

# Pipeline & Gas Journal

connecting you to the pipeline industry worldwide



For several sections of damaged line, the coils were installed side-by-side to accommodate the complete length of the damaged area. (Photo courtesy of Allied Engineers)

## Composite Sleeves Restore Gas Pipeline Integrity in Gujarat

By **K.P. Radhakrishnan**, Deputy General Manager (O&M), **GSPL**, **Andrew Patrick**, Executive Vice President Global Sales, **Clock Spring**, and **Bidyut B. Baniah**, Chief Project Manager, **Allied Engineers**

**S**afe distribution of natural gas is enabling development in many regions of the world, but in places where new lines are being installed, maintaining pipeline integrity and executing repairs is particularly challenging.

Repair timelines often are negatively affected by the difficulty of getting skilled and certified workers and the necessary equipment to the repair site, a situation that makes coordinating repair efforts frustrating and providing continuous service difficult.

In hard-to-reach areas, a much better solution is one that can be delivered to the site quickly, requires no heavy-lifting or welding and can be performed using simple tools. A recent, urgent composite repair carried out in Gujarat, India, illustrates how local installers redressed pipeline damage,

rapidly restoring line integrity and delivering a safe and durable solution.

### Growth Challenges

India's industrial base is growing, and its gas pipeline infrastructure is expanding to keep pace. According to the Observer Research Foundation (ORS), an independent think tank based in New Delhi, the country's economy is expected to grow more than five times its current size by 2040.

As India experiences growth, ORS predicts gas demand will grow faster than for any other energy source, including coal and oil. Recognizing the potential for available energy to fuel industrial growth, the Indian government began working to make natural gas more readily available, and part of the solution has been to expand the country's

natural gas pipeline grid.

Lines have been installed across the sub-continent in pursuit of this goal, and many have been transporting gas for decades. The Baroda-Ahmadabad-Kalol Pipeline (BAKPL) is one of these. It has been in operation since April 2004, serving the natural gas needs of the north and south regions of Gujarat on India's northwest coast.

The pipeline begins in the village of Sherghi and terminates at Kalol near the region's main urban center, Ahmedabad, 132 km (82 miles) away. Sections of this pipeline branch out and interconnect to other regions to fulfill demand in various industries, including steel, power generation, fertilizer production, and pharmaceuticals, while others serve municipalities where gas is provided for domestic use.



The initial pipeline excavation covered 22 meters (72 feet) and included the pipeline ROU.

(Photo courtesy of Allied Engineers)

Gujarat State Petronet Ltd. (GSPL), the pipeline operator, is responsible for managing a number of gas pipelines in Gujarat, including the BAKPL line. Part of GSPL's responsibility is to ensure service, which means the company is tasked with surveying the lines to identify areas that require attention and executing maintenance and repair efforts when anomalies are identified.

The company has developed an integrity management plan (IMP) to monitor the health of the pipeline and has implemented the IMP since 2014, which includes conducting annual maintenance activities on the pipeline as well as right of use, shutoff valves and terminals.

Executing the IMP takes multiple forms, including regular foot patrolling to look for obvious damage, checking emergency



A total length of 22 meters (72 feet) was repaired, with an average daily repair length of 2.5 meters (8 feet).

(Photo courtesy of Allied Engineers)

valve operation for functionality, line surveys, and monitoring the cathodic protection system. GSPL is diligent in managing maintenance responsibilities to ensure line integrity and uninterrupted service.

### Identifying an Anomaly

As part of periodic inspections carried out to meet local codes and regulatory requirements, the pipeline operator performed a closed interval survey on the BAKPL line in August 2017. During the survey, engineers noticed a drastic drop in pipe to soil potential at a particular location on the pipeline and determined there was a need for physical verification.

When the inspection team arrived at the area in question, they saw that unauthorized surface excavation had recently been carried out. Through conversations with a local farmer, the team discovered that the land had been sold for a commercial purpose and that excavation had been carried out using traditional mechanical digging equipment.

