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

Phase 2–Design of RFEC System for 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, a remote-field eddy current (RFEC) system is being designed to accommodate internal restrictions**.** This system is designed for integration with the Explorer II robot under development at Carnegie Mellon University.

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**.** The system concept for adding RFEC capability is to develop modules that can be added to the Explorer to accommodate RFEC. Designs were developed for RFEC exciter and detector modules that meet these size requirements. The detector module contains a series of 48 sensors on spring-loaded, retractable arms. The arms expand to the required pipe diameter and retract as necessary to negotiate bends or obstacles in the pipe.

During this period, an eight-channel laboratory version of the RFEC system was developed for use in a demonstration test held at Battelle**.** The approach taken for this test was to perform the demonstration using a tool that meets the requirements and specifications for the Explorer II robot**.** All of the instrumentation (except for external power, which will be supplied by the robot), including excitation signal generation, amplification, filtering, multiplexing, analog-to-digital conversion, and digital signal processing (to provide phase-sensitive signal detection), was located on the RFEC tool**.** Total power required was less than half of the power budget available from the robot**.** Communication of commands and transfer of the processed signal data to an external computer were accomplished using a CAN bus—the same bus that will be used on the robot**.** Although the tool incorporated 8 channels (coverage of 60 degrees circumferentially) instead of the 48 intended for the robot tool (to achieve 360 degrees coverage), the circuitry is readily scalable to the full number of channels**.** Data were acquired by all 8 channels simultaneously during a single scan**.**

SwRI (along with other sensor providers) participated in the demonstration testing during the week of January 9, 2006. Tests were performed on three 8-inch-diameter pipes containing numerous external corrosion-type defects**.** Except for four calibration defects of known size, all of the defects were hidden from view, and the dimensions were not disclosed**.** RFEC data were taken at a velocity of 1.5 inch/sec, and it was demonstrated that 4 inch/sec (the maximum scan speed of the robot) was possible**.** The data were post-processed for analysis to determine defect characteristics (length, width, and depth). These results were reported to Battelle, and a report will subsequently be issued by Battelle documenting the test results.

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