Enhancing Strain Capacity of Pipelines Subjected to Geohazards

SBD-1-6

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PRCI 2018 TC Meeting
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Outline

- Background and incentives
- Project status to date
- Type-B sleeve analysis
- Request for the inputs
- Project budget/schedule and next steps
- Comments and questions
Background and Incentives

- When a pipeline is subjected to geohazards
  - Girth welds may be under high longitudinal stress/strain.
  - Strain capacity of girth welds may be not adequate.

- Circumstances that are different from “regular” sleeve repair
  - Pipe/girth welds could be under moderate to high longitudinal stress at the time of installation
  - Pipe/girth welds may take on more longitudinal stresses after the installation
  - Most of the sleeve repairs have been used for pressure containment without specifically address the effects of longitudinal stresses
    - Exception, recent work by ExxonMobil*

- Possible methods to enhance girth welds
  - Type-B sleeves
  - PetroSleeve®
  - Grouted sleeves
  - Composite wraps
  - Compression sleeves

Project Status to Date

- **Objectives**
  - Examine the options for enhancing pipeline strain capacity
  - Identify circumstances where the options can be applied
  - Develop operational procedures to properly apply the options

- **Major activities since the last TC meeting in May**
  - Held two team review meetings
  - Conducted a survey on Type-B sleeves
    - Material conditions for Type-B sleeve repair
    - Type-B sleeve configuration for girth weld repair
  - Continued the analysis on Type-B sleeves during and after installation
Overview of Type-B Sleeve Analysis

- Goal of the analysis is to
  - Determine if Type-B sleeves can be applied
  - If Type-B sleeves can be applied, determine the applicable conditions

- Failure modes
  - During installation
    - Pipe wall thinning and rupture at the carrier pipe where the fillet welds are installed
  - After installation
    - Overstress of fillet welds when the carrier pipe and annulus are pressurized
    - Pipe wall thinning and rupture in the carrier pipe HAZ near the fillet welds
    - Hydrogen cracking at the fillet weld toe
Type-B Sleeves during Installation

- **Conditions**
  - **Pipe**
    - 12” OD and 0.25” WT; X52
    - 42” OD and 0.50” WT; X70
  - Welding heat input: 1.0 and 2.0 kJ/mm

- **Under longitudinal loads below SMYS**
  - The maximum wall thinning is below 2.1% for 0.25” WT and 0.9% for 0.5” WT.
  - The selected conditions are OK for Type-B sleeve installation.

- **Under longitudinal loads above SMYS (~ 0.75% strain)**
  - The maximum wall thinning is about 60% for 0.25” WT and 18% for 0.5” WT.
  - For the thin wall pipe under high heat input, the pipe may breach during the Type-B sleeve installation and the stress relief is needed before the installation.
Fillet welds of the Type-B sleeves may not fail under the following conditions:

- **Geometry**
  - Pipe: 12" OD, 0.25" WT
  - Sleeve length: 32"
  - Fillet weld size: average size based on ASME B31.8 Fig. I-3.1
  - Size of the gap btw sleeve and carrier pipe: 1/8"

- **Material**
  - Pipe: X52
  - Sleeve: X52

- **Loading**
  - Pressurized pipe and annulus
  - Longitudinal load
    - 50% SMYS
    - 90% SMYS
    - 0.75% remote strain

0.75% remote longitudinal strain
Nature of Recent Request

- The potential integrity issues of Type-B sleeves are different and depend on the pipeline materials in terms of vintage vs. modern steels
  - Hydrogen cracking at fillet weld toe due to propensity of HAZ hydrogen cracking of vintage steels
  - Reduced deformation resistance at the softened HAZ of modern carrier pipe due to the propensity of HAZ softening of modern low-carbon low-hardenability TMCP steels
- The research team needs your inputs to plan out the work and to finalize the proposal of FY2019
  - Priority between vintage vs. modern steels
  - Pipeline materials for full-scale tests
Inputs Needed from the Team

- What pipeline materials do you currently have in your system?
  - Vintage,
  - Modern, or
  - Both

- Which pipeline material, vintage or modern, do you wish to be addressed first?

- Once the type of material is selected, do you have preferred (representative) dimensions and grades for the considerations of testing?

- Do you have some pipe joints available for donation?
  - Suggested characteristics of pipe joints
    - Pipe OD: 12” to 18”
    - Pipe WT: 0.25” to 0.375”
    - Pipe Grade: vintage or modern grade
    - Preferably joints with girth weld
    - Pipe joint length: not less than 3 OD on either side of girth weld
Project Budget/Schedule and Next Steps

- Status of project budget and schedule
  - FY2018 budget is not enough to cover all the analyses.
    - Will finish the analyses of the first two major failure modes in FY2018
  - FY2018 work was delayed by about two months.
  - FY2018 and FY2019 work will be executed in parallel.

- Next steps
  - Get the feedbacks from the team on pipeline materials and FY2019 work scope
  - Follow up with the team on the donation of pipe joints
  - Finalize FY2019 work scope and proposal
  - Continue the analysis on Type-B sleeves after installation
  - Draft a short summary report for FY2018
Comments and Questions

- Thank you