

AADE
ADVANCED APPLIED DATA ENGINEERING

Advances in Real-Time ECD Management

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Remote Operations Centers Present State

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Have we been here before?

- *"Surface measured real-time data is generated from the rigsite data acquisition system and is transmitted every foot and/or every five minutes"*
 - Isaacs and Bobo, SPE 13109 (1984)
- *"Data Saturation – nobody can digest all of the real-time data now available at the rigsite"*
 - Rusty Foreman, SPE 14387 (1985)

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When does "Real Time" really mean "real time"?

- **Webster:** real time n 2: the actual time in which an event takes place with the reporting on or recording of the event practically simultaneous with its occurrence
- **Real World:** real time: a dynamic process is monitored and reported as it occurs, and data are analyzed promptly so that the process can be improved during its execution

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Issues Common to Difficult Wells Deepwater, HTHP and ERD

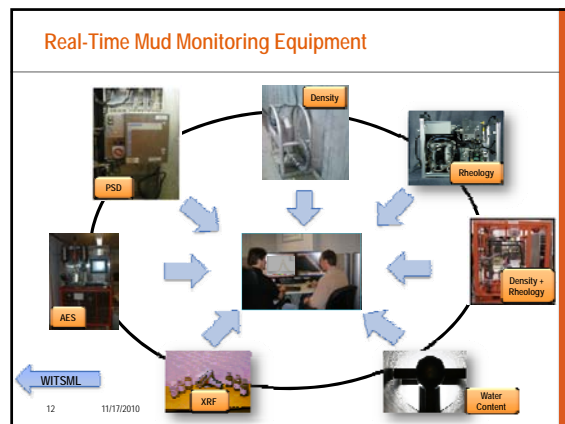
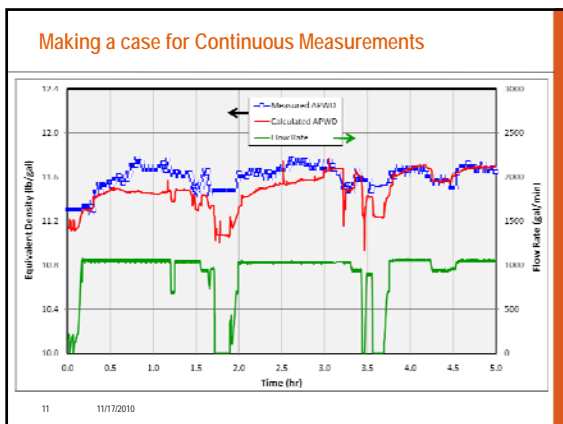
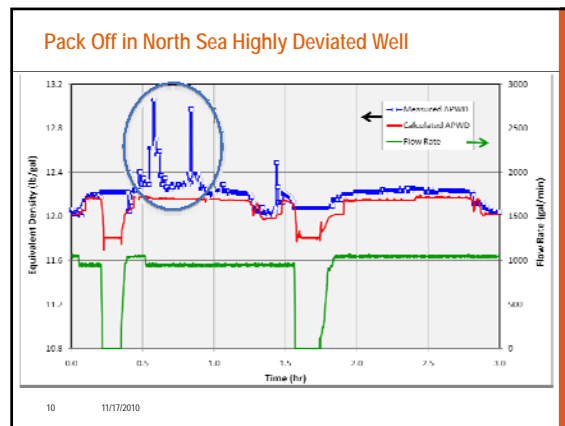
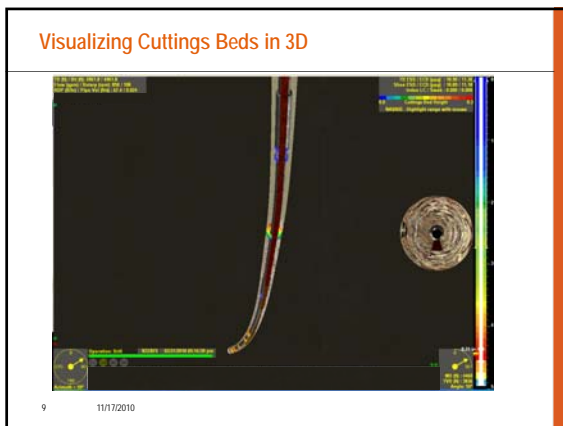
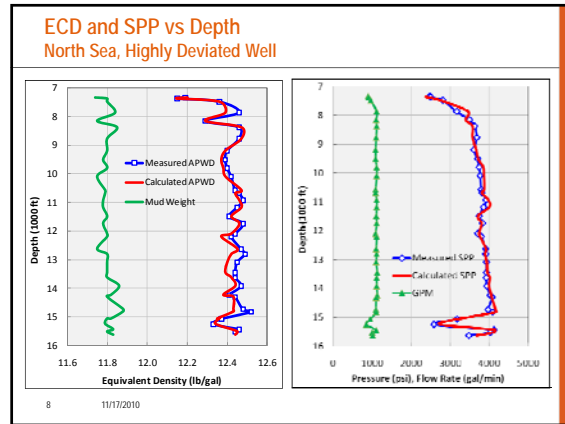
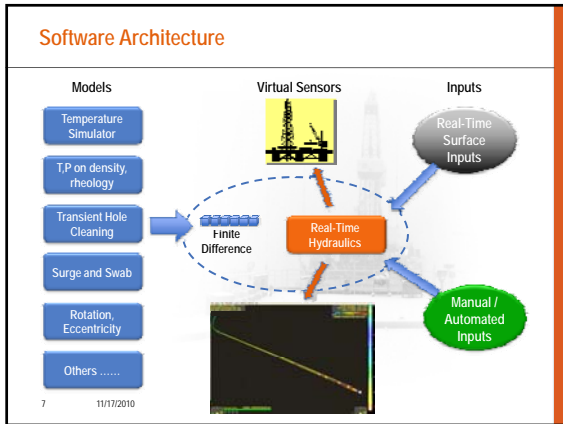
- **Narrow Operating Windows**
 - Shallower well depths: ultra-low fracture gradients
 - Deeper well depths: convergence between pore and fracture pressures
- **Additional Complications**
 - Thermally sensitive / compressible drilling fluids
 - Extreme temperature and pressure effects on mud density and rheology
- **Real-Time Consequences**
 - Wellbore instability and well-control problems
 - Lost circulation while drilling, tripping, and running casing, especially with synthetic and oil-based muds
- **In-Time Solutions**
 - Annular Pressure-while-drilling (APWD) measurements
 - True real-time hydraulics modeling and interpretation (RTHS)

