Faster, Safer, Cheaper Drilling

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Jan 2012

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How to Drill FASTER, SAFER and CHEAPER?

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Process for a Successful Project

1) Plan
2) Practice
3) Execute
4) Learn

Learn → Plan

Execute ← Practice
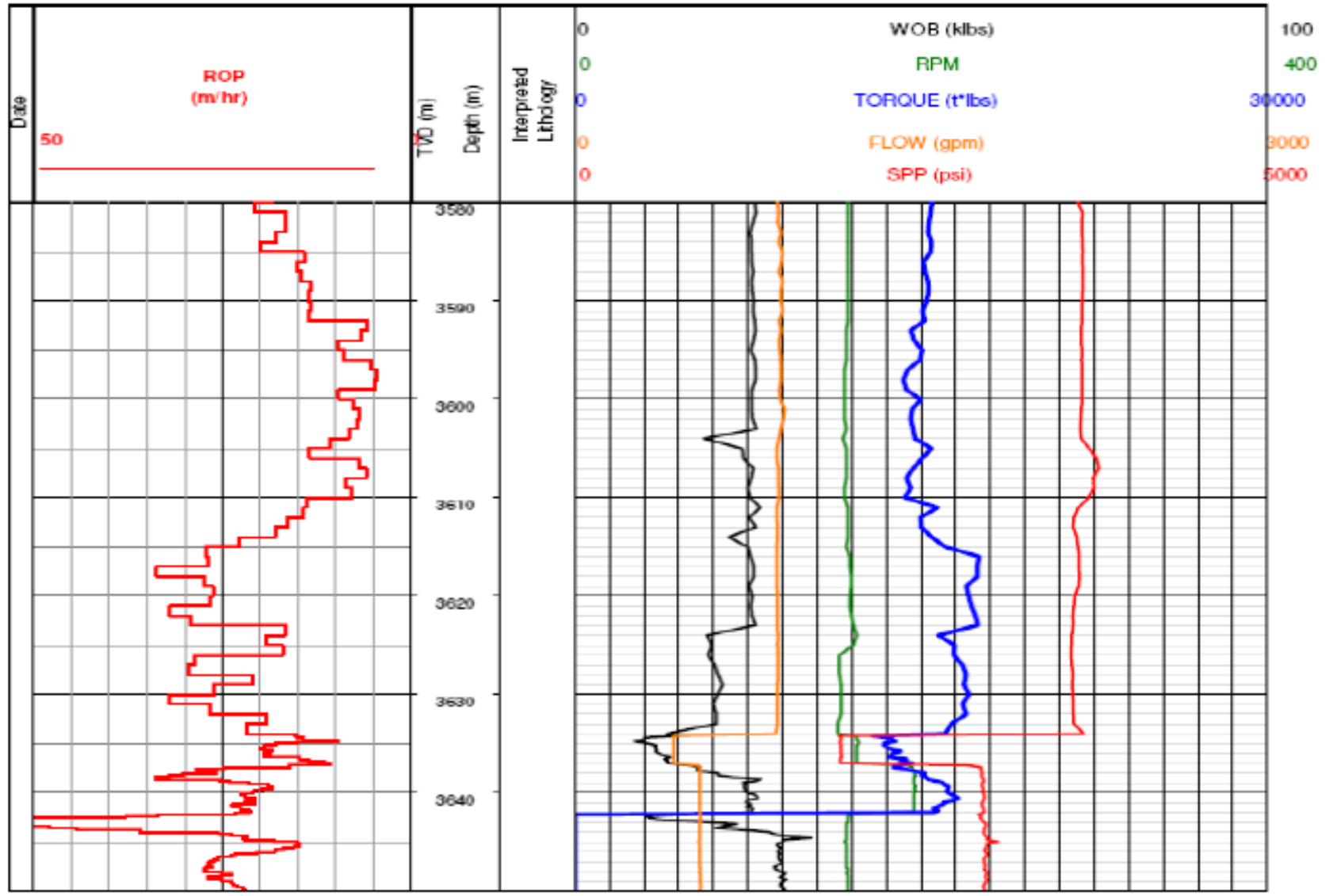
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Drilling

