Remote CP Monitoring of 2,500 Miles of Liquid Petroleum Products Pipeline

MICHAEL PEARCE, *Colonial Pipeline Co., Spartanburg, South Carolina*

Historically, rectifier inspections were made manually by right-of-way inspectors. Corrosion technicians were then dispatched to repair any malfunctions. The operator realized that remote rectifier monitoring would provide significant benefits. After investigating several products, the one that best met their needs was selected and installed. The monitors, combined with the manufacturer's software, greatly simplified rectifier maintenance as well as utilization of close interval surveys.

Colonial Pipeline Co. operates a large-volume refined liquid petroleum products system, comprising over 2,500 miles (4,023 km) of right of way, with over 2,000 miles (3,218 km) of stub lines (Figure 1). Throughput in 2009 was 849 million bbl (134,991 million L)—2.4 MBD (382 million L/d)—of gasoline, home heating oil, diesel fuel, commercial jet fuel, and defense fuels for the U.S. military. Products are delivered primarily from refineries in Texas, Louisiana, Mississippi, and Alabama to 262 marketing terminals at 78 locations. The system also includes 128 booster stations, 15 tank farms, and more than 600 tanks to help manage deliveries. The average delivery time from Houston to New York is 18 days.

Regulatory Obligations

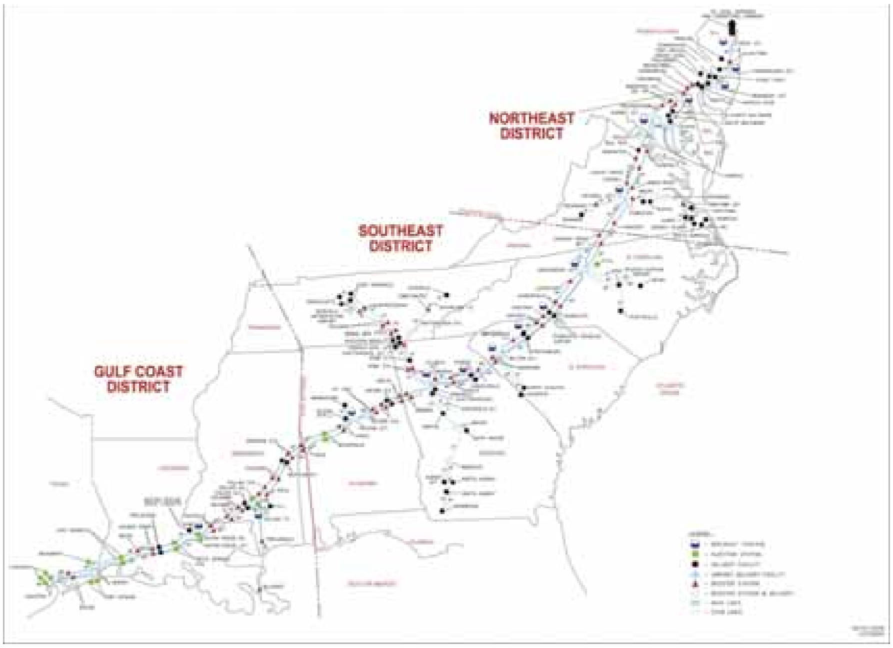
The main regulatory body governing the safe transportation of natural gas, petroleum, and other hazardous materials by pipeline is the Office of Pipeline Safety (OPS) within the U.S. Department of Transportation's Pipeline and Hazardous Materials Safety Administration (PHMSA). OPS is the federal safety authority for the nation's 2.3 million miles (3.7 million km) of natural gas and hazardous liquid pipelines. Its mission is to ensure the safe, reliable, and environmentally sound operation of the nation's pipeline transportation system.