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RTHS vs APWD

- APWD routinely used to protect and control wellbore annular pressures during well construction operations
- RTHS complements APWD, does not replace
 - Adds "what-is-expected" to "what-is" scenario
 - Provides complete profiles, not just at tool location
 - Provides platform for analyses of a wide variety of concerns
- Substitutes for APWD when not available
 - No real-time APWD data (no circulation)
 - APWD tool not working (general failure, excess temp)
 - No APWD tool installed (running casing)
- APWD can be used to validate RTHS results in anticipation of situations where measurements are interrupted or not available

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People, Reliability, Economics Issues

- "Unmanned rigsite data acquisition systems require rigid preventive maintenance and calibration programs to be successful"
- "A growing need in the industry exists for reliable, accurate sensors that are economically attractive"
 - Isaacs and Bobo, SPE 13109 (1984)
- "Equipment could be a problem for 4-5 months, but that's self-correcting. The problem today is having the skilled people that can run the equipment out there"
 - Pete Miller, Drilling Contractor (Jan/Feb 2007)

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Main Elements in Remote ECD Management

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Evolution of RTHS from monitoring to optimization

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Managed Pressure Drilling

- Accurately controls wellbore pressures at pre-determined levels using imposed surface pressure
- Presents significant opportunity for dynamic pressure management for drilling optimization
- Allows automatic / manual control of surface equipment to control downhole pressures
- Possibilities exist to monitor, analyze and provide control signals from remote operations center in real-time

MPD and Drilling Choke Combo Manifold

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Summary of Real-Time Hydraulics

- Most unscheduled trouble events are still hydraulics related
- ECD management, optimization, stability all about windows
- Hydraulics depends on downhole behavior
- True real-time hydraulics is perfect APWD companion
- Transient reconnaissance and real-time monitoring and analysis key to success in many applications
- 3D visualization has exciting potential in drilling applications
- Effective ECD management can only be achieved by implementing a suite of applications targeting specific areas
 - Planning and Design, Analysis, Monitoring, Re-planning

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Conclusions

- True real-time hydraulics analyses have spear-headed progression from observing and monitoring towards real-time interpretation and analysis
- This technology has routinely helped facilitate drilling in critical wells by complementing APWD, and even substituting for APWD when data were neither available nor transmitted to surface in real time
- Opportunities exist to also monitor even in non-critical wells due to use of remote operations centers as part of normal workflow, and the reliable and instantaneous availability of drilling data
- Most rig sensors adequate for conventional use, however the use of new generation sensors can greatly enhance this technology towards drilling fluid optimization and ultimately drilling optimization

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