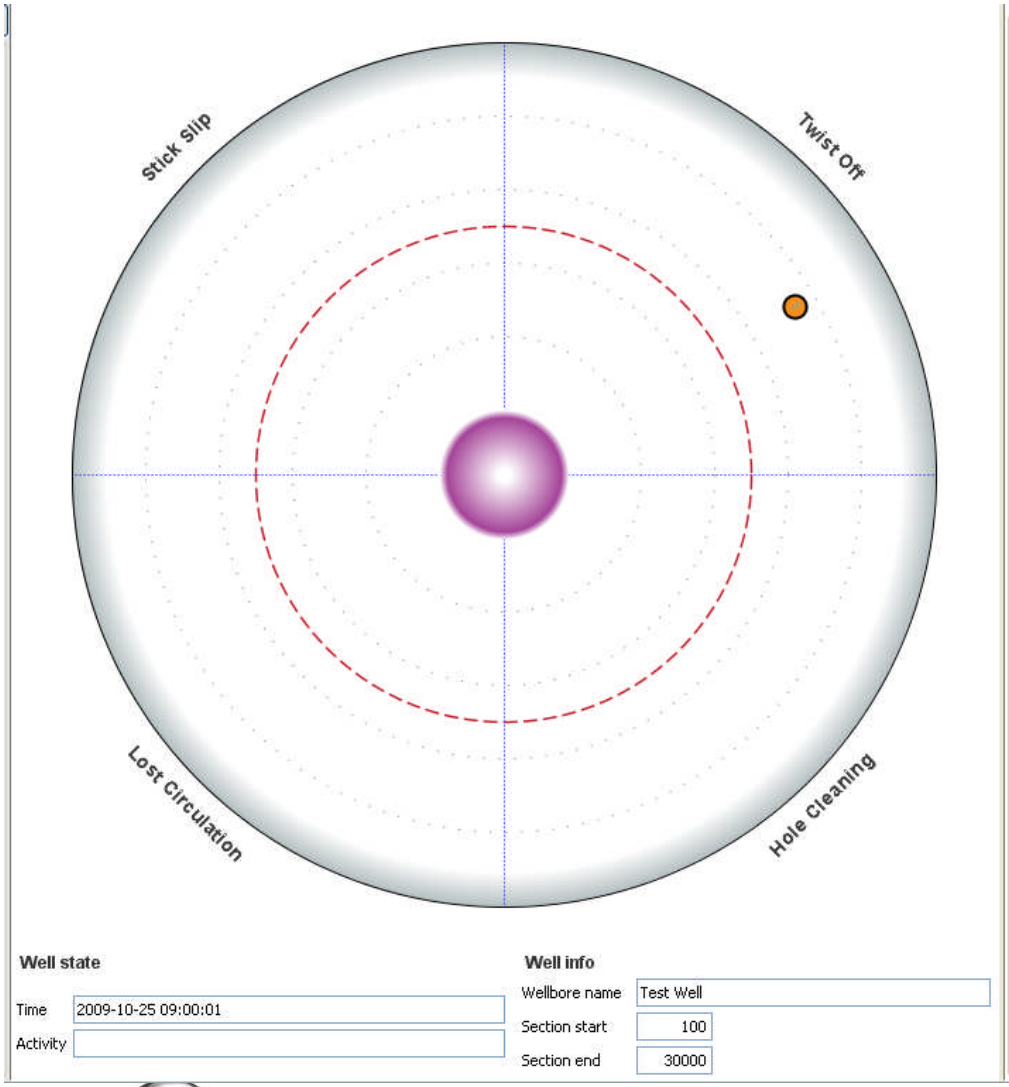
Twist-off occurs at 7:22 AM, at 3,143 m.

First case appears on the radar approximately 2 days before the twist off. A bit trip was made, and there were three opportunities to take action before the twist off occurred.



So What?

.



Case

102 Twist Off

Operation:

-

Problem:

While drilling 28" Hole from 2
ft to 3081 ft, observed instar
drop in toque to 4000 ft-lbs
circulating pressure to 800 p

Action:

After the drop in torque and
pressure, Picked off from bot
stopped rotary and pumps. L
80K of string weight. POOH
found pipe twist off (the cros
over "X/O" between 9-1/2" d
collar and 8-1/2" drill collar
parted 0.3 ft below the box
connection).