- Plan
  - Well design, use of any previous data and experience available

- Practice
  - Drill the well on paper, training rig crew on the procedures to be used

- Execute
  - Drill the well following the plan and adjusting it as reality is different from the plan

- Learn
  - Lessons learned exercises to allow improvement for future wells to be drilled in similar situation

Reality of the Drilling Industry

- Software and models used for well design are not the same used during training and drilling the well

- Difficult to compare planned with actual conditions

- Poor use of experience to improve future operations
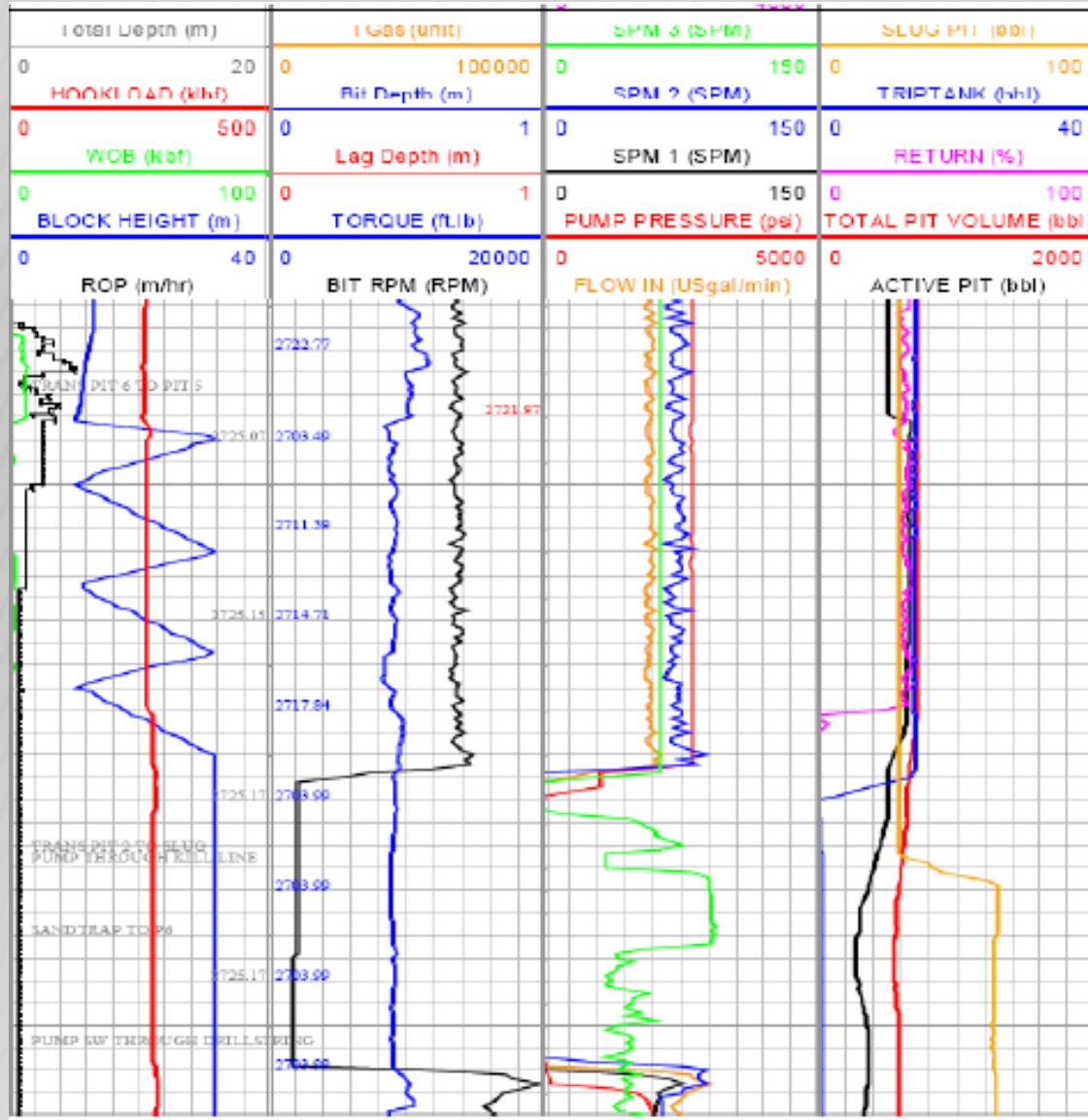
- No standard

