

Pipeline Research Council International

Crack Management SRP Update

High Level Overview



LEADING PIPELINE RESEARCH

Taylor Shie
Senior Hydrogen Supply Chain Engineer (Shell)
Fall Technical Committee Meeting
October 15th, 2024

Agenda

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- **Crack Management SRP Overview**
- **Updated Roadmap**
- **Preview of this Afternoon**
 - Status of Key Outcomes
 - Status of MAT-8-3 Gap Closure
 - How it all Fits Together:
 - Selective Seam Weld Corrosion
 - Areas of High Hardness and/or Low Toughness
 - Suggestions to Technical Committees



Crack Management SRP Overview

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- **Efficient and effective crack management is a need for all PRCI operating companies**
 - Efficient – Resources are utilized on the highest risk pipelines by cracking threat such that there are no unnecessary excavations.
 - Effective - Mitigate the risk of crack failures that damage the pipeline community's global license to operate to As-Low-As-Reasonably Practicable (ALARP).
- **Build on the significant amount of work that has been and is being performed**
- **Distinguish strategically important outcomes from the nice to have information**
- **SRP will be divided into four areas each with core goal for each:**

Susceptibility

Susceptibility assessments by cracking threat/morphology lead to selection of the appropriate integrity assessment method

Inspection

Known strengths and limitations of the inspection technique(s) allow operators to have confidence in their assessment and remediation program and ultimately to improved threat management

Management

Management of known crack-related threats to reduce failure rates and minimize likelihood of releases before reassessment

Assessment and Remediation

Effective and efficient response to inspections including improved remaining strength equation variables, dig criteria, repair criteria, and reassessment intervals



Crack Management SRP Roadmap Priorities

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- **Priority 1 – Continuous Improvement of ILI**
- **Priority 2 – Why Cracks Fail**
- **Priority 3 – Material Property Database Enhancement**
- **Priority 4 – Advanced Threat Management – Autogenous Weld Defects**
- **Priority 5 – Advanced Threat Management – Environmentally Assisted Cracking**
- **Priority 6 – NDE Qualification for ILI Validation**
- **Priority 7 – Technology Qualification for ILI Technologies and Vendors**
- **Priority 8 – Acquisition of Real Pipeline Defects**
- **Priority 9 – Reliability Model Framework for Crack Assessment**

Crack Management SRP Roadmap

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Priority	Project Number	Description	2020		2021				2022				2023				2024				2025			
			Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
1	NDE-4-12	Continuous Improvement of ILI Capabilities	I&I TC		I&I TC																			
2	MAT-8-3	Understanding Why Cracks Fail			DMC TC																			
	MAT-8-3b	Workshop of SMEs for Hydrogen Related Failure Review								DMC TC														
	MAT-8-3C	Understanding Why Crack Fail - Results Sharing											DMC TC											
	TBD	Crack Management SRP Compendium																				I&I		
3	NDE-4-17A	Pipeline Material Property Database Enhancement							DMC TC															
4	EC-2-12	Evaluation of Selective Seam Weld Corrosion Susceptibility							Corrosion TC															
	EC-2-13	Response to Corrosion Intersecting the LSW in Liquid Pipelines							Corrosion TC															
	NDE-4-22	Guidelines for When to Perform a Crack Detection ILI Survey							I&I TC															
	IM-3-03	Comprehensive Review of SSWC Assessment											I&I TC											
	NDE-4-17B	Crack-Like Defects Created by Pipe Manufacturer Database																I&I TC						
	IM-1-10	Matching ILI tool to expected crack morphology																I&I TC						
	IM-1-13	Modeling the Effects of Crack Tip Radius and Crack Profile																I&I TC						
5	SCC-02-15	Crack Dormancy and Prevention of Crack Growth for SCC							Corrosion TC															
	NDE-4-24	Circumferential Crack Management Risk Evaluation Framework											I&I TC											
	MAT-7-2	Hard Spot Susceptibility Review											DMC TC											
	EC-08-13	Influence of External Hydrogen on Crack Growth											Corrosion TC											
6	NDE-2-14	NDE Technician Improvement Training Course for LSW Testing											I&I TC											
	NDE-4-25	Fast and Accurate Feedback from Site to ILI Vendor											I&I TC											
	NDE-4-27	Protocol for PRCI Pipe Sample Evaluation and Documentation											I&I TC											
7	NDE-4-26	In-Line Inspection Performance on Tight Cracks											I&I TC											
	NDE-4-28	Protocol for Testing New Technologies at the TDC											I&I TC											
8	Idea 3216	Acquisition of Real Pipeline Defects - Cancelled																						
9	EC-2-14	Machine Learning for Integrity Management																Corrosion TC						
RFP'd	Active SRP	Notes:			I&I SRP Funding					Traditional PRCI Funding														
Future	Complete	*Split 50/50 with Emerging Fuels Institute			DMC SRP Funding					Corrosion SRP Funding														

