Program Design, Engineering Key To Infrastructure Replacement And Cost Containment

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Infrastructure. It's a word we'll hear a great deal about in the next few years due to U.S. government stimulus funding. The natural gas distribution industry, unfortunately, shouldn't count on federal funds for our infrastructure concerns. Other than the occasional parallel construction with a public works project — to possibly save resurfacing costs — we're pretty much on our own. That has been the case for our industry since the 1960s when plastic pipe was first used to replace bare steel and cast iron in the approximately 2 million miles of distribution pipeline now delivering natural gas to homes, offices, businesses, schools, and hospitals in the U.S.

Although federal money may not be forthcoming, new federal regulations will be. The Distribution Integrity Management Program (DIMP), directed through the U.S. Department of Transportation's (DOT) Pipeline and Hazardous Materials Safety Administration (PHMSA), is a proposed rule and is expected to be a final rule soon. The DIMP rules follow regulations established by the same federal authority in 2001 for liquid pipelines and in 2003 for natural gas transmission pipelines.

While the goal of the new DIMP regulations is to make the nation's pipeline systems safer and more reliable, the rules will also require local distribution companies (LDCs) to develop an integrity management program consisting of seven elements. These seven elements include mandating that the LDCs do the following:

- Demonstrate knowledge and an understanding of their distribution system.
- Identify threats to their system by gathering data from several sources.
- Evaluate and prioritize risks posed to their system.
- Identify and implement measures to address risks.
- Develop and monitor performance measures to evaluate the effectiveness of their program.

An Operator's Perspective On Pipeline Replacement

By **Jim Francis,** Director of Engineering and Asset Management, **Vectren Corp.**

After an evaluation of our pipeline distribution system, Vectren Corp. set out creating an infrastructure-replacement program that would improve the reliability and safety of service to our more than 1 million customers in Indiana and Ohio. Working closely with regulatory commissions in Indiana and Ohio, we agreed on a rate case strategy that would allow for the replacement of more than 1,700 miles of aging bare steel and cast iron pipeline over 20 years. That replacement project is now under way with a target rate of approximately 90 miles a year. Here is what we've learned from our experience to date.

Use the experience of others to guide your own strategy. Seek out the counsel of other gas distribution companies before rolling out a significant infrastructure-replacement program.

If you're going to make your best business case for a long-term replacement program to state officials, shareholders, and customers, you have to know your system's data, performance, and leak history; all costs associated with the project; and the value that your customers are going to gain from the replacement program.

Dedicate internal staff to whom the engineering consultant and design firm will report. This allows for more effective management of the entire project.

When identifying a design-engineering consultant, you might initiate and test the relationship with a controlled and focused assignment such as: working on a small set of design projects; portions of an integrity management program; or, on some other tasks like project management, metallurgy work, or procedure writing.

Engage your key resources early in the process. Your engineering firm, construction firms, and material-management people should be engaged in the structure of the program and in establishing design and construction standards. Creating a specific manual for bare steel and cast iron program design and construction standards is critical to implementing both an efficient design and construction process.

Few distribution companies have the additional workforce to make the jump in the level of engineering design work that must be performed in a short period of time (such as the design of a pipeline replacement program). At the outset of a replacement program, in year one particularly, it is essential for everyone involved in the project to bring enough resources to bear to begin construction.

Outside firms that have considerable experience in pipeline design can provide assistance (and cost savings) during the material-procurement process, in bid preparation, and in reviewing construction-installation costs.

Large pipeline-replacement programs dictate that work is done in sequence, which increases the need for coordination among all parties to achieve necessary cost containment and economies of scale. A solid audit process is necessary to make certain that costs are reasonable.

You achieve the greatest success when you plan the work far enough in advance that you can feed your engineering firm a steady stream of work so they in turn can design the requisite miles per year of new pipe to support an efficient materials management and construction process.

Provide training for your consultant, as needed, on your company's systems and processes. Having direct access to systems and data through a Web portal is extremely helpful. It is important that the consultant engineer designs exactly as if they were sitting in one of your offices.

Engage regulators in the process. Be open with them on what you're proposing to do and on the impact to the consumer. You want to be sure you're moving in the direction of successful implementation before a big investment is made that can't be recovered. ***P&GJ***

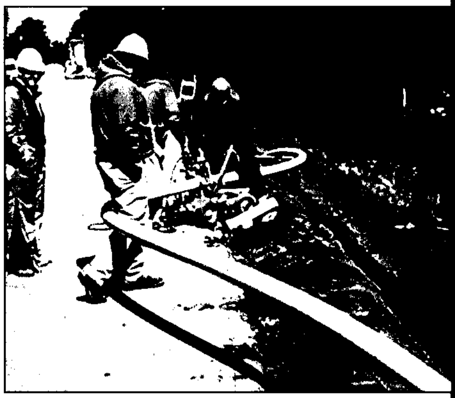
Editor's Note: Vectren is working with EN Engineering on infrastructure-replacement programs in Indiana and Ohio.

