DOWNHOLE VIBRATION MONITORING & CONTROL SYSTEM QUARTERLY PROGRESS REPORT #6

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ABSTRACT

The objective of this program is to develop a system to both monitor the vibration of a bottomhole assembly, and to adjust the properties of an active damper in response to these measured vibrations. Phase I of this program entails modeling and design of the necessary subsystems and design, manufacture and test of a full laboratory prototype.

The project continues to advance, but is behind the revised (14-month) schedule. Tasks 1-3 (Modeling, Specification and Design) are all essentially complete. The test bench for the Test and Evaluation (Tasks 4 & 5) and the laboratory prototype were constructed by the end of the period. During assembly, however, several of the key subassemblies became galled together, and had to be cut apart. These parts are being remachined with harder surfaces to prevent recurrence of this problem. One key component, the MR damper mandrel, has been redesigned into a three-piece assembly which will facilitate assembly and reduce the cost of replacement of worn components.

The remade parts will be delivered by April 19, and the prototype assembled. Testing will begin during the first week of May and is anticipated to be completed before the revised end date for Phase I, May 31, 2004.

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Executive Summary

The project continues to advance, but is behind the revised (14-month) schedule. Tasks 1-3 (Modeling, Specification and Design) are all essentially complete. The test bench for the Test and Evaluation (Tasks 4 & 5) has been designed and constructed. All parts for the laboratory prototype are in and it is being assembled. Long leads for some parts for the test equipment will delay the start of testing to March 15 or beyond.

The project continues to advance, but is behind the revised (14-month) schedule. Tasks 1-3 (Modeling, Specification and Design) are all essentially complete. The test bench for the Test and Evaluation (Tasks 4 & 5) and the laboratory prototype were constructed by the end of the period. During assembly, however, several of the key subassemblies became galled together, and had to be cut apart. These parts are being remachined with harder surfaces to prevent recurrence of this problem. One key component, the MR damper mandrel, has been redesigned into a three-piece assembly which will facilitate assembly and reduce the cost of replacement of worn components.

The remade parts will be delivered by April 19, and the prototype assembled. Testing will begin during the first week of May and is anticipated to be completed before the revised end date for Phase I, May 31, 2004.

Modeling (Task 1)

The initial modeling is essentially complete, as described in the Second Quarterly Technical Report¹. Analysis of the predicted response of the particular mechanical design (**Task 3**, below) in relation to the testing (**Task 5**), which is part of **Task 4** has begun. An enhanced version of the ANSYS program has been procured to assist in this next level of modeling.

Design

Specification (Task 2)

Complete. See Third Quarterly Progress Report.²

Mechanical Design (Task 3)

Complete. The design for both the laboratory test piece and the test equipment for use with the bench are complete. The laboratory prototype and test bench were assembled in March, but problems were encountered. (See below.)

Electrical Design (Task 3)

Complete. The electrical design was presented in the second quarterly report¹. The circuit boards and software needed to control the laboratory prototype are complete.

Experimental (Task 5)

Determination of damping coefficient

This task was completed in the last quarter.³

Testing of DVMCS prototype

The laboratory prototype was assembled in February. Photographs of the prototype assembly are shown in the Appendix (**Figures 1 –7.**)

During the assembly, however, several key subassemblies became galled together. Photographs of some of the problem areas are shown in the Appendix (**Figures 8 – 9.**) The galling was attributed to several factors:

- While hard steels were used for the components, extensive surface treatments, which will be used in downhole prototypes, were considered unnecessary. This proved to be an erroneous assumption.
- Assembly of the prototype requires threading pieces into long blind holes with very tight tolerances, making misthreading fairly easy.
- Alignment problems were complicated by the horizontal assembly of the tool, which tended to accumulate all of the tolerances on one side. Also, torquing the threads across long sections applied side forces which can further misalign the components.

After the components were disassembled or cut apart, and evaluated, a detailed design review was held, and several changes were made in materials, surface treatments and tolerances. One component, the MR valve mandrel, was redesigned into a three-piece assembly. This will facilitate its integration into the tool, and make it easier and less costly to replace the part when the threaded areas wear in use. The new design is shown in **Figure 11.**

Results and Discussion

Results of the damper testing were reported in the last quarter.³

Conclusions

As a result of the difficulties encountered, the laboratory prototype tool will be assembled in the last week in April, and the testing will begin in the first week of May. Barring any additional unforeseen problems, Phase I will be completed by its currently scheduled date of May 31, 2004.

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 "Downhole Vibration Monitoring & Control System: Quarterly Technical Report #2," Report 41664R02, April 2003.

² "Downhole Vibration Monitoring & Control System: Quarterly Technical Report #3," Report 41664R03, July 2003

³ "Downhole Vibration Monitoring & Control System: Quarterly Technical Report #5," Report 41664R05, January 2004.

Appendix: Figures

Figure 1: Assembling torsional bearing section

Figure 2: Prototype showing torsional bearing with races for ball bearings

Figure 3: Torsional bearing with ball bearings in place

Figure 4: Assembled bearing section

Figure 5: Winding MR magnet coil on damper

Figure 6: MR damper section showing magnet coils before potting

Figure 7: MR valve coils being potted

Figure 8: Galling on outer surface of MR mandrel

Figure 9: Detail of galling damage to o-ring groove of MR valve housing

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A	INITIAL RELEASE	TFR 03/23/04	CAP 03/23/04

DETAIL B
SCALE 1 : 1

ITEM NO.	QTY.	PART NO.	DESCRIPTION
1	1	SK-10376	DAMPER- REWORKED
2	1	T-10750	EXTENTION, DAMPER (11.125 LG)
3	1	T-10749	EXTENTION, DAMPER (13.375 LG)
4	16	81683	SET SCREW, CUP POINT 8-32 X .312
5	2	81687	O'RING -245

MATERIAL: N/A	HEAT TREAT: N/A	FINISH: N/A
APS CAD FILE NAME: 60336 A DAMPER ASSY, MR VALVE - AVD.SLDDRW		

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SHEET 1 OF 1