Arrangements were made to excavate the line where the unauthorized excavation had taken place. The GSPL operations and maintenance team oversaw the initial manual excavation activity near the town of Asarma, where pipeline depth coverage was only 60 cm (24 inches) for an 80-meter (263-foot) segment of pipe. The initial pipeline excavation covered 22 meters (72 feet) and included the pipeline ROU, so additional manpower was allocated to the project to manage the expanded scope.

With the line excavated, the inspection team noticed dents in the pipeline and began the process of removing the polyethylene coating on the line. As the remediation team removed the damaged coating, they uncovered more damage on another section of pipe. Eventually, 26 areas were identified where there were minor dents in the pipe and 2 to 3 mm (0.08 to 0.12 inch) metal loss in the form of gouges on the surface of the line.

The maximum operating pressure was reduced from 95 bar (1,378 psi) to 73 bar (1,059 psi), and line capacity had been drastically decreased, hampering the ability to meet customers' emergency operations demands.

At this stage, GSPL also deployed a

technical service crew to carry out magnetic particle testing and phase array ultrasonic testing to more precisely determine the extent of the damage, which was verified using X-ray and circumferential E-scan. With the damage fully assessed, the pipeline operator had enough information to begin evaluating repair options.

### Finding a Solution

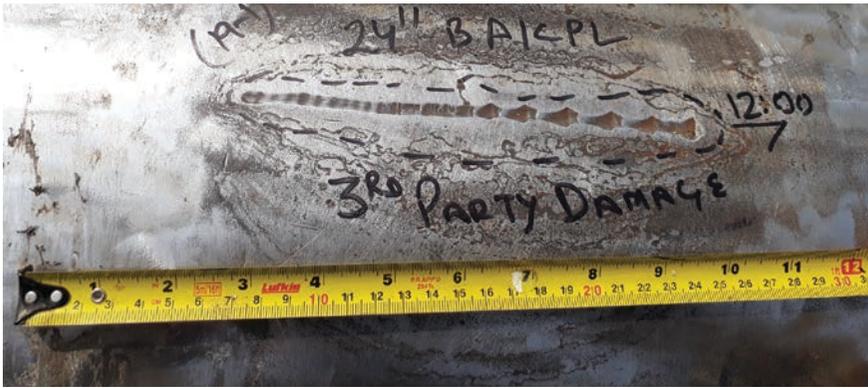
With more information in hand, GSPL was able to quantify damage. An 80-meter (263-foot) segment of longitudinal submerged arc welded (LSAW) pipe coated with impressed current cathodic protection in the form of three layers of polyethylene exhibited dents and more than two dozen areas of 2 to 3 mm (0.08 to 0.12 inch) metal loss in the form of gouges that needed to be repaired.

The company was looking for a solution that could be executed easily and quickly without hot work and that would not require the line to be taken out of service, as a large number of customers would be affected. The company wanted assurances that the repair would be sustainable and reliable and would not affect the original design life of the pipeline.

Most importantly, the repair needed to be permanent for restoring the long-term integrity of the pipeline per the respective ASME codes. The selected repair would have to address both dents and gouges along with areas of missing coating, and the provider would have to offer proof that the materials and installation method had undergone testing to assure the repair would be performed as expected.

Clock Spring could meet these requirements along with the ASME B31.8S standard and would be able to deliver the product to India, clearing customs and delivering it to the site for installation within the project schedule. After weighing its options, GSPL determined that cold composite sleeves were the optimal solution for restoring the integrity of the line.

The composite sleeve is designed and manufactured in a controlled, ISO-certified facility and sent to the installation site pre-cured and ready to install by certified installers. All the materials required for installation are supplied in a kit that includes the composite sleeve, two-component filler and adhesive, and the



When the survey was concluded, engineers had identified 26 areas with minor dents (Photo courtesy of Allied Engineers)

application accessories. The repair sleeve is bonded in place using a fast-curing methacrylate adhesive that is designed to secure the sleeve to the pipe, restoring 100% of its original capacity.

