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DEVELOPMENT OF INDUSTRY GUIDELINES FOR THE ENGINEERING CRITICAL ASSESSMENT (ECA) PROCESS UNDER IVP

PRCI PROJECT IM 1-4

PHMSA Hazardous Liquid Pipelines IVP Forum

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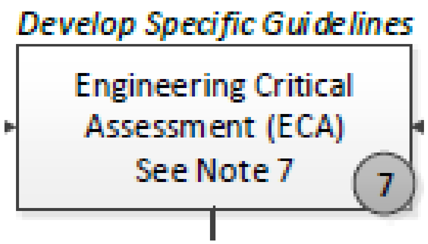
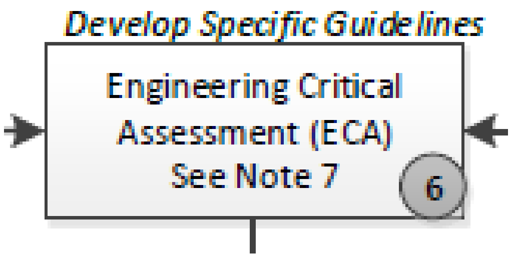
EPD LISTED NYSE

WHERE DOES ECA FIT IN THE IVP?

- Draft rules cite ECA as alternative option in lieu of pressure test for establishing MAOP/MOP





DRIVERS FOR ECA DEVELOPMENT

- Some lines/segments (gas & liquid) will be challenged to confirm IVP requirements are met
  - Meeting Subpart E/J for hydro
  - Material properties and TVC
  - Pipelines pre-dating regulatory code

- New technology is evolving rapidly and our industry is best served if ECA guidelines best leverage it to facilitate more effective regulation.

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WHAT EXACTLY IS AN ECA?

- The purpose of an Engineering Critical Assessment is to determine if a piece of equipment or structure is sound enough to meet the service requirements for which it was intended.

- API 1104 = An Engineering Critical Assessment (ECA) is an analysis, based on fracture mechanics principles, of whether or not a given flaw is safe from brittle fracture, fatigue, creep or plastic collapse under specified loading conditions.

- IVP flowcharts also have descriptions

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- The goal is to develop guidelines for conducting ECA's
  - Flexible and practical
  - Based on integrity principles / best practices
  - Suitable for both hazardous liquids and natural gas
  - One time exercise to support MAOP / MOP
  - Leverage new and future technology developments

- The pipeline industry believes that:
  - We have a substantial volume of information and experience that can be applied to ECA guidelines.
  - As the daily practitioners of Integrity Management, we're well suited to develop them.

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- 23 Participants from many parts of the industry
  - Hazardous liquid operators
  - Natural gas operators
  - Industry expert service providers
  - Would like PHMSA involvement

- Will leverage outcome of other projects
  - PRCI IM 3E – API-PRCI project to develop practical guidelines on when to hydrostatically test and how to design appropriate tests for end needs
  - PRCI NDE 4A – Determining pipe properties with ILI
  - PRCI NDE 4C – In ditch mechanical properties measurement

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WHAT'S IN A NAME? – ECA VS MVA

- ECA definition rewritten for context to IVP = An Engineering Critical Assessment (ECA) is an analysis, based on integrity management principles, of whether or not a given pipeline has sufficient safety margins under specified loading conditions (MOP/MAOP).

- Because of a multiplicity of definitions, the project team is currently proposing a new definition - MAOP / MOP Verification Analysis (MVA)

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PROJECT APPROACH

- Identify all "parameters" subject to IVP
- Identify each parameter's relevancy to safety and integrity
- Identify what integrity data can be used as a "substitute" for each parameter
- Identify what technology and integrity processes are currently available and applicable to these substitutes
- Identify what process and technology gaps currently exist and develop plan for filling these gaps
- Develop parameter specific MVA guidelines (with options where possible).

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PARAMETERS SUBJECT TO IVP

- Both aspects of MAOP / MOP determination
  - Pressure Test Record requirements
  - Internal Design Pressure (IDP) material requirements

Test record examples

- Test Charts
- Test chart location & elevation
- Test temperature
- Instrument calibration
- Description of facility
- Responsible party
- Et al.

Material documentation examples

- Pipe Grade
- Diameter
- Wall Thickness
- Seam Type

All records requirements in Parts 192 & 195 will be included.

