NACE INTERNATIONAL

ROUNDTABLE

Integrity Programs Key To Protecting Today's Pipelines From Corrosion

Tony Keane, Executive Director of NACE International

Tony Keane, Executive Director of NACE International, recently assembled a panel of NACE member pipeline corrosion control experts to answer a series of questions on the challenges involved in pipeline protection, including the best engineering and management practices for ensuring their integrity.

"The emphasis on pipeline integrity has increased significantly in recent years, largely in response to several high-profile, catastrophic failures that were caused by corrosion—the second leading cause of pipeline failure after third-party damage," says Keane. "Stricter regulations, liability and safety issues, and increased emphasis on protecting the environment are bringing corrosion control considerations to the forefront of pipeline protection programs."

The four expert panelists have worked for a variety of companies charged with managing pipeline protection systems in all types of environments. Here, they comment on their programs, challenges, opportunities, and visions for future requirements and improvements in the field of pipeline corrosion control. The panelists are Oliver Moghissi, senior vice president of CC Technologies, Inc., a DNV company; Jerry Rau, director of pipeline integrity, Panhandle Energy; Joe Pikas, vice president-Houston Gulf Coast, MATCOR; and John H. Fitzgerald III, consultant for Corrpro Companies, Inc. and technical editor of NACE International's *Materials Performance.*

Oliver Moghissi, Senior Vice President of CC Technologies, Inc., a DNV Company.

Jerry Rau, Director of Pipeline Integrity, Panhandle Energy

Joe Pikas, Vice President-Houston Gulf Coast, MATCOR

John H. Fitzgerald III, Consultant for Corrpro Companies, Inc., Technical Editor of NACE International's *Materials Performance.*

Q: How does corrosion impact pipeline integrity plans, and what factors must you consider when designing and implementing your program?

Moghissi: Threats on pipelines are often categorized on the basis of their time-dependence. Examples of time-independent threats are mechanical damage resulting in immediate failure or material defects that do not grow. Time-dependent threats such as corrosion are managed differently. Since the time to initiate damage and the time between initiation and failure can be many years, integrity management needs to address the development of damage in addition to detecting and repairing existing problems.

Rau: Corrosion threats are the majority of time-dependent categories that must be considered in every integrity plan, so a great deal of emphasis must be placed on corrosion assessment, remediation, mitigation and prevention. We use standard operating procedures as a main component of our integrity management plan, which fully describe how we perform corrosion control on our facilities. For external corrosion, we perform routine close interval surveys, which allow us to better formulate the required mitigation efforts, such as recoats and the application of additional levels of cathodic protection (CP). For internal corrosion, we continuously monitor gas quality before mitigation is required.

The threat of stress corrosion cracking (SCC) is a bit more problematic. We do have a rigorous pressure-testing program that addresses assessment and mitigation of the threat. We are anxiously waiting for an effective inline inspection technique that can be used in natural gas service.

Q: What are the primary challenges involved in ensuring integrity?

Pikas: Overall, when preparing integrity programs for many of our clients, the most challenging issue is integrating these programs into the pipeline's existing procedures and operation and maintenance plans. We need to ensure the operation of a safe pipeline while complying with Pipeline and

Hazardous Material Safety Administration (PHMSA) regulations.

Rau: There are many challenges in implementing the requirements of an integrity plan and verifying compliance with the regulations. Of course the key component of any integrity program is ensuring public safety and protecting company assets. Prioritization and scheduling are complex challenges when resources are confined.

One of our biggest logistical issues is the piggability of our older lines. We have couplings, reduced port valves, non-standard construction practices from the 1930s and 1940s, river headers, and lack of launchers and receivers. It is a big drain on our company to get these issues resolved.

Moghissi: New regulations require integrity assessments of pipelines by inline inspection (ILI), pressure testing, or direct assessment (along with provisions for other technologies). A large portion of pipelines can be assessed for the majority of threats, but portions of pipeline systems are not easily assessed by available tools. From a corporate standpoint, some gaps in assessment might be acceptable because they do not significantly affect overall risk, but many locations will likely exceed acceptable local risk.

Many gaps in assessment can be addressed by technology development. It is important that regulations and standard practice documents allow the flexibility for research and development to meet those needs (i.e., they are not too prescriptive). For example, improving understanding of corrosion within the annular space of cased pipe is expected to enable external corrosion assessment and ILI tool development is expected to improve the ability to detect and size cracks.

Q: What are the opportunities available today that are improving pipeline integrity and safety; please include tools, technologies, and trends?

