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Using pipeline integrity rule for pipeline inspections

Historically, transportation of oil and gas by pipelines remains the safest and most economical mode compared with other modes. However, pipeline integrity does cause a concern to the public and environment along the pipeline route because it is ever present at the location for its useful life. U.S. pipeline failure incidents in the late '90s accelerated the process of mandating pipeline integrity rules, which, when implemented, will assure safe, reliable and environmentally responsible operation of oil and gas pipelines.

The pipeline integrity rule for Hazardous Liquid (CFR 49 § 195.452) and Natural Gas (CFR 49 § 192 Subpart O) became effective May 29, 2001, and Jan. 14, 2004, respectively. These regulations are a result of seven years of technical studies that focused on the causes of failure in pipelines and the best practices in mitigating these failure causes. These studies identified 21 failure causes, which were categorized into the following nine categories — corrosion external, corrosion internal, stress corrosion cracking, pipe manufacturing defects, pipe fabrication defects, equipment failure, third-party damage, incorrect operation and natural forces.

As the U.S. pipeline industry started to implement the new rules, API, ASME and National Association of Corrosion Engineers (NACE) International standard bodies presented a host of standards to comply with the pipeline integrity rules. These standards are now being adopted by international pipeline operators as a benchmark, especially in countries where no local regulations on pipeline integrity exist. Internationally, some of the major operators have already developed advanced models of pipeline integrity management programs based on the standards.

The key requirements of the integrity management program in these standards can be summarized into seven processes: 1) Identifying pipeline segments in high-consequence areas (HCA) (high population, etc.); 2) Data collecting and comprehensive analysis to identify pipeline failure threats of concern; 3) Performing risk assessment based on probability of failure from each identified threat and its consequences; 4) Performing a prioritized integrity assessment on segments in HCAs using tools and methods capable of detecting defects associated with identified threats; 5) Evaluating integrity assessment results, and identifying and performing prioritized repairs; 6) Collecting, analyzing and performing a risk assessment periodically on new pipeline data; and 7) Establishing integrity assessment interval.

Operators are now integrating these seven pipeline integrity processes into their business model to optimize their operation and maintenance expenditures.

The 80/20 rule can be applied when implementing these processes. When applied to pipeline integrity using the seven processes, most (80 percent) of the integrity issues are a result of a smaller number (20 percent) of causes, which is explained as follows:

➢ Targeting pipeline segments in HCAs allows resource allocation to pipeline segments that are likely to cause major consequences in an integrity failure event.

➢ The task of finding defects from each of the nine categories of integrity threats and 21 causes that may initiate a failure can be appalling and a drain on resources.

➢ The risk assessment process prioritizes pipeline segments and associated threats based on risk.

➢ By identifying the top few (20 percent) of the threats, the selection of tools and methods remain focused on the real problems and optimize the cost of integrity assessment.

➢ The repair decision process is critical in meeting the objectives of performance goals. By categorizing criteria for immediate repairs, 90-day repairs and 180-day repairs, the 80/20 rule is at play.

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When pipeline integrity processes are implemented diligently, the 80/20 rule helps in budgeting and optimizing operation and maintenance costs. However, at the start of implementation, the risk assessment will get to the problems that are easy to detect, but once the low-lying fruits are taken, the next stage risk of assessment will result in decisions that have a higher impact on maintenance costs and should be seen as efforts to achieve higher performance goals.

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