Integrity Management System for NG Pipelines: Challenges & Way Ahead

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Integrity Management Process

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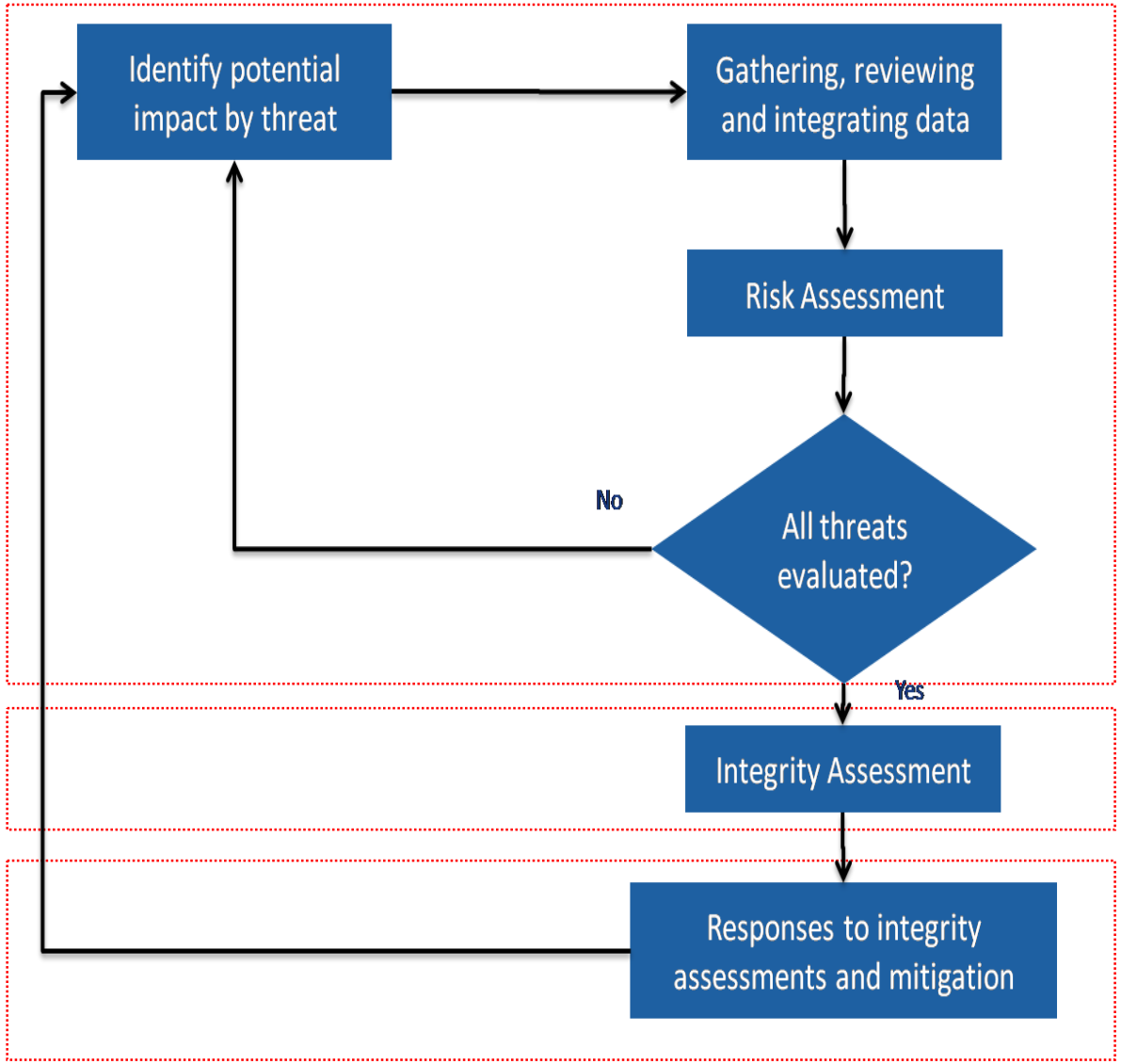
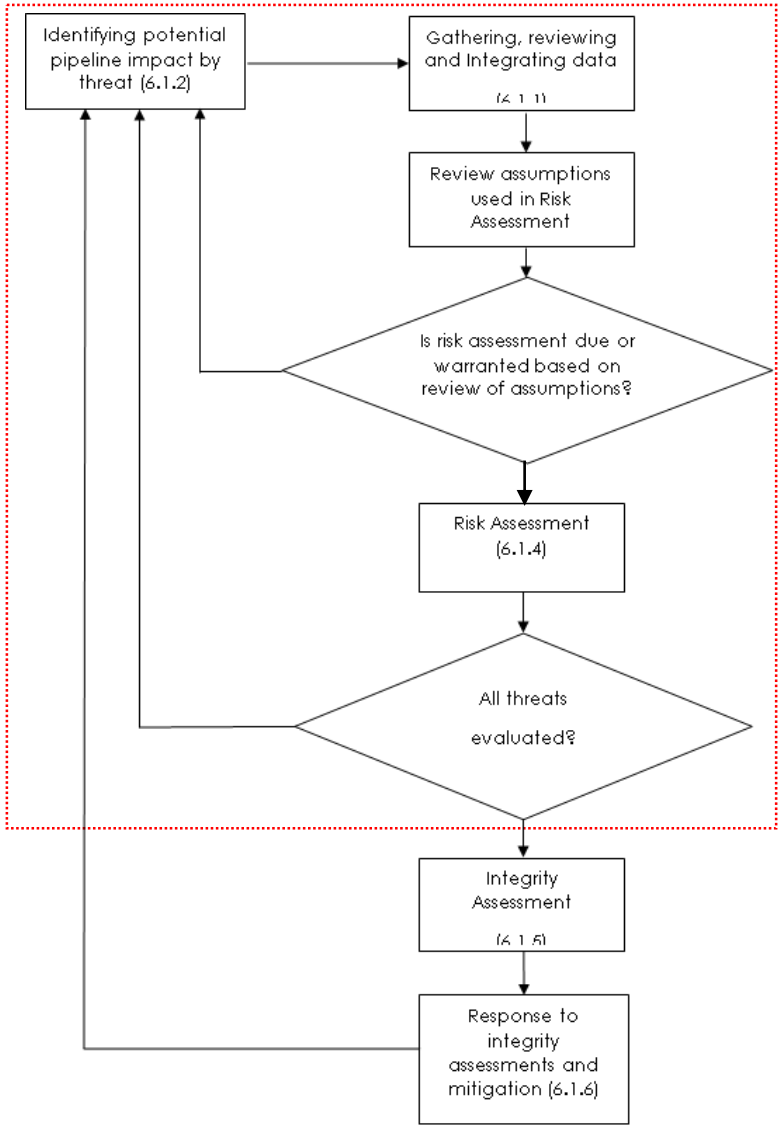
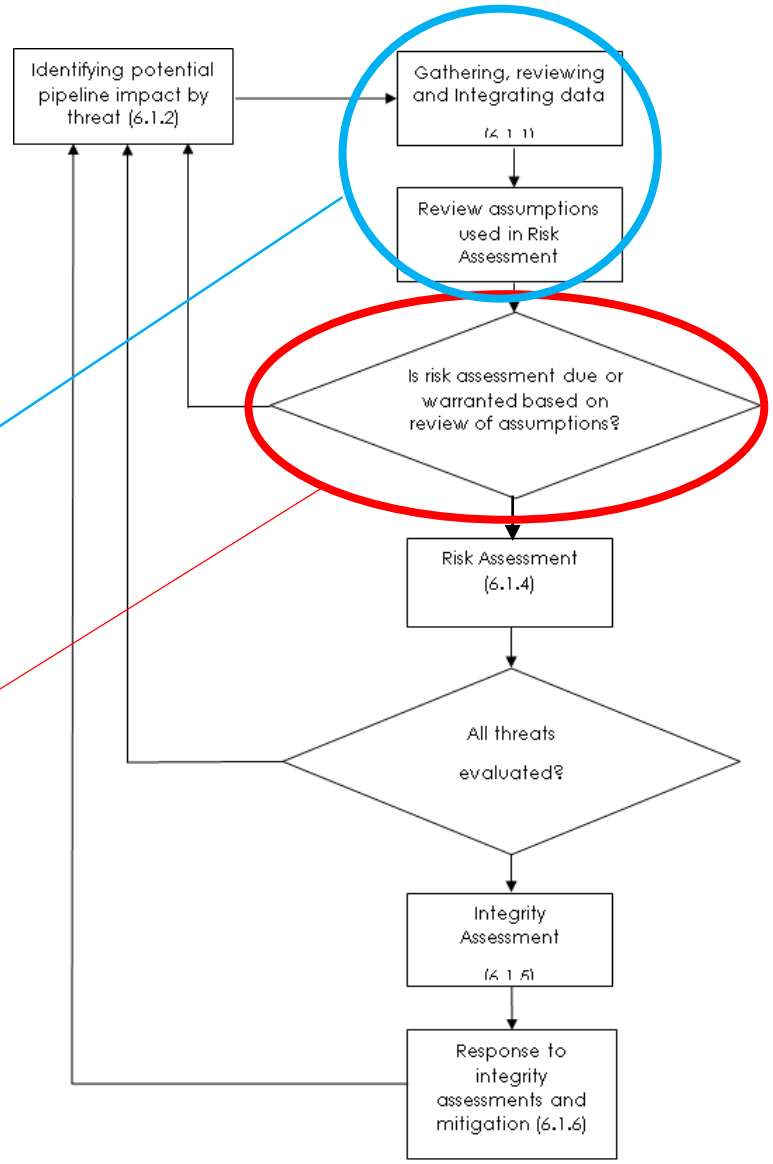