RELEVANCE TO SAFETY & INTEGRITY

- One size doesn’t fit all when it comes to partial records and a pipeline’s ability to safely support MAOP / MOP
- Dependent on what records you do have and the quality of critical ones.
- Also dependent on quality and quantity of supplemental records (those not specifically called out by regulation)
- Highly dependent on operating scenario and history

- The project is establishing three levels of relevancy to the MVA process

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RELEVANCE TO SAFETY & INTEGRITY

- **High Relevance** – parameters that are critical to knowing what MAOP / MOP a pipeline can safely support
  - Examples include: Pipe Diameter, Wall Thickness, Test Pressure

- **Moderate Relevance** – important parameters for knowing what MAOP / MOP can be supported but conservative assumptions can be applied
  - Examples include: Pipe grade, Seam type, Test station location

- **Low Relevance** – parameters that have no or very little impact on pipe's ability to maintain MAOP / MOP.
  - Examples include: Test Media, Test Date, Responsible Party signature

IDENTIFYING SUBSTITUTE INTEGRITY DATA

- For each parameter, one or more sources of Integrity data will be identified that can analyzed and applied as a "substitute" for missing record information.

- Requires threat analysis – substitute data will likely be threat specific

- Focus will be on ILI data but will also include other testing data where applicable.

- May identify that integrity data needs additional or different types of analysis than traditionally performed.

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EXISTING TECHNOLOGY AND PROCESSES

- There are a number of technology applications and existing analysis processes or those in development which could be applied.

  - "Standard" IM processes such as threat analysis, repair strategy determination, Remaining Life Determination, etc.
  - Risk Based Analysis (RBA) – Build on operator's existing plans and procedures for complying with RBA requirements. These can be applied to Natural Gas assets if the science is right.
  - Concept of establishing ILI equivalence to hydrostatic testing
  - In-situ materials testing
  - Other applicable technologies may be identified

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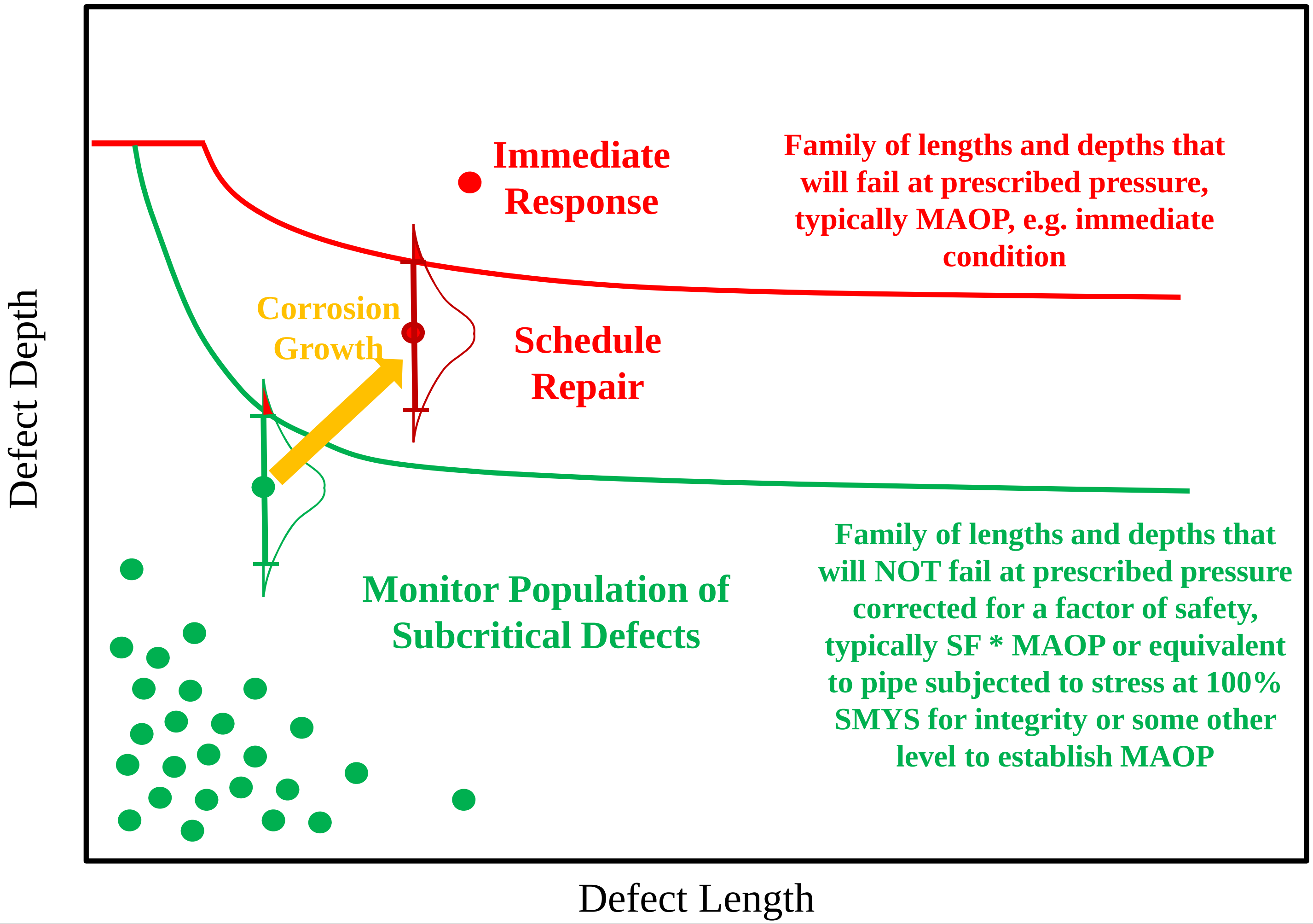
ILI EQUIVALENCE FUNDAMENTALS

