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Field Demonstration Report Enhancing Direct Assessment by Inspection through Coatings and Buried Regions of Non-Piggable Pipelines

EMAT Ultrasonics, Inc.

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Enhancing Direct Assessment by Inspection through Coatings and Buried Regions of Non-Piggable Pipelines

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Pipeline and Hazardous Materials Safety Administration

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BACKGROUND: Sonic Sensors of EMAT Ultrasonics Inc, with support from Pacific Gas and Electric as well as Southern California Gas has an R&D Contract with the DOT, PHMSA, OPS No. DTPH56-06-T-0009. The goal of this contract was to develop a method to inspect the full body of a pipe without having to remove the coating or completely excavate the pipe as shown in Figure 1. External Corrosion Direct Assessment, ECDA, depends on exploratory digging to evaluate the condition of suspect coatings detected by cathodic protection CIS. Minimizing the extent of excavation required to perform an ECDA evaluation has obvious cost savings as well as minimizing environmental impacts which are so critical in High Consequence Areas.

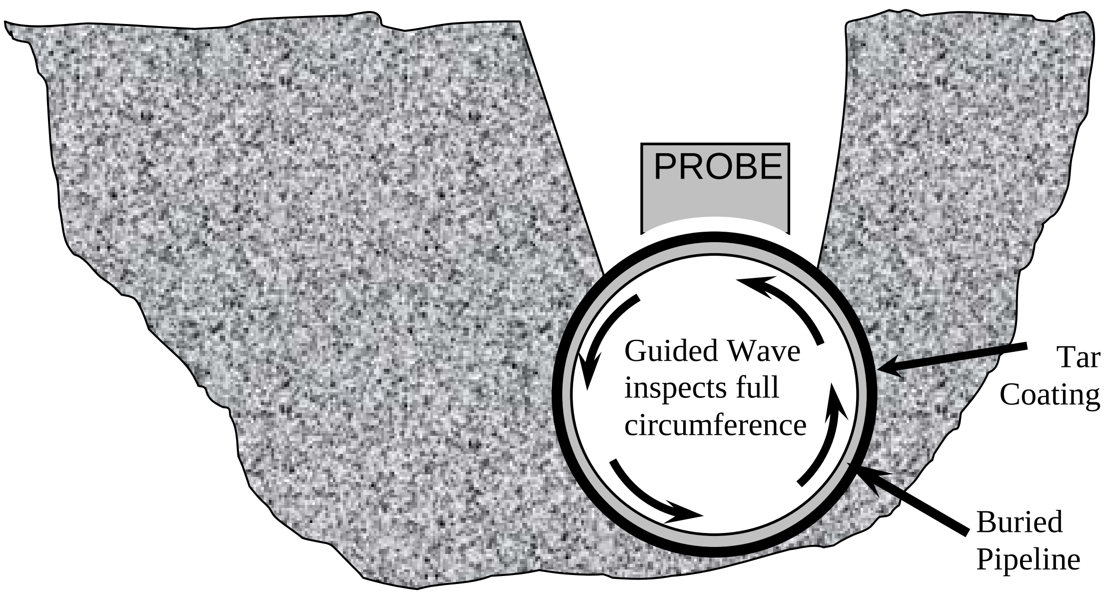

Figure 1: Full body inspection from the top surface of the pipe. There is no need to remove good coating or fully excavate the pipe to perform a complete inspection.

COMMERCIAL SUCCESSES:

1. During the beginning of this R&D Project, in August of 2006, there was a major petroleum line in Prudhoe Bay Alaska shut down due to internal pitting corrosion. The 34” oil transit line was responsible for approximately three percent (3%) of the petroleum supply to the lower 48 states. This shutdown immediately became highly visible to the environmental groups, jurisdictional authorities and even the national media. Approximately 10 miles of insulated pipe had to be inspected for internal corrosion as soon as possible. Any applicable NDE technique was mobilized to attach this monumental task. The USDOT and DOE became involved to evaluate the effectiveness of these techniques because conventional Ultrasonic Testing, UT, and Automated UT, AUT, was simply too slow to be practical. To make matters worse most of this line was

insulated which required a significant effort to remove the coating and prepare the surface sufficiently for conventional UT. The Non-Contact EMAT CIRC tool was prepared to inspect this pipe through the tape wrapped coating and after extensive qualifications by the DOT and DOE the method was determined to be the "Prefered Screening Tool for Coated Pipelines". The Sonic Sensors EMAT CIRC tools were the only EMAT tools and they completed the entire exam before Thanksgiving of 2006 where the extreme cold of the North Slope posed great hardships for the equipment and operators. The inspection performance for this pipeline required a 100% probability of detection, POD, for a 50% deep pit. The EMAT CIRC tool proved a 100% POD for a 25% deep pit in uncoated pipe and a 30% deep pit in the tape wrapped coated pipe.

