Northeast GAS ASSOCIATION

NYSEARCH

Technology Brief

Liquid Cleaning of Unpiggable Pipelines

Description: **To enhance the Explorer 20/26 series robots when liquid is present in unpiggable live pipelines. This technology will ultimately enhance Explorer's ability to conduct In-Line Inspections (ILI) when encountering liquids.**

Status: **Development and testing is underway.**

BENEFITS

The objective of the Explorer 20/26 liquid cleaning project is to understand what is required to increase the liquid capability of the Explorer robot. The Explorer robot is intended, through this project to traverse and scan through liquid in pipelines with natural gas flow. Thus, we are working to further enhance the capable of driving and scanning through large and small amounts of liquids. Based on a detailed technology assessment, in 2019 it was determined that the Explorer is better suited to drive through the liquid versus cleaning the liquid in pipelines. This is a more cost-effective solution to managing liquid in live natural gas pipelines.

The new capability would enable the Explorer 20/26 robot to conduct inspections where previously, in those cases, the inspection job was halted because there was liquid present in the pipeline.

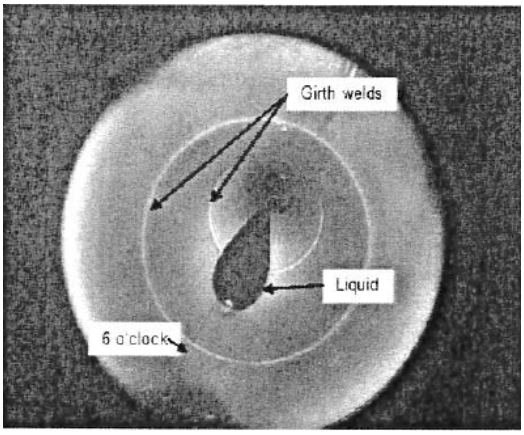

Figure 1: Accumulated liquids during an inspection

BACKGROUND

Previously, the Explorer robots could handle a small amount of liquid in the pipeline during an inspection. However, even the small amount of liquid can potentially damage the sensors and negatively impact the sensors' readings. When there is enough liquid in the pipeline, it can result in the Explorer robot not being able to complete a scan. Thus, the inspection would be less efficient and timely. Then, other liquid extraction methods would be investigated and implemented, and the robot would be introduced back into the live pipeline to continue the scan.

Previously NYSEARCH funded and developed a cleaning tool for dry debris for the Explorer 20/26 robot. The cleaning tool was extensively tested in the lab and in the field. The cleaning tool demonstrated a capability for removing dry debris and only small amounts of liquid. Therefore, the additional capability to remove large amounts of liquid was seen as a separate initiative.

It is noted that the amount of commercial inspections where the Explorer robot has encountered liquid has been minimal. When the data was analyzed, the infrequency of encountering an impassible amount of liquid and the additional cost and logistics that were required indicated that the liquid cleaning design would not be a viable option.

TECHNICAL APPROACH

Currently, when encountering liquid, the Magnetic Flux Leakage (MFL) sensor is lifted to minimize the impact of the pooled liquid as the robot passes and the data is missed for that section. This project focuses on determining whether a liquid-resistant Explorer 20/26 robot can scan in these conditions.

Based on an extensive database of Explorer commercial jobs, the average amount of liquid was calculated to determine which components of the robot would be affected by liquid. With that information, the approach is to waterproof the sensors to assure effective scans through any amount of liquid.

The major components were tested for vulnerabilities. Liquid penetration tests and compressed air tests aided in discovery of the vulnerabilities. Liquid reactive paper was used to discover leak paths. Once the vulnerabilities are fully established on the components, additional hardened prototypes are to be designed and retested.

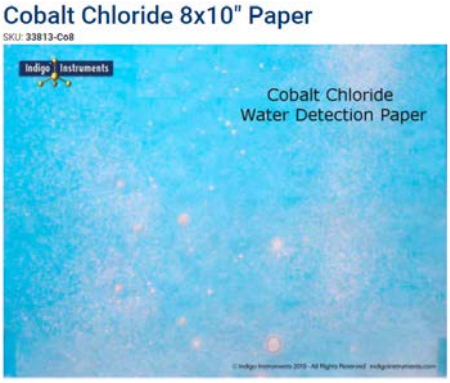

Figure 2: Liquid Reactive Paper

PROGRAM STATUS

The testing of the drive tracks and magnets (magbars) is complete and vulnerabilities have been established. Components such as face-to-face seals and bearing seals were tested simultaneously.

The results of the initial work are being analyzed and some retesting with alternative parameters is taking place. The results of the prototype testing will also be applied to the design to increase the liquid capability of the magbars and drive tracks.

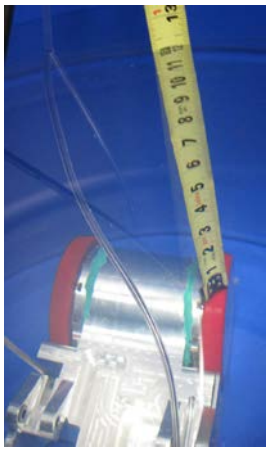

Figure 3: Drive Track – Liquid Penetration Test

In addition to the major components, a list of sealing methods has been generated for static sealing such as gaskets for surface to surface contact and dynamic sealing such as bearing seals.

Highlights

- Tool that can traverse through liquid in pipelines
- Tool that can continue scanning while liquid is present for more coverage
- Goal is to improve efficiency and reduce inspection cost

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