- No integration

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A) Simple mud logging display

B) More complex mud logging display

Top: Scene inside the control room of the gas treatment facility, BLNG Liquefaction plant at Lumut, Seria, Brunei

Bottom left: Shell employees in a meeting at the Real Time Operating Center RTOC which has the capacity to monitor real time data from 9 wells being drilled. USA

Bottom right: Employees operate computer equipment in the OP-2 ethylene plant control room at Deer Park. USA

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Another system - Same concept as usual
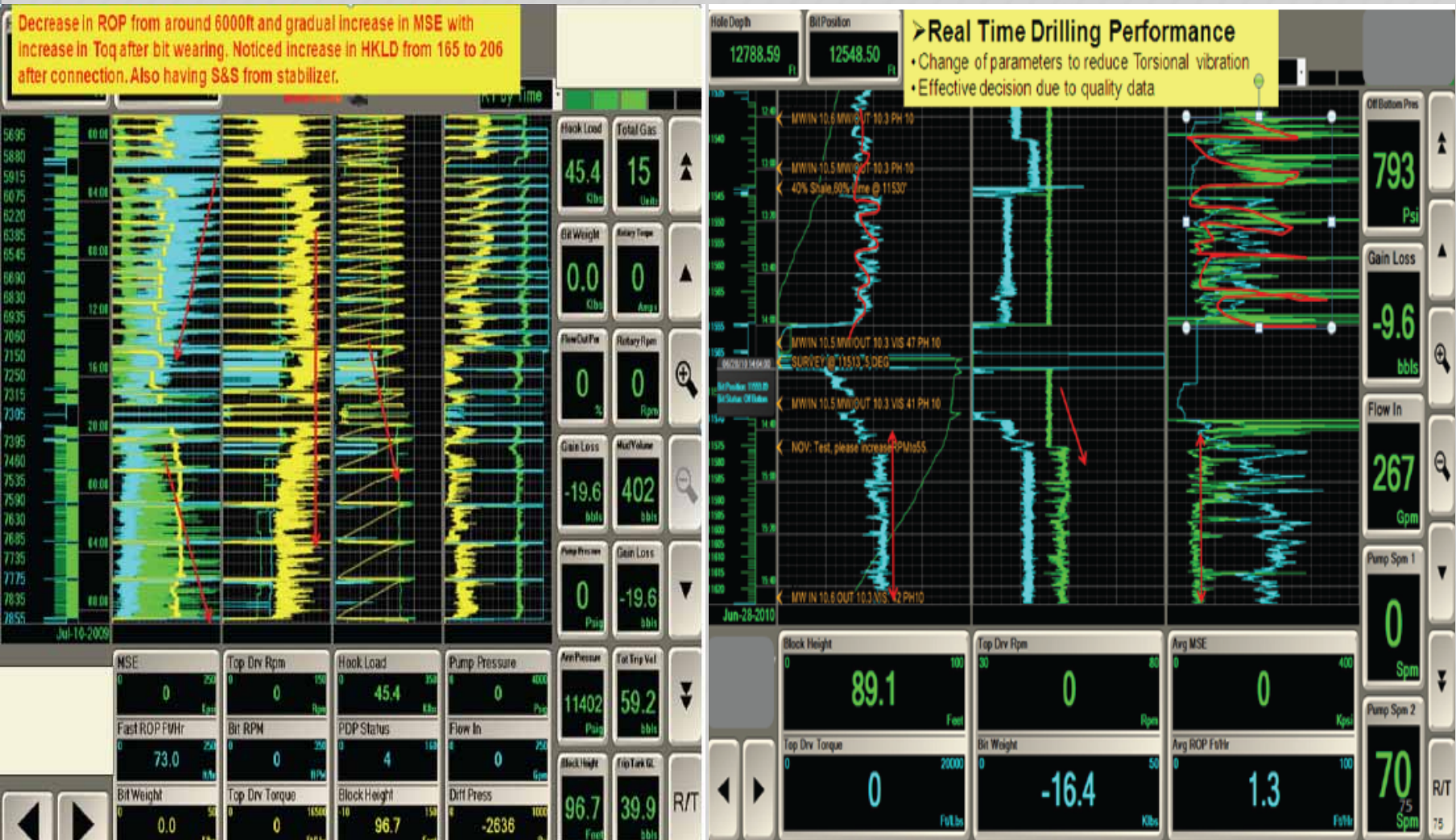
Provide a Clear Visualization of the Well Conditions