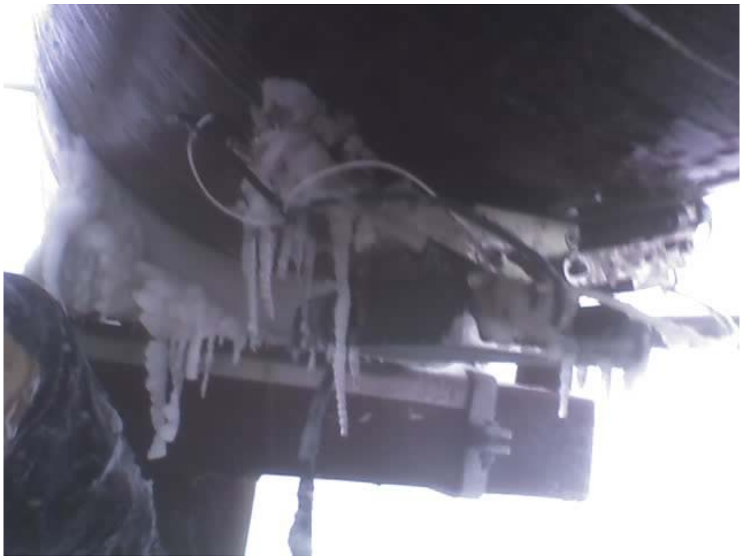

Figure 2: EMAT CIRC Scanner with icicles scanning the bottom of the 34" oil transit line in Prudhoe Bay Alaska.

2. FIELD TRIAL was performed on December 15th 2006 on a section of a 24 inch buried pipeline which has been replaced due to internal corrosion. A portion of this corroded pipe was preserved, with the coating intact, to evaluate the through-coating inspection tool. There were three clusters of pitting corrosion present in this pipe sample. The clusters were approximately 1.5 inches in diameter, and were 20%, 40% and 70% deep. All of these indications were detected and sized relatively to each other from a single scan across the top surface of the pipe, on top of the bitumen tar wrapped coating. The success of this inspection qualification, on the known pipe sample, justified some additional inspections on some partially excavated active crude oil pipelines. Five of these 16 inch lines were inspected by simply brushing the dirt off the top surface of the bitumen tar wrapped surface. No indications were detected on four of the five lines. The fifth line was a dead leg, without flow, and indications were found for most of its length. The indications were up to the 70% through wall pitting of the sample pipe for most of the pipe length. The pipe closest to the Tee joint was clear of indications. The indications grew larger and more numerous away from the Tee joint. Apparently the lack of flow in this leg provided a preferential environment for internal corrosion.

Assuming the sample pipe to be equivalent to the partially excavated active pipelines with the same coatings; the blind field test on 16” active pipes could be qualified to a detection limit of 20% corrosion.