Risk Assessment

RA Approach

Selection of Model	• Subject Matter Experts (SMEs) • Relative Assessment Models • Scenario-Based Models • Probabilistic Models
Competence	• In-house • External Agencies
Data gaps	• Data Adequacy • Accuracy • Integration – Segmentation • GIS
Frequency	• Annual • Change in Operating Conditions • Change in Operating Environment • Change in Assumptions



Common factors:

- They identify potential events or conditions that could threaten system integrity.
- They evaluate likelihood of failure
- They permit risk ranking and identification of specific threats that primarily influence or drive the risk.
- They lead to the identification of integrity assessment and/or mitigation options.
- They provide for a data feedback loop mechanism.
- They provide structure and continuous updating for risk reassessments.

Risk Assessment

- Risk is typically described as the product of two primary factors:

  the failure likelihood (or probability) that some adverse event will occur and the resulting consequences of the event.

  A method of describing risk is:

  $Risk_j = P_i \, x \, C_i$ for a single threat

  Risk = $\sum_{i=1}^{9} (P_i \, x \, Ci)$ for threat categories 1 to 9

  Total Segment risk = $(P_1 \, x \, C_1) + (P_2 \, x \, C_2) + \ldots + (P_9 \, x \, C_9)$

Where

1 to 9 = failure threat category

C = failure consequence

P = failure likelihood

- Risk Assessment at Pipeline Design / Construction Phase Vs Operational Phase
- Abstract concepts to clear and actionable agenda
- Segmentation

Risk Assessment

Threats	Challenges
(a) Time Dependent	
1) External Corrosion	AC/DC Interference, Casings Shorts, Disbonded Coating
2) Internal Corrosion	Quality of fluid, Piggability, Fluid velocity, Fluid Cleanliness
3) SCC	All types of env. induced cracking in future?
(b) Resident (earlier Stable)	
(4) Manufacturing related defects	Design, Manufacturing Process, QA/QC
(5) Welding / Fabrication related	D/t ratio, High grade steel, QA/QC, Steel Grade / Wall Thickness Matching, Bends related
(6) Equipment	Gasket life / Inspection, IJ failure, Valve problems, Pig Barrel doors
(c) Random or Time Independent (earlier Time Independent)	
(7) Third-party/mechanical damage	Unregulated development, development of transport corridors across / along pipelines
(8) Incorrect operational procedure	
(9) Weather-related and outside force	Wash-out, pipeline cover erosion, free-spanning, slope stability, ground movement

Integrity Assessment

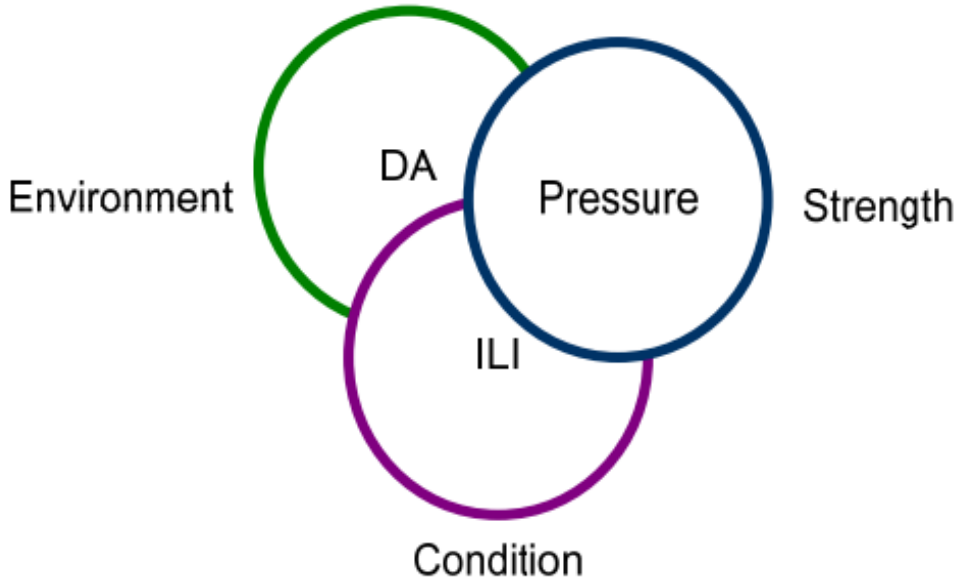
Inspection Techniques

ASME B31.8S

In-Line Inspection (ILI)