Below the Rig Floor

If You Really Want to Understand What is Going on…

- Where is the bit? Inside the casing, open hole or riser?

- What is the well configuration? Casings, liners, shoe depths, diameters, top of cement?

- Is the BOP open or closed? Is the choke/kill line open or closed? Are they aligned to take returns from the well or to inject into the well?

- Where are and what are the fluids inside the drill string and annulus?

- What is the operation being conducted?

- What is the pore/frac pressure and pressure along the wellbore?

- Are we likely to be under or overbalanced? By how much?

- Is the well likely to be cleaned (without cuttings)?

- What are the expected conditions (pressures) in the next 3 hours?

Directions Taken

- Display valuable information instead of just raw data

- Raw data => Simulation => Intelligent Processing => Valuable Information

- Display needed information avoiding overloading

- Integrate all the operations – BOP open or closed

- User friendly and straightforward display

- Same system to be used before, during and after the operations, as well as for training

- Same information available to all involved, on and off the rig

Example of converting data to information

- Instead of providing spm, mud weight, rpm => ECD along the entire wellbore annulus
- Instead of providing spm and rop => cuttings distribution in the annulus
- Instead of providing mud weight => trip margin
- Instead of block position (height) => surge/swab pressures
- ??? => Kick tolerance
- Information is obtained using calculation not feasible to be done by hand, taking into account several important factors

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Current Modules

- Well Visualization
- Fluid Tracking
- Integrated Hydraulics
  - Temp and pressure effects on mud properties
  - Effect of pipe rotation
  - Effect of pipe movement – surge/swab
  - Effect of cuttings load
- Solids Transport
- Kick Tolerance
- Trip Margin
- Negative Pressure Test

