Interstate Natural Gas Association of America
20 F Street, N.W, Suite 450, Washington, D.C. 20001
phone: 202.216.5900 **www.ingaa.org**

Resident Manufacturing and Construction Threats

Purpose

This document is intended to highlight various conditions related to manufacturing and construction threats, and provide pipeline operators with guidance.

Definitions

There are many terms that have been used interchangeably related to imperfections, anomalies and defects. The definitions given in API 1163 are appropriate and are used throughout this document. To avoid confusion, the following definitions apply:

- Anomaly – An unexamined deviation from the norm in pipe material, coatings or welds
- Imperfection – An anomaly with dimensions and characteristics that do not exceed acceptable limits
- Defect – A physically examined anomaly with dimensions or characteristics that exceed acceptable limits

Introduction

Historically, all engineered structures contain small, sub-critical imperfections, the normal result of construction and manufacturing workmanship or material imperfections that have survived manufacturing quality inspections, processes and proof tests. Although these pre-existing conditions (or "resident threats") might contribute to pipeline deterioration, their existence typically is compensated for and factored into pipeline design, operation and maintenance.

Since 1928, all pipe mills qualified by API 5L have required each pipe joint to pass a mill pressure test. In addition, the ASME B31.8 pipeline standard has recommended leak tests since 1935 and full post-construction pressure tests (>110% MAOP) since 1955. These many successful pressure tests demonstrate that required strength has not been compromised by imperfections.

Pipeline Quality Controls

Minor manufacturing and construction imperfections, having already survived their initial inspections and tests, are considered stable, unless acted upon by time-dependent failure mechanisms or time-independent events such as external force. Stable means that these resident imperfections do not deteriorate independently and will not threaten integrity unless changes occur that increase the imperfection to a size that can continue to grow under operating conditions or that change the pipe or its properties or characteristics such that the imperfection can grow.

Pipeline segments that have been subjected to a 49 CFR 192 Subpart J pressure test are considered to be fit for service at that time, consistent with industry research.

What Can Cause Resident Imperfections to Grow

Although manufacturing and construction quality control practices leave behind only sub-critical imperfections, future operations-related conditions could cause these imperfections to grow in size and lead to the possibility of failure. Deterioration could occur over time due to changing operating pressures, active corrosion and other phenomena. Deterioration could also occur during a single event resulting from time independent events such as unusual weather or an unexpected outside force event. For example, severe flooding may generate excessive stresses at a pre-existing subcritical imperfection.

Resident imperfections should be evaluated for plausible deterioration conditions that could lead to increased failure potential. Various threat-related conditions could initiate imperfection growth on pipe joints containing subcritical imperfections. These threat conditions - and how they can affect resident imperfections - include (but are not limited to):

1. Incorrect Operations
    a. over-pressurization
2. Cracking
    a. linking with subcritical imperfections
    b. initiation of environmentally-assisted cracking
3. Corrosion
    a. selective corrosion (by/on long seams)
    b. hydrogen cracking at hard spots and heat affected zones of long seams, girth welds, or other stress risers associated with fabrication welds
4. Manufacturing/Construction
    a. rock and other dents
5. Third Party Damage
    a. dent concurrent with damage or seam or girth welds
6. Weather and Outside Force
    a. soil settlement, instability or washout affecting a vintage girth weld, mechanically coupled joint, or acetylene girth weld,
    b. fabricated branch weld resulting in overstress, or
    c. a resulting buckle across a seam

Pipeline operators should therefore update their facility records after they inspect their pipelines and then proactively use science, engineering, and data integration to manage their pipeline safety.

Conclusion

Based on operator knowledge, empirical data, and public domain research and development, identifying failure mechanisms that may weaken a pipe at possible resident imperfection sites is difficult. The identification of these mechanisms requires the integration of multiple data sets such as mill procedures, construction practices, operational history, prior related inspections and environmental conditions, among others, affecting the pipe.

Proper evaluation of these considerations occurs as part of a robust risk-assessment program. The risk assessment will identify and prioritize potential threatening conditions. Managing both the known and unknown requires that additional inspections, assessments and preventive measures be implemented to minimize a risk of failure.

INGAA has developed a Fitness for Service (FFS) methodology to manage pre-regulation pipelines. This FFS document provides specific actions that should be taken based on the location and pressure-test history of the pipeline. INGAA believes this methodology is acceptable for managing potential resident threat issues and should be applied when operators lack traceable, verifiable and complete records.