DOWNHOLE VIBRATION MONITORING & CONTROL SYSTEM QUARTERLY REPORT #7

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ABSTRACT

The deep hard rock drilling environment induces severe vibrations into the drillstring, which can cause reduced rates of penetration (ROP) and premature failure of the equipment. The only current means of controlling vibration under varying conditions is to change either the rotary speed or the weight-on-bit (WOB). These changes often reduce drilling efficiency. Conventional shock subs are useful in some situations, but often exacerbate the problems.

The objective of this project is development of a unique system to monitor and control drilling vibrations in a 'smart' drilling system. This system has two primary elements:

- The first is an active vibration damper (AVD) to minimize harmful axial, lateral and torsional vibrations. The hardness of this damper will be continuously adjusted using a robust, fast-acting and reliable unique technology.
- The second is a real-time system to monitor drillstring vibration, and related parameters. This monitor adjusts the damper according to local conditions. In some configurations, it may also send diagnostic information to the surface via real-time telemetry.

The AVD is implemented in a configuration using magnetorheological (MR) fluid. By applying a current to the magnetic coils in the damper, the viscosity of the fluid can be changed rapidly, thereby altering the damping coefficient in response to the measured motion of the tool.

Phase I of this program entailed modeling and design of the necessary subsystems and design, manufacture and test of a full laboratory prototype. Phase I of the project was completed by the revised end date of May 31, 2004. The objectives of this phase were met, and all prerequisites for Phase II have been completed.

The month of June, 2004 was primarily occupied with the writing of the Phase I Final Report, the sole deliverable of Phase I, which will be submitted in the next quarter. Redesign of the laboratory prototype and design of the downhole (Phase II) prototype was begun.

Executive Summary

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Results and Conclusions

During the past quarter, the rebuilt laboratory prototype was tested in the laboratory and the data analyzed. These results and analysis are described in the Phase I final report (to be submitted next quarter.) The conclusions of Phase I can be summarized as follows:

The overall objectives of this phase of the project have been met.

- The DVMCS environment has been modeled and the tool specifications set.
- Extensive mechanical modeling demonstrated that the DVMCS will have a significant, even dramatic, effect on the drilling process.
- The AVD component of the DVMCS has been designed, tested, modified and re-tested. The second design has shown that it can provide the necessary range of damping under downhole conditions, at acceptable power levels, to produce the effects mentioned above.
- The design of the downhole prototype will include significant segments of the laboratory unit, and the downhole tool may include some of the actual laboratory hardware.
- Sufficient data has been gathered to develop effective feedback algorithms, but additional data will be taken in Phase II to optimize the design.

On June 16, 2004, the results of Phase I were present to Gary Covatch and others at NETL Morgantown.