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Future Modules

Operations - under development

Well Control – under development

Kick and Loss Detection

Leak Off Test

BOP and Casing Test

Tripping

Cementing

Accurate Representation of All Drilling Steps

- Drilling
- Making connection
- Circulating
- Tripping and Reaming In& Out
- Washing Down
- Pumping Out
- Displacing Pills
- Running and Cementing Casings & Liners
- Cement Plugs
- With BOP Closed:
  - Well Control Procedures
  - Leak-off Tests
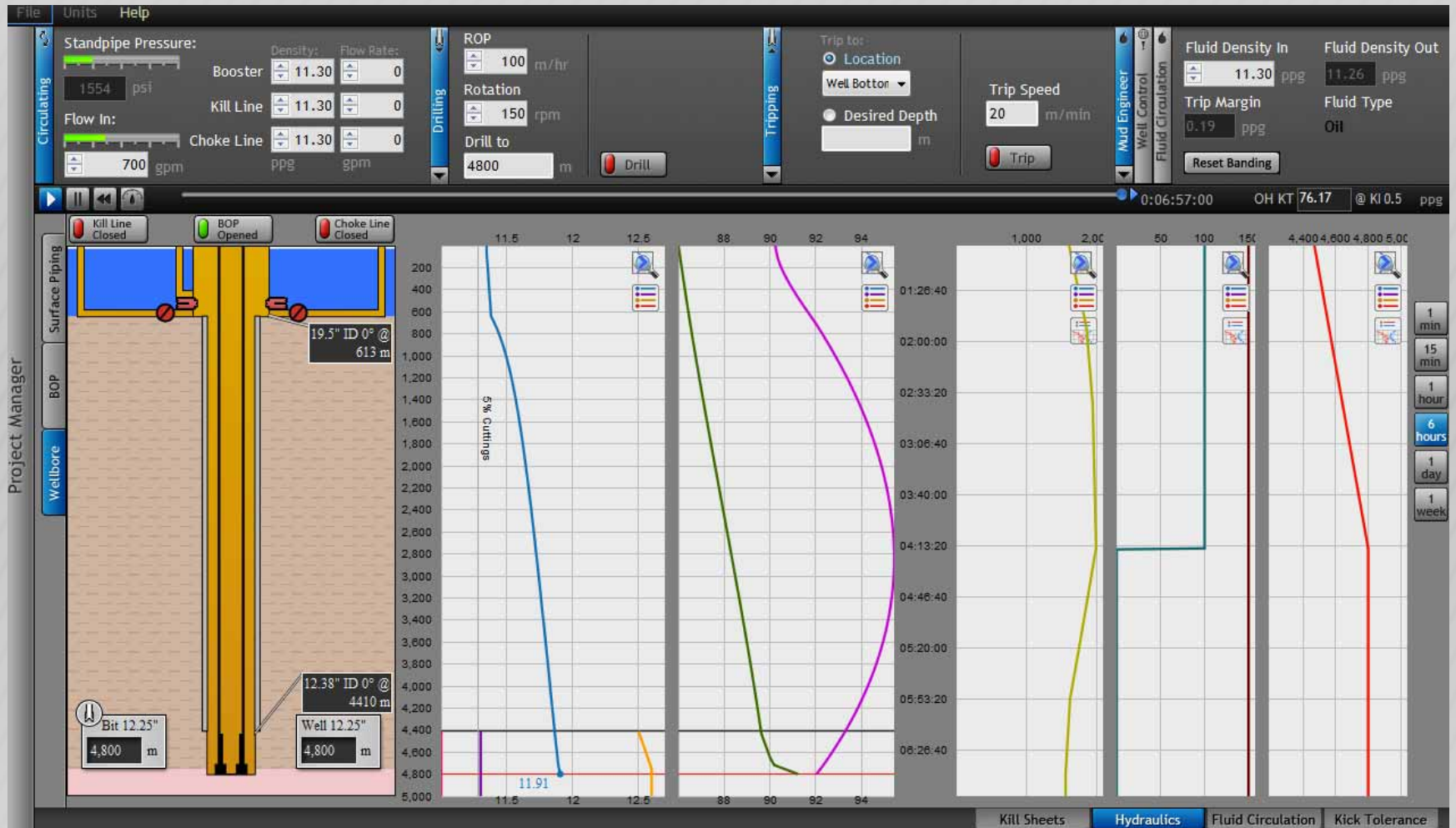 - Casing and BOP Pressure Tests