Preview of this Afternoon Status of Key Outcomes

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- 1. Close identified gaps in performance demonstration for crack ILI and NDE**
- 2. Close identified gaps in material properties performance data**
- 3. Next generation of susceptibility models by cracking threat/morphology**
- 4. Broadly communicate outcomes to advance crack management within industry fabric**
- 5. Further operationalize the TDC and VTDC for crack management**

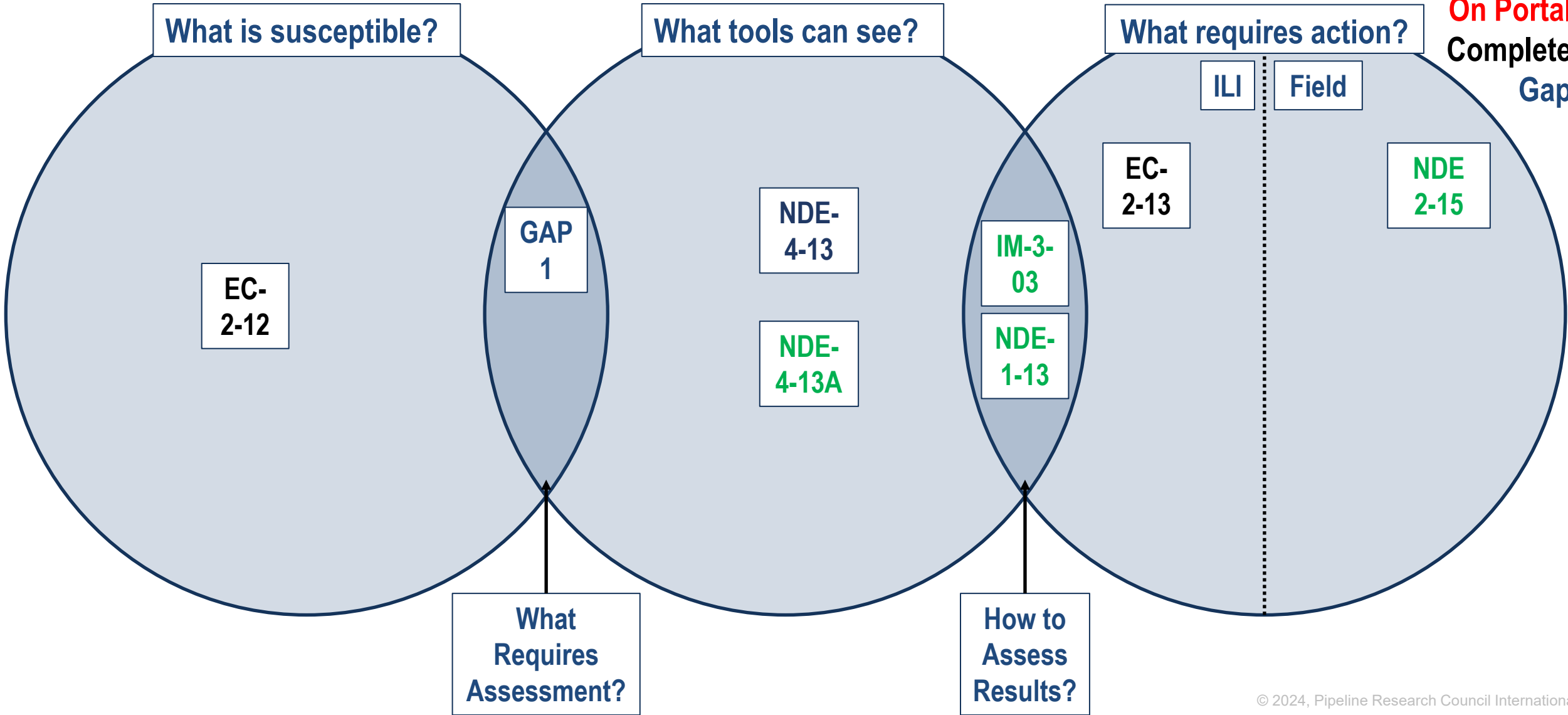
Preview of this Afternoon Status of MAT-8-3 Gap Closure

