Continuous Flow Sub System

Drilling Engineering Association, Quarterly Meeting

6/23/09
CFS Overview

- CFS is a sub based system that allows flow to continue during drill pipe connections while drilling and tripping out.

- Any hole section length can be drilled with continuous circulation. 1 sub is needed for each stand.

- Focus of design is reduced connection time and safe operation.

- CFS has smaller footprint than comparable systems.

- CFS enhances Constant Bottom Hole Pressure (CBHP) variant of MPD.
CFS Benefits to Operator

- Stable downhole pressure management resulting in:
  - Reduced mud losses.
  - Reduced likelihood of kicks.
  - Reduction of pressure spikes associated with breaking circulation.
  - Reduced chance of stuck pipe.
  - Less formation damage.

- Better hole cleaning.

- Better cooling for downhole tools.

- Ability to drill and trip out of a hole section while continuously circulating, reducing the chance for problems in open hole.
CFS System Implementation on Rig

① CFS Control Panel is positioned in a safe area on rig floor.

② Side Circulation Hose is routed to rig floor.

③ CFS Suspension Device and Clamp are placed on rig floor.

④ Flow Control Skid is positioned near main mud flow line and integrated into mud system.
CFS Safety Features

- Clamp/Actuator device installed onto sub by operator with no pressure in side circulation hose.

- Side Port Pressure Plug removed hydraulically after Clamp/Actuator device installed, preventing potential exposure of personnel to pressure.

- Operator is not required to be near any high pressure piping during flow switching procedure.

- Flow switching procedure is automatic and controlled by a PLC with operator input.

- Make up or break out of connections is done normally. CFS does not interfere with operation of manual or power tongs.
CFS Specifications

- All system components are rated to 5000 psi.
- Hydraulic Control System is ATEX Zone 2 certified.
- Sub has 4 ½ IF connections, 6-5/8” OD, 36” long.
- Through bore is 2”.
- Permits wireline access after running a lock-open tool to open flapper-style valves in all subs downhole in one trip.
CFS Operation (1 of 3)

- Completed drilling stand of pipe.
- Ready to make Connection.
- CFS Clamp attached.
- Plug removed from side port.
- Flow initiates into side port.
CFS Operation (2 of 3)

- Flow through Top Drive stopped.
- Check valve closes.
- Top Drive removed.

- New stand made up to CFS.
- Flow re-established through Kelly.
CFS Operation (3 of 3)

- Flow through side port stopped.
- Plug re-installed.
- Clamp removed.
- Drilling resumes normally.
CFS Project Status

- Preliminary lab tests of CFS hardware completed.
- Complete lab test on rig by Q4 2009.
- Ready for field test in Q4 2009.