Consequence:

After POOH layed down 2 x
8-1/2" DC and damaged X/O
Fish left in the hole: Bit, NB R
Reamer, 1x 9-1/2" DC, R rear
1 x 9-1/2" DC, shock sub, 2 x
9-1/2", R reamer, 7 x 9-1/2"
Jars, 1 x 9-1/2" DC, 0.3 ft of
Ran with 11-3/4" fishing over
shot assembly with 9-1/2"
basket grapple on top of fish
retrieved the fish to surface
layed down BHA. Connection
were excessivley torqued up
heated up collars to break th
connections. NPT 56 hrs.

Similarity details

Case

Fish left in the hole: Bit, NB Roller Reamer, 1x 9-1/2" DC, R reamer, 1 x 9-1/2" DC, shock sub, 2 x 9-1/2", R reamer, 7 x 9-1/2" DC, Jars, 1 x 9-1/2" DC, 0.3 ft of X/O. Ran with 11-3/4" fishing over shot assembly with 9-1/2" basket grapple on top of fish, retrieved the fish to surface and layed down BHA. Connections were excessivley torqued up; heated up collars to break the connections. NPT 56 hrs.

Recommended Action:

It is recommended to check the make up torque of all connections while making connections at surface, since it was found that the DC connections were extremly torqued up. Observed high RPM for 8 hours associated with high torque values which can lead to damaging the BHA. It is recommended to follow up optimal drilling practice.

General Experience:

The X/O is always the week point in the BHA. Extra care should be taken to inspect the X/O box and pin threads and make sure the make up torque is applied correctly. Over torqueing the X/O can lead to X/O damage and risk of twist off. On the other hand, over torquing the BHA can happened while drilling under tough conditions, such as high vibration.

