Pipeline Research Council International

Crack Management Strategic Research Priority

Update at Fall Technical Committee Meeting

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Location – Calgary, AB
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Agenda

- **Crack Management SRP Overview**
- **Roadmap**
- **Discussion of Key Outcomes**
- **Approved Additional Work**

- **Backup Slides**
  - Work Completed in Last Year
  - Work in Progress
  - Work to be Contracted
  - Details of Key Outcomes



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Crack Management SRP Overview

- **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 was 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



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Crack Management SRP Roadmap Priorities

- 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

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Updated Roadmap

Priority	Project Number	Description	2020		2021				2022				2023				2024				2025				2026				
			Q3	Q4	Q1	Q2	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										
	NDE-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																											
RFP'd	Active SRP	Notes: ^Bundled with NDE-4-12, NDE-4-27, NDE-4-28			I&I SRP Funding						Traditional PRCI Funding																		
Future	Complete	*Some Funds from Emerging Fuels Institute			DMC SRP Funding						Corrosion SRP Funding								**Will continue into 2027										

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Key Outcomes

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

Note – Details of how projects fit into these key outcomes is in the backup slides

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thank you



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Previously Completed Work

- Priority 2 - MAT-8-3 (Idea 3211) - Understanding Why Cracks Fail
- Priority 2 - MAT-8-3b (Idea 3506) - Workshop of SMEs for Hydrogen Related Failure Review
- Priority 2 - MAT-8-3C (Idea 3543) - Understanding Why Crack Fail - Results Sharing
- Priority 3 - NDE-4-17A (Idea 3436) - Pipeline Material Property Database Enhancement
- Priority 4 - EC-2-13 (Idea 3374, 3449) - Response to Corrosion Intersecting the LSW in Liquid Pipelines
- Priority 4 - NDE-4-22 (Idea 3363) - Guidelines for When to Perform a Crack Detection ILI Survey
- Priority 4 - EC-2-12 (Idea 3375, 3448) - Evaluation of Selective Seam Weld Corrosion Susceptibility
- Priority 4 - IM-3-03 (Idea 3544) - Comprehensive Review of SSWC Assessment
- Priority 5 - MAT-7-2 (Idea 3507, 3558) - Update of INGAA Document Related to Hard Spots
- Priority 6 - NDE-2-14 (Idea 3477) - NDE Technician Improvement Training Course for LSW Testing

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Work Completed in the Last Year

- **Priority 5 - NDE-4-24 (Idea 3440) - Circumferential Crack Management Risk Evaluation Framework**
  - With hydrogen enhancements funded by the EFI
- **Priority 6 - NDE-4-25 (Idea 3449) - Fast/Accurate Feedback from Site Investigation for Continuous Improvement of Crack ILI**
  - Note – Not SRP funded but bundled with NDE-4-12, NDE-4-27, and NDE-4-28
- **Priority 6 - NDE-4-27 (Idea 3546) - Protocol for PRCI Pipe Sample Evaluation and Documentation**
- **Priority 7 - NDE-4-28 (Idea 3548) - Protocol for Testing New Technologies at the TDC**
- **Priority 9 - EC-02-14 (Idea 3142) - Machine Learning for Integrity Management**

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Work in Progress:
Work to be Completed in the next quarter (end of 2026)

- Priority 1 - NDE-4-12 (Idea 3055, 3210, 3316) - Continuous Improvement of ILI Capabilities
- Priority 4 - NDE-4-17B (Idea 3551) - Crack-Like Defects Created by Pipe Manufacturer Database
- Priority 4 - IM-1-10 (Idea 3318) - Matching ILI tool to Expected Crack Morphology
- Priority 4 - NDE-1-13 (Idea 3350) - Modeling the Effects of Crack Tip Radius and Crack Profile Shape in the FFS of SSWC & ERW/EFW Manufacturing Defects
- Priority 5 - SCC-02-15 (Idea 3450) - Crack Dormancy and Prevention of Crack Growth for SCC

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Work in Progress:
Work to wrap-up in 2027

- **Priority 7 - NDE-4-26 (Idea 3442) - In-Line Inspection Performance on Tight Cracks**
  - Funded 50/50 with EFI
  - Project Lead – Taylor Shie
- **Crack Management SRP Compendium ($100k)**
  - Report on how the SRP succeeded in achieving the five Key Outcomes
  - Map MAT-8-3 “Why Cracks Fail” numbers to what was done to resolve them
  - Gap closure plan for remaining items and assist TCs in developing new ideas
  - Commence after fall TC with report ready for 2027 road mapping exercise
  - Project Lead – Taylor Shie

