Report Title:	**Development of a Remote External Repair Tool for Damaged or Defective Polyethylene Pipe**
Type of Report:	**Technology Status Assessment**
Period of Report:	**November 12, 2003**
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Report Issue Date:	**November 2003**
DOE Award Number:	**DE-FC26-03NT41879**
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DISCLAIMER

Remote External Repair Tool for Damaged or Defective Polyethylene (PE) Pipe

Technology Status Assessment

BACKGROUND

The use of polyethylene (PE) pipe for natural gas transmission and distribution within the United States has been steadily growing over the past decade and currently accounts for a majority of America's natural gas distribution network. It is very important that the natural gas delivery system remain safe, reliable, and operate efficiently. The current delivery system consists of 650 thousand miles of underground plastic piping that has been in service for over 30 years. The American Gas Association (AGA) report, "Fueling the Future" (1), predicts that natural gas consumption will grow as much as 50 percent over the next 20 years. To meet this demand, the number of miles of distribution and transmission polyethylene (PE) pipe will increase (**See Figure 1**). According to the Department of Energy reports (2) there exists a special need for improved tools for construction, maintenance, and repair of PE pipe to keep up with the expected growth.

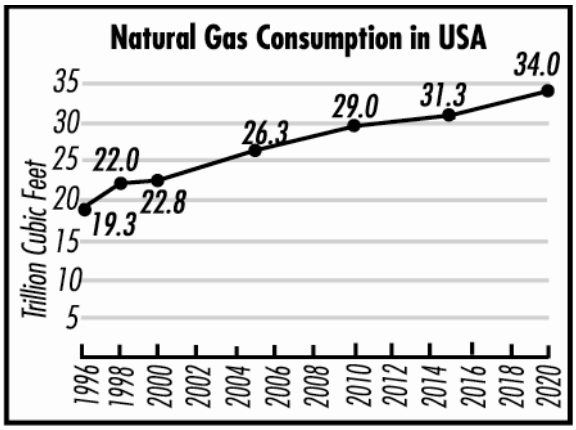

Figure 1

TECHNOLOGY BEING DEVELOPED

The proposed project will develop an innovative new methodology and tool that will allow workers to externally repair damage or defects on polyethylene (PE) pipe by applying a repair patch over the compromised area. The innovation employs a mechanical tool to apply a patch that is chemically bonded to the PE pipe, and covers the damaged area.

The mechanical basis for the proposed tool is a jaw design, open on the end, curved to fit the contour of the pipe as it closes. The open jaw configuration of the repair tool, with minimum excavation under the pipe, will allow the operator to fully enclose the damaged section of pipe with the repair patch, stopping the flow of gas through the damaged pipe wall.

This new repair tool will operate remotely from the "top-down", without the need to fasten the device under the pipe. The proposed new remote repair tool will dramatically improve the safety and repair procedures because only one operation and one excavation will be required. This will eliminate the need for additional excavations. The repair tool will be portable and lightweight, allowing for single person operation. It will operate in

difficult and keyhole access situations without the need for squeeze-off (**See Figure 2**). Most importantly, the proposed remote repair tool enhances worker safety by keeping the operator out of the trench and away from the leaking natural gas. Time and labor savings due to reduced excavation and ease of application are expected to be significant.

Figure 2

COMPETING TECHNOLOGIES

Mechanical or Electrofusion Couplings (3)

Mechanical or electrofusion couplings are frequently used for replacement of damaged plastic pipe segments. In these instances the gas flow is stopped, the damaged section of pipe is cut out and replaced with a new section using two couplings or a fusion joint and a coupling. These methods require substantial excavation and the necessity of shutting down a portion of the natural gas grid.

Bonded Patch or Full Encirclement Sleeve (3)

A bonded patch or full encirclement sleeve can be applied on a damaged section of pipe. The patch or sleeve must be at least the same wall thickness, grade, and material as the damaged pipe. These methods also require large excavations and shutting off the gas supply.

Excess Flow Valves (3)

Excess flow valves may be installed in service lines. These are typically installed on single service lines. They are not effective on the larger transmission lines.

Current Gas Industry Repair Method (4)

If a pipeline of greater than ¾-inch diameter is damaged more than 10% of the wall thickness, or if the pipe wall has been fully penetrated, current procedures for repairing buried natural gas pipe require excavations upstream and downstream from the rupture and isolation of the damaged section of pipe by "squeezing off" the flow of gas on both sides of the damage. Then the damaged section of pipe is excavated and cut out of the line, and replaced with a mechanical repair fitting or a new segment using either two couplings or a fusion joint and a coupling. These repair procedures are time consuming and expensive.

Electrofusion Repair Sleeve (5, 6)

A sleeve with a PE core is bolted onto the damaged section of pipe; then, using built-in electrofusion equipment, the sleeve is permanently fused to the external surface of the damaged PE pipe. The repair sleeves are single-use only devices that must be manually fitted around the pipe and bolted on by hand. This method is commercially available in Europe though, not currently approved for use in the U.S.

ANTICIPATED BENEFITS OF THE PROPOSED TECHNOLOGY

The proposed repair tool technology will operate remotely from the ground surface (**See Figure 2**) keeping the operator out of the trench, away from the danger of cave-in and flowing natural gas. The safety of the utility operator is the most important benefit of this proposed repair tool. Another key benefit of the repair tool is the ability to operate the tool in "keyhole" excavations. These types of excavations minimize the impact to the surrounding environment and disruption to the neighborhood.

Maintenance and repair costs will be significantly lowered by the increased efficiency of the new tool during pipe repair operations. Current standard operating procedures for repairing natural gas pipelines require hours to accomplish. The proposed repair tool will allow the natural gas operator to repair the PE pipe at the site of the damage without additional excavation, and without shutting off the gas supply and interrupting the natural gas distribution to homes and businesses. By perfecting this repair process, thousands of pipe leaks can be repaired at a fraction of the current remediation cost that is estimated at $3.5 billion per year (7).

Recent advancements in excavation techniques using keyhole technology lessen the impact to the environment and society. Repair tools must now be developed to reduce costs associated with pipe repairs in these situations.

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