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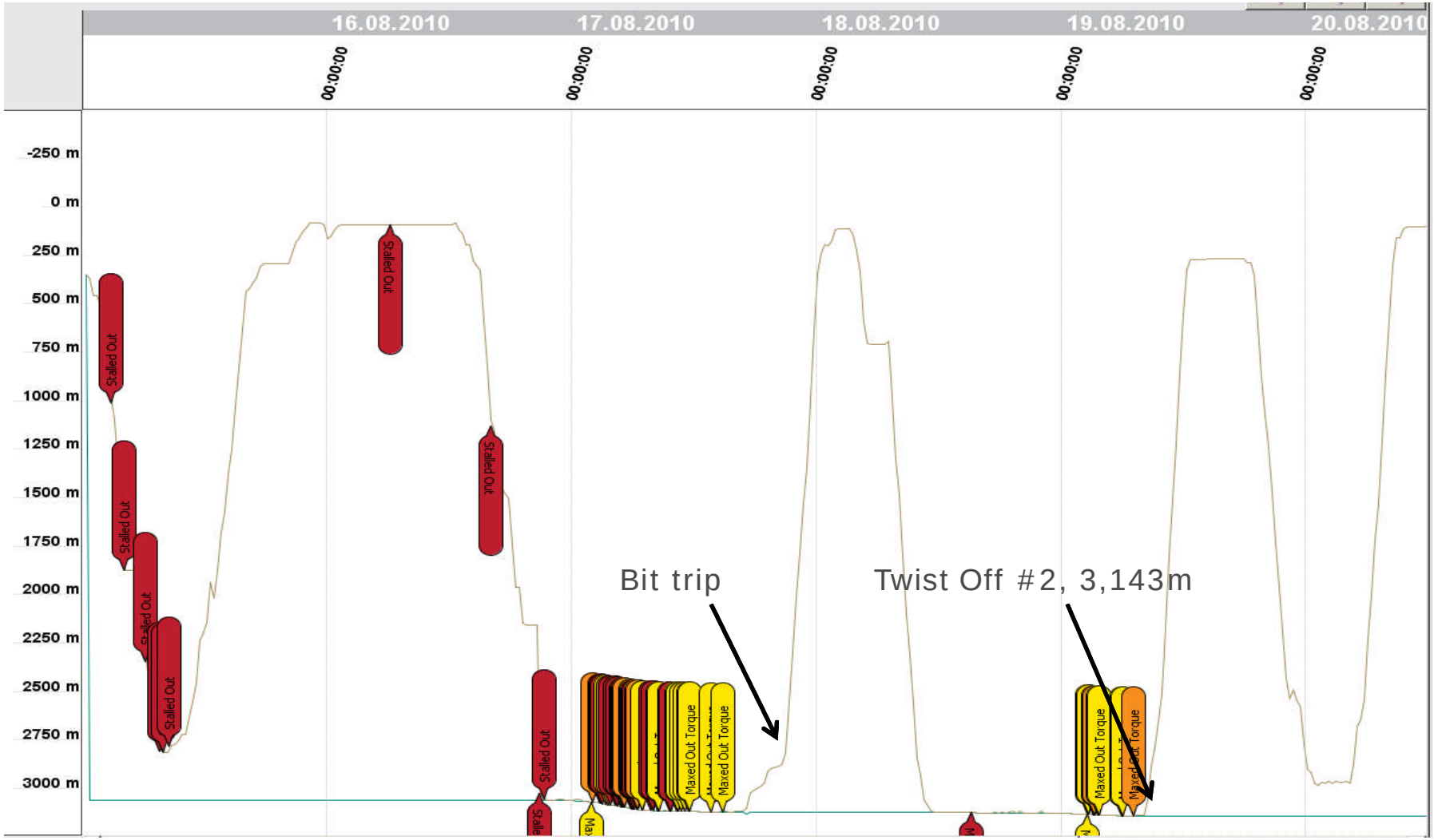
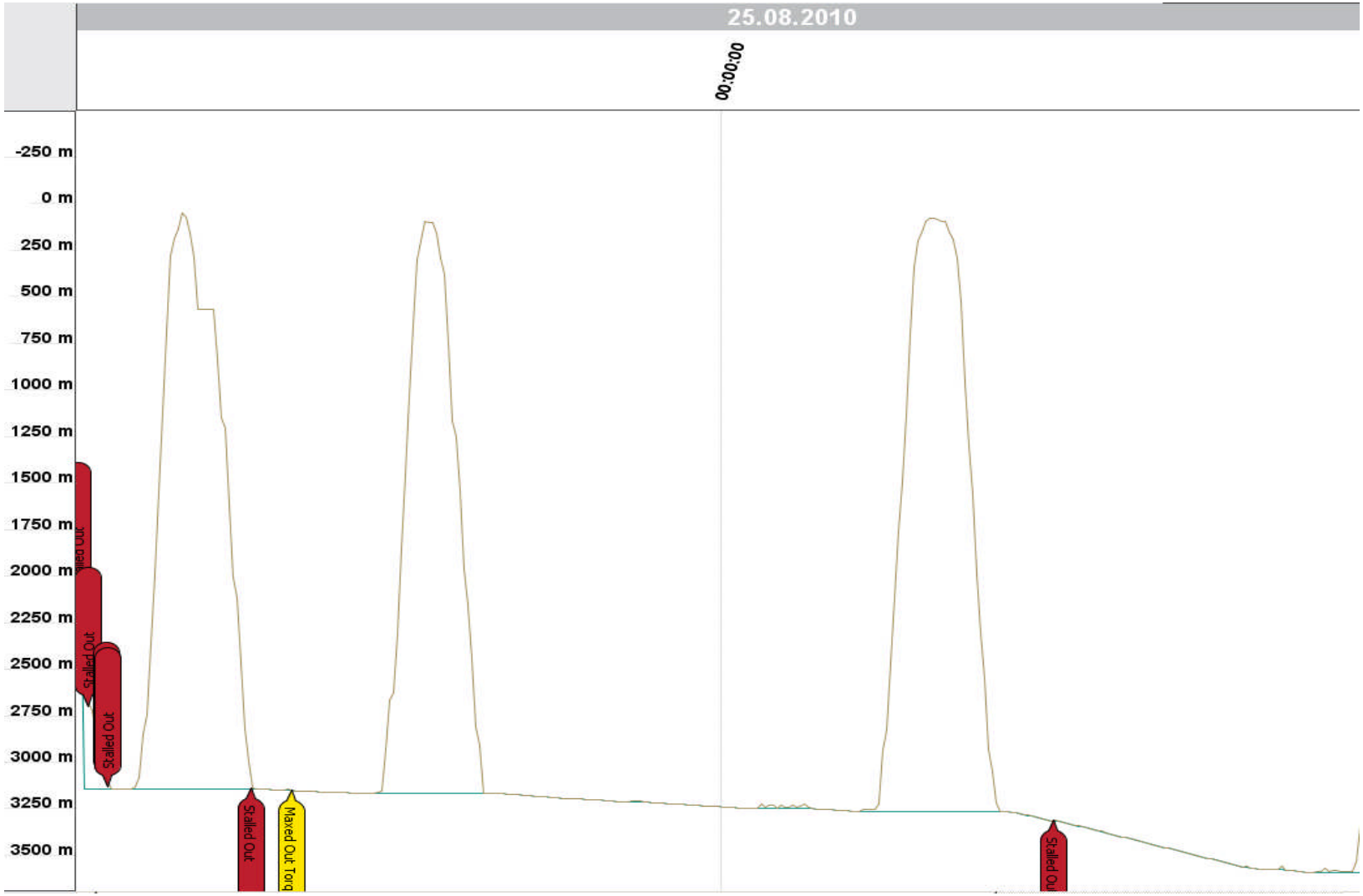
Twist-off analysis #2

Time/depth event file - Bit trip was made after a sequence of events.
Twist-off occurred on next run.



