FIBER REINFORCED POLYMERS (FRP) AND CURED-IN-PLACE LINERS (CIPL)

– A Match Made in Heaven

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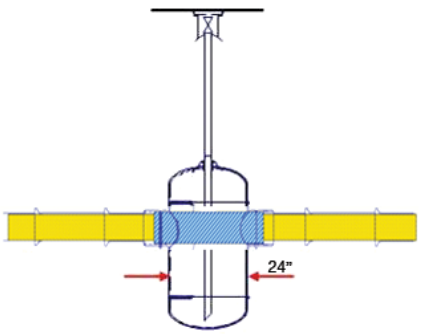
A strong odor of gas emanated from a RR right-of-way where an 8-inch cast iron main crossed under the tracks

Since 2010, Public Service Electric & Gas (PSE&G) has worked together closely with Progressive Pipeline Management (PPM) and Quake Wrap to pioneer the first use of FRP as a bridge to reinforce gaps in natural gas piping attributable to fittings (drip pots, abandoned tees, crosses, etc.), while doing CIPL renewal on segments of pipe with these fittings.

Previously, these fittings needed to be excavated, removed and replaced with steel before lining because the relatively long unsupported length of liner would inevitably fail over time. The time consuming and costly process involved in excavating removing and replacing these fittings discouraged the use of the trenchless CIPL renewal technique in these situations. Gaining access to such piping was also often extremely difficult because these fittings are frequently located under highways, railroads (RR), golf courses, newly paved areas, heavily trafficked commercial areas, etc.

Back in January 2011, at the time of the very first installation of FRP bridging a 24-inch gap in pipe due to a drip pot which had been used to collect fluids in the old gas manufacturing days (, the author had stated "the use of FRP in gas CIPL renewal applications was limited (only) by one's imagination". In fact, since then, the use of FRP in the CIPL renewal process has expanded to include internal reinforcement for corroded piping, acting as a secondary internal sleeve for pipe running through bridge abutment walls, and support for pipe running through casings at end point transition zones, where corrosion problems due to water entry are common.

Applications involving the use of FRP continue to evolve and a broken cast iron (CI) gas main operating at low pressure (approximately ¼ psig) located under a RR crossing in NJ in early 2017 presented a unique opportunity to bridge and reinforce



The first installation of FRP in a CIPL renewal of a gas main bridged a 24-inch gap in pipe due to a drip pot

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The 4-foot wide SRS was mounted on an expandable pig and pulled to location over the break

a circumferential break with a 4-foot wide FRP sleeve. This would be done prior to CIPL renewal of the entire 174-foot segment of 8-inch pipe, to complete a permanent repair.

In February, 2017 the complaint of a strong odor of gas was reported in the vicinity of Ellison Place and Madison Avenue, in Paterson, NJ near a RR crossing. After a comprehensive leak investigation, it was determined that the leak was emanating from a RR right-of-way (ROW) where an 8-inch diameter CI main crossed under the tracks. It was suspected that the crack was caused by non-uniform stresses on the main created by frost in the ground and prior excavation work performed by the RR authority to modernize and update the at-grade crossing.

The main was immediately cut and capped-off to stop the flow of leaking gas ensuring the area was safe. Before the use of FRP as part of the CIPL renewal application, the main would have been relayed using a jack and bore process. This would have required preparation and submission of design drawings by a PE, RR permitting, and ultimately, RR authority approval, a very time consuming and costly process which typically takes 6-8 months.

Fortunately, with extensive experience gained through the use of FRP for gas mains in a wide variety of gas applications going back to its first use in 2011, we were confident the break could be bridged with FRP acting as an internal structural reinforcement sleeve (SRS). The 4-foot wide SRS mounted on an expandable pig would be centered over the break and then the pig expanded to hold the FRP against the ID of the pipe until cured.

FRP has been previously used to bridge corrosion holes in pressure pipe

Circumferential break in main pre-cleaning

Extent of break was more evident post-cleaning

SRS in place before lining

CIPL installed through SRS

The SRS installation process involved wetting-out the nearly 13-foot long section of biaxial glass laminate material

Air was fed into the expandable pig from a compressor hose attached to the pig. This held the FRP against the ID of the pipe until cured

APPLICATIONS INVOLVING THE USE OF FRP CONTINUE TO EVOLVE

First, the lining contractor PPM, performed a CCTV inspection of the main to pinpoint the exact location of the break, and to determine if any other anomalies, protrusions, fittings, etc. were present that would obstruct the pig in placing the SRS. Fortunately, the main was verified as straight and contained no fittings preventing the 6-foot long pig from reaching the break.

The entire 174-foot section of main was then grit-blasted internally to a bright white metal finish while the debris-laden grit was simultaneously collected and contained using a vacuum truck. This material was eventually delivered to PSE&G's Environmental Department for analysis and proper disposal according to environmental regulations. After cleaning, the main was again CCTV inspected and the break was now considerably more evident and easier to see. Exact measurements to the break were taken from one end of the cut pipe and double-checked.

The SRS installation process involved wetting-out the nearly 13-foot long section of biaxial glass laminate material and tightly wrapping it onto an expandable pig using a two-part water repellent epoxy. The expandable bladder was protected from the epoxy by plastic wrap. After the final wrap, duct tape was used to prevent unwrapping, and a fishing line installed under the duct tape in order to cut through the duct tape once the pig was pulled to the location of the break, which was approximately 84 feet in from one end. Using a measuring tape attached to the rear of the pig extending to the sending pit, the pig was centered over the break. The fishing line was then pulled cutting the duct tape to allow the SRS to unroll and expand as air was fed into the expandable pig from a compressor hose attached to the pig.

Because the work started on a Friday the SRS cured over the weekend. On Monday, the pig was deflated and removed, followed with an additional CCTV inspection to confirm a successful installation. The entire 174-foot segment of 8-inch CL pipe was then lined by PPM using the Starline liner and then cured over a 2-day period. Once cured, the liner ends were trimmed flush with the host pipe and a final CCTV inspection was performed to ensure a quality installation. The renewed main was then successfully pressure-tested to 90 psig for one hour before it was gassed-in to restore the flow of gas underneath the RR crossing.

ABOUT THE AUTHOR:

George Ragula *is the Distribution Technology Manager at Public Service Electric & Gas (PSE&G) with over 40 years of experience in gas industry engineering, operations, construction, research/development/deployment and management. George is a noted authority on trenchless applications for the gas industry having spent 30 years specifically focused on trenchless. He received his B.S. in Mechanical Engineering from Polytechnic Institute of Brooklyn in New York. George is a past Chair of NASTT and serves on the NASTT No-Dig Show Program Committee. He also teaches several NASTT courses on various trenchless technology topics, including CIPL for the Gas Industry.*