Safety standards are set out in Title 49 in the Code of Federal Regulations.[1] Part 192 addresses the transportation of natural and other gas by pipeline and Part 195 addresses the transportation of hazardous liquids by pipeline. Integrity management is an organizational standard for pipeline operations, inspection, and maintenance that seeks to address the requirements of these regulations and to achieve best practice. In common with other pipeline operators, Colonial Pipeline runs a major pipeline integrity program aimed at protecting the environment, employees, and the general public.

Cathodic Protection

Cathodic protection (CP) is a major component of ensuring the integrity of this pipeline system. The regulations lay down specific criteria for determining the adequacy of an impressed current CP (ICCP) system. They further stipulate that an operator shall take prompt remedial action to correct any deficiencies. Of course, this should be done not simply as a response to regulation but as a necessary precaution to ensure both the safety and the longevity of the pipeline. It is therefore important to obtain information on the performance of the CP system

FIGURE 1



The extent of the large-volume refined liquid petroleum products pipeline.

FIGURE 2

Rectifiers must be checked frequently to comply with regulations.

in a timely and accurate manner, which drives the debate within pipeline operating companies as to the best way of gathering the requisite performance data (rectifier outputs and pipeline potentials).

Regulation 49 CFR 195.573(c)[2] states that rectifiers must be electrically checked for proper performance "at least six times each calendar year, but with intervals not exceeding 2 ½ months." Our procedures go beyond this and state that CP rectifiers will be electrically checked ~12 times per year, with intervals not exceeding 2 ½ months (Figure 2). Historically, manual readings of rectifier outputs were carried out by right-of-way (ROW) inspectors. As the pipeline network developed, however, this became very expensive and labor-intensive, requiring hundreds of miles of driving every month, which itself became a safety concern. Furthermore, problems could be detected only when the rectifier was checked, and if it was not working properly, a corrosion technician would need to be called out to repair it.

Remote Monitoring: Justification and Selection

We decided that remote monitoring of our CP systems could provide some significant benefits:

- Minimize driving exposure for ROW inspectors.
- Free up their time to perform other duties.
- Improve the accuracy of CP data.
- Provide critical alarms so that rectifiers could be repaired more quickly.
- Save money overall.

With a number of products available on the U.S. market, we recognized that it was important to take time to select the right remote monitoring unit/system. We spent three years assessing the various products and evaluating their features to select the most appropriate remote monitoring solution. We reviewed 12 units from nine different suppliers. Of these, nine were field-tested before drawing up a short-list of five for detailed evaluation against our key criteria, which were:

- Communication method (Global System for Mobile Communication [GSM] vs. satellite)
- Two-way communication
- Integration with our corrosion compliance database
- Survivability, especially with respect to lightning damage
- Software/Web site capabilities
- Internal/external installation
- Interruption capabilities
- Ease of installation
- Unit cost

Among the short-list of five, all products had merit and some had interesting features that differentiated them. The Abriox MERLIN† system was selected by Colonial's Southeast District for the following key reasons:

- Software and database integration
- Ease of installation and commissioning
- Compact size—the only unit that could easily be installed within our rectifier enclosure (Figure 3)
- Survivability (a robust, durable design)
- Two-way communication using

†Trade name.

GSM, which proved to be the most economical and reliable solution in our geographical area
- Interruption capability with very precise Global Positioning System (GPS) synchronization

The monitoring system consists of two different types of monitor for installation at rectifiers and at test points, together with user software that enables inspectors to quickly identify any alarms or deficient measurements. Using GSM communication, the selected system offers reliable, low-cost messaging. A monitor with satellite communication has also been developed for very remote areas with no GSM signal.

FIGURE 3

A remote monitoring unit (circled) installed at a rectifier, with cell phone communication.

