

## Reducing risk and cost by utilizing an automatic supervision and decision support system during challenging HPHT well

eDrilling's well suite piloted on operator Total's new well in 2010

### CHALLENGE

- Very small window between pore and fracture pressure. RT ECD simulations were performed with an advanced hydraulic and thermal wellbore model
- Increased probability for instabilities in the tight window. This was mitigated in the System by RT stability modeling during drilling
- Uncertainties in pore pressure predictions. This was mitigated in the System by updating predictions during drilling.

### SOLUTION

wellAhead installed in Total E&P infrastructure

- Tested on Victoria HPHT well data (Real-time and Playback)

Drilling team involvement on operation HILD

- Workshop on operational challenges
- PSI/PRESSIM Pre-modeling work
- ECD Pre-modeling

Real-time modeling during operation

- ECD
- Pore pressure PPM
- Well Stability

### SOLUTION

A very challenging HPHT well was drilled while running an advanced decision support and ECD Management System including early diagnosis of upcoming problems and real time simulations using state-of-the art mathematical models.

The system ran in parallel with the operation, and used all available real time drilling data (surface and downhole) in combination with real time modelling to monitor and optimize the drilling process. This information was also used to visualize the wellbore in 3D in real time. Automatic forward-looking of ECD was also part of the active system.

It was implemented in Total E&P Norge TASC (Total Activities Support and Collaboration) Center in Norway. The system was piloted by Total, and was therefore not integrated in Total's work and decision process



### BENEFITS

- The forward-looking capability gave early warning of a near-future kick situation. And the diagnosis functionality gave first an early warning of an upcoming kick and then a firm diagnosis.
- A loss situation was warned against and eventually diagnosed by the system.
- Potentially at least 10 rig days, large amounts of drilling mud and a squeeze cement job could have been avoided by fully utilizing the system.
- The drilling risks could have been reduced and safety increased through reducing the impact of the kick/loss situations and possibly even avoiding them.

## ABOUT TOTAL

Total is the world's fourth-largest oil and gas company and second-largest solar energy operator with SunPower. With operations in more than 130 countries, we have more than 100,000 employees who are fully committed to better energy.

Total E&P Norge is part of 103 licenses on the Norwegian Continental Shelf, and an operator of 24 of these.

## ABOUT MARTIN LINGE

The Martin Linge field in the North Sea is an oil and gas discovery that was made in 1975. The field is located 42 kilometres west of Oseberg, at a water depth of 115 metres. New wells drilled in the following years confirmed that this was a complex, high-pressure area, consisting of an oil reservoir at 2000 metres depth and a sizeable gas reservoir at 4000 metres depth.

Total is operator on the Martin Linge project, and holds a 51% interest in the project. Its partners are Petoro (30%) and Statoil (19%).

Oil and gas production is expected to start in 2016 with a capacity of 80,000 barrels of oil equivalent per day (boe/d)

## ABOUT eDRILLING

eDrilling is a world leading provider of drilling and well performance solutions.

We work closely with E&P companies, operators, and service companies to help them save cost, improve safety, and increase efficiency of drilling operations through one solution with mathematical models developed, tested and verified over 20 years.

## TECHNICAL SOLUTION

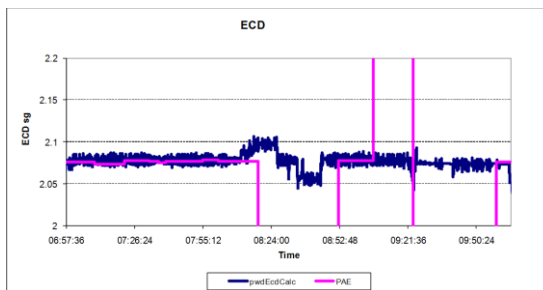
- Modelling the different drilling sub-processes dynamically, and interaction between these sub-processes in real time
- Automatic forward-looking during drilling
- What-if evaluations
- The transient flow & thermal wellbore model coupled to the well stability model in real time, so that the RT logs; updated well pressures and temperatures and drilling mud properties were used by the well stability model for real time predictions
- A multi-purpose geo-pressure modelling tool coupled to the simulator and utilizing RT logs, gave updated pore pressure predictions during drilling
- Methodology for diagnosis of the drilling state and conditions, obtained from comparing model predictions with measured data
- Virtual wellbore (RT 3D Viz) with advanced visualization of the downhole process



## FACT BOX

The 30/4-D-1 AH well appraised the Martin Linge East structure. The well was drilled with the 6<sup>th</sup> generation semi submersible rig West Phoenix from Seadrill.

## 8 1/2" DRAIN HOLE



In 8 1/2" section signals from the MWD tool was lost during part of the section. wellAhead was still giving good ECD values in this period.