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#	Cracking Susceptibility	#	Crack Inspections	#	Crack Assessment and Remediation	#	Crack Management
28	Factors made pipe susceptible to operational fatigue cracking	6	ILI issue - signals misinterpreted	4	Repair did not perform as planned	13	Unaware of severity of manufacturing defects in new line pipe
10	Factors made pipe susceptible to HAC or HIC	4	Hydrostatic test issue - cracks initiated or grew	2	Issues with data quality	10	Unaware of construction damage
10	Factors made pipeline susceptible to nnpH SCC	3	ILI issue - weld geometry	2	Issues with calculation inputs	8	Inadequate integrity management (IM) program
6	Factors made pipe susceptible to selective corrosion	2	ILI issue - feature depth and length	1	Lack of well-developed assessment model	5	Not running crack ILI tool
4	Manufacturing features in pre-1970 LF-ERW pipe made pipe weld bond line and HAZ susceptible to failure, e.g., from pressure-induced fatigue	1	ILI issue - lack of detection and sizing of feature that later failed	1	Assessment missed including important factor	4	Unaware of transportation damage to new line pipe
4	Factors made pipe susceptible to transportation fatigue	1	ILI issue - feature not characterized effectively	1	No assessment performed for crack-like feature (wrong defect type)	4	Issue with specifications
4	Factors made pipe susceptible to high-pH SCC	1	Hydrostatic test issue - hydrostatic test not very effective for high toughness pipe			3	Issue with operational management
3	Factors made pipe susceptible to corrosion fatigue	1	ILI issue - threat not recognized			1	Procedure not followed

Preview of this Afternoon - How it All Fits Together Selective Seam Weld Corrosion

