MANAGING CRACKS AND SEAM WELD ANOMALIES ON PIPELINES

Introduction:

Various forms of cracks or crack-like indications are known to be present on pipelines, which could become a safety concern to their safe operation. The most typical forms of cracking and its derivatives are environment-, manufacturing- or operations-related, such as stress corrosion cracking, corrosion fatigue cracking, hydrogen-induced cracking, hook cracking, and seam-weld anomalies (such as those related to ERW/flash-welded pipe). This course will provide an integrated, data-driven approach for addressing these forms of cracking and seam-weld anomalies. It covers in greater depth the formation of these types of anomalies and the conditions that drive their growth until they become unstable, leading to leaks or ruptures. The appropriate assessment methods such as ILI crack tools, pressure-testing and direct assessments will be presented as well as traditional and current engineering approaches for establishing crack severity and determining future integrity.

Documentation and Materials:

Participants will receive a full set of course slides and notes in paper and electronic form, in color throughout.

Who Should Attend?

- Pipeline engineers and maintenance personnel who are involved or responsible for the maintenance, inspection, assessments and repair of pipeline systems.
- Non-Destructive Inspection personnel who wish to acquire or increase their knowledge of crack formation and growth on pipelines

What will be learned:

On completion of the course, the student will understand what factors contribute to the formation and growth of crack□like features and seam-weld anomalies on pipelines. In addition, the participant will be able to gather and analyze the type and extent of cracking found, key operational parameters, pipe material properties, full-scale testing data, and ILI crack tool data, and to apply industry-recognized engineering methods for developing and recommending appropriate remedial action.

Course Outline:

Material Behavior and Engineering Fracture Mechanics

- Fracture of metals. Brittle and ductile fracture behavior. Engineering mechanics of crack formation and growth. What factors drive the formation and growth of cracks on pipelines?
- Engineering equations that govern stresses around a crack

Characteristics and Behavior of Cracks Found on Pipelines

- What are the various forms of cracks and seam-weld related anomalies typically found on pipelines? Description of SCC or corrosion fatigue, hydrogen-induced, hook cracks, seam-weld anomalies: lack of fusion, cold welds, stitching,
- Are material inclusions, laminations and roll-in slug/scab cracks or not?

Evaluating Crack Severity

- What are significant cracks on pipelines? Review of US and Canadian guidelines.
- When do cracks become a safety threat to the pipeline?
- Selecting an appropriate failure criterion
- Evaluating methods for determining crack severity:
    - ❖ NG□18 Equation derived: KAPA, PAFFC
    - ❖ Failure Assessment Diagram derived: API□579, BS-7910
    - ❖ CorLAS
- Determining the severity of cracks expected to fail at MAOP and at a Safety Factor x MAOP (such as 1.39 MAOP or 110% SMYS)
- Elements of an O&M procedure for addressing crack severity. What are the guidelines in your O&M procedure with respect to addressing the severity of cracking?

Repairing Crack-like Features and Seam Weld Anomalies

- Repairing by buffing out, installing a sleeve systems or cut out. What are the factors that determine an appropriate repair of crack-like indications and seam weld anomalies?
- Review recommended and appropriate repairs options: ASME, API, PRCI/PDAM, and applicable regulations
- Latest research and developments on repairing cracks
- What are the repair options for cracks in your O&M procedures?

Appropriate Crack Assessments

- Factors to consider when deciding the most appropriate assessment method or methods for a particular pipelines segment. When do these assessment methods complement each other to enhance existing remediation program?