9th QUARTERLY REPORT - PUBLIC PAGE
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"Full Scale Testing of Interactive Features for Improved Models"

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1.0 Results and Conclusions

Task 2: Material Selection, Acquisition, and Characterization

Pipe 6 material characterization by GDF SUEZ is in progress: tensile tests, Charpy V impact tests, and chemical composition are taking place. The same tests will be applied to Pipe 7 once it is shipped.

Task 3: Baseline Existing Features

BMT completed the baseline measurements of the dimensions of the corrosion features ahead of the schedule and reported the results in the last quarter for Task 4. Table 1 is reproduced here to show the 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%

Table 1: Listing of Corrosion Features Identified in Pipe E

Task 4: Full Scale Testing of Complex Dents

Full scale dent fatigue test was carried out on Pipe D (24 inch OD, 0.375 inch wall thickness, Grade X-70). The dent was created using 4 inch round bar indenter transverse to the pipe axis. The indenter travel was 2.4 inch (10% OD) in the pipe body to create an unrestrained dent. The instrumentation/sensors used during the test included measurement of force, measurement of indenter travel, measurement of ovality/pipe expansion at 3/9 o'clock location and strain measurements during dent creation. 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

GDF SUEZ started setting up cathodic overprotection parameters for one dent and gouge test. Preliminary tests were performed over about ten days to qualify the different components: de-aeration set-up, shape and size of electrodes, both anode and reference electrode in the box above the defect, overprotection voltage, current density, etc.

This preparation was performed with the actual defect to ensure proper operation of all parameters. Fatigue cycling had been defined between minimum pressure 20 bar and maximum pressure of 60 bar, keeping the same 40 bar pressure range as in previous tests, as the burst pressure of a previous similar dent and gouge defect was 80 bar.

To optimize cathodic overprotection parameters, a polarization curve was established to determine the relationship between applied potential and cathodic protection current. This curve was established on an area of known surface equal to that of the defect to be able to determine current density, away from the region containing the defect. Both the sample are for the polarization curve and the actual defect were the only surfaces electrically exposed to the solution, the remaining surroundings being insulated by an insulating paint.

Tests results are being interpreted.

Task 5b: Interaction between Defects

During this quarter, GDF SUEZ also tested interacting defects. Two configurations are considered, one with two interacting defects, as the dents are adjacent, and another one with dents spaced by one diameter. Both interacting defects sets were instrumented with 3 triaxial strain gauge rosettes on each of the 4 defects.

A leak indicator was installed as well as a TC to measure pipe temperature. Internal pipe pressure was continuously monitored during cycling.

The same fatigue loading between 20 and 60 bar was applied to all interacting defects. One of the two interacting defects failed after 2 cycles. Experimental data and the failed defect will be thoroughly analyzed.

Task 5c: Dent and Gouge Defects Removed from Service

A dent with a gouge was identified in a pipe removed from service, which is first being analyzed before actually delivering it to the test facilities.

GDF SUEZ examined this defect based on photos and on a field NDE characterization. As soon as the pipe arrives at the lab facilities, the pipe material will be mechanically characterized (tensile tests, Charpy V impact tests, chemical composition) and the dent+gouge defect will be characterized in more details. It appears that the defect affects several areas that are close to each other, interference between the individual defects being uncertain at this stage.

A corrosion defect is present close to the dent but should not interfere with further experiments.

Task 6: SCC Colonies and SDO Modeling Coordination

A first approach to defining the testing protocol was previously mentioned, and this information was updated based on the latest choices made for actual colonies and test organization. It is important at this stage to gain consensus from the TAB on these choices in order to move forward.

The main objective is to validate the University of Alberta model for SCC crack growth rates in loading conditions specific to oil and gas pipelines.

Loading conditions

Mechanical and electrochemical testing protocols have been updated for the two loading cases:

- oil transmission pipeline test (R=0.5)
- gas transmission pipeline test (R=0.85).

The aim is to optimize test duration in order to perform the maximum number of cycles.

The critical aspect of these loading sequences is to demonstrate the effect of underloading (accelerating effect) and overloading (decelerating effect) on NNPHSCC crack growth rates (CGR). The combinations of these different cycling profiles are quantified as a combined mechanical factor which is used subsequently.

Crack colonies and machined EDM notches:

Several real crack colonies have been characterized. One real crack colony was chosen for each of the oil and gas transmission pipeline tests:

Regarding combined factor values, EDM notches ranges have been redefined. EDM notches will be machined on six sections of X63 grades line pipes from one pipeline with established susceptibility to near neutral pH SCC. Three vessels will be used for oil transmission pipeline tests and three vessels will be used for gas transmission pipeline tests.

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 report.

1.1 Problems, Technical Issues or Major Developments

There has been a six week delay in full scale testing of dents (Task 4) due to equipment breakdown. The issues have been resolved and the full scale fatigue testing has been resumed. This will not affect the overall schedule of the program.

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

- Characterization of pipe 6 and eventually 7 if shipped.

Task 3: Baseline Existing Features

- No direct work will be done on this task.

Task 4: Full Scale Testing of Complex Dents

- Full scale fatigue testing of dents will be continued.

Task 5a: Dent and Gouge Severity

- 6.5.1 will be chosen
- 6.5.2 will be in progress
- 6.5.3 will be in progress
- Set up for 6.5.2a and 6.5.3a will be performed

Task 5b: Interaction between Defects

- 5.5.3i1 and 5.5.3 will be accomplished

Task 5c: Dent and Gouge Defects Removed from Service

- Pipe 7 should be available and characterized

Task 6: SCC Colonies and SDO Modeling Coordination

- EDM notches will be machined
- Oil transmission pipeline test will be started