

## Visual Inspection of Two (2) Inch Plastic Pipe

**Description:** A program to develop a new advanced platform that carries a camera, which is capable of navigating two (2) inch polyethylene pipelines and associated features to detect degradation and delamination.

**Status:** Feasibility proven. Detailed design to be finalized.

### BENEFITS

The development of new non-destructive evaluation (NDE) technologies to inspect natural gas pipelines has been a focus of the NYSEARCH consortium, and its members have invested considerable resources in research, development, and demonstration activities of these technologies to provide pipeline operators with a plethora of solutions to efficiently and effectively inspect natural gas pipelines. The benefit of this project is that it provides a new platform capable of visually inspecting two (2) inch polyethylene (PE) pipe internally to identify internal defects, including potential degradation and delamination, which has been documented to occur in PE pipe installed between 1978 and 1999 that has been subjected to elevated temperature conditions such as those experienced in the south and the desert southwest or the United States. This In-Line Inspection (ILI) tool will allow internal inspection of two (2) inch PE pipe over long distances and under live conditions. This new design will allow the systematic inspection of PE pipes, sometimes in service for over (50) years and provide detailed information over longer inspection distances than what is presently possible. This additional information will provide predictive analytics on fusions on PE pipe as well as straight sections to aid asset management decisions and to expand the proactive pipeline safety management culture that the gas industry wants to advance. Increased range and simplicity will avail more inspections in a range of PE pipes.

### BACKGROUND

Medium and high density PE pipe, MDPE and HDPE respectively, manufactured between 1979 and 1997, and installed in natural gas distribution systems between 1978 and 1999, was flagged in PHMSA's March 2012 Advisory Bulletin as being a potential pipeline integrity risk because it was found to degrade when subjected to elevated temperatures such as those experienced in desert-like environments in the southwestern United States, namely Arizona and Nevada.

In November 2013 Performance Pipe, a division of Chevron Phillips Chemical Company and the manufacturer of the pipe, published a report reporting on the findings of their testing and engineering analysis and this report recommended that that *“operators in the highest temperature regions, such as the desert southwest and southern most regions of the United States may want to inspect and sample a broader portion of their system in conjunction with the risk ranking.”*

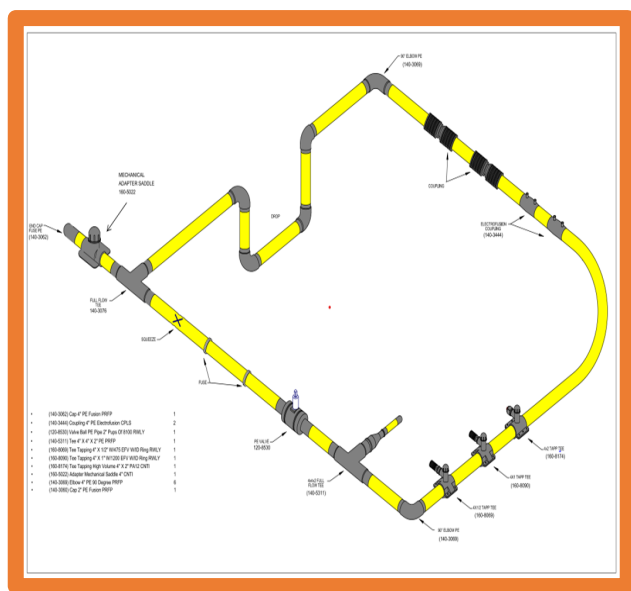


**Figure 1: Two (2) Inch PE Pipe Test Layout**

A small number of efforts have tried to identify technologies that would be able to inspect from the inside or the outside of the pipe with very limited success. After investigating acoustic and ultrasonic technologies (GE USM-Go+ system), both were tried, and proven to be impractical for the two (2) inch PE pipe inspection application. Camera technologies were also tried for internal use, but were abandoned as they provided very limited operational range in addition to facing other operational issues, such as causing substantial damage to the internal surface of the PE pipe.

Therefore, the industry is in need of a tool that will allow live insertion of a sensing element and a camera to be able to detect degradation and delamination in MDPE and HDPE, which is able to travel relatively

long distances and negotiate the obstacles encountered in the typical distribution network, such as bends and tees. Ideally, the new tool would be capable of operating without a tether and be controlled by the operator wirelessly while having enough power to provide for a long range. Over the past 15 years, a system with such capabilities, Explorer, was successfully developed by NYSEARCH/NGA with co-funding from PHMSA for metallic transmission natural gas pipelines. Through a successful feasibility study conducted in 2022 for PE pipe, a new design for a robotics platform with a sensory system was selected for further development and eventual commercialization for pipe sizes of 4" and greater, while a camera-only system was selected for 2-inch PE pipes.



**Figure 2: Two (2) Inch PE Pipe Layout**

## TECHNICAL APPROACH

This project is a continuation of the earlier NYSEARCH project “Feasibility Study for a Robotic Platform and Suite of Sensors to Identify Degradation in Non-Conforming Driscopipe® 8000” and is focused on utilizing the results from the aforementioned study, which identified robotic technologies equipped with sensors capable of detecting degradation and delamination in non-conforming Driscopipe® 8000 (NCDP) through live in-line field inspection, to specifically focus on inspection of two (2) inch MDPE and HDPE.

The objective of this project is to design, build, and lab test a new platform concept for the visual inspection of two (2) inch plastic pipe under live conditions and focusing on long-range operation. A systematic study of sensory technologies for the detection of defects in 2”

pipes was carried out and it was determined that no non-destructive evaluation technologies exist that could fit in the extremely limited physical space available on such a small system; as a result the only sensory technology onboard will be a camera. This project has taken the selected concept from the precursory project, mentioned above, and performed a detailed design and development of a lab test setup. Detailed design of a prototype engineering system has been completed including a tether for stabilization, speed control, and retrieval capability, including an on-board battery, and has been reviewed by funders.

Next steps are to finalize the design, and begin manufacturing components and assemble the engineering prototype for system testing and baseline performance evaluation. Once testing is complete and baselines are set, funders will review and move forward with commercial prototype building and field testing. Additional phases towards commercialization will follow.

This work was conducted by a team consisting of NYSEARCH; Invodane Engineering/Intero (IE), of Toronto, Ontario, Canada, and the robotics platform developer.

## PROGRAM STATUS

This project has successfully developed and proven a new concept for an advanced visual inspection system for two (2) inch MDPE and HDPE pipes that could enhance the safety and operational efficiencies of the natural gas distribution network. Additional phases are needed to design, test, and commercialize the technology for the benefit of the natural gas industry and the public.

### Highlights

- Successfully developed a concept for a new visual inspection platform for 2-inch PE pipe.
- Early-stage test results show commercialization feasibility.

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