Remaining Strength of Corroded Pipe Under Secondary (Biaxial) Loading Project 153J

2nd QUARTERLY PUBLIC REPORT

Period: July through September 2005

Consolidated Research and Development Program to Assess the Structural Significance of Pipeline Corrosion

ELECTRICORE
POWERING THE FUTURE

PRCI

ADVANTICA

Contact

Ian Wood

Program Manager

Electricore, Inc.

Office: 661-607-0261

Fax: 661-607-0264

ian@electricore.org

www.electricore.org

Background

Metal loss due to localized corrosion and pitting of pipelines can significantly increase the risk of rupture. Therefore, it is vitally important to accurately determine the residual strength of corroded pipelines so that proper remedial actions may be taken to avoid catastrophic events. Although historical methods and practices for inspection and integrity assessment have led to an overall safe and reliable pipeline infrastructure with a low frequency of failures, public expectations concerning pipeline safety are growing, and industry is committed to pursuing further improvements. Consequently, new US regulations and sophisticated inspection technologies have burdened many operators with large quantities of data that are often difficult to interpret and apply within the framework of existing assessment guidelines. Clearly, the industry needs a technically sound, comprehensive and integrated approach to assess and mitigate the effects of localized corrosion in gas and oil pipelines, and to assure appropriate pressure-containment safety margins.

Several methods have been developed for assessment of corrosion defects, such as ASME B31G, RSTRENG and LPC. These methods were developed using an early fracture mechanics relationship for toughness-independent failure of pressurized pipes and were empirically calibrated against a database of full-scale burst tests for thin wall pipes. Some work has already been done to address the limitations of existing assessment methods available to the industry. The objective of this project is to develop simplified guidance to assess corrosion metal loss defects in pipelines that are subjected to external loadings in service.

Summary of Progress this Quarter

Three dimensional finite element (FE) models have been generated for a selected number of pipe (*D/t*) ratios. Common transmission pipe diameters (36”, 18” and 8” with (*D/t*) ratios of 72, 82 and 27 respectively have been selected). Pipe material to API 5L grade X65 and B/X42 has been selected. FE models to represent combined loading tests for the Alyeska Pipeline Company have also been created. These selections have been previously agreed with PRCI Materials Technical Committee members.

Following a meeting with the PRCI (Wytze Sloterdijk and David Batte) on 9 August 2005, it was agreed that selected combined loading tests undertaken for the Alyeska Pipeline Service Company. The results of these tests are available in the public domain, published in proceedings of the ASME International Pipeline Conference (1996 – 2000). This approach will allow validation of the FE analysis approach used to determine the failure locus under combined loading.

Results

The rig that will be used to undertake the full-scale tests will be based on the set up shown in Figure 1. 18" diameter grade B/X42 pipe has now been procured. Defects geometries have been agreed with PRCI and are being machined. The rig will comprise two hydraulic rams that will be positioned under the pipe inboard of the restraints to apply bending. The locations of the restraints and rams will be adjusted depending on the bending moment to be applied (this will vary from one test to another). The test pipes will be internally pressurized using water. Pressures will be measured using pressure transducers. Strain gauges will be installed on the surface of the pipe to monitor stresses in the main body of the pipe and in the vicinity of the defect.

Figure 1: Bend/Pressure Loading Test Rig

Future Activities

Work over the next two quarters will focus on completing the FEA and assessment as well as the biaxial loading FEA and assessment for buckling.

Partners in Success

- Electricore, Inc. www.electricore.org
- Pipeline Research Council International, Inc. (PRCI) www.prci.org
- Advantica, Inc. www.advantica.biz

ELECTRICORE
POWERING THE FUTURE

PRCI

ADVANTICA

Principal Investigator

Vinod Chauhan

Advantica, Inc.

Office: +44 (0)1509 282363

Fax: +44 (0)1509 283119

vinod.chauhan@advantica.biz

DEPARTMENT OF TRANSPORTATION
UNITED STATES OF AMERICA