BRIDGES TO NO REPAIR

By: Mario Carbone, Progressive Pipeline Management

Since 2002, Progressive Pipeline Management (PPM) has been renewing natural gas pipelines in challenging situations including highways, bridges, railroad lines and environmentally sensitive areas. We use the Starline® Cured-in-place-lining, which is a proven, cost effective trenchless technology that extends the life of a pipeline by 100 years.

In 30 years, I haven't met a utility that didn't have pipelines along bridges in their inventory. As bridges age, so do the pipelines. Like us, they are getting older. Over forty percent of the bridges in the US are over fifty years old. In the Northeast, gas pipelines and bridges are typically 75 - 100 years old.

As they age, pipelines are vulnerable to corrosion. Leaks come from corrosion, which is accelerated in pipelines along bridges. Repair of a gas pipeline alongside a bridge or overpass is nothing like a repair in a typical roadway where a pipeline is buried. Let's say a leak is identified in the abutment wall. Go-to methods are to put a sleeve on or to remove the pipe from the abutment wall and replace the piece of pipe. Here's the dilemma. The owner of the bridge will never allow that. If you can't disturb the pipe on the bridge, or cut and cap the main, there are no viable alternatives.

Leaking pipelines on bridges cannot be repaired using conventional methods of replacing the pipe. There is another way that has been around for 30 years. Cured-in-place-lining is a proven and cost effective way to repair pipelines without disturbing the bridge.

WHY ARE PIPELINES ON BRIDGE CROSSINGS SO DIFFICULT TO REPAIR?

Pipelines run under or alongside and traverse the bridge's abutment walls. The position of some of these gas pipelines places them in a problematic location as they are mostly hung under or alongside the bridge structure, limiting access to the pipeline. In some cases, and the most convenient, the pipeline is resting on top of the structure completely exposed except for where it re-enters the road or offsets into the abutment walls. Most of these bridge or overpass crossings place the pipeline through the concrete abutment wall of the structure, either with a protective sleeve, or in some cases without a sleeve.

Bridges are highly susceptible to the elements. Wind, salt and extreme temperatures accelerate corrosion, which is the reoccurring issue, especially where the hangers supporting the pipeline make contact with the gas-carrying pipe. The greatest corrosion concerns are within the abutment wall itself, where the concrete accelerates the localized corrosion. The pipeline is weakened at that juncture and in most cases a gas leak is present. Excessive corrosion of the pipeline where the pipe enters the abutment wall of the bridge cannot be repaired without removing the pipe.

Figure A. Bridge with pipeline hanging under bridge

Figure B. Bridge with pipeline alongside

Figure C. Pipeline under bridge going towards abutment

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Let's say a manager in charge of a bridge sends the leak truck out to investigate, and decides that a section needs to be replaced. Here's where the nightmare begins. Pipelines at bridge crossings require multiple levels of approvals, and layers of restrictions, from

"CIPL IS THE RIGHT CHOICE AS AN ALTERNATIVE TO CONVENTIONAL MAIN REPLACEMENT GIVEN THE LOWER COSTS AND 100-YEAR SERVICE LIFE. BRIDGES, ROADWAYS WITH HIGH RESTORATION COSTS, HISTORICAL AREAS, AND RAILROAD CROSSINGS ALL MAKE CIPL THE LOGICAL CHOICE."

- CASEY GIAMBRONE, VICE PRESIDENT, PROGRESSIVE PIPELINE MANAGEMENT

the owner and regulators. Bridges are owned by municipalities or railroads, so the utility is limited to what is permitted by these owners. Traditional replacement presents utilities with multiple engineering hurdles to overcome.

When a bridge or crossing is functioning, the owners are not open to a utility coming in and messing with the pipeline. When a bridge is in need of repairs, there is no way the owner will let anyone near it. Existing pipelines are grandfathered into the bridge, but any replacement pipe or hanger is not. The structure of the bridge may or may not support a new pipe and the owner won't take a chance with it.

In addition to owner permissions, there are regulator and Department of Transportation (DOT) approvals and inspections. Engineering designs have to be submitted and approved to the bridge owner, DOT and city/county regulators before any traditional replacement can be completed. Hangers that support the pipeline need to be replaced with new hangers of approved designs, per owner's SOP. Re-engineering pipe supports and hangers, or attempting to remove the old corroded pipe from the abutment wall, are cost prohibitive methods, and in most cases simply not allowed. Even a simple change in hangers can sometimes make the project a no-go.