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Standalone - Simulating Drilling
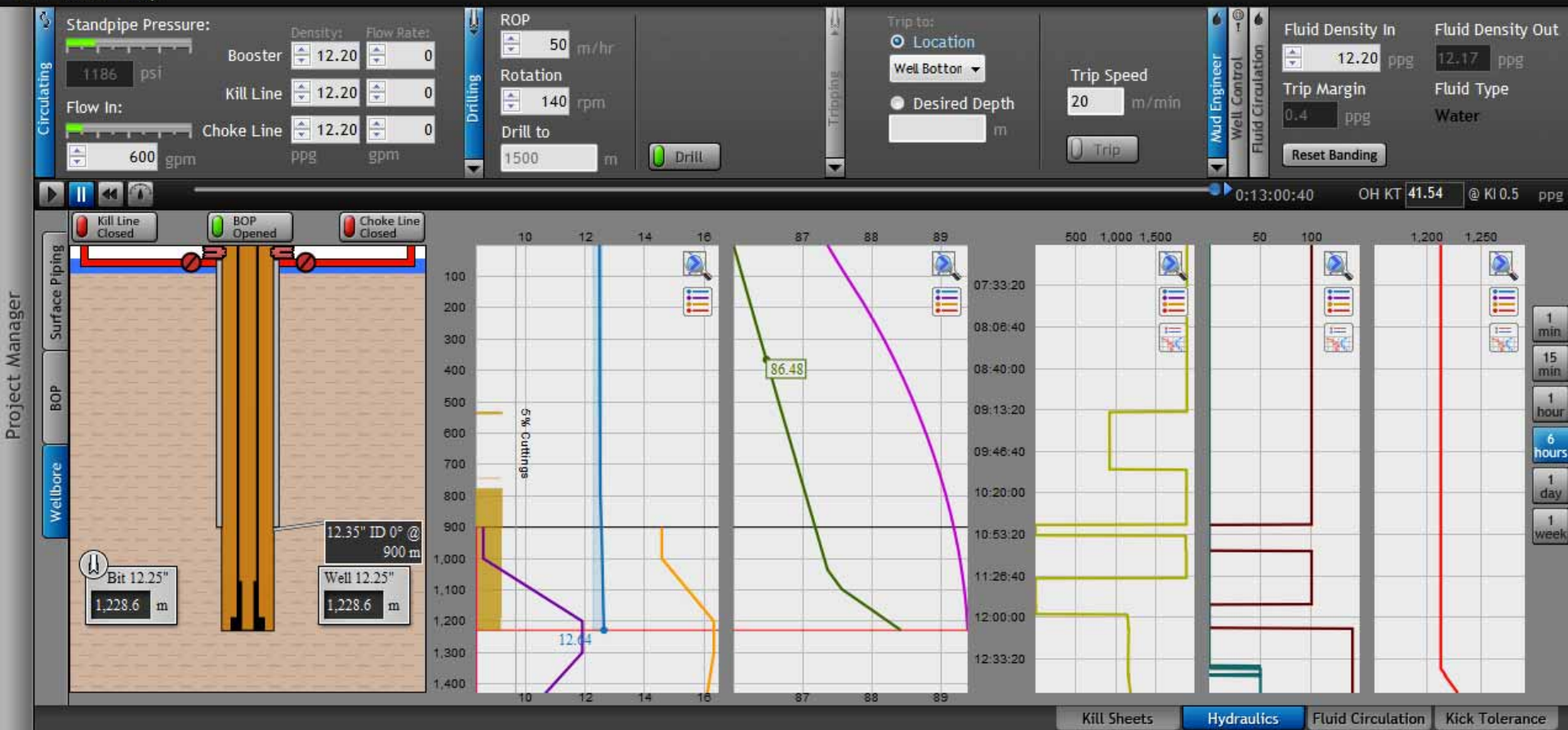
Circulating