Fitzgerald: The continuing development of pipeline integrity technology brings regular improvement to pipeline integrity and safety. The accuracy with which the indirect inspections can pinpoint areas of concern or of apparently good pipe continues to improve. In my experience, the combination of data from close interval surveys, direct current voltage gradient and alternating current (AC) voltage gradient surveys, AC attenuation surveys, soil resistivity surveys, and smart pigging gives very accurate results. The accuracy of these data has improved safety since now problem areas can be located quite well and remedial action taken as required.

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— Oliver Moghissi, Senior Vice President of CC Technologies, Inc., a DNV Company.

Moghissi: The biggest opportunity is to optimize the use of existing tools and technologies through the use of risk and decision analysis principles. Corrosion specialists can improve their knowledge about cost optimization, and financial decision-makers can improve their ability to evaluate technical corrosion recommendations.

Corrosion specialists can improve their ability to draw from multiple corrosion control technologies (e.g., coatings, corrosion-resistant alloys, cathodic protection and chemical treatment) and communicate technical recommendations in the context of return on a corrosion-control investment. Many corrosion specialists presently behave parochially be-

cause their knowledge is limited to a narrow technical area. Many corrosion specialists also lack the financial and risk knowledge to make recommendations in terms that financial decision-makers understand.

Financial decision-makers can improve their knowledge to evaluate the merit of technical corrosion recommendations. Those with financial authority often have incentives to reduce annual cost but lack the ability to understand what level of investment is required to efficiently manage risk over the life of an asset. This is exacerbated by the fact that the consequences of poor corrosion control are often not realized until many years have passed (sometimes well beyond the transfer of the decision-maker to another management post).

For both corrosion specialists and financial decision-makers, decisions are rarely made on the basis of life-cycle cost. In particular, the struggle between teams that control capital expenditures and operating expenses is inefficient because the incentives for project teams to reduce initial costs conflict with the incentives on operations staff to reduce maintenance costs.

Rau: All challenges cannot be solved simply by improving technology. Technology, of course, is invaluable in assessing pipeline integrity and reliability. But true improvements in integrity rely on process control and appropriate analysis and reaction to assessment results.

Q: In your experience, have recent legislation and liability issues changed the way companies invest in and implement corrosion control systems on pipelines?

Pikas: Overall, I think pipeline operator managements are getting the point and are responding in a responsible manner. However, pipeline operators are just beginning to understand the responsibilities of running and maintaining a pipeline against the environmental/corrosion forces that have a direct impact on the integrity of the pipeline system. This is a time-related problem.

Moghissi: Recent visible failures have made operators more aware that a single location with an unexpectedly high corrosion rate coupled with a consequence made higher by loss of reputation can affect corporate risk. Relying on average corrosion rates across an asset and average consequence is no longer considered adequate, and the exceptions now play a role. It is possible that the same awareness caused legislation and regulatory changes (rather than the other way around).

Rau: We must stay ahead of the curve on regulatory issues. Research and standards development is the key. We cannot afford to have reactions to the issues of the day drive the regulatory process. We must stay in the forefront in developing the research to improve our processes and tools and have those incorporated into international standards in a timely fashion.

Fitzgerald: My experience in this area lies in the corrosion-control short courses and conferences at which I speak and teach classes. In the last five years, I have seen a marked increase in the level of interest that attendees have in learning more about pipeline integrity. I have been involved in short courses for about 40 years and have never in the past seen so much interest as we now experience. In talking with attendees, and from the increased number of people that pipeline companies are sending to these courses, it is apparent that companies are willing to spend the money required to educate personnel and to take the action to meet the pipeline integrity regulations.

Q: What is the most critical issue(s) you will face concerning pipeline corrosion control in the next decade and beyond?

Rau: The aging workforce is one of my most immediate concerns, being in that category myself. We must be prepared to replace that experience that will be lost in technicians, specialists, and engineers. The direct result will be a greater dependence on the timeliness and applicability of training.

Moghissi: Operators will continue to face life-extension of assets that are far beyond their original design life and have already experienced corrosion damage. Regardless of forecasts on energy demand, energy prices, public risk tolerance, encroachment, and evolving regulations, consensus exists that the majority of the existing U.S. pipeline network will still be in service well beyond the next decade.

Fitzgerald: I think a critical issue that will occur is if legislation is expanded to standard distribution piping. Because of the complexity of underground structures in the streets and roads of distribution areas, many of the techniques that are presently used for pipeline integrity will not work. This challenges both pipe-

line companies and corrosion-control personnel in general to develop methods of determining pipeline integrity in distribution systems.

