Advanced drilling engineering and operation

- Safe operations
- Solutions for all well types
- Dynamic tool for the entire work process
"We have been using Drillbench® Presmod and Kick successfully for well planning and follow-up. In addition, it has been used for crew training purposes on HPHT wells in the UK sector."

BP, Aberdeen

"The Drillbench® Presmod dynamic hydraulics simulation program was successfully used on the Marlin A-5 well: The program produced accurate downhole temperature and density profiles. The accuracy of the predictions was confirmed by downhole PWD measurements."

Baker Hughes Inteq, USA

"With Drillbench® Dynaflo's dynamic UBD simulation capabilities, we can discover UBD features not possible to unveil with steady-state software."

Shell, USA

"Drillbench® Kick was used very successfully during the drilling of our first deepwater exploration well in Angola. The well was drilled deeper than the originally planned TD, and Drillbench® Kick was very important to stretch the well design with the result of saving one casing string."

StatoilHydro, Angola

Customer Experience
“WWCI currently uses Drillbench® to assist our clients with critical well planning and resolution of well control problems. The simulators in Drillbench® are versatile and realistic. They provide practical tools for kick analysis, dynamic kill and other aspects of engineering for well planning or emergency response operations. They represent a significant addition in the advancement of well control technology.”

Wild Well Control Inc., USA

“The planning of +5000m TVD exploration wells in a remote area in the Iranian desert, requires engineering software packages that can identify limitations, optimise the casing programme and subsequently cut cost. Hydro Zagros uses the Drillbench® Hydraulics packages both in the planning phase as well as execution phase, to ensure that we reach our targets.”

StatoilHydro Zagros Oil & Gas, Iran

“Both Drillbench® Presmod and Kick have been very useful for decision making in two difficult HPHT wells and have contributed to us reaching the planned targets.”

ConocoPhillips, Scandinavian Division

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Dynamic Hydraulics provides critical information with regards to well integrity and downhole tool limitations. Know the impact of gel strength when breaking circulation (figure 2). Identify effects on downhole ECD due to changes of parameters such as pipe rotation and flow rates, and know the related temperature changes. Find the time frame for temperature development and exposure of downhole tools during static periods. Identify and quantify thermal expansion in the planning phase and avoid misinterpretation of surface pit gain during the actual operation (figure 4).

ECD at bit
Fracture pressure
Pore pressure
ECD with gel effect
ECD no gel effect
Temperature oil based mud
Temperature water based mud
Pit gain
Predictor of downhole conditions providing increased awareness and understanding through dynamic consideration of:

- ECD management
- Temperature variations
- Multiple fluids
- Tool limitations
- Gel breaking effects
- Thermal expansion
- Pressure build up
- Surge & swab
- Managed pressure drilling
- Dual gradient
- Torque & drag

Drillbench provides profile plots showing pressure conditions for the entire wellbore at any time. Identified weak zones and narrow margins necessitates evaluation of not just the bottom hole but the entire open hole section.

Understanding the entire system ensures that wellbore ECD and equivalent static density stays within the operational window defined by the formation pressure and strength. Maximum and minimum values are updated and kept during the simulation, providing an excellent tool for examination of the downhole boundaries making sure that no weak zone of the well is challenged (figure 2).

1 Pore pressure
2 Fracture pressure
3 Wellbore ECD
4 Minimum/Maximum

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DRILLBENCH®
DYNAMIC
WELL CONTROL

Realistic multiphase well control simulator providing the best planning and operational support through consideration of:

- Personnel safety
- Rig downtime
- Kick tolerance
- Maximum pressure loads
- Free gas breakout depth
- Water based gas migration
- Oil based gas dissolution
- Mud gas separator capacity
- Horizontal kicks
- Well kill operations

Every well design requires kick tolerance calculations to ensure that reasonable kick volumes can be safely handled and circulated to surface. In addition to the interactive mode, Dynamic Well Control features an automatic simulation option for sensitivities. Specify different kick scenarios and perform a complete and realistic kick tolerance evaluation for each section with minimal effort.
Dynamic Well Control calculates pressure conditions for the entire well, including necessary choke settings to maintain constant bottom hole pressure while circulating out an influx. By accounting for changes in well geometry and operational parameters, required choke regulations can be displayed versus time, pumped volume or number of strokes. Being prepared increases the chance of performing a successful well control operation.

Maximum values during a simulation show free gas breakout below the BOP (figure 1). Gas dissolution in oil based mud (figure 2) and gas breakout depth are dynamic effects with significant impact on the pressure development during a well control operation. This is accounted for in Dynamic Well Control, providing realistic pressure development for casing design and kick tolerance considerations.
Under-Balanced Drilling

Client/Operator: Shell - Wyoming, USA
System Purpose: Monitor underbalanced drilling process in one well
System Integration: WITS, OPC and Modbus
Model (OLGA®): Dynamic model of the wellbore
System Features:
- Monitoring pressure while drilling (open loop control).
- Controlling the underbalance by adjusting chokes on the wellhead (closed loop control).
- Estimating reservoir inflow while drilling - (on-line reservoir characterization during the drilling operation).

