

e-Drilling

Advanced real time drilling modelling, optimization, diagnosis, and visualization.

Drilling in new dimension

e-Drilling will provide the technology elements to realize real time modelling, supervision, optimization, diagnostics, visualization, and control of the drilling process from a remote drilling expert center. These technology elements are:

- An advanced and fast integrated drilling simulator which is capable to model the different drilling sub-processes dynamically, and also the interaction between these sub-processes in real time
- Data Quality Module DQM
- Real time supervision methodology for the drilling process using time based drilling data as well as drilling models / the integrated drilling simulator

- Methodology for diagnosis of the drilling state and conditions
- Advisory technology for more optimal drilling
- A Virtual Wellbore, with advanced 3D visualization of the downhole process
- Data flow and computer infrastructure



Applications

Downhole Pressure and Flow: An advanced transient flow and temperature model is established. The model handles calculation of:

- Pressure/ECD, temperature, and pit volume vs. time while drilling and circulating, including flow of cuttings.
- Transient well pressure and flow vs. time during surge and swab.
- ESD and temperature vs. time during static periods, e.g. flow tests.
- Transient pressure and flow vs. time while resuming circulation after static periods.

Torque and Drag: The advanced Torque/Drag model will be applied for the calculation types:

- Calculate WOB and TOB from surface. Automatic calibration routines will be incorporated.
- Back-calculation of friction factor with input of measured surface and bottom hole weights or torques. Friction factor can be monitored with warnings issued on unexpected changes.
- Bit depth correction due to string elasticity. More accurate bit depth will increase value of LWD.
- Initial calibration of rig specific parameters, such as model parameters for force/torque transfer from top drive system to string.

Drilling Vibrations: Drillstring vibration problems are detected and solutions will be recommended.

Rate of Penetration: By simultaneous analysis of ROP and drilling parameters the ROP monitor will determine the optimum set of drilling parameters. In addition the ROP monitor will help identify drilling problems and give better information on bit condition and formation parameters such as pore pressure and compressive strength.

Wellbore stability: SINTEF state-of-the-art models are expanded to estimate the probability of well bore instability in RT based on formation description and the temperature and pressure history along the well path.

Pore Pressure: The multi-purpose geo-pressure modeling tool PRESSIM includes all processes relevant to pressure generation and dissipation.

Hole Cleaning: Calculated and measured data are combined to detect early signs of poor hole cleaning and suggest corrective action.

Stuck Pipe: Captures early indications of stuck pipe and suggest corrective action.

Lost Circulation: Combine calculated and measured data to detect early lost circulation signals and warn when lost circulation is detected or predicted by the models.

Forward Looking: Automatic forward-looking is performed by the calibrated models by projecting the drilling process a given time period ahead.

The information is combined in a 3D visualization environment (presented as different information layers for various operator modes):

- Planned well
- Actual well path
- Realtime drillstring information
- Realtime MWD data
- Realtime surface data
- Geology (layers)
- Seismic plug-in
- Intervention & Subsea
- Simulation of process (forward looking)
- Playback of historical well activity
- Diagnosis, supervision & advisory



SINTEF Petroleumsforskning AS (SINTEF Petroleum Research)
POB 4763 Sluppen, NO-7465 Trondheim, Norway
Phone: + 47 73 59 11 00, www.sintef.no/petroleum

CONTACT

Thor Ole Gulsrud
Cellphone: +47 469 69 237
e-mail: thor.o.gulsrud@sintef.no