

Weyland

NOVEL HIGH-SPEED DRILLING MOTOR FOR OIL EXPLORATION & PRODUCTION

INTERIM PROGRESS REPORT #5

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ABSTRACT

The overall objective of this effort is to develop, build and test a high-speed drilling motor that can meet the performance guidelines of the announcement¹, namely: "The motors are expected to rotate at a minimum of 10,000 rpm, have an OD no larger than 7 inches and work downhole continuously for at least 100 hours. The motor must have common oilfield thread connections capable of making up to a drill bit and bottomhole assembly. The motor must be capable of transmitting drilling fluid through the motor." To these goals, we would add that the motor must be economically viable, in terms of both its manufacturing and maintenance costs, and be applicable to as broad a range of markets as possible.

Phase I is proceeding, although behind schedule, with significant progress on all but one of the eight tasks. Specifically:

1. The power section is on order.
2. The gearing design is complete & detailed and on order.
3. The overall design concept is complete.
4. The high-speed and low-speed seals have been designed and ordered.
5. The flexible coupling marine bearing design is complete and on order.
6. The work on evaluating critical frequencies and damping has been deferred again for a month or two, pending some more detailed design effort.
7. The flow loop is operational.

The project has been extended to September 30, 2007.

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Executive Summary

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14. The flow loop is operational.

15. Project Tasks & Progress

1.0 Analysis & Design [1st year]

The objective of this phase was to arrive at a viable design for the motor. The design completed during this phase has proven to have some difficulties, particularly with the ability to manufacture the gears. A partial redesign is underway, while key components and materials are being ordered.

1.1 Evaluation & Design of Power Section

While this task was completed during Year 1, it was reopened because of problems with the manufacturability of the gearing design (see below.) The new power section has been chosen and is on order. **COMPLETE.**

1.2 Gearing Design

In order to meet the design goals of the Announcement Error! Bookmark not defined., while simultaneously producing a system that is commercially viable, flexibility is essential. The system must be compatible with a wide range of power sections, and serve the broadest market, including that for bits requiring 10,000 rpm or higher to operate efficiently. Redesign is finished and parts are on order. **COMPLETE.**

1.3 Overall Conceptual Design

The overall conceptual design encompasses the power section and gearbox described above, and must combine them into a survivable, manufacturable product. To do so, several problems must be addressed. The seals, coupling, casing and bearings are discussed below, but one of the most critical aspects of the design is the management of the flow around the gearbox. **COMPLETE**

1.4 Sealing System Design

COMPLETE and on order.

1.5 Flexible Coupling & Casing

Marine bearing chosen, flexible coupling designed and order. **COMPLETE.**

1.6 Bearings

COMPLETE and on order.

1.7 Critical Frequencies & System Damping

This task is not yet underway. As it relies on the particular details of the design, it will be deferred to later this year.

1.8 Test Equipment Design

The primary test equipment used in this project will be a flow loop. While initially planned for purchase and assembly in Year 2 of the project, it has become clear that it will be needed by the end of the first year, as we expect to have prototype components to test. **COMPLETE**

2.0 *Laboratory Testing [2nd year]*

2.1 Laboratory System

Test unit (dynamometer) has been designed and built and is operational. **COMPLETE.**

2.2 Test Facility

Flow loop is operational. **COMPLETE.**

2.3 Laboratory Testing

None in this period. Dynamometer testing began after the end of the period.

2.4 Drilling at Test Facilities or Test Wells

None to date. It may not be possible to test the motor in actual drilling as a result of the total lack of any high speed bits to use with it.

Units

To be consistent with standard oilfield practice, English units have been used in this report. The conversion factors into SI units are given below.

1 ft.	=	0.30480 m
1 g	=	9.82 m/s
1 in.	=	0.02540 m
1 klb.	=	4448.2 N
1 lb.	=	4.4482 N
1 rpm	=	0.01667 Hz
1 psi	=	6984.76 Pa

References

¹ U.S. Department of Energy, National Energy Technology Laboratory, Funding Opportunity Master Announcement No. DE-PS26-04NT15450-0, "Oil Exploration and Production Program Solicitation," issued November 4, 2003

² U.S. Department of Energy, National Energy Technology Laboratory, Funding Opportunity Master Announcement No. DE-PS26-04NT15450-0, "Oil Exploration and Production Program Solicitation," issued November 4, 2003