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"Full Scale Testing of Interactive Features for Improved Models"

SUBMITTED BY: Team Project Manager

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1.0 Results and Conclusions

Task 3: Baseline Existing Features

In order to facilitate the baseline measurement of the dimensions of corrosion features, BMT surface cleaned the coating on Pipe E (20 inch diameter, 0.25 inch wall thickness, Grade X-52, 1971 vintage), which has corrosion features in the range of 5% -28% in depth (based on ILI data). Most of the corrosion and pitting seem to be confined close to the long seam.

Table 1 lists the corrosion features identified, to date, in different pipe segments. The corrosion depth listed in Table 1 was measured using pit gauge and lists the deepest pit depth measured in the corrosion patch. The corrosion depths identified in the Pipe E are <20% deep, however, these shallow depths are ideal to ascertain the effect of corrosion (surface finish and pitting) on fatigue life. The shallow corrosion features are not going to affect the dent shape and, therefore, can be compared directly to the fatigue life of similarly created plain dents.

Table 1: Listing of Corrosion Features Identified in Pipe E

Pipe Segment	Feature ID	% Depth
1	1-2	17%
1	1-8	6%
2	2-3	12%
2	2-6	14%
3	3-1	13%
4	4-3	8%
4	4-6	5%

Task 4: Full Scale Testing of Complex Dents

Series of dummy pipe test specimen have been prepared for full scale tests to validate test set up, test control, instrumentation, data acquisition and cyclic loading. During cyclic pressure loading, pressure and strain gauge data was recorded. Dent axial and circumferential profiles were also measured and recorded. BMT performed FE modeling of the full scale test and compared it to the experimental data.

Task 5a: Dent and Gouge Severity

The summary Table 2 was produced to illustrate the current status of the work in Tasks 5a, 5b and 5c.

	PIPE 5 (24" or 26")		PIPE 6 (< 12")	PIPES 7 & 8
	Task 5a & Task 5b		Task 5a	Defect removed from service Task 5c
	Destructive characterization	5.4.1	5.5.1a & 5.5.1b	6.4.1
Burst test	5.4.2	5.5.2	6.4.2	7.ext1.2
Pressure Swings Fatigue test	5.4.3	5.5.3	6.4.3	
Fatigue test & CP overprotection = environmentally assisted cracking	5.4.3.cp			8.ext2.3cp
Fatigue test interacting defects, 2 spacings: i1 & i2 (Task 5b)	2 defects 5.5.3i1 spacing 600 mm	2 defects 5.5.3i2 spacing 0 mm		
Burst test combined with axial load			6.4.2a	
Pressure swings fatigue test with combined axial load			6.4.3a	
Numbering legend: Pipe#.Defect type.Defec#.Attribute (Attribute: i interaction, cp cathodic protection, a axial load.)				
Legend		Defect created		
		Burst / fatigue test or characterization performed		

Table 2: Test matrix and progress summary for Tasks 5a, 5b and 5c at the end of September 2015

GDF SUEZ instrumented and burst tested the vessel with dent and gouge defect 5.5.2, achieving a failure pressure of around 80 bar.

Defect 5.5.1 underwent detailed characterization: 3D laser mapping, MPI defect characterization.

Task 5b: Interaction between Defects

Defects of similar characteristics of Defect 5.5.2 will be used for the two fatigue tests of interacting dent and gouge defects. They consist of repeated defects located at different distances one from another and named 5.5.3 i1 and 5.5.3.i2 (see Table 2).

For the combined axial load testing, GDF SUEZ has designed the vessel and has purchased a second 12" OD pipe along with a few implements to prepare for the combined axial loading tests.

Task 6: SCC Colonies and SDO Modeling Coordination

GDF SUEZ has characterized the crack depths and lengths of the pipes with SCC crack colonies retrieved from service. The results showed shallow cracks, around 1 mm depth. During this quarter, GDF SUEZ performed calculations to estimate the necessary fatigue loading in order to start the actual fatigue testing with corrosive environment once a depth of at least 2 mm is achieved.

Task 8: Dissemination of Results

The team has completed the following in the dissemination of the results.

- The project team held monthly internal meetings with the Technical Advisory Committee (TAC).

Task 9: Project Management and Reporting

The team has completed the following project management and reporting sub-tasks:

- The project team held regular teleconference meetings to track performance, schedule and budget.
- The project team completed and submitted the required monthly and quarterly reports.

1.1 Problems, Technical Issues or Major Developments

There are no major issues; however, the team will start Task 5c this coming month

2.0 Plans for Future Activity

Over the next 30-60 days, the following activities will be conducted:

Task 2: Material Selection, Acquisition, and Characterization

The team will perform this task as needed.

Task 3: Baseline Existing Features

BMT will complete the corrosion feature measurement on Pipe E and will prepare test pipe test segments based on the corrosion features identified.

Task 4: Full Scale Testing of Complex Dents

BMT will continue the comparison of the experimental and modeling data and will identify and implement any changes, if necessary, to the testing and instrumentation plan. Full scale testing using round bar indenter will be started.

Task 5a: Dent and Gouge Severity

The characterization of defects and full scale tests will be continued.

Task 5b: Interaction between Defects

The two pairs of dent and gouge defects will be fatigue tested sequentially.

Task 5c: Dent and Gouge Defects Removed from Service

The team plans to start this task in the next month.

Task 6: SCC Colonies and SDO Modeling Coordination

Based on the results from the initial flaw characterization, GDF SUEZ will select the pipe and colonies to be used. Work is planned to size the EDM notches for providing a controlled additional set of cracks, in each of the two loading cases, representative of oil and gas pipelines.