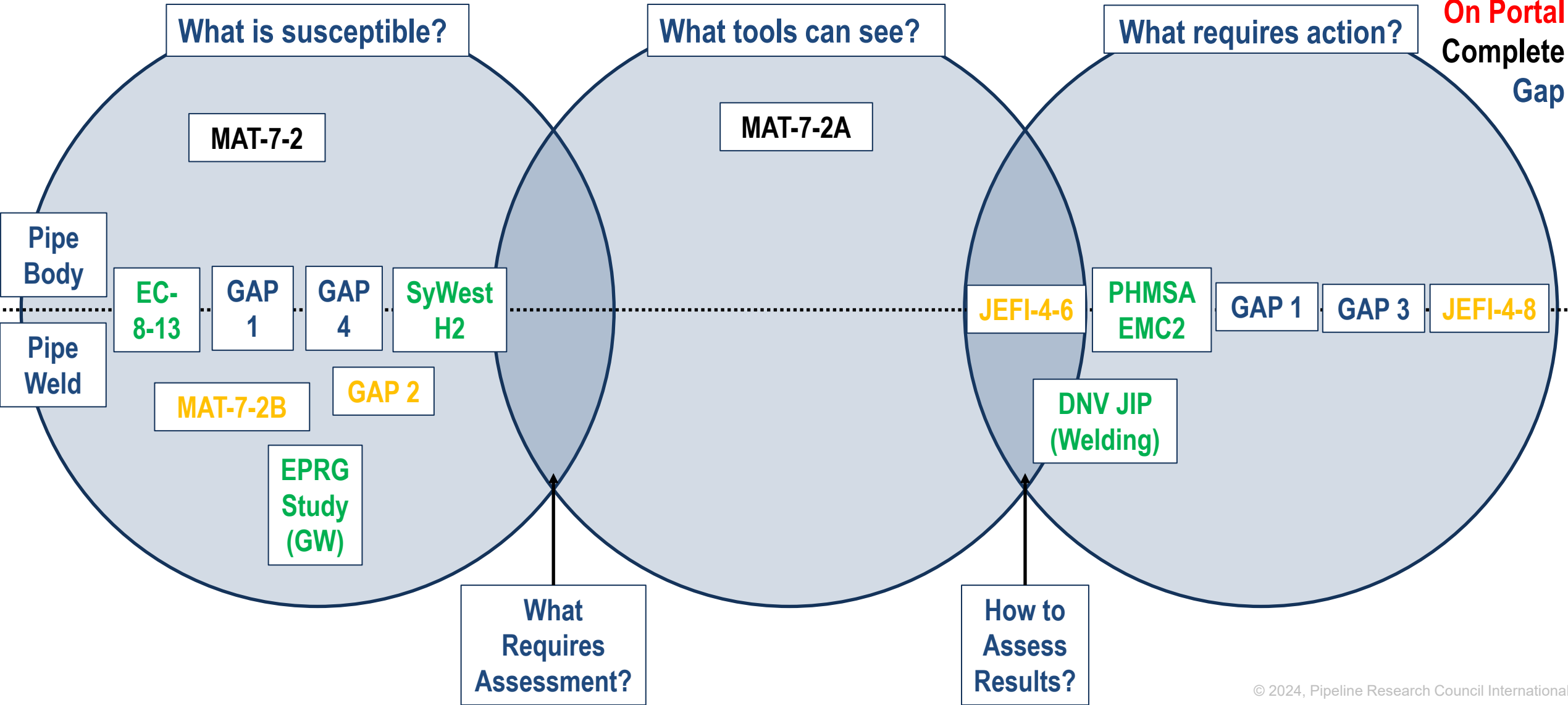
Funded
Proposed
On Portal
Complete
Gap



Preview of this Afternoon - How it All Fits Together

Areas of High Hardness and/or Low Toughness

Funded
Proposed
On Portal
Complete
Gap



Preview of this Afternoon - How it All Fits Together

Suggestion to Technical Committees

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- **Make similar diagrams for:**
 - Longitudinal Seam Welds
 - Girth Welds
 - Corrosion
 - Others
- **Why?**
 - Breaks down TC silos
 - Shows true gaps by threat type

Thank you



Taylor Shie
*Senior Hydrogen Supply Chain
Engineer (Shell)*

+1-281-544-6079

Taylor.Shie@shell.com

How it All Fits Together – Projects

Selective Seam Weld Corrosion

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- [EC-2-12](#) - Evaluation of Selective Seam Weld Corrosion Susceptibility
- [EC-2-13](#) - Response to Corrosion Intersecting the LSW in Liquid Pipelines
- [IM-3-03](#) - Comprehensive Review of SSWC Assessment
- [NDE-2-15](#) - In-the-ditch SSWC Identification, Sizing, & Measuring Grooving Ratio
- [NDE-4-13](#) - Selective Seam Weld Corrosion Detection with In-line Inspection Technologies
- [NDE-4-13A](#) - Seam Weld Corrosion Detection with ILI Technologies – Continuation and Expansion
- [NDE-1-13](#) - Does SSWC features behave as cracks

How it All Fits Together – Gaps Selective Seam Weld Corrosion

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- **Gap 1 – Based on susceptibility and risk, when should you run an ILI tool to find the threat**
- **Additional projects to be added as they are identified**

How it All Fits Together – Context

Areas of High Hardness and/or Low Toughness

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- **Areas of High Hardness or Low Toughness**
 - Pipe Body
 - Welds
 - Longitudinal Seam Welds
 - Girth Welds
- **Sources of Hydrogen**
 - External Influence (e.g., Cathodic Protection, welding)
 - Internal Source (e.g., Blended or Pure Hydrogen)
- **Need a feedback loop from what requires action to what is susceptible**

How it All Fits Together – Projects

Areas of High Hardness and/or Low Toughness

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- **EC-8-13 – Influence of External Sources of Hydrogen on Cracking**
- **JEFI-4-6 – Hydrogen Impact on Usage of Existing Integrity Assessment Models**
- **MAT-7-2 – Hard Spot Susceptibility Review – Pipe Manufacturers, Pipe Type, Vintage**
- **MAT-7-2A – Hard Spot Detection (100% funding required by 4/19)**
- **MAT-7-2B - Hard Seam Susceptibility Review – Pipe Manufacturers, Pipe Type, Vintage**
 - There may be a link to the work for SSWC for toughness (and other seam threats)
- **JEFI-4-8 – Full Scale Testing of Pipe for Hydrogen Service**
- **EPRG Girth Weld Hardness Project**

How it All Fits Together – Projects (Continued) Areas of High Hardness and/or Low Toughness

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- **DNV JIP (In-Service Welding) – Hardness limits in welding (Bill Bruce)**
 - May be applicable to areas of high hardness away from girth welds
- **PHMSA H2 Threat Project (EMC2)**
- **Additional projects to be added as they are identified**

How it All Fits Together – Gaps

Areas of High Hardness and/or Low Toughness

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- **Gap 1 – Interaction of external hydrogen and internal hydrogen**
- **Gap 2 – Material Testing of low toughness pipe**
 - Proposed extension of DNV Onshore JIP
- **Gap 3 – Behavior of areas of high hardness under pressure cycling**
- **Gap 4 – What are the hardness limits by material type?**
 - May be covered by the API 1104 hardness project
- **Gap (Global) – How is what has been learned in one area connected to others**
 - E.g. Girth weld learnings applied to pipe body or longitudinal seam weld
- **Additional projects to be added as they are identified**