As seen in the March 2009 issue of
PipeLineandGas TECHNOLOGY

Improving AC mitigation

Ted Huck,
MATCOR, Inc.,
Doylestown, Pennsylvania;
and Rob Shoaf,
Williams Gas Pipeline Co.,
Princeton, New Jersey

Williams deploys a unique, specialized copper conductor product to insure a robust AC mitigation on its pipelines.

Pipelines are often located in common utility rights of way with the pipeline taking advantage of corridors reserved for high voltage AC (HVAC) overhead electrical transmission lines. This efficient use of public lands for common utilities offers many advantages when it comes to planning and routing of both overhead and underground services. This is particularly true for highly industrialized or heavily developed urban and near urban areas.

One consequence of placing utilities in a common right of way, however, is that the high voltage overhead transmission line creates an electromagnetic field and the buried pipeline can be influenced by this field. The result of this interaction is an electrical phenomenon known as induction. The transmission line causes an induced AC voltage level on the pipeline. This induced AC voltage can present problems for pipeline operators, and the goal here is to describe the traditional approaches to mitigating induced AC voltage, then present an innovative engineered AC mitigation system that has been recently developed for this application.

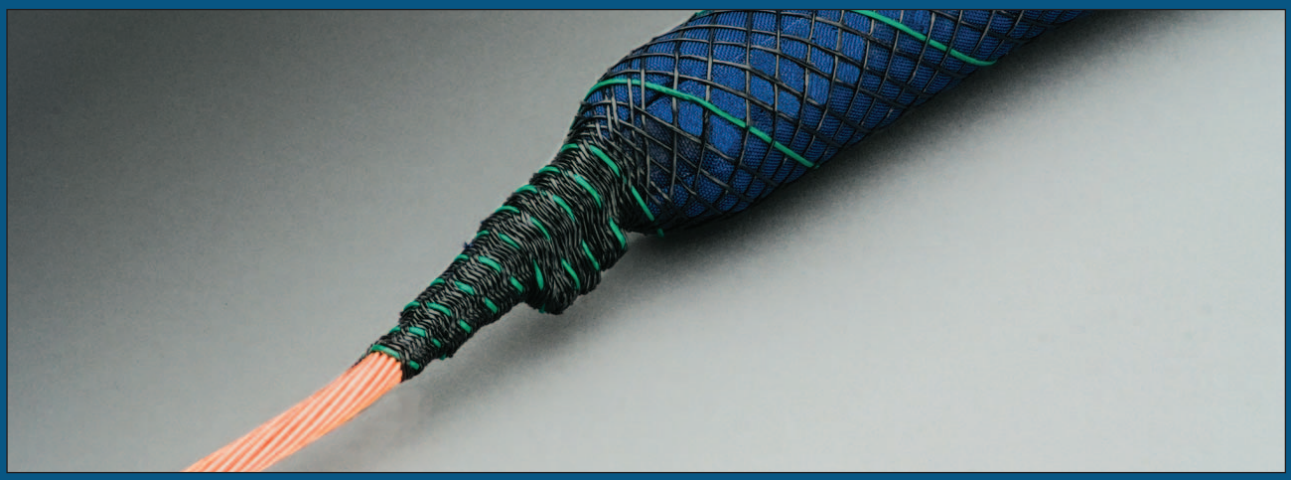
Pitting on a pipeline due to AC induced corrosion

AC induced voltage

Electrical fields and the effect that they have on circuits is a very well-established science and is at the root of electrical transformers, AC induction motors and many other electrical devices. The unintended consequences of electrical fields, however, can be very difficult to predict because of the many variables and site-specific issues that are often difficult to anticipate and/or model predictably. Some of the factors that influence induction include peak and non-peak load factors, usage patterns for HVAC transmission, tower grounding systems, diameter and coating quality of the pipeline, changes in pipeline geometry with respect to the transmission tower layout, soil environments and resistivity, and other information.

There are two key issues for pipelines subject to induced AC voltage pickup. The first critical issue is a safety hazard. Anyone touching a valve or other aboveground appurtenance might be subject to being electrically shocked. The presence of induced AC can thus become a dangerous step and touch potential hazard. It is quite common for pipeline companies to install grounding mats under any aboveground appurtenance to protect personnel from the risk of electrical shock. The grounding mats are typically zinc ribbon/mesh buried below the aboveground structure to provide a low-resistance ground path for AC current to dissipate. NACE International standards provide for a maximum of 15 VAC for personal protection purposes.

