Evaluation of Girth Weld Flaws in Vintage Pipelines

SIA-1-7

Contract Number: PR-350-154501

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Outline

- Objective and deliverables
- Value to members
- Project status to date
- Next steps
- Gaps beyond this project
- Concluding remarks
- Comments and questions
Objective and Deliverables

- **Objective**
  - To develop a TSC estimation tool for vintage girth welds

- **Deliverables**
  - A TSC estimation tool that allows
    - The computation of TSC
    - The evaluation of the impact of various parameters
  - Recommendations on the user inputs for the tool
Value to Members

- The ability to assess the TSC of vintage girth welds enables operators to prioritize maintenance activities and reduce unnecessary remediation work.
  - Assess the risk of tensile rupture
  - Make remediation decisions with confidence
  - Reduce unnecessary digs
  - Justify maintenance decisions to regulators
  - Allow better integration and use of ILI and other inspection results
Project Status to Date

- Part 1: Development of TSC estimation tool in FY2015 and FY2016, completed
  - TSC estimation tool
  - Recommendations of input values for the tool

- Part 2: Evaluation of TSC estimation tool in FY2017 and FY2018
  - Curve wide plate (CWP) and accompanying small-scale tests in FY2017, completed
    - CRES coordinated and organized tests.
    - Test welds were selected purposefully.
    - Small-scale tests done by CRES
    - Eight CWP tests done by CFER
  - Evaluation and closeout in FY2018
    - Comparison between measured and predicted TSCs (completed)
    - Update the tool and the instructions for its use (completed)
    - A full final report is being drafted. (ongoing)

- Project is on budget and schedule.
Status of the Deliverables

- **TSC estimation tool**
  - The draft version of the tool was uploaded to PRIME on 9/8/2018.
  - The voting on the tool was open on 10/17/2018.

- **Reports**
  - CWP test report was uploaded to PRIME on 7/5/2018.
  - An interim report for the FY2015 and FY2016 work was uploaded to PRIME on 9/17/2018.
  - The interim report has been reviewed by the team lead.
  - A draft full final report is being prepared to cover
    - Development of TSC estimation tool (covered by the interim report)
    - Material property characterization via small-scale tests
    - CWP testing (covered by the CWP test report)
    - Evaluation of the TSC estimation tool
    - Use of the tool including applicability, limitations, and etc.
  - Draft full final report will be uploaded to PRIME by 12/31/2018.
TSC Estimation Tool

Evaluation of Girth Weld Flaws in Vintage Pipelines (SIA-1-7)
Applicable Range and Recommended Value of Input Parameters

- Pipe OD: no limits
- Pipe WT: 5.2 – 12.7 mm
- Pipe grade: X42 – X65
- Pipe Y/T: 0.6 – 0.9
- Girth weld misalignment: 0.6 – 1.6 mm (1.6 mm)
- Weld strength mismatch ratio: 0.8 – 1.0 (0.85)
- Flaw depth: 10 – 80% WT (2.5 mm)
- Flaw length: (6 – 12) × flaw depth (25.4 or 50.8 mm)
- Fracture toughness
  - Apparent CTOD toughness: 0.1 – 0.6 mm (0.3 mm)
  - Charpy Impact Energy: 20 – 70 J (30 J)
  - 3PB CTOD toughness: 0.05 – 0.3 mm (Ave: 0.15 mm, Min: 0.1 mm)
  - Max converted CTOD toughness: 0.45 mm
Next Steps

- Obtain the inputs from the team
  - Feedbacks on the draft TSC estimation tool
  - Comments on the interim report
- Draft the final report
- Update the tool based on the feedbacks from the team
- Revise the final report based on the comments from the team
- Submit the final version of the TSC estimation tool and report
Gaps beyond this Project

❑ More test data are needed to gain more confidence
  ❖ Only 3 vintage girth welds were tested.
  ❖ Vintage girth welds can have large variations in weld strength mismatch, weld profile, and other characteristics.

❑ More FEA cases to improve the precision of the TSC estimation tool
  ❖ Increase the coverage of the tool to more variety of pipes and welds
  ❖ Refine the increment of variables

❑ Influence of volumetric flaws on the integrity of vintage girth welds
  ❖ Volumetric flaws such as slag and porosity are more prevalent than planar flaws.
  ❖ Treating volumetric flaws as planar flaws may be overly conservative, leading to unnecessary girth weld repairs and cutouts.
  ❖ Test data is needed to examine the effect of volumetric flaws on TSC.
Concluding Remarks

- Integrity assessment of vintage girth welds
  - This project provides a good framework.
  - TSC estimation tool
  - The tool inputs are supported by the outcome of SIA-1-4.

- A new project is needed to further improve the tool
  - More cases are needed to refine the tool and to increase the applicable range.
  - More validation tests are needed.
Comments and Questions

❑ Thank you