Removing the pipe that is nestled in an abutment wall is an extremely costly and difficult process that affects the structure of the bridge. The local municipalities or owners of the bridge will not allow the replacement of the pipeline, especially where it enters and exits the abutment wall of the bridge structure. A bridge owner will never permit a utility or contractor to drill through the foundation of the abutment wall to put a pipe in. If they were to gain permission, the equipment, insurance and safety protocols required would be cost prohibitive.

The red tape and headaches that come with trying to use conventional replacement lead to months and months of dead ends. All the while the leak is still there and getting worse. This is what is meant by "Bridges to No Repair."

HOW BIG IS THE BRIDGE PROBLEM?

There are more than 614,387 suspension bridges in the U.S. Forty percent are 50 years or older. Pennsylvania has the third-largest number of bridges in the nation with 25,000 state-owned bridges, some dating back to 1929. On top of that are the millions of overpasses that cross creeks, highways or railroad tracks. These are still bridges although not as iconic as the Brooklyn Bridge. The majority have utilities, since pipelines have to go under or over the pass.

CURED IN PLACE LINING A SOLUTION FOR BRIDGE CROSSINGS

There is a simple solution to the headaches that come with "Bridges to no Repair". Reconditioning the pipeline using Cured-in-Place Lining (CIPL) reinforces the pipeline within the abutment wall without disturbing the pipeline or the structure of the bridge. The first step is to review the drawings of where the pipe connects to the road. The process is done using two excavation points at the beginning and ending points where the liner is inserted. These excavation pits are done outside or beyond the limits of the bridge. We cut and cap the main and line it from these two points.

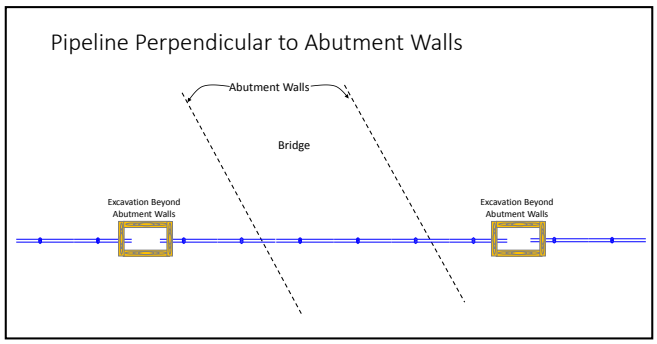

Figure D. CIPL process takes place outside the limits of the bridge

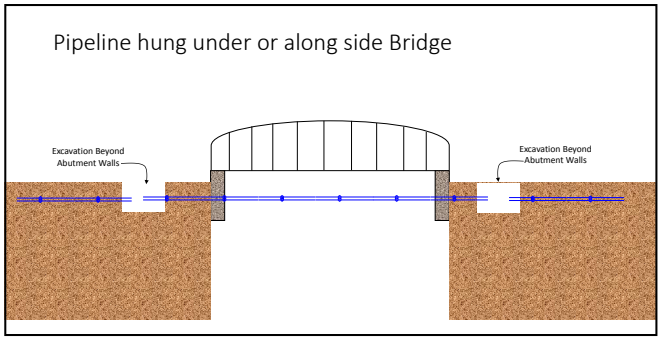

Figure E. Same process if the pipeline hangs under or alongside the bridge

Figure F. SRS liner prep

Figure G. PPM crew installing SRS sleeve and PVC pipe between abutment wall and gas main

Figure H. Interior of pipeline with SRS installed at the bridge abutment

Leaving the pipeline in place and repairing it using CIPL falls within "grandfathering" guidelines, thus avoiding the need for total replacement. CIPL is far less expensive than replacement, and in most cases is the only viable option.

CARBON FIBER STRUCTURAL REINFORCEMENT SLEEVES (SRS) IDEAL FOR ABUTMENTS

PPM developed an innovative solution that prevents the need for the removal or excavation of a pipeline. Installing a structural reinforcement sleeve (SRS) has been a choice of gas utilities throughout the industry for this purpose. The carbon fiber SRS reinforces the corroded pipe with a carbon fiber sleeve without the need to remove the pipe. The SRS has been tested at pressures to 250 PSI and approved by the Gas Technology Institute for its strength, durability and compatibility with PPM's Starline CIPL product. This innovative approach is accomplished by installing a Carbon Fiber sleeve into the gas carrying pipeline directly at the bridge abutment wall. PPM's SRS sleeves are made of a high strength carbon fiber laminate with a glass outer skin, and are installed robotically into the pipeline. The laminate composite material and glass outer coating prevent corrosion.

