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## **A Comprehensive Update in the Evaluation of Pipeline Weld Defects**

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### Summary

Girth weld defect acceptance criteria are set and enforced in all pipeline constructions in the U.S. per federal regulations (CFR 49 Parts 192 and 195). With the increased use of mechanized welding and AUT (Automated Ultrasonic Testing) in new pipeline constructions, alternative defect acceptance criteria based on ECA (Engineering Critical Assessment) principles are frequently used in lieu of the traditional workmanship criteria. The objective of this project is to provide technical basis towards a major update to the alternative girth weld defect acceptance criteria. There are two focus areas in this project. The first focus area is to update the alternative defect acceptance criteria to address the immediate need of the majority of onshore pipeline constructions in the U.S., typically with pipeline longitudinal strains less than 0.5%. The second focus area is the development of alternative defect acceptance criteria for pipelines in geotechnically challenging environments, such as arctic area and deep water offshore, