BEM PIPELINE ASSESSMENT TECHNOLOGY GREENLIGHTS RAILROAD CROSSING

Use of Condition Assessment Technology for Ferrous Pipe Allows Project to Proceed

By: Casey Giambrone, Progressive Pipeline Management (PPM)

The ability to identify and measure the integrity of ferrous pipe walls provides critical data needed to determine the condition and integrity of an underground facility. PPM has invested in Broadband Electromagnetic Probe (BEM) to accurately assess the condition of pipelines and identify the degree of corrosion or graphitization. The technology proved to be valuable when a utility client needed to assess a section of a 20-inch cast iron main that runs under a railroad right-of-way. The task was to determine if the pipe was a good candidate for cured-in-place-lining.

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

In November 2020, Progressive Pipeline Management was lining a 2,000 foot section of 20-inch cast iron main for a major eastern gas utility along Edgewater Avenue in Ridgefield, New Jersey. A section of the main, roughly 150 feet, runs underneath the railroad right-of-way and belongs to the railway. Railroad companies operate differently, but the railroad would not allow the utility to perform work on their line within the right-of-way unless they verified the condition of the line. It had to meet the conditions to be a good lining candidate.

BEM FERROUS WALL CONDITION ASSESSMENT

For the railway to greenlight the cured-in-place-lining project to proceed, the utility had to perform an assessment. We recommended Broadband Electromagnetic Probe (BEM) on the 150-foot section. BEM is a patented, ferrous main assessment tool that's been in operation in Australia for over 20 years. It was developed by Rock Solid Pty. Ltd. The Australian company has extensive experience with non-destructive assessment of cast iron and other ferrous piping.

The first step was a field visit. We reviewed the maps showing the layout of the pipe geometry to determine the layout of the pipes. Was it a straight run? Were there any 90-degree bends or 45-degree bends? The inspection tool has some limitations on the pipe geometry it can negotiate.

We identified that the pipe was a straight run which made it feasible for us to perform the internal BEM inspection. After the section was isolated, the next steps were cleaning operations and CCTV inspections. Two excavations were required. The BEM crew was scheduled to start the inspection once the excavations were complete.

BEM technology for ferrous pipe integrity assessment can determine wall thinning, graphitization and cracks. The BEM tool allows pipeline assessments to be performed in-line or externally. Both inspection techniques produce the same data. Sensor shapes and sizes for emitting and collecting suitable data are highly flexible for each type:

1. **In-line or remote application**: used for the segment in this project uses an internal delivery vehicle such as a 'pig' to transport the device.
2. **External Flexible Array Scanning Tool (FAST)**: for surface application devices where manned access is possible

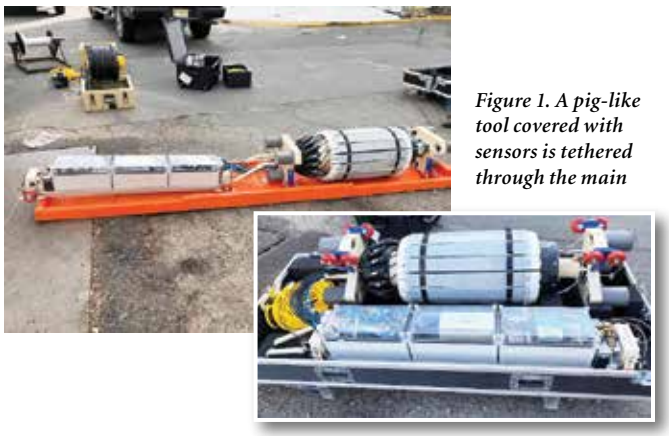

Figure 1. A pig-like tool covered with sensors is tethered through the main

"THE TESTING AND LAUNCH HAS EXCEEDED EXPECTATIONS."

-DAVID WICKERSHAM, CEO, PROGRESSIVE PIPELINE MANAGEMENT.

INTERNAL BEM ASSESSMENT TOOL

Once the pipeline was taken out of service, a pig-like tool covered with sensors and probes was inserted into the pipe and pulled along the inside of the gas main. [Figure 1] The tool was approximately the same diameter of the gas main. A power source trailed behind the pig as it traveled through the pipe. Antennae on the pig sent electromagnetic signals into the pipe. A series of sending and receiving readings indicated if there was any level of pipe loss. The pig moved along in increments via a tether and took multiple readings throughout the entire length of the pipe. [Figure 2]

Figure 2. BEM internal tool inserted into 20-inch cast iron main

HOW BEM TECHNOLOGY WORKS

The technology works by inducing eddy currents to flow in close proximity to the transmitter. In a ferrous pipe, these eddy currents migrate, allowing a complete profile of the ferrous pipe to be obtained. Data is recorded at distinct frequency increments; the duration and number of increments depend upon the material conditions as well as the nature of the target. Parameters were set with the aid of a pre-survey calibration of the ferrous material. BEM recorded data can reveal the location of perturbations in the thickness of the ferrous pipe. With appropriate configuration, indications of fracturing can be detected.

