Northeast GAS ASSOCIATION

NYSEARCH

Technology Brief

Cleaning Unpiggable Pipelines

Description: **This project enables Explorer 20/26 series robots to clean unpiggable pipelines. This technology ultimately enhances Explorer's ability to conduct In-Line Inspections (ILI) for corrosion, cracks, mechanical damage, hardness, and metal loss.**

Status: **Project complete. A separate project to develop a cleaning tool to address liquids is underway.**

BENEFITS

This objective of this project is to develop the first technology able to clean unpiggable natural gas pipelines. Explorer 20/26 will be outfitted with a cleaning module that will enable lines to be cleaned under live conditions prior to inspection. Due to Explorer's modular design, this module is easily adaptable for integration with the robot. The subsequent inspection of clean lines will result in increased accuracy and yield superior results over a pipe that buildup and debris in various areas.

BACKGROUND

Beginning in 2010, NYSEARCH commercialized a full range of Explorer robotic platforms to conduct ILI of unpiggable pipelines. Explorer operates under live, pressurized pipeline conditions to detect metal loss, mechanical damage, and other features of interest to operators.

Figure 1: Launching an Explorer robot

In some cases, a clean pipe wall is important for inline inspection due to the close proximity of sensors to the wall. Debris in the line can negatively impact ILI operations by forcing corrosion and crack sensors away from the wall, resulting in an inadequate saturation of the magnetic field in the wall. As a result, the quality of data collected in that region can become compromised. Not only is a clean pipe desirable to conduct complete inspections, but it also increases the reliability and efficiencies in gas throughput, which result in a cost savings for the operator.

Cleaning a pipeline is a multi-step process, which involves scraping or brushing debris away from the pipe wall, transporting the debris through the pipeline, removing the debris, and returning clean gas back to the pipeline.

TECHNICAL APPROACH

This technical effort was initiated with a feasibility study to determine whether or not it was practical to develop a tool for integration with Explorer for cleaning unpiggable pipelines. The study indicated that such a design was feasible, with no/low flow conditions presenting significantly greater challenges than pipelines with medium/high flow. The study also indicated that handling dry debris and small amounts of liquids would be less complex than a tool to address primarily liquids.

This focus of this project is to develop a tool for use in pipelines with medium/high flow conditions. The report also identified the need to design efficient flow paths around the tool to optimize the suspension of debris in front of the tool, rather than push it along the bottom of the pipe. As with the other Explorer robots, the robot equipped with the cleaning tool is launched via a hot tap into the pipeline.

To initiate operations, the cleaning tool is inserted

upstream of the pipe segment to be cleaned. Once the robot reaches the area to be cleaned, it deploys its brushes (as seen in Figure 1) against the wall and continues to move in the direction of gas flow. The deployed brush array creates a very slight pressure drop over the brushes, forming a jet of gas that propels the debris along the pipe in front of the robot. The robot, gas jet, and debris all move together in the direction of gas flow toward a gas-solid separator.

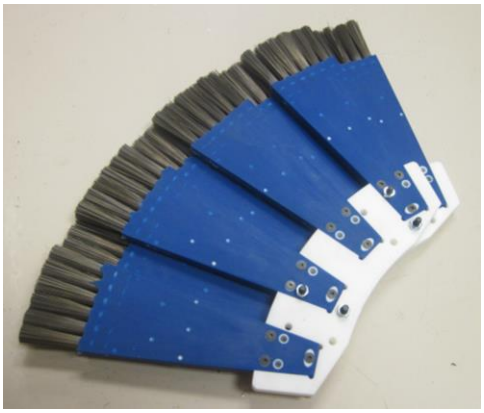

Figure 1: Section of prototype brush array

Gas flow is directed into the separator, where any debris/contaminants are removed from the gas. The clean gas is then returned to the pipeline, resulting in uninterrupted flow. In cases where a gas-solid separator is not located near the cleaning site, a portable filtration skid can be connected via a second hot tap in the line. In such an instance, a diverter is used to redirect gas flow into the filtration skid, where the gas is cleaned and returned to the pipeline. Figure 2 shows images of the same segment of pipe both before and after cleaning operations.

Figure 2: Explorer 20/26 with cleaning tool

The amount of debris in the line, number of passes to remove the debris, and length of pipe to be cleaned all affect power consumption onboard the robot. In order to maximize inspection time and reduce complexity of operations, the robot can be recharged while it is in the pipe.

PROGRAM STATUS

Due to its operational flexibility and effectiveness in conducting ILI, NYSEARCH sought to leverage Explorer's success and expand the platform's capabilities to include the cleaning of unpiggable pipelines.

The cleaning tool has been developed and integrated onto EXP 20/26. It also has been extensively tested in the laboratory and tested in a live, pressurized pipeline. Field testing demonstrated the cleaning tool's ability to remove both small amounts of liquid as well as solid debris from pipelines. The testing was deemed successful and has led to the development of a cleaning tool to remove large amounts of liquid from a pipeline. Revisions to this system are planned based upon the results of that separate project.

While the cleaning module was developed for EXP 20/26, the design can be adapted and applied across the remainder of the EXP family of robots.

Highlights

Clean live, unpiggable pipelines

- Enhanced inspection capabilities
- Greater efficiency and throughput
- Increased reliability

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