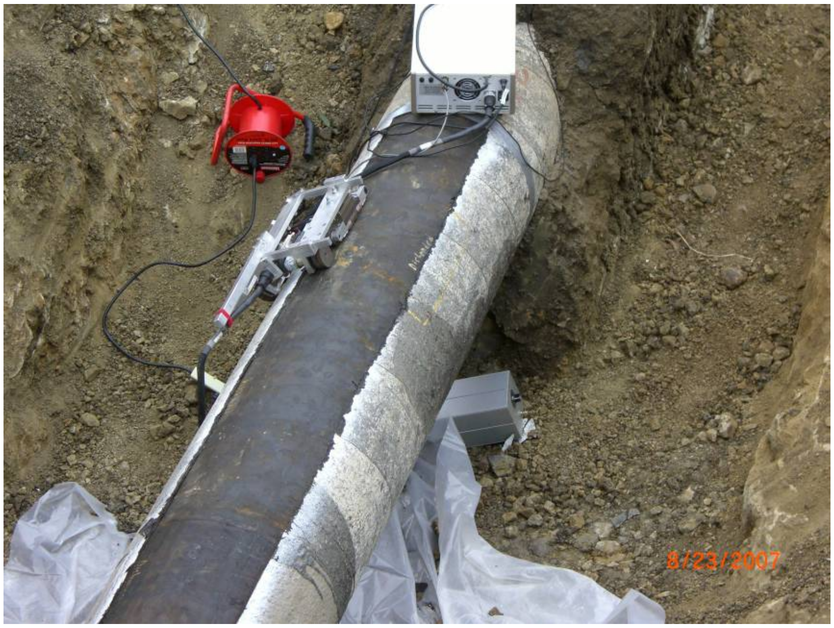

Figure 3: Field demonstration at an ECDA dig on a 20” asphalt coated pipe. The scanner is shown half on the ¼” coating and half on the bare pipe. The inspection instrument is on the pipe at the top of the photo.

3. OFFICIAL FIELD TRIAL AND DEMONSTRATION

Latter in the project, the tool was further advanced into two variants, a thin coating tool capable of inspection of coatings less than 1/8 inch thick and a large lift-off tool capable of coatings over ½ inch thick. At the end of the first year of this project on the 23rd of August 2007, these tools were demonstrated in a field trial at an actual ECDA dig site.

This field demonstration was witnessed by participants from two gas pipeline operators, Pacific Gas and Electric (PG&E), Southern California Gas; a petroleum pipeline operator, Occidental Petroleum; and two EMAT Inspection Service providers, Spectrum Services and, QPro Technical Services.

A 20 inch pipeline was completely excavated exposing approximately 10 feet of the pipe. The asphalt coating was approximately ¼ inch thick and was too thick for the thin coating tool. A 12 inch wide strip of the coating was removed from the top surface of the pipe as shown in Figure 3. One scan was performed on the exposed bare metal surface of the pipe and the other scan was half on the coating and half on the bare pipe. The results of both scans were identical and effectively proved the pipe free of internal corrosion as well as external corrosion without removing the remaining 80% of the asphalt coating. There integrity of the coating was also evaluated and a previous coating repair 14 inches to one side and including the girth weld was bonded significantly better than the original coating. This was apparent on the scan.

The inspection was verified by removing the remainder of the coating exposing no visible external corrosion. The EMAT CIRC scan was repeated on the bare pipe for verification and no corrosion was detected but an insignificant "Stable" long seam variation was detected and visually confirmed.

This tool can be utilized for "Time Dependent" pipeline threats including corrosion and cracking as well as "Stable" as manufactured pipeline threats in the long seam or material defects in the body of the pipe. The tool is more sensitive when applied on bare pipe but the sensitivity is only slightly impaired by the presence of coatings less than 1/8 inch thick.

For coatings greater than 1/8 inch the large lift-off tool under development will be applicable. This tool was demonstrated in the lab on August 23, 2007 after the field demonstration. A scan was performed on a 6 inch schedule 40 pipe with Densotherm hot applied tar tape wrapped coating. The total lift-off of the coating and the transducer was about 3/8 inch. The tape wrapped sample had simulated corrosion thin areas of 65%, 55%, 25%, 11%, and 6% machined into the surface. All of these thin areas could be detected on the display. This new tool under development shows a near linear response to depth of wall loss which suggests possible quantitative capabilities.

This large lift-off tool is expected to provide significant cost savings as an inspection tool for thick asphalt coated pipes or other thick irregular coating materials. Perhaps the greatest advantage of this tool will be ability qualify a pipe AND it's coating, without disturbing the coating or completely excavating the pipe. The cost savings of minimizing the size and depth of a hole can be substantial when the dig is in a populated area or on a busy street, or, in the case of California, the dig site may disturb a red legged frog or spotted salamander habitat.

These are important considerations for the pipeline operator in high population density areas such as Los Angeles, San Francisco, New York or much of the east coast. The needs of the pipeline owner/operator on the populated east and west coast are much more demanding than the sparsely populated central United States. High Consequence areas require a high level of inspection scrutiny whose inspection costs may be dwarfed by the permitting costs for an excavation. Minimizing the dig requirements will result in minimizing costs and environmental impacts.

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