Corrosion Assessment Guidance for Higher Strength Pipelines Project 153H

3rd QUARTERLY PUBLIC REPORT

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

Period: September through December 2005

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 select number of pipe (*D/t*) ratios. Transmission pipe diameters (36-in and 48-in) and material grades X65, X80 and X100 (equivalent) have been selected to investigate the sensitivity of failure pressure on *D/t* ratio and material grade. To further validate models and investigate the damage tolerance of X100 material, Advantica has obtained permission to use the results of a test program undertaken on behalf of a major pipeline operator.

Results

Figure 1 (below) provides an example of the calculated failure pressure versus defect length for 36 -inch diameter pipes of grades X65, X80 and X100. The results show that higher failure pressures are predicted as the material strength increases for shallow defect depths (20% to 50%). As the defect depth increases up to 80%, the change in failure pressure predictions is not as marked.

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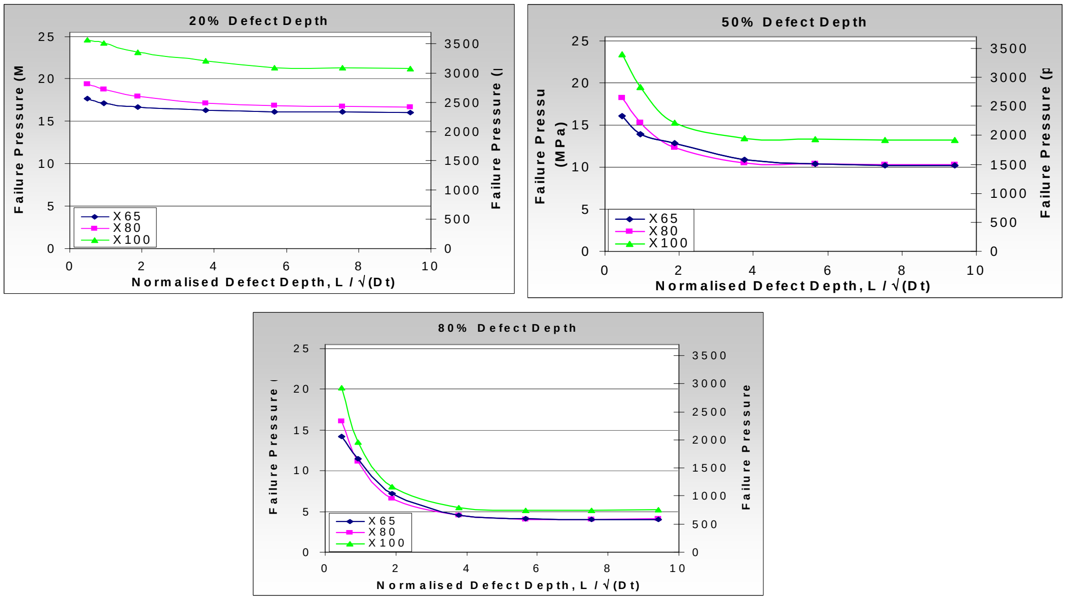

Figure 1: 36in x 12.7mm Models – Example Failure Pressure versus Normalized Defect Length for Varying Defect Depths

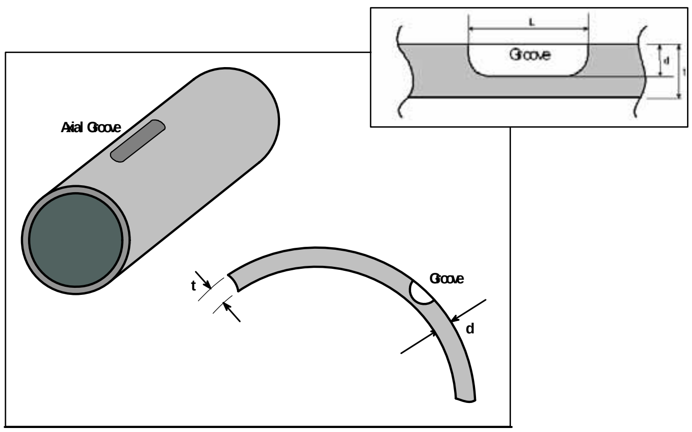

Figure 2: Diagram of material cross section showing Defect Geometry measurements

Future Activities

Work over the next two quarters will focus on completing the finite element analysis and comparison of predicted failure pressures with BP test results.

FE models of 52-inch diameter pipe (*D/t*=57.9) are to be constructed. Both groove and patch (including a circumferential extent dimension) defects (defect depth to wall thickness ratio approximately 50) will be modeled. Failure pressures will be predicted and compared with the results of the full scale burst tests.

Additionally, the research team will be participating in a DOT sponsored Peer Review of the program on February 7, 2006.

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