Direct Assessment (DA)

Hydrotest (Pressure Test)



PNGRB IMS Regulations

In-Line Inspection (ILI)

Direct Assessment (DA)

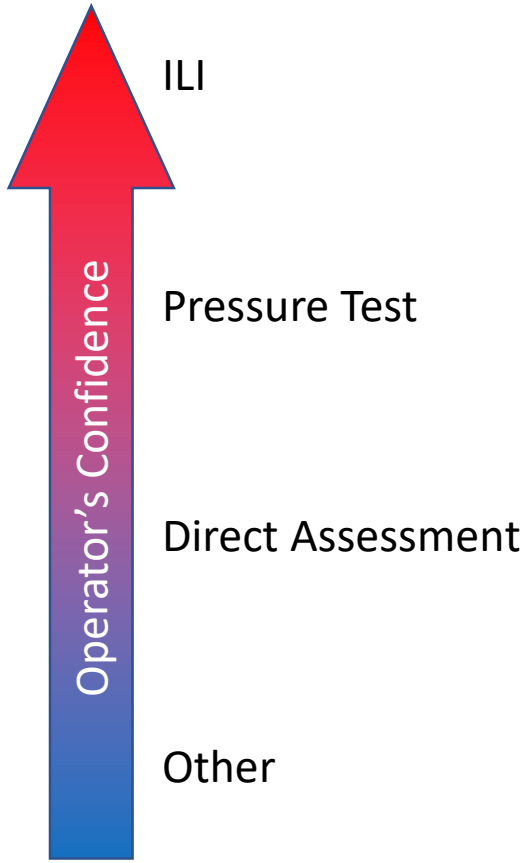
Hydrotest

Other assessment techniques such as Magnetic Tomography Method (MTM)

Integrity Assessment

Integrity Assessment: Operator Confidence

SN	Threat	In-Line Inspection	Direct Assessment	Pressure Test
1	External Corrosion	✓	✓	✓
2	Internal Corrosion	✓	✓	✓
3	Stress Corrosion Cracking	✓	✓	✓
4	Manufacturing related defects	✓		✓
5	Welding or Fabrication related	✓		✓
6	Equipment			
7	Third Party or Mechanical Damage	✓		
8	Incorrect Operations			
9	Weather Related and Outside Forces			



ILI Challenges

- Magnetic Flux Leakage tools are most deployed ILI tools
- Most suitable for
  - Corrosion
  - Other metal loss (voluminar)
- Limited detection, identification and sizing capability for
  - Anomalies in pipe bodies
    - Crack or crack like anomaly
    - Mid wall lamination / inclusion
    - Hard spots
  - Weld anomalies
    - Crack or crack like anomalies
    - Seam and Girth weld anomalies

Difficult to Pig or Unpiggable Pipelines

Difficult to Pig Lines

- Low / No flow Line
- Without Launcher/Receiver
- Sharp Bends / Multi-Dia /Reduced bore valves
- Station Piping

Deployed Techniques

- Direct Assessment
  - Only gives probable location of corrosion
  - ICDA not applicable to low/no flow lines
- Pressure Test
  - Difficult to take lines out of service
  - Does not provide indication of defects
- Other Techniques (GWUT, LSM, Phonon, etc.)
  - Only screening tool
  - No industry established standard
  - High cost implication

Response to Integrity Assessment

Veracity of Report • Correctness & validity of inputs • Performance metrics of survey • Validity of selected engineering assessment methods	**Present and Past Anomaly Tracking** • Verified / unverified • Coverage and techniques of NDT employed • Documented System of keeping track of data
Actionable Anomalies • Locating the features • Accessibility • Repair Methodology • QA/QC	**Re-inspection Interval** • Estimates of deterioration of unverified / unremedied anomalies / defects • Preventive measures against damage mechanisms • Determining MAOP

Robust Integrity Management System

- Management Focus, Involvement and Commitment
- Process to **identify weak links** on a continual basis and measures to mitigate them through structured Risk Assessment Program
- Regular and Open Communication channels and interaction among all stakeholders.
- Competency Development and Resource Planning
- Adoption of new technologies and Support to innovation & research

Thank You