The data acquired is sent to a laptop via a data cable and is represented graphically as heat maps with color contours depicting the level of wall thickness. [Figure 3] If the pipe wall thickness is between 90 to 100 percent, meaning a loss of 0 - 10 percent, it will come up as green. If the pipe wall thickness is between 70 to 89 percent, a loss of 11 to 30 percent, it will show as yellow, which is an indication of some metal loss on that particular sensor location. If the pipe wall thickness is less than 70 percent of the original thickness, it shows red. In this case, there would be a high level of graphitization in the pipe at that location, indicating an area of major concern.

In the case of the Edgewater Avenue Project, the data was good quality and our client presented the charts and images from the BEM report to the railroad company. Both parties were comfortable with the wall thickness and corrosion parameters and the lining project was green lighted to proceed with lining under railroad right-of-way. The rest of the project proceeded smoothly.

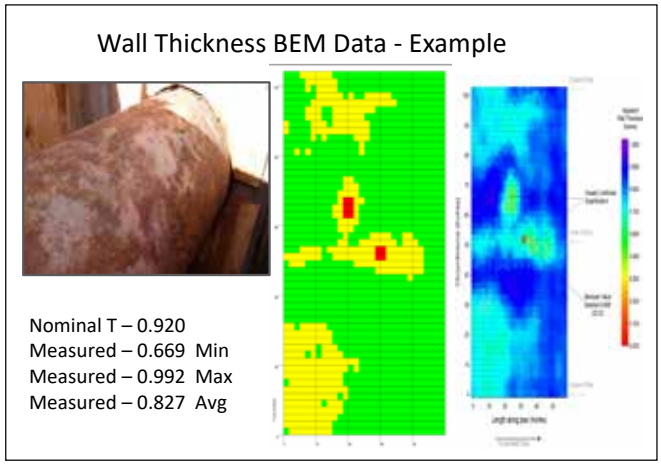

Figure 3. BEM heatmap indicating pipe wall thickness

EXTERNAL FERROUS WALL CONDITION ASSESSMENT TOOL

The second type of BEM is done externally and is effective for spot inspections. The Flexible Array Scanning Tool (FAST) is ideal for external pipe wall condition assessments carried out

Figure 4. External BEM is effective for spot inspections and opportunistic scans during planned maintenance &/or emergency work

Figure 5. Sensor blanket for BEM external Flexible Array Scanning Tool (FAST) wraps around the pipe

Figure 6. BEM is a valuable tool when considering CIPL. Lining can cost one third the cost of direct bury replacement

on all types of ferrous pipelines to explore the integrity of pipe diameters from 2 inches and upwards [Figure 4]. The pipe wall is scanned externally and pipe wall integrity is determined without interrupting the pipe flow or disrupting gas service. Manned access is needed to position the sensors and antennae which surround the pipe. Complete coverage of the pipe can be obtained without diameter or shape restrictions. Individual readings are taken along the surface of a pipe. The coating (bitumen, polyethylene, or even concrete) does not need to be removed. The wall can be scanned with the aid of a temporary marked grid around the outside of the pipe allowing for accurate positioning of each reading taken.

In this case, the pipe needs to be excavated and fully exposed. A fabric "blanket" has snaps and sensors and antennae. It wraps around the pipe and you take a shot of the pipe at that position. Then the blanket is re-situated to the next position until the section has been fully scanned. [Figure 5] It is great at capturing a sample of what the integrity of the pipe looks like at problematic locations, for example if there is pipe wall loss. It is fast and effective informing decisions about specific sections of a pipeline.

WHY IS BEM EFFECTIVE?

The need to utilize technology to identify the integrity of a ferrous pipeline's health is recognized by industry operators and by the governing bodies of the natural gas industry. Within the gas industry there are a number of different types of technology used. BEM is a cost-effective method that can be performed on a routine basis. It can be an ideal companion when considering lining.

"For non-destructive testing of cast iron, there has not been a technology available like this before. Prior to investing in the technology invented by Rock Solid in Australia, we formed a work group with three utility customers. The testing and launch has exceeded expectations," says Dave Wickersham, CEO Progressive Pipeline Management.