Field data gathered following testing in field conditions for two to seven years showed the repairs suffered no measurable loss of strength or degradation, no deterioration of the resin matrix or glass fibers, no changes in the composite's physical properties resulting from exposure, and no evidence of chemical breakdown.

### Composite Design

The composite installation engineers used the measurements from the deepest anomaly identified in the BAKPL line to develop the composite repair. The resulting product underwent pressure burst analysis to determine if it had the appropriate strength and durability to be used on the line.

Test results showed that a composite repair could be designed to meet the maximum pressure 117.5 bar (psi) expected in the gas line and would provide a durable and long-lasting repair.

The repair sleeve designed for the BAKPL pipeline comprised eight layers with a wrap thickness of 1.59 mm (0.06 inch) that would cover the entire circumferential extent of the defect area and would have a completed repair thickness of 12.7 mm (0.5 inch) when the installation was complete.

### Executing Installation

Once the repair was fabricated and arrived onsite, the installation team prepared the surface of the pipe to ready it for application of the composite repair. With the pipe properly cleaned, the selected composite sleeves were installed in accordance with the ASME B31.8S 2016 guidelines. The certified installation team applied the starter pad first per PEM procedures and began installation of the pre-coiled sleeve units.

Once the coil was wound around the pipe and adhesive was applied to the complete surface area of the coil, installers slid the sleeve into place onto the starter pad. In multiple places along the repaired line, the composite units also were placed over girth welds to provide a complete repair solution for the entire length. For several sections of damaged line, the coils were installed side by side to accommodate the complete length of the damaged area.

In all applications, the final permanent repair restored the line to 100% of its original strength. With the installation complete, the operator-approved corrosion coating was applied over the entire repair area prior to backfilling over the pipeline.

A total length of 22 meters (72 feet) was repaired, with an average daily repair length of 2.5 meters (8 feet) and a maximum repair in a single of 4.5 meters (14.5 feet). The accelerated repair timeline allowed the pipeline operator to assure the original strength of the pipeline was

restored before the originally scheduled deadline, allowing the pipeline to be uprated to the original pressure sooner than the original plan.

### Mitigating Risk

The composite repair allowed GSPL to restore the BAKPL line to full operational integrity in a short time and led to a number of significant improvements in line operation and maintenance to prevent future damage. The pipeline operator made a number of changes, including installing more markers to demarcate critical pipeline location so it would be apparent to people where the underground lines run, investing in an optical fiber-line intrusion detection system and purchasing pipeline integrity management system software so the line can be monitored more effectively. GSPL also is employing survey teams to patrol the line periodically, looking for activities that could threaten the safety of the pipeline.

Recognizing the importance of educating people about pipeline safety, the pipeline operator conducted a villager awareness program at Hathipura, providing a brief introduction on "do's and don'ts" where there are buried natural gas pipe lines to share information that will prevent future line damage and more critically, potential harm to people. The company distributed pamphlets explaining the dangers of excavating around buried pipe and has scheduled additional awareness programs in towns along the BAKPL line.

### Looking Ahead

With a stronger program in place to maintain line integrity and safety, GSPL is making strides toward more effective and efficient operations. By adding the composite sleeve repair to its current tool kit, the company will be able to rapidly repair future damage quickly to maintain gas service to an increasingly important growth area in India. **P&GJ**

ePrinted, posted and single printed copies for distribution with permission to Clock Spring Company, LP from *Pipeline & Gas Journal* September © 2018 Gulf Publishing Company



**Clock Spring Company, LP**  
 North America (USA) – Headquarters  
 621 Lockhaven Drive | Houston, TX 77073  
 P: +1-281-590-8491 | F: +1-281-590-9528  
[www.clockspring.com](http://www.clockspring.com)