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Work to be Contracted

- **Crack Management SRP Compendium ($100k)**
  - Report on how the SRP succeeded in achieving the five Key Outcomes
  - Map MAT-8-3 “Why Cracks Fail” numbers to what was done to resolve them
  - Gap closure plan for remaining items and assist TCs in developing new ideas
  - This was requested after the additional years (‘24 and ‘25) and scope of the SRP were approved
  - Executive Assembly approved this funding for 2026 at their meeting in September

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Status of Key Outcomes

Key Outcomes

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

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1 - Close Identified Gaps in Performance Demonstration for Crack ILI and NDE

- **Problem Statement or Recognized Gap**
  - ILI tools are used to identify features that warrant response. NDE is used to feed truth data back to the ILI vendor. Each technology needs to report as accurate information as possible to ensure integrity management of crack like defects is efficient and effective.

- **SRP Projects Performed or In Progress to Close the Gap**
  - NDE-4-12 - Continuous Improvement of ILI Capabilities
  - NDE-2-14 - NDE Technician Improvement Training Course for LSW Testing
  - NDE-4-25 - Fast and Accurate Feedback from Site to ILI Vendor
  - NDE-4-27 - Protocol for PRCI Pipe Sample Evaluation and Documentation
  - NDE-4-26 - In-Line Inspection Performance on Tight Cracks
  - NDE-4-28 - Protocol for Testing New Technologies at the TDC

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2 - Close Identified Gaps in Material Properties Performance Data

- **Problem Statement or Recognized Gap**
  - Pipeline material property record is one of the important datasets for effective management of cracking defects. FAQ 23 states that PHMSA is not aware of material property sharing.

- **SRP Projects Performed or In Progress to Close the Gap**
  - NDE-4-17A - Pipeline Material Property Database Enhancement
    - Gap Analysis findings
      - Insufficient pre-1970's tensile data
      - Insufficient X56/Gr.386 CVN data, limited cold temperature & Grade v. Decade data
    - Data Requests (pipe body, long seam, GW)
      - Tensile data: all vintages & grades, longitudinal & transverse
      - Charpy data: all vintages & grades & temperatures
      - CTOD data: all vintages & grades

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3 - Next Generation of Susceptibility Models by Cracking Threat/Morphology

- **Problem Statement or Recognized Gap**
  - The largest gap from the Why Cracks Fail (MAT-8-3) project was that the pipeline operator was not aware that the pipeline was susceptible to the form of cracking that led to the failures

- **SRP Projects Performed or In Progress to Close the Gap**
  - EC-2-12 - Evaluation of Selective Seam Weld Corrosion Susceptibility
  - NDE-4-22 - Guidelines for When to Perform a Crack Detection ILI Survey
  - NDE-4-24 - Circumferential Crack Management Risk Evaluation Framework
  - MAT-7-2 - Hard Spot Susceptibility Review
  - EC-08-13 - Influence of External Hydrogen on Crack Growth

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4 - Broadly Communicate Outcomes to Advance Crack Management Within Industry Fabric

- **Problem Statement or Recognized Gap**
  - Address identified gaps within API RP 1176 – Second Edition
  - Establish opportunity for communication with PHMSA
  - Pathway to close identified gaps in ILI and NDE technologies with service providers
- **Projects with Results Embedded in the Next Edition of API RP 1176**
  - NDE-4-20 - Considerations for Crack ILI Response in Liquids Pipelines
  - NDE-4-22 - Guidelines for When to Perform a Crack Detection ILI Survey
  - Suite of selective seam weld corrosion projects will be in API RP 1160
- **Projects with Direct Communication with PHMSA**
  - Almost all
- **Projects with Direct Communication with ILI or NDE Service Providers**
  - All with NDE project designation

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5 - Further Operationalize the TDC and VTDC for Crack Management

- **Problem Statement or Recognized Gap**
  - Samples that allow for targeted validation of ILI and NDE technology
  - Accessible and consumable database of material properties
  - Accessible and consumable database of ILI performance by cracking threat/morphology

- **SRP Projects Performed or In Progress to Close the Gap**
  - NDE-4-12 - Continuous Improvement of ILI Capabilities
  - NDE-4-17A - Pipeline Material Property Database Enhancement
  - MAT-8-3C - Understanding Why Crack Fail - Results Sharing
  - NDE-2-14 - NDE Technician Improvement Training Course for LSW Testing
  - NDE-4-27 - Protocol for PRCI Pipe Sample Evaluation and Documentation
  - NDE-4-26 - In-Line Inspection Performance on Tight Cracks
  - NDE-4-28 - Protocol for Testing New Technologies at the TDC

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