OVERVIEW

At the heart of any good managed pressure drilling (MPD) operation is a reliable and trustworthy real-time hydraulics model. The hydraulics model is responsible for calculating the surface backpressure required to maintain a desired equivalent circulating density (ECD). It does that by calculating, in real time, the hydraulic pressure (the static pressure of the well based on mud properties), frictional pressure (pressures induced by hole geometry, pipe rotation, and pump rate), and other pressure drops (such as surface pressure), and determines the required surface backpressure needed in order to maintain the ECD at a desired location.

A good model can also incorporate variations from rig to rig and well to well – controlling ECD at any point in the well, incorporating offshore features – controlling ECD at any point in the well, incorporating offshore features such as a boost line, handling various pressure-while-drilling (PWD) providers, compensating for downlinking for measurement while drilling (MWD), adjusting surface pressure drops, and compensating for surge and swab effects during running and tripping.

Finally, a good real-time hydraulics model should be able to automatically adjust surface backpressure when an event is detected. As there are varying approaches to event control depending on the scenario, the hydraulics model should provide some sort of flexibility for how much the software automates the process, along with the specific process that is followed.

The GB Setpoint™ real-time hydraulics model is the heart of our Halliburton MPD services. Leveraging the Baroid DFG™ drilling fluids graphics software program and the iCem® cementing services model, it has some of the most innovative capabilities on the market. The user interface allows the configuration of all required inputs – along with visualization of the well; clear and understandable equations; readings of real-time partial and final results; notification of missing data, wrong data, and forced data; and real-time charting.

FEATURES

- Three Real-Time Surface Backpressure Setpoint Methods
  - Target ECD at a Specified Depth
    Control at any point in the well by simply selecting the depth and setting the desired ECD or pressure value at that location. The system automatically applies a surface backpressure to achieve the desired downhole pressure. A table of values based on depths can also be automatically imported, and the system will control to these values.
  - Volumetric Control
    Control the flow out to equal the flow in. The system automatically regulates the backpressure applied to ensure that the Coriolis meter flow out is equal to the injection flow rate. This setpoint control method can be utilized all the time, or only when an event is detected in order to minimize the size of an influx or loss – or it can be turned off completely.
  - Standpipe Pressure Control
    Control the backpressure to maintain a constant standpipe pressure. This function is primarily used when circulating out an influx.

- Full Wellbore ECD Monitoring
  Besides the depth where the ECD is being controlled, the GB Setpoint model can also monitor any point in the well when multiple points in the well are critical.

- Multiple Fluids
  The DFG software is able to handle an infinite amount of muds in the wellbore, and the user can color code the muds to easily visualize and track the muds throughout the well.
» **Fully Automated Surge and Swab**
Most calculations to estimate surge and swab pressures are developed for static conditions, but, in reality, these effects are present during circulating and drilling operations. The GB Setpoint model calculates the effects every second during both static and dynamic conditions, and adjusts the backpressure every second to compensate for these effects.

» **Frictional Pressure Correction with PWD Data**
Several assumptions that influence the friction must be made in each hydraulic model, which is why many hydraulic models are usually validated with PWD data. The GB Setpoint model uses PWD data to properly calibrate the frictional pressure in the model and updates this calibration automatically when conditions require reducing the need for the costly fingerprinting exercises typically required with MPD systems.

» **Thermal Corrections**
The thermal profile can be loaded into the DFG software, and the mud properties (such as compressibility) will be updated throughout the model to provide a more accurate bottomhole pressure. Furthermore, the software automatically calculates an ECD based on monitoring the changing flow rates and using the power of the DFG software to estimate the proper transient fluid behavior between static and fully dynamic conditions.

» **Cumulative Flow Calculator**
The DFG software includes the injection flow; any surface flow rate that is part of the system (backpressure pump, or a rig pump diverter); and the booster flow rate to calculate a cumulative gain or loss rate, as well as the current gain or loss rate. During tripping operations, the calculator accounts for the drillstring displacement and drillstring volume, depending on the tripping strategy (tripping wet or tripping dry). This reduces the reliance on conventional pit trends and speeds up the ability for a driller to react to potential events.

» **Real-Time Data Monitoring**
Visual indicators notify the user of the condition of the real-time data. If the data is erroneous, the system can automatically filter out the data, protecting the system from controlling to an incorrect value. If the data is stale, the system alerts the user to the stale data set, and then uses the last values of the data to continue with automated control.

» **Real-Time Mud Properties**
In addition to loading various fluids in the wellbore at any time, the GB Setpoint model can also incorporate a BaraLogix® real-time mud density and rheology unit to automatically update mud properties every 20 minutes, instead of the more typical every 12 hours.

» **Hold for Standpipe Pressure**
The DFG software has a feature that monitors the pumps and the standpipe pressure when starting pumps. Sometimes there is a delay from when the pump reaches the desired stroke rate to when pressure starts building in the standpipe. This feature compensates for this lag and slowly transitions the choke to compensate for the pump rate with regard to the standpipe pressure, thus giving you better bottomhole control during ramp-up of the pumps.

» **Surface Pressure Drop Calculator**
The user can select between several options on how to calculate the surface pressure drop. This can be calculated from the difference in pressure between the rotating control device and the choke manifold pressure readings, by inputting the surface line information, or by simply applying a fixed value.

» **Bottoms-Up Tracking**
Users can add markers to the bottom of the well in order to monitor a particular bottomhole event, and then track the marker visually up the wellbore.

» **Boost Flow Capability**
Users can access real-time data to boost line flow rates, and can correct flow rates by adding data based on actual returns.

For more information, contact your local Halliburton representative or visit us on the web at www.halliburton.com