Oribis Drilling Solution

Client/Operator: Ocean Riser Systems (ORS) - Base Concept
System Purpose: Support managed pressure drilling (MPD) operations
System Integration: OPC Client-Server
Model (OLGA®): Dynamic model of the ORS-LRRS system (Low Level Riser Return and mud-lift pump System). ORS uses a subsea mud pump connected to a high-pressure drilling riser to take returns from some point below the ocean surface.
System Features:
- Monitoring and control riser hydrostatic head while drilling.
- Constant bottom-hole pressure (BHP) while drilling and during connections.
Advantage:
- Improved well control - Drill longer sections
- Faster & more efficient drilling.

DRILLBENCH®
eFIELD SOLUTION

Improved performance through monitoring and control

- Run time modules for integration in other systems
- Complete control system
- Industry standard communication

Drillbench®

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Typical work flow for Underbalanced Operation tools include:
- Investigate stable/unstable flow behavior in the operating window
- Define and check operational procedures
- Training of drilling crews before specific operations
- Look ahead simulations during a drilling operation

Illustrate the transient effects of:
- Moving from over – to underbalanced conditions
- Circulation
- Blowdown
- Drilling
- Tripping
- Connections
- Variations in reservoir inflow
Data entry in Drillbench is easy. All required inputs can be found on any typical daily drilling and mud report. In combination with a self-explanatory user interface, this lowers the threshold to start using the Drillbench modules.

Default values are provided to enable quick preliminary screenings, but also advanced input options are available for more in-depth evaluation if required. A built-in help function offers input guidance as well as definitions of submodels. Common string components and casing elements are easily accessed from a library that can be amended to and shared by several users.

Powerful graphical output and more than 100 built-in plot options make it easy to analyze and present results. The well schematic window (right) can show various dynamic effects such as gas migration, gas dissolution, mud density or temperature profile. It is possible to use a slide bar to go back in time to investigate specific interesting effects seen in any simulation window. Tracking of minimum and maximum values is available. This provides a unique tool to verify that well integrity is not challenged by critical parameters in any part of the well during the simulation. Maximum pressure loads along the wellbore during a well control scenario can also be easily evaluated.

Drillbench enables the user to specify batch simulations that can replicate the actual drilling process, making it easy to evaluate and identify operational limitations for an entire section in one simulation run.

Dynamic simulations with Drillbench software provide safe and reliable planning and execution of any challenging drilling operation, minimizing expensive non-productive rig time.
Training
How does a kick enter the well and evolve? Why, when and what choke regulations are necessary? What kind of pressure and flow rates can be anticipated during a well control operation? How long can the well be static before the temperatures reach above the tool rating? Why can it be important to maintain a specific flow rate to avoid turbulent flow? What gas injection rates are ideal?

Train your personnel:
• Learn your well’s operational limitations
• Prepare for unplanned events
• Use automatic and interactive simulations
• Avoid costly mistakes

Planning
Small margins and increased complexity put more focus on well planning. Large temperature variations will have a significant effect on well behavior. No matter how narrow your operational window, dynamic well planning will optimize hydraulics, gel effects, casing design, well control operations, and tripping speeds. Dynamic planning can make the crucial difference for an advanced operation.

Identify your operational limits:
• Replicate complete drilling operations
• Understand dynamic effects such as thermal expansion
• Use multiphase kick tolerance simulations
• Optimize your well design

Operations
Identifying the possible cause for deviation from normal well behavior is important in order to make the right decision for the next operational step. Is the actual influx volume larger than the pit gain observed due to dissolution in oil based mud? Is thermal expansion accounting for parts of your pressure build up? Is your ECD profile still within your margins when pumps are off?

Keep watch over your operation:
• Detect abnormal well behavior early
• Know downhole conditions at all times
• Validate your next operational plan
• Minimize non-productive rig time

Post analysis
Unexpected events can occur regardless of how well the operation is planned. Proper post analysis facilitates learning and improvement. Specify the actual operation leading up to an event as a batch job in Drillbench, and it will be easy to run sensitivities to gain understanding of what went wrong. Benchmark for future planning by comparing simulated versus actual data.

Optimize your procedures:
• Analyze unexpected events
• Learn about downhole conditions
• Transfer knowledge to future projects
• Improve cost efficiency

DRILLBENCH®
YOUR WORKFLOW SOLUTION

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SPT Group is the world leader in dynamic modelling for the oil and gas industry. Employing highly skilled professionals worldwide, SPT Group provides a combination of software and consulting services within multiphase flow and reservoir engineering.

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