Southeast District Early Experiences

In our Southeast District, the remote monitoring program was spread over 2,500 miles (4,022 km) encompassing six states (Alabama, Georgia, Tennessee, South and North Carolina, and Virginia). Over 600 monitors were installed at rectifiers—a hardware investment of more than $1 million. The ease of installation, however, meant we were able to save on the labor costs that were originally budgeted. Because the unit could easily be accommodated within the rectifier, we did not have any problems with installing external enclosures and wiring them back into the rectifier. With standard tools and wiring, a magnet, and their cell phone (for configuring the monitor), our technicians found that they were able to install as many as 10 units in a day—and the entire installation process was completed within a three-month period in mid-2009.

Because of the wide geographical distribution of the monitors and our inspectors, it was important to be able to access CP data remotely. We can now do this from any Internet-enabled PC using a standard Web browser and logging into a secure database hosted by the unit manufacturer. A further advantage of the Web-based system is that software upgrades are available immediately—in fact, we have suggested a number of useful improvements to the software, many of which have been implemented.

Because we selected monitors with two-way communication, once they were installed we were able to carry out the more detailed configuration—such as setting alarm levels, measurement and reporting times, time zones, etc.—from the office. Again, this has saved a lot of time and ensures that we get useful data immediately.

The software allows us to identify any units that are in alarm (Figure 4), which may be created by a number of causes, such as electrical supply failure, a blown rectifier fuse, low voltage or current output. We can then schedule maintenance promptly. This is a major advantage over the old manual collection method because we did not know which rectifiers needed maintenance or what type of fault had occurred.

The southeastern United States is subject annually to very severe effects from lightning storms. Because remote monitors are connected to both the electrical supply and the pipeline, resilience to lightning was always identified as a key factor in our product selection. The monitor we selected had been tested at a world-leading lightning test laboratory and we were able to implement a number of improvements. We have identified an installation configuration, including alternating current and direct current surge arrestors, which is proving to be robust and is protecting our investment in the monitors, even when the rectifier itself is badly damaged.

Program Benefits

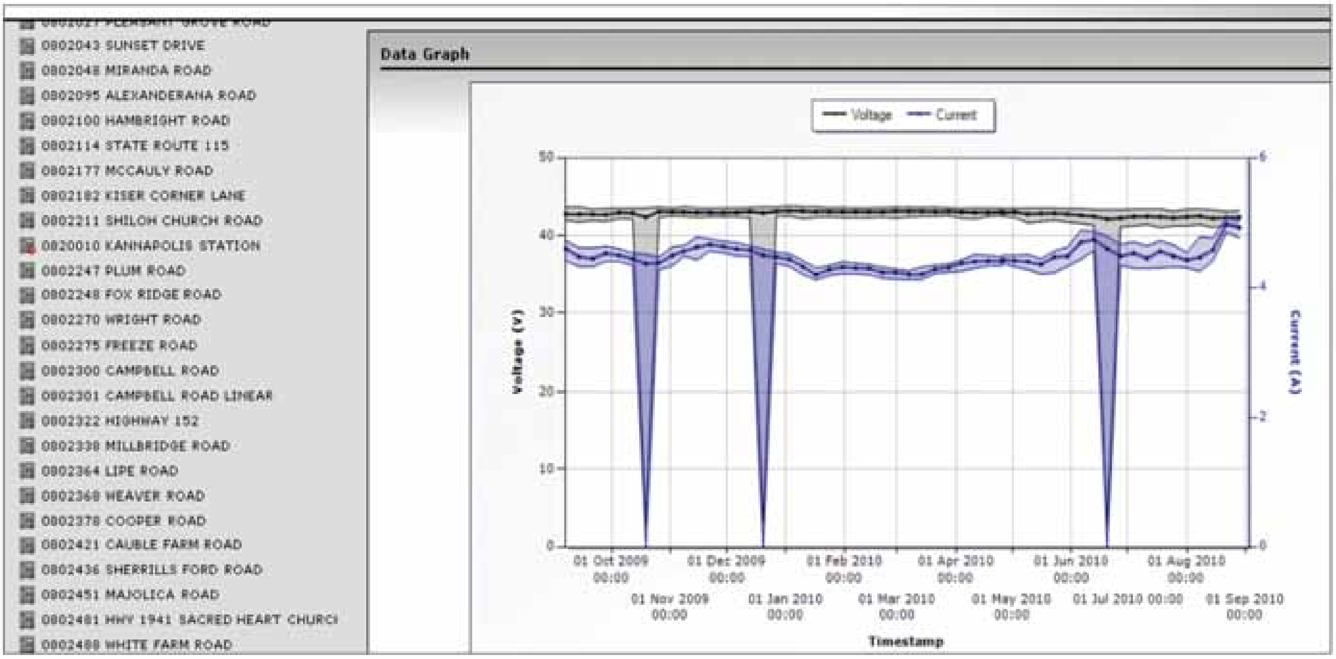
We are pleased to have realized the benefits we targeted at the start of the program. In particular, we have improved safety for our inspectors through fewer driving hours and freed up their time to become more productive in areas that require their special experience.