- Continually re-evaluate risks.
- Annually report program results to PHMSA.

The positive news is that there are utility engineering and design consulting firms available to assist operators with DIMP regulations. Since 2004, when regulations for the transmission pipelines fueled engineering demand, these firms have gained significant experience in developing integrity management programs and in dealing with state and federal regulators.

Under the proposed regulations, LDCs will have to develop written plans that pull together a large amount of operating, maintenance, and construction data to show knowledge of the performance and integrity of their system infrastructure.

Integrity management programs will need to include a detailed risk analysis in which operators: 1) formally identify threats to their systems based on data collected from incident and leak history, corrosion records, surveillance and patrolling records, and maintenance history; 2) evaluate and prioritize these risks; 3) develop ongoing risk-management measures to address them, and 4) annually report back to federal regulators. Engineering firms that specialize in natural gas infrastructure consulting should be able to assist in each of these four areas.



An Aging Infrastructure

According to DOT statistics, approximately half of the gas distribution piping in the U.S. is metallic – of which more than 100,000 miles is bare steel and cast iron pipe. In some cases, the country's pipeline infrastructure includes bare steel and cast iron gas mains that have been in service for 100 years or more. Over the years – and across the industry — a number of systemic problems have been identified, such as compression-coupling failure on plastic pipe, accelerated corrosion of bare steel pipe, and cracking of cast iron pipe. When operators have a complete picture of their system and a better idea of the status of their infrastructure, they may determine it prudent to accelerate their existing repair program or to formalize a multi-year replacement program.

In some cases, state commissions may mandate some type of replacement or rehabilitation program. In other cases, it may be more cost-effective to systematically replace older piping systems than to continue costly maintenance and repair. In yet other scenarios, safety issues themselves will dictate these decisions. The integrity management programs — not to mention the design and engineering of the large-scale construction projects that could result — are time-consuming and manpower-intensive.

For many LDCs, the data required is not

integrated on a functional basis, but is scattered among different departments, separate information systems, or subsidiary utilities. Gathering and analyzing this data is a perfect assignment for utility engineering and design-consulting firms, which have the trained people, the resources, and the overview of industry best practices to deliver regulatory reporting and replacement/rehabilitation programs. Additionally, engineering and consulting firms can provide the timeliness and cost efficiency required of operators in this era of tight budgets and strict oversight.

Setting Priorities

An integrity management program is an early step in the process to determine the condition of a system's infrastructure, one taken well before any design and engineering can be performed on a bare steel/cast iron replacement program. Under the federal regulations for gas transmission pipelines, highest risk areas — where the population density could result in greater damage and injury due to pipeline failure — could be identified by periodic inspections for corrosion and other defects.

A different approach is necessary for gas distribution piping as most, if not all, of the pipe is located in close proximity to people and because associated service lines deliver gas directly into homes, businesses, and offices. For a variety of reasons, distribution systems in general cannot be internally inspected in the same manner as transmission lines. Hence, an intensive data research effort is necessary to develop an integrated perspective on system performance. Outside consultants can provide the resources and focus to research data in a timely manner and bring relevant decision-making practice to identify and prioritize the piping recommended for replacement.

Within a pre-determined main segment — which in urban areas could be 10 feet, one block, 10 blocks, or 10 miles in length — historic data from several internal sources is reviewed. Areas of active corrosion are identified from leak histories; soil samples may be taken to identify "hot spots" or corrosive soil areas; and pipe coupons can be taken during excavations to determine pipe wall thicknesses.