Time/depth event file – slide 3

Demonstrates few events, no cases, no twist-off to end of data set.



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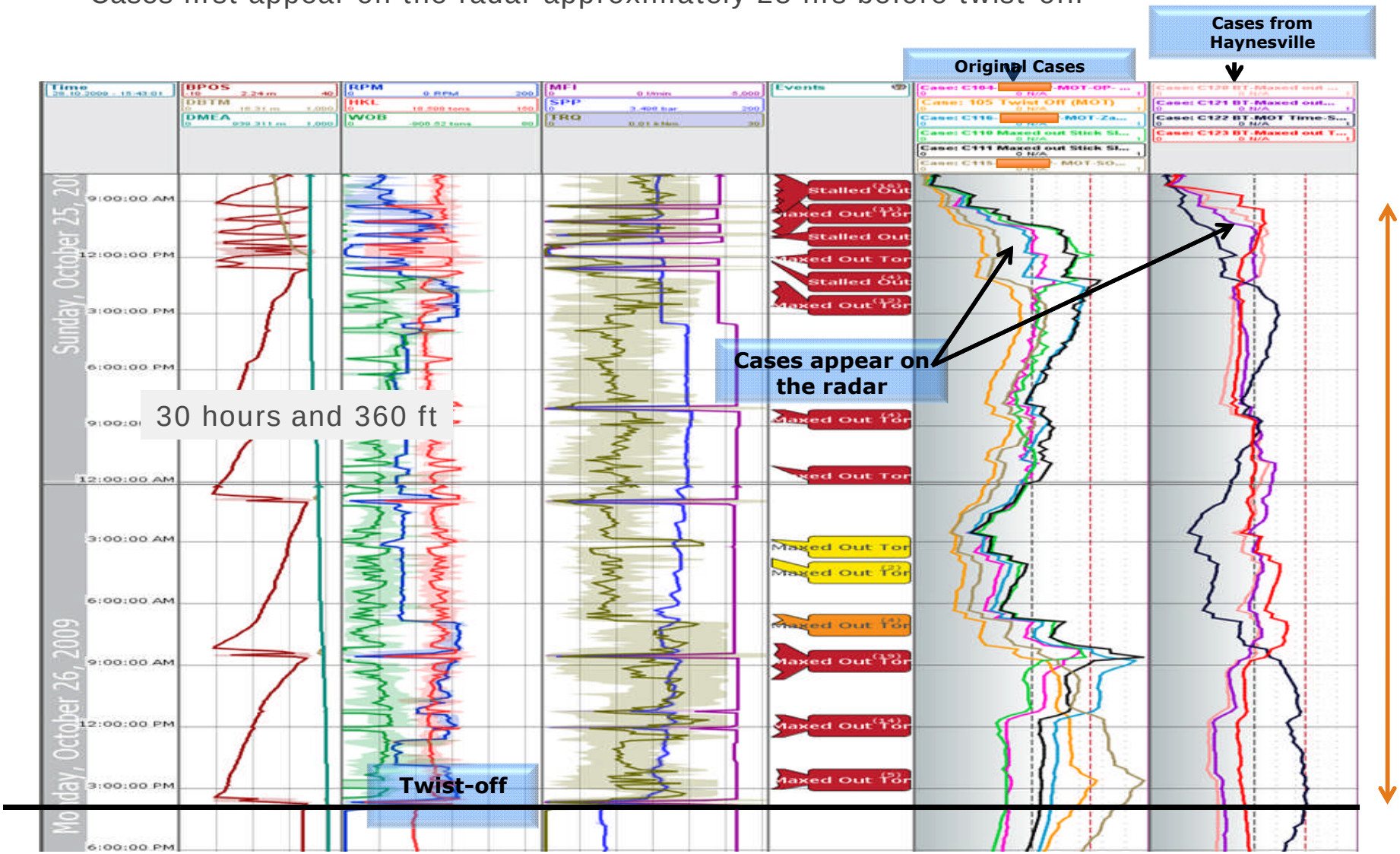
Time view response from Haynesville before twist-off on Middle East well
Cases first appear on the radar approximately 28 hrs before twist-off.



Contact Information

- www.verdandetechnology.com
- tim@verdandetechnology.com

Additional Information

- Further details on the case study published in World Oil, April 2011

"Case-based reasoning system predicts twist-off in Louisiana well based on Mideast Analog."