Counter-Rotating Tandem Motor Drilling System

DE-FC26-05NT15489

Goal

The project objective is to increase the supply of natural gas available to the United States with minimal environmental impact by decreasing the cost and footprint of drilling operations for slim holes (3½ inches) at relatively shallow depths. The technology is specifically directed toward gas reserves in unconventional or low-permeability formations in which a large number of wells are necessary to effectively drain the reservoir. In such cases, economic development requires these wells to be drilled at a lower cost and with less environmental impact than current technology allows.

The project goal is to develop a novel coiled tubing drilling (CTD) system, specifically designed to drill at high rates of penetration (ROP) with low weight on bit and low reactive torque. The Counter-Rotating Tandem Motor Drilling System (CRTMDS) will aid in achieving higher ROP with a coiled tubing system.

Performers

Gas Technology Institute
Des Plaines, IL

Dennis Tool Company
Houston, TX

Results

Manufacturing has begun following development and evaluation of a detailed design for a CRTMDS. After evaluation of the design, the decision was made to proceed with the fabrication and testing of a prototype system. The prototype system is undergoing an extensive testing program to evaluate its performance and reliability vs. conventional CTD systems. By the end of the program, a system suitable for use in commercial gas wells is expected to be available.

A similar tool design was tested for Los Alamos National Laboratory (LANL) in September 2005 at the Rocky Mountain Oilfield Testing Center near Casper, WY. The smaller, 2.625-inch tool averaged 82 feet/hour drilling 130 feet in 1.6 hours. Conventional 2.625-inch PDC bits average 10-30 feet/hour.

Reamer, flow diverter and bit for CRTMDS tool.

The LANL test proved the design elements of higher ROP using low weight on bit (WOB)—about 700 pounds—and low reactive torque.

Design changes to the CRTMDS tool based on the LANL test have been made to maintain the diameter ratio of pilot bit to reamer. A resulting increase in pilot bit size from 2.25 to 2.75 inches allows for the use of a larger, 2.875-inch, right-hand positive-displacement motor (PDM) and a 2.125-inch, left-hand PDM.

Benefits

Drilling costs will be lowered through the development of an improved drilling system suitable for CTD operations. Current CTD systems are able to drill at relatively low cost and with improved environmental characteristics as compared with conventional drilling rigs. However, CTD would have a much greater impact on oil and gas development if the rate of penetration could be increased by 25-60%, while decreasing the drilling cost by up to 40%.

Background

Overall drilling costs can be lowered by drilling a well as quickly as possible. For this reason, a high ROP is desired. In general, high ROP can be achieved by increasing the WOB, the amount of torque on the bit, and the rotary speed of the bit. Two important limitations commonly associated with coiled tubing systems are the inability to apply high WOB to the bottomhole assembly and the torque-handling capacity of the coiled tubing. These two limitations work against the goal of high ROP.

Summary

The CRTMDS developed in this project will combine a counter-rotating pilot bit and reamer to drill with low WOB and reduce reactive torque transmitted to the coiled tubing. The system uses a small-diameter, left-hand polycrystalline diamond compact (PDC) pilot bit driven by a left-hand turning PDM to drill a small pilot hole. A 3½-inch PDC reamer with an integrated stabilizer is run in tandem with and powered by a right-hand turning PDM. The bit contains premium PDC cutting inserts manufactured with advanced microwave-sintered carbide substrates.

The proposed project is divided into six tasks:

- Conceptual design.
- Final design.
- Prototype fabrication.
- Bit testing and evaluation.
- Tool modification.
- Technology transfer.

Current Status (January 2006)

Final designs have been completed and manufacturing begun on the pilot bit, stabilizer, reamer, and left-hand PDM. First tests of the tool were expected in February 2006 at the GTI Catoosa Test Facility near Tulsa, OK.

Project Start / End: 2-1-05 / 1-31-07
DOE / Performer Cost: $654,953 / $163,743
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