The second key issue for pipelines in the presence of induced AC voltage pickup is the potential for corrosion. Historically, pipeline corrosion experience has found AC induced corrosion to be a negligible threat. Recent advances in coating technol-



The MATCOR MITIGATOR™ with copper cable lead wire and green color coded external braiding provides an easily installed, low impedance, continuous AC ground.

ogy, however, have fundamentally shifted the risk posed by AC induced voltages. Unlike older coating systems, which provided ample contact between pipe and ground to discharge induced AC current, today's coating systems are exceptional. Induced AC potential picked up along a buried pipeline with an advanced, high quality coating has only a limited number of very small coating defects from which they can dissipate to ground. This can result in exceptionally high localized AC current densities at the discharge locations. AC induced corrosion can occur even when the AC voltage levels are well below the 15 VAC safety threshold.

Conventional AC mitigation

The typical approach to AC Mitigation involves providing a low resistivity drain to allow AC current to discharge to ground. This typically involves running a gradient control wire parallel to the pipeline in areas prone to high AC induced voltage. These can be long segments of copper wire or zinc ribbon. Copper provides a longer service life and lower impedance than zinc ribbon. Often, it is necessary to place a special carbon grounding backfill around the copper wire or zinc ribbon to lower the system impedance and provide for a better system ground. This is especially true for applications in higher-resistivity soils or where soil conditions vary seasonally.

It is important to note that the AC mitigation system is intended to provide for a low resistivity ground to allow induced AC current to drain off the pipeline through a metallic path without causing corrosion. This low resistivity grounding system, however, is not good for cathodic protection systems. Placing a large amount of bare structure parallel and connected to the pipeline will render the pipeline's cathodic protection (CP) potentials severely degraded. This problem is resolved by decoupling the AC current flow from the DC current flow. A solid state device designed to allow AC current to flow freely while providing DC isolation is installed selectively along the AC mitigation system, allowing both the AC mitigation system to discharge current while assuring that the isolated pipeline is receiving all of the intended CP current.

Packaged AC mitigation solution

This innovative product has recently been developed specifically for use in AC mitigation service. This engineered solution provides an easily installed, low impedance, continuous AC ground in a factory assembled package. The assembly is available in 500 ft and 1,000-ft reels that can be installed using a simple trenching unit or it can be plowed into the ground using a standard cable plow. The system utilizes a 19 strand #2 AWG copper conductor, machine packaged in an acid resistant fabric sock with special copper corrosion inhibited coke backfill. The entire assembly is wrapped with a robust outer braid that is color coded with a green colored ground identifier.

Case history

Williams' interstate gas pipeline operations span more than 15,000 miles and deliver approximately 12% of the natural gas supplied in the United States. The Transco system supplies 8.2 Bcf of natural gas to markets in the Southeast, Mid-Atlantic and Northeastern States from production sources in the Gulf of Mexico and LNG plants along the Gulf Coast.

Passing through some of America's densely populated areas and some of the fastest growing states, shared rights of way with high-voltage AC transmission systems are unavoidable. As part of Williams' comprehensive integrity management program, the threat of AC

The new induced AC mitigation system is installed along Williams Gas Pipeline's Transco system, which lies along a HVAC corridor in northern New Jersey.

induced voltage is constantly being evaluated and, where warranted, mitigation systems have been and are being installed to reduce the threat of AC induced corrosion.

In densely populated northern New Jersey, an on-going program to reduce the threat of AC induced corrosion has been undertaken. Those areas with the highest risk have been identified and are being systematically addressed. Initially, bare copper cable was being installed in a trench, backfilled by hand with coke to provide for a low impedance AC ground. The installation was time consuming and required a large quantity of coke backfill.

Seeking a simpler, more efficient installation, Williams sought an engineered packaged solution that could be installed without additional backfill. The first 20,000 ft of this product was delivered in January, and is currently being installed along two HVAC corridors. The use of the packaged grounding system has facilitated the installation process, reducing costs and assuring a robust AC mitigation system. ■

The authors

Ted Huck *is Vice President of Sales and Marketing for MATCOR, Inc., headquartered in Pennsylvania with an office in Houston. He holds a BS in Electrical Engineering and a Masters in Business Administration. He has worked with clients worldwide on cathodic protection applications in pipelines, power plants, condominiums, parking garages, above ground storage tanks and more. He can be reached at* thuck@matcor.com.

Rob Shoaf*, P.E., is a Pipeline Integrity Team Leader for the Princeton, New Jersey, division of Williams Gas Pipeline Company. He holds a B.S. degree in Mechanical Engineering from The Pennsylvania State University. He has sixteen years of experience in the pipeline and oil and gas industry and is a NACE Cathodic Protection Technologist. He can be reached at* william.R.Shoaf@Williams.com.