DOWNHOLE VIBRATION MONITORING & CONTROL SYSTEM QUARTERLY TECHNICAL REPORT #4

Starting date: July 1, 2003

Ending Date: September 30, 2003

Principal Author: Martin E. Cobern

Date Issued: October 30, 2003

DOE Award Number: DE-FC26-02NT41664

Submitting Organization APS Technology, Inc.
800 Corporate Row
Cromwell, CT 06416

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

Table of Contents

Table of Contents	3
Executive Summary.....	4
Modeling (Task 1).....	4
Design	4
Specification (Task 2)	4
Mechanical Design (Task 3).....	4
Electrical Design (Task 3)	4
Experimental (Task 5)	4
Results and Discussion	5
Conclusions.....	5
Units	6
References	6

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 equipment for the Test and Evaluation (Tasks 4 & 5) has been designed constructed. Initial testing had some problems, which seemed to have been resolved after the end of the month. Given these delays, it will not be possible to complete all of the tasks within the 14 month schedule. ***We have, therefore, requested a four month extension of Phase I, to March 31, 2004.*** This change will not affect the budget for Phase I and should not impact either the total budget or overall project schedule.

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**) will be done in **Task 4** to begin this quarter. 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)

The overall mechanical design was presented in the second quarterly report¹. A redesign of the original MR valve reduced the estimated power consumption from an unacceptable value of 450 W to ~6 W, which can be provided downhole. This new design is being evaluated in the testing (see Task 5, below.)

Electrical Design (Task 3)

The electrical design was presented in the second quarterly report¹. We have now selected the accelerometers to be used for the monitoring of the vibrations. No commercially available LVDT will fit into the current design. We are working with a vendor to develop a magnetically coded strip ("bar code") to measure the relative motion of the two sections of the damper mechanism.

Experimental (Task 5)

The test bench is complete as reported in the last quarterly report.² A prototype valve assembly is complete and is being tested on the bench, as was described in this last report.

Results and Discussion

Testing of the prototype valve began during this quarter. The objective of the first preliminary tests was to determine the pressure drop that can be created across the valve under different conditions of flow and pressure. As described in Quarterly Report 3², the system uses pneumatic pressure to activate a cylinder which in turn loads two hydraulic cylinders containing the MR fluid.

Testing was performed with no sensors or gauges other than the air pressure supply gauge. The valve was powered at 36 volts and drew about 3.5 amps. The valve held back the MR fluid at 30 psi. (This is the air pressure required to get the cylinders to move without any flow obstruction.) The air pressure was then increased gradually until the valve could no longer hold back the MR pressure and the cylinders moved slowly.

The maximum air pressure that could be held without movement of the cylinders was 85 psi; however, as much as 30 psi of this pressure may be required to overcome stiction. Thus, the maximum pressure we were able to stop was somewhere between 55 and 85 psi of air. This translates into 1500 to 2330 psi MR fluid pressure. Based on the ratio of the piston area to that of the MR damper valve, this in turn translates to a force of 9,700 to 15,000 pounds. A force of this magnitude is what is required for operation of the damper under typical downhole conditions.

Conclusions

Initial testing indicates that a valve capable of producing the required damping under the anticipated downhole conditions is technically feasible.

The project is progressing, but behind schedule, and a four-month extension of Phase I is being requested. This extension will not alter the budget for Phase I and is expected to have no significant effect upon the overall program schedule or budget.

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