SOUTHWEST RESEARCH INSTITUTE®
QUARTERLY STATUS AND PROGRESS REPORT
FOR PERIOD ENDING JUNE 30, 2006

OTHER TRANSACTION AGREEMENT DTRS56-02-T-0001
SwRI® PROJECT 14.06162

APPLICATION OF REMOTE-FIELD EDDY CURRENT (RFEC) TESTING TO INSPECTION OF UNPIGGABLE PIPELINES

Phase 3—Development of RFEC System and Integration with Explorer II Robot

Many pipelines contain internal restrictions that do not allow the passage of inspection pigs that use conventional inspection technology. In the current phase of this project (Phase 3), a remote-field eddy current (RFEC) system is being developed to accommodate internal restrictions**.** This system will be fabricated and integrated with the Explorer II robot under development by Carnegie Mellon University. The integrated system will be tested on a live operating pipeline.

The Explorer II robot consists of a series of 11 modules that are linked together to form a self-propelled device that can travel untethered through a pipe. The robot is designed for pipe that ranges in diameter from 6 to 8 inches. In order to accommodate sharp bends in the pipe, however, the robot must have the capability to collapse to 4 inches in diameter**.** RFEC inspection capability is being added to Explorer II by developing two modules, one containing an excitation coil and the other an array of 48 sensors on spring-loaded, retractable arms. The arms expand to the required pipe diameter for inspection and retract to 4 inches to negotiate bends or obstacles in the pipe.

During the current reporting period, designs of the mechanical, electronic, software, and sensor/exciter coil systems were initiated to include production details and to incorporate lessons learned from the previous demonstration testing. The electronic design is focused on extending the previous design to accommodate all 48 channels and to communicate with the Explorer II CAN bus. This includes selection of a more powerful digital signal processor and addition of a microprocessor for control and communications. The electronic design is also addressing filtering to minimize (1) interference from 60-Hz currents induced in the pipeline from power lines and (2) signals induced in the sensors from residual magnetic fields in the pipe (due to magnetic flux leakage). Layout of the electronic analog PC board was initiated. The mechanical design is directed at refining the external profile of the collapsed detector module so that it will move smoothly around bends and from the launch tube into the pipe, as well as making sufficient space available for electronic PC boards. The mechanical design is also addressing manufacturability of the module components. The software design has involved performing benchmark testing for the digital signal processor, defining sensor control states, and designing CAN bus communications in accordance with the protocol defined by CMU.

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