Circulating with BOP closed

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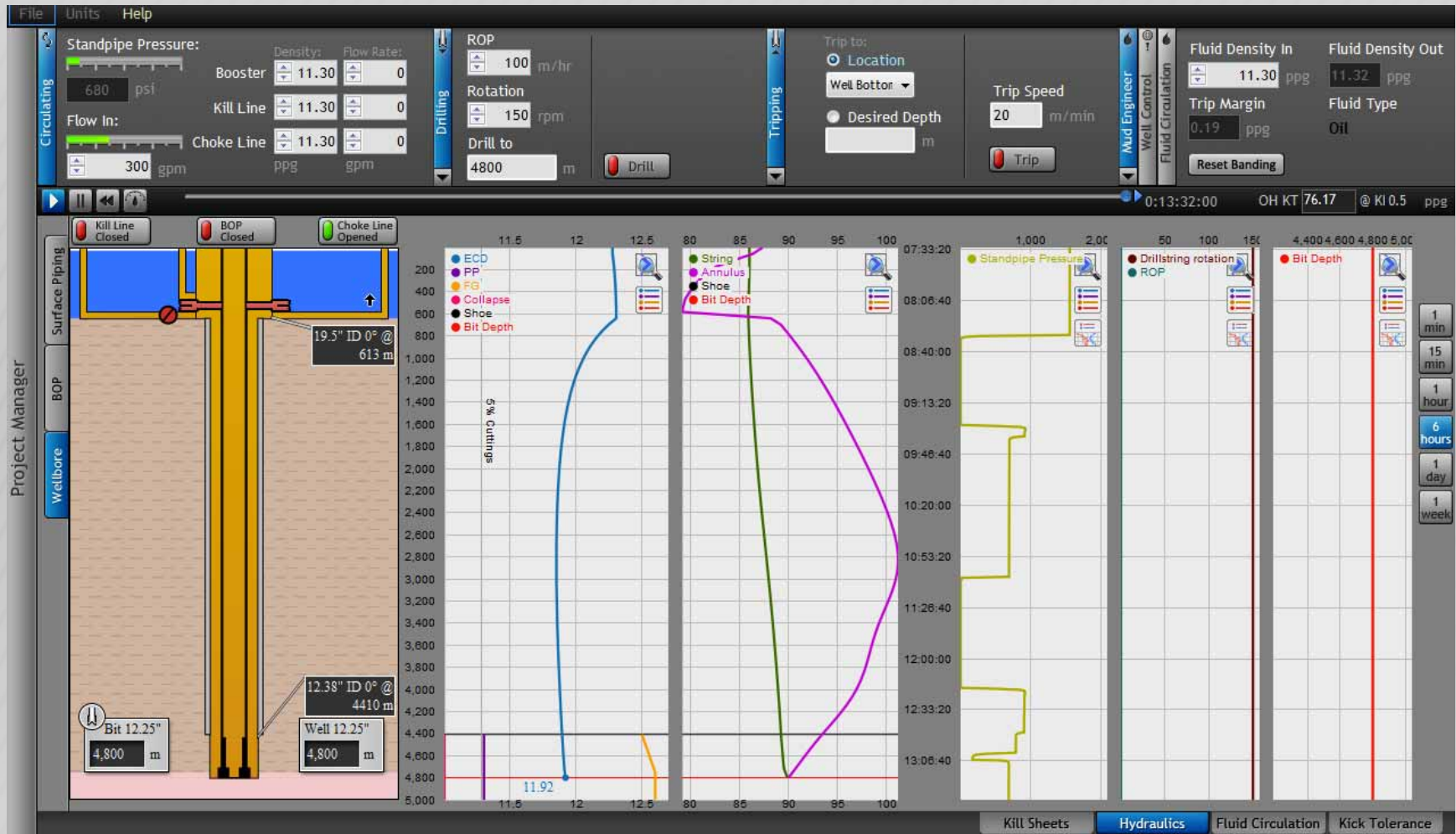
Well Data Package

David Payne, Chevron's vice president of drilling, speaking at the GE Oil and Gas Annual Meeting in Florence on January 31st, 2011:

- "My theory is that interface (providing information about drilling operations) was too complex";

- "Simplifying the human interface is an engineering problem most engineers don't want to deal with";

- "We need to focus on simplicity and standardization".

A company focused on Situation Awareness, SA Technologies (www.satechnologies.com) made the following comments when commenting about the Macondo incident:

- "In the future, the instrumentation and displays used for well monitoring must be improved. There is no apparent reason why more sophisticated, automated alarms and algorithms cannot be built into the display system to alert the driller and mudlogger when anomalies arise. These individuals sit for 12 hours at a time in front of these displays. In light of the potential consequences, it is no longer acceptable to rely on a system that requires the right person to be looking at the right data at the right time, and then to understand its significance in spite of simultaneous activities and other monitoring responsibilities".

Thank you for your attention

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