Pikas: There are many issues; however, alternating current (AC) corrosion is one that seems to raise its ugly head on well-coated pipelines in AC corridors. Using high dielectric materials on girth welds that disbond and shield can result in severe corrosion problems.

Q; With the new regulatory requirements for inline inspection, hydrostatic testing and direct assessment, what has been the impact on pipeline integrity and how have they enhanced the corrosion management programs?

Moghissi: New U.S. regulatory requirements have significantly increased the amount of pipelines assessed for corrosion damage, but they have not yet significantly enhanced how corrosion is managed. Many integrity management programs still take the form of "pig-and-dig" or "find-it-and-fix-it." On this basis, a flaw is found and repaired. Enhancing corrosion management would include understanding why the damage occurred, performing a mitigation action, and using the results of the experience to predict and prevent similar failures elsewhere.

Pikas: Using a variety of tools gives the pipeline operator an understanding of the problems and issues that are occurring on the structure. However, not following up with adequate excavations and understanding the root cause of the problems is another issue by itself.

Rau: I would turn it around and say that because we already have very mature corrosion-control programs, we have been able to utilize those processes to verify integrity of our systems. The prevention and mitigation elements of the rule come into play with these deeply imbedded processes. We have taken advantage of the procedures that were developed over many years to verify appropriate levels of corrosion prevention. Assessment requirements verify that these existing processes are highly effective and identify areas where additional efforts are required.

Specifically, Panhandle has utilized pressure testing for SCC mitigation since the early 1970s and began to establish baseline integrity assessment of the entire pipeline system in 1992. My belief is that the biggest benefit of the rule lies in the requirements for process control.

Q: Are there any other comments you would like to make?

Moghissi: Communicating integrity management practices to local communities will be a continuing challenge. Effective risk communication requires high ethical standards, use of established public communication practices, and sympathy to local community members who are exposed to pipeline risk without realizing a benefit. A specific area of recent improvement has been the wider appreciation of technology limits for ensuring pipeline integrity.

Fitzgerald: I have been in corrosion engineering since 1959 and spent the first six years of that experience in gas distribution. From my early days until perhaps 10 years ago, I found that corrosion engineering was just not taken particularly seriously by owners and consulting engineers alike. It is satisfying now to see this very important discipline, which affects nearly all the areas of safety, ecology, environment and resources, finally coming into nationwide acceptance and understanding. ***P&GJ***

Tony Keane *is the Executive Director of NACE International, the technical society for corrosion professionals. Founded in 1943 by 11 pipeline engineers, NACE now has more than 19,000 members in 100 countries and is involved in every industry and area of corrosion prevention and control. With a mission to protect people, assets, and the environment from the effects of corrosion, NACE offers technical training and certification programs, sponsors conferences, and produces industry standards, reports, publications, and software. For more information, please visit www.nace.org.*

John H. Fitzgerald III *is a consultant for Corrpro Companies, Inc. and Technical Editor of NACE International's Materials Performance. He previously was with Columbia Gas of Ohio and has been involved in corrosion work since 1959. He is experienced in underground and submerged structures, cathodic protection, and stray current control. He received the Mars Fontana Award, T.J. Hull Award, NACE Outstanding Service Award, and the Colonel Cox Award. A NACE Fellow, Fitzgerald is a registered professional engineer, a NACE-certified Corrosion Specialist, and a NACE Past President.*

Oliver Moghissi *is Senior Vice President of CC Technologies, Inc., a DNV company. He manages the Corrosion and Materials Technology Laboratory, which performs research and development, testing, and failure analysis services. His experience is focused on developing technology to improve corrosion management programs. Moghissi is an active member of NACE International and serves on its board of directors. He has a Ph.D. degree in chemical engineering from the University of Florida and M.S. and B.A. degrees from the University of Virginia.*

Joe Pikas *has been Vice President, Houston Gulf Coast with MATCOR for the past five years. He previously was Risk Coordinator/Senior Corrosion Engineer with Williams Gas Pipeline for more than 36 years. A 37-year member of NACE, Pikas is a NACE-certified Corrosion Specialist and Cathodic Protection Specialist and is past president of the Coating Society of the Houston Area. He has written more than 20 technical papers, has presented at various conferences and seminars, and has received several awards from pipeline organizations and technical societies.*

Jerry Rau *is the Director of Pipeline Integrity for Panhandle Energy, a major supplier of gas to markets in the South and Midwest. An active member of NACE and ASME, Rau has more than 35 years of experience in corrosion control and integrity issues. He has made many presentations to trade organizations and has authored numerous papers on corrosion control. He has served on various technical committees and is chairman of the Pipeline Committee of PRCI.*