e-cd™ System
CONTINUOUS CIRCULATION SERVICES
Continuous Circulation Services

In today’s drilling environment, the industry is facing greater pressure-related challenges while developing mature and unconventional fields, both on land and offshore. There is also a greater focus on marginal well improvement while increasing efficiency and improving safety. Managed pressure drilling (MPD) is an enabling technology that aids in accomplishing these goals while mitigating drilling risks.

Managed pressure drilling with surface back-pressure requires rotating control devices (RCDs), pressure pumps, chokes, and a full crew in order to safely and effectively drill at, or slightly above, reservoir pressure. On the other hand, continuous circulation services provide a much smaller footprint and equipment requirement. The e-cd™ system ensures constant equivalent circulating density (ECD) during connections, thus maintaining drilling fluid circulation.

Although significantly less equipment is used, the e-cd system still addresses many of the same challenges that MPD with surface back-pressure addresses, most notably around the effects of cycling mud pumps while making connections. The e-cd system enables continuous circulation while either drilling or tripping in and out of the hole.
On and off pump cycling during connections in conventional rotary drilling causes bottomhole pressure fluctuations. When the pumps are on, frictional pressure and fluid rheology remain constant. When the pumps are turned off, the frictional effects are no longer contributing to the downhole ECD, with only the hydrostatic pressure of the drilling fluid acting on the openhole section. The differences in downhole pressure between pumps that are turned on and off can cause bottomhole pressure to either exceed fracture pressure or fall below reservoir pressure. These conditions increase chances of nonproductive time related to hole instability, fluid loss, reservoir influxes, and stuck pipe.

On and off pump cycling also reduces the effectiveness of the drilling fluid to carry cuttings out of the hole. While pumps are turned off, cuttings fall down the wellbore in vertical wells or fall at transitional angles in horizontal wells. This increases the chance of incidents such as well pack-offs and stuck pipe.

Continuous circulation systems can be used in conjunction with a full MPD package with back-pressure applied, or as a stand-alone MPD solution. It can be a good option for a floating drilling vessel, where major modifications to the rig are not required to make it MPD ready, particularly a surface back-pressure MPD application requiring riser modifications.

Continuous circulation has been proven over the years to enable operators to reach total depth more effectively and to also run liners to full depth. The benefits of continuous circulation can be seen in wells with narrow-pore-pressure to fracture-pressure windows, as well as in high-pressure/high-temperature (HPHT) and extended-reach wells.
HISTORY OF E-CD™ SYSTEM

The e-cd system is an Eni-patented technology offered through Halliburton, and is the first sub-based continuous circulation system brought to modern drilling operations. It has been used successfully in more than 120 wells from 2006 to 2016, with over 21,000 connections. No other offering has the proven track record, flow rate capacities, and reliability of the e-cd system.

HOW IT WORKS

Prior to drilling operations, subs are pre-installed on the drillpipe and the manifold is rigged into the rig standpipe. During drilling operations, the standpipe flow is diverted through the diversion manifold with a gate valve and plug valves into the diversion manifold inlet and outlet. The gate valve is closed when the e-cd system is to be used, but can be opened to bypass quickly if needed. Before e-cd drilling begins, the system is installed, the gate valve is closed, and the plug valves are opened. The mud from the rig's pumps then flows through the diversion manifold, through the top drive and downhole.

As drilling continues and a new stand of drillpipe is needed, a side port connection is made into the sub with a high-pressure hose. Through a series of steps, the flow path is safely diverted from the top drive to the side port without pressure surges.
A TYPICAL E-CD SYSTEM IS DEPICTED IN THE ABOVE LAYOUT

In this view, the process of adding a new stand is almost complete; a new stand has been installed on the top drive, but the side port connection has yet to be removed.

A new stand of drillpipe is then added and filled with fluid. The diversion of flow is returned through the top drive and the side port hose is removed. Throughout the drilling process, the pumps are not turned off, thus maintaining constant ECD.

With this system, the connection time is roughly the same as the standard connection time, when considering all aspects of the connection. The additional time in making the side port connection can be offset by not having to ramp pumps up and down, circulate connection gas, or conduct hole-cleaning flow periods before connections. The total time for side port connection to removal is approximately three to five minutes.
At a Glance

FEATURES

» Pumps are not turned off while making connections or tripping
» Subs contain dual metal-to-metal seal barriers
» Built-in fluid filtration
» Non-spring-loaded axial valves enable simple intervention operations
» Measurement-while-drilling/logging-while-drilling (MWD/LWD) data available during pipe connections
» Axial flapper valve closes and acts as additional safety barrier with back-flow
» Pressure transducers are incorporated into the manifold to monitor e-cd connection process
» API connections available for 7-inch and 8-inch tool joint range
At a Glance

**BENEFITS**

» Enables drilling difficult formations with small-pore/fracture-pressure windows
» Eliminates possible mud rheology changes that can occur during pipe connections
» Provides constant hole cleaning during connections
» Ideal for extended-reach drilling applications
» Maintains constant circulating temperature
» Extends life of electronic downhole (MWD/LWD) tools in high-temperature environments due to continuous circulation cooling effects
» Eliminates connection gas and enables continuous monitoring of background gas during pipe connections
» Eliminates need to wait for bottoms-up prior to making a connection in critical well applications
» Eliminates back-pressure control equipment required to maintain constant bottomhole pressure, and reduces potential transition errors during connections
» Provides constant ECD while making connections and tripping along the well profile
» Reduces stuck-pipe incidents and ballooning effects
Products

**E-CD™ CIRCULATING SUB**

- Dual flapper configuration
- Enables access to the drillstring flow through side port entry
- Allows for intervention work in the workstring
- 10,000-psi working pressure
- Available with multiple drillpipe threads, such as 4½ IF, 5½ FH, 6 5/8 FH, HT-55, XT-54, XT-57, TT525, TT575
- Other threads available upon request

**E-CD™ DIVERSION MANIFOLD**

- Available in 5,000-psi and 7,500-psi pressure ratings
- Enables safe diversion from top drive to side port connection and back when making connections
- Designed for high flow rates up to 1,200 gpm
- Provides access to bleed off and fill up lines
- Compatible with high-density fluids
- Air over hydraulic control panel and valves
Sales of Halliburton products and services will be in accord solely with the terms and conditions contained in the contract between Halliburton and the customer that is applicable to the sale.

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