The carbon fiber material bonds to the interior of the pipeline, and improves the pipe's integrity at the position of the installation. While each project is unique, carbon fiber SRS can save utilities as much as $500,000 per project by preventing future corrosion and eliminating the need for costly additional excavations and pipe work.

During a 12-inch rehabilitation project in East Orange NJ, the pipeline went directly through the bridge's concrete abutment wall. As shown in Figure G, the crew installed the SRS in the abutment wall, with temporary PVC piping between the 12-inch gas main and abutment wall. After lining, the PVC pipe was removed and the utility re-installed the expansion joint at that point.

Figure H shows the SRS sleeve and PVC pipe successfully installed between the abutment wall and wrought iron main. The liner has already been installed in main. As noted, this section was cut out and the utility re-installed an expansion joint at that point.

CURED-IN-PLACE-LINING PROCESS

Whether on a bridge or under a highway, the CIPL lining process follows the same steps, with the entire process taking just a couple of days. After the sending and receiving pits are excavated, the first step requires a pre-clean CCTV inspection. Robotic cameras confirm the pipeline geometries, check for anomalies and protrusions, and assess the overall internal condition of the host pipe. The next step involves a thorough internal surface preparation using robotic sandblasting and subsequent recovery of the leftover sand and debris.

Adhesive is mixed and prepared and added to the liner. The liner is loaded into the Starline drum, and then inverted and inserted into the pipe. The Starline® liners are a seamless / joint-less circular woven fabric-hose made of polyester yarns and a plastic coating (PU/PE) which is bonded as inner liner into the

Figure I. PPM team members load the liner into the Starline pressure drum prior to inversion in the excavation pit

Figure J. PPM Cured-in-place-liner inversion in process

host pipe using a solvent-free two-component adhesive custom fit to each project. After the liner cures, it is cut out on both ends flush with the end of the pipe.

The CCTV camera is inserted again to ensure it looks good. The final step is a pressure test and the gas is turned back on.

During the entire process, the host pipe remains in the bridge, with no interference at all with the bridge structure. All the action happens at the excavation points. The owner will not have issues with a process that happens outside his domain. The complete reconditioning of the entire segment, plus the SRS reinforcement of the pipeline at the abutment wall, is typically completed within a few days. Curing times vary depending on the ambient temperatures. Reconditioning a pipeline will add an additional 100 years of reliable life to the old existing pipeline including the reinforcement of the pipeline at the abutment walls.

The entire lining process does not disturb the pipeline, will not affect the supporting hangers, or disturb the pipeline within the abutment wall. Cured-in-place-lining plus the Carbon Fiber SRS is a perfect marriage and ideal solution to expensive, and often impossible, repairs within bridge pipelines.

"CIPL is the right choice as an alternative to conventional main replacement given the lower costs and 100-year service life. Bridges, roadways with high restoration costs, historical areas, and railroad crossings all make CIPL the logical choice." Casey Giambrone, Vice President, Progressive PIpeline Management.

BACKED BY $15M INDEPENDENT TESTING

Extensive R & D and independent testing on rehabilitated pipe with the Starline technology has confirmed a service life of 100-plus years. The natural gas industry has invested over $15 million in testing of the liner and its capabilities at such esteemed institutions as Cornell University, Battelle Labs, ASTM, NYSEARCH and PHMSA. PPM now has liners capable of installation at a maximum allowable operating pressure of 99 PSI, 180 PSI, 250 PSI and soon, 450 PSI.

PPM holds the exclusive license for North America for the Starline® liner. PPM has decades of specialized expertise associated with gas pipeline related issues, including lining and trenchless technology. This depth of understanding and engineering of the entire project is applied from inception to completion. The PPM team and crews have collaborated with industry experts at leading utilities and institutions. Together, they have developed and tested innovative technology that will extend the life of gas infrastructure for generations to come. Through advanced robotics and offering Broadband Electromagnetic Inspection technology, PPM is taking pipeline integrity management into the 21st century.

"The beauty of CIPL is that it not only addresses the leaks that our customers have identified, but eliminates the ones that have not been identified. The most dangerous leaks in the industry are the ones you don't know about."

-Casey Giambrone, Vice President, Progressive PIpeline Management.

ABOUT THE AUTHOR:

***Mario Carbone's** ingenuity and perseverance define his leadership. His 46 years in the gas pipeline industry include 32 years in design, maintenance and construction with Brooklyn Union Gas/KeySpan Energy and ten years as the senior manager for gas research and development with KeySpan Energy. Mario's decades of experience enable PPM to design, develop and test new technologies and robotics on demand while complying with required industry standards. As a respected authority on innovative trenchless techniques, he has frequently been a speaker at industry events.*