Other options are more costly and inefficient. Smart pigging technology can be expensive but effective for a very in-depth assessment. The old-fashioned way is direct assessment, when the company excavates the line and performs a hands-on investigation of problematic areas. With the cost of excavation, impact on the environment, and resources required, this should only be considered as a last resort.

THE POWER OF DATA FOR DECISION MAKING

BEM can help determine whether the effort and costs of direct bury are necessary and justified. Too often, the first decision for pipeline replacement is to utilize direct bury. This requires a full trench excavation and the abandonment of the old pipe. It is costly, especially when using steel for larger diameter pipes. Other costs include back filling, paving (temporary and final restorations), equipment and labor. Some streets are so congested there's no place to put another piece of pipe, and conditions such as bridges, railways and historical protected areas make excavation difficult or impossible.

Trenchless pipeline rehabilitation has been PPM's specialization for 20 years using Starline ® Cured-In-Place-Lining (CIPL), proven to extend the life of pipelines by 100+ years. [Figure 6] Lining can cost about one third the cost of direct bury replacement. Benefits to lining also include the ability to maintain flow volumes through systems. The use of CIPL also allows for capitalization of asset replacement costs.

BEM is a valuable tool when considering CIPL as it captures actual data on pipe conditions providing decision makers real time data [Figure 7]. With the data provided by BEM tools, replacement methods can be evaluated with empirical data and facts to help determine the most cost effective and environmentally efficient solution.

PPM has invested in Broadband Electromagnetic Probe (BEM) pipe inspection technology for gas Distribution Integrity Management Program (DIMP) programs. It gives utilities the tools to make informed decisions on the most appropriate manner to replace gas facilities and accurately rank pipe replacement. Greater depth of knowledge around assets, the condition they're in, and the degree they're in, creates value down the road.

These tools empower decisions for safe and effective networks. Using tools that aid proactive actions for preventing potential gas leaks or dangerous situations is essential.

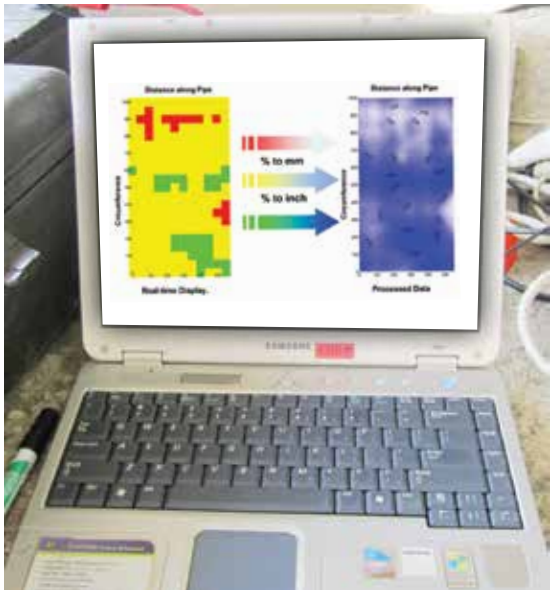

Figure 7. Initial results can be seen live via a laptop. The real-time wall thickness display uses color to denote wall thickness ranges and areas of concern

Ferrous pipeline materials– steel, cast iron and ductile iron- can be investigated and pipes of any size from 4inches (110mm) diameter and upwards. BEM can process continuous data records along extensive lengths of pipeline. Due to the large volumes of data recorded as part of any scan, distances surveyed along smaller diameter pipes are typically 200 - 250 feet per day, while in large diameters lower footages per day are scanned.

PIPELINE INTEGRITY MANAGEMENT INTO THE 21ST CENTURY.

PPM has decades of specialized expertise associated with gas pipeline related issues, including lining and trenchless technology. They hold the exclusive license for North America for the Starline® CIPL liner. This depth of understanding and engineering is applied from inception to completion of the entire project, any time, any place. 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 Broadband Electromagnetic Inspection (BEM) technology, this truly non-destructive testing method investigates ferrous pipelines of all types and all diameters.

"THE BEM TOOL ALLOWS PIPELINE ASSESSMENTS TO BE PERFORMED IN-LINE OR EXTERNALLY."

ABOUT THE AUTHOR:

***Casey Giambrone**, Vice President at PPM, is an MBA and Industrial Engineer who has the ability to balance sharp technical understanding with a business mindset. Before joining the PPM family in 2020, his career included twenty years with National Grid. He was responsible for National Grid's New York City and Long Island City State Construction practice and helped create the NYC Public Works Tracking System. Casey leads CIPL projects in New Jersey, Baltimore, Chicago, New England, and other US territories.*