- Illustrated by Sentence Plot for each pipeline calculated using appropriate threat based Fitness for Purpose (FFP) equations
- Respond to defects that would theoretically fail at a hydrostatic test pressure
- This approach depends on understanding the uncertainties with ILI data



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PROCESS AND TECHNOLOGY GAPS

- Plans will be developed to fill identified gaps in technology or process

- Recent technological developments around determining material properties of pipe
  - In-ditch methods for determining chemistry and physical properties
  - In-line methods for identify pipe of similar properties

- Processes need to be developed in order to bring these technologies together for use in MVA's
  - Validation requirements, sampling protocols and confidence statistical analyses
  - Correlation of ILI data with in-ditch data
  - Integration with other important data
    - Line Pipe Manufacturing History "Bible"
    - Construction and operational data
    - One-off metallurgical analyses

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DEVELOP GUIDELINES

- Guidelines will be parameter specific and flexible to account for
  - Different applicability of integrity threats
  - Different levels of relevancy for missing records
  - Differences in quality and quantity of supplemental records
  - Operational and Integrity history of the asset

- Currently considering a process flow chart or table that correlates
  - Documentation requirement (parameter)
  - Integrity Threat
  - Recommended IM testing (including technology)
  - Recommended data analysis processes (and data integration)

- The guidelines will identify scenarios where MVA is not appropriate and hydrostatic testing is the best alternative

EXAMPLE SCENARIO

- A pre-regulation hydrostatic test record has no calibration certificate
  - This is required piece of documentation

- This “parameter” has low relevancy
  - Could cause lower test pressure than targeted
  - Conservative assumptions can be made but:
    - What is expected / typical deviation?
    - What is most likely worst case?
    - Is MOP governed by pipe properties instead of test pressure?
      - If it was a 100% SMYS test, error in test chart pressure might have no impact on MOP

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EXAMPLE SCENARIO

- This is a candidate for an ILI equivalency approach and existing IM practices can be used. All pressure based threats would be examined
  - What is current repair philosophy for line? Repair to MOP vs IDP
  - What tolerance is used in ILI analysis

- A process gap is identified - there's no industry guidance on what typical, expected, or most likely worst case error might be associated with an out-of-calibration gauge
  - This is an opportunity for PRCI to collect and disseminate this information.

- Guideline would recommend the following steps:
  - Determine appropriate potential gauge error
  - Compare this amount to current MOP and how it was established.
  - Adjust ILI response strategy (tolerance, dig criteria, repair level) to account for potential difference between actual and perceived test pressure.

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ACKNOWLEDGMENTS

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Questions