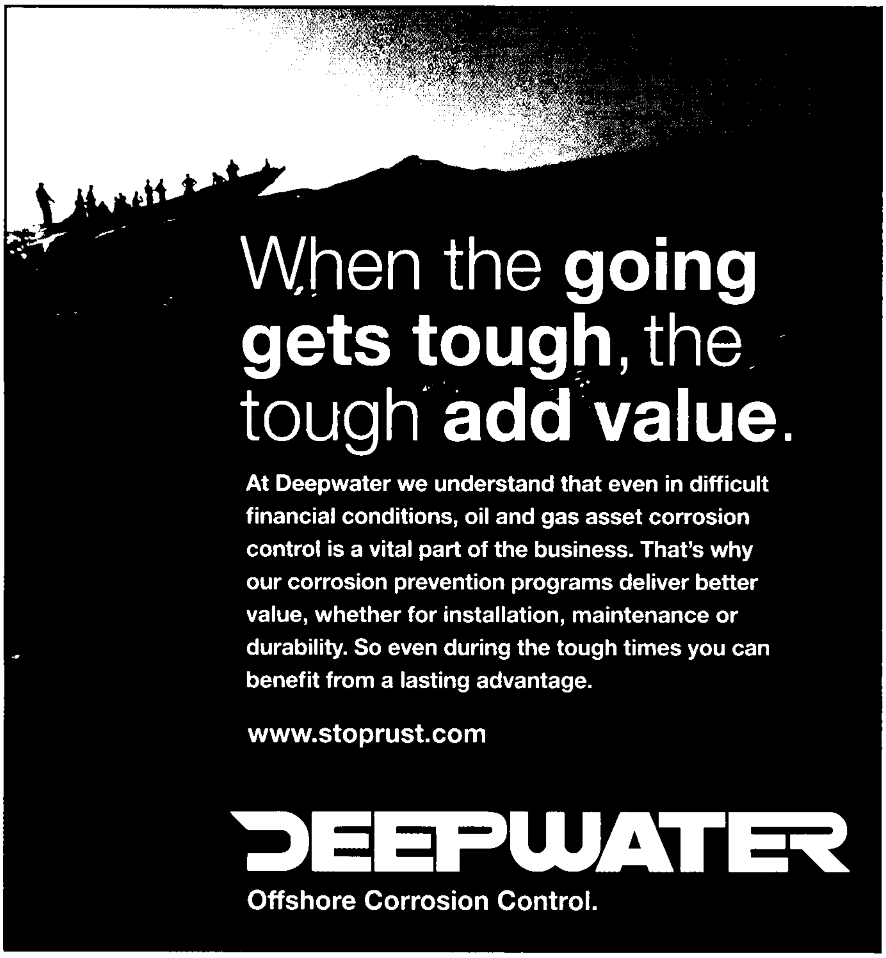
Causes of leaks are determined to eliminate those from third-party damage (as opposed to corrosion, material defects, fitting failure, soft pipe, etc.). An algorithm is developed, considering multiple factors to determine a relative risk level for each segment within the entire system. The segments with the highest risk value receive priority for repair or replacement.

Based on this prioritization, a repair or replacement determination can be made. When feasible, the operator may work in tandem with street improvement schedules to time a replacement program that minimizes the impact of construction disturbances and site-restoration costs. A prioritized replacement strategy can also reduce operation and maintenance costs by avoiding further leak repairs.

When considering a replacement strategy, risk alone may not be the sole factor taken into account in determining an optimal time to replace. Operators can take a systematic approach and achieve cost savings by converting large areas of their system from a like-sized replacement to smaller diameter, higher pressure pipe which may also include eliminating the need for associated pressure regulator stations requiring annual inspection and maintenance.

Designing A Replacement Program

Following these analyses and the iden-



tification and prioritization of the higher risk areas, the overall design can begin. Designers should tailor recommendations to include material, pressure, locations of source gas, system analysis, methods of installation and construction, tie-ins with the existing system, types of connections and fittings, service line replacement criteria, coordination with other utilities, and the creation of bills of materials and job estimates.

Finally, a construction plan can be devised with the full determination of pipe connections to each necessary service. In order to optimize the plan, an experienced design firm can also bring an outside perspective and industry best practices developed from working with multiple LDCs across the country.

In some cases, replacement programs are long term, with cost recovery determined by state commissions. A Georgia project, for example, is now two-thirds of the way through a 15-year effort to replace more than 2,600 miles of pipe — some of which was installed in the 1860s. In Pennsylvania, $1.4 billion will be spent over 20 years to replace 2,400 miles of bare steel gas lines in some of the nation's oldest towns and cities. In one service territory in parts of Indiana and Ohio, Vectren Corp. has begun replacing more than 1,700 miles of aging infrastructure — a program expected to last 20 years (see sidebar).

The majority of the cost of these and other infrastructure replacement programs is in construction, material, and utility labor. Design engineering, by comparison, is one of the smallest aspects of the program as a percentage of total costs. But proficient design engineering performed by pipeline experts can have a significant impact on minimizing overall costs.

Although most LDCs have internal engineering resources, they are finding more benefits in turning to outside utility engineering consultants. These benefits include a focused approach that provides for on-time delivery of standard materials and methods (based on industry best practices), to reduce carrying and inventory costs. Typically, utilities do not have the required number of internal resources to take on and complete such a large amount of additional work within the desired time constraints.

Whatever the final DIMP regulations stipulate, the likely result will be to accelerate the inevitable replacement of pipe. While some of the nation's outdated infrastructure poses a risk of failure, at least operators are aware of the potential financial, political, and legal costs of these risks to their stakeholders. What operators may not be aware of are the resources available in the form of utility engineering and design consulting firms to assist them in complying with the new DIMP regulations. ***P&GJ***