In response to our request, the monitor manufacturer has interfaced its CP System Manager† software to our compliance database and, with automatic alarms and on-demand CP readings (available from our cell phones even when in the field), we have achieved a significant improvement in the accuracy of our CP data, timely attention to potential corrosion issues when they occur, and the quality of our compliance reporting.

The ability to turn off the rectifier output remotely has also yielded tremendous savings. Previously, when other pipeline companies needed to carry out CP testing and investigations on their adjacent or bonded pipelines, our technicians were required to drive out into the field to switch off our rectifiers. These "cooperative shutdowns" can now be executed remotely from a cell phone or from the central Web software—eliminating hundreds of man-hours of travel time.

Another major benefit is rectifier interruption, which is used for our close interval survey work (an aboveground profile of the pipeline route, requiring switching of the rectifier output) (Figure 5). Historically, this was a major exercise,

FIGURE 4



Alarms at the rectifier are automatically identified, with data accessed via Internet.

requiring many man-days to install and set up portable interrupters at each rectifier. Now, with a few mouse-clicks and no additional equipment, we can remotely synchronize the outputs of multiple rectifiers along the pipeline. We can also quickly identify any rectifiers that are out of synchronization (an issue in the past) and can start and stop interruption each day to avoid depolarization. In 2009-2010, we surveyed over 750 miles (1,206 km) of pipeline, with estimated cost savings of 20 to 25%. An additional 550 miles (885 km) have been surveyed in the Southeast District in 2011.

FIGURE 5

Remote synchronized interruption has greatly increased the speed of close interval survey work. Photo courtesy of CEM Resources.

Conclusions

We have found that remote CP monitoring has enabled us to improve our corrosion program and to realize cost savings in several areas. This has not been achieved by accident, but through careful product selection (out of several that are available in the United States today), working closely with the supplier to maximize hardware and software performance, and the dedication and commitment of our corrosion team.

References

1 U.S. Code of Federal Regulations (CFR) Title 49, "Transportation," Part 192, "Transportation of Natural and Other Gas By Pipeline: Minimum Federal Safety Standards," and Part 195, "Transportation of Hazardous Liquids by Pipeline" (Washington, DC: Office of Federal Register).

2 U.S. Code of Federal Regulations (CFR) Title 49, "Transportation," Part 195, "Transportation of Hazardous Liquids by Pipeline," Subpart H, "Corrosion Control," § 195.573, "What must I do to monitor external corrosion control?" (c), "Rectifiers and other devices" (Washington, DC: Office of Federal Register).

MICHAEL PEARCE is the corrosion program manager at Colonial Pipeline Co., 180 Keltner Ave., Spartanburg, SC 29302, e-mail: MPearce@colpipe.com. He is originally from the State of Texas and has been in the corrosion industry for eight years. He has held the positions of corrosion technician, project manager, and corrosion program manager. An 8-year member of NACE International, Pearce is a graduate of the University of Texas and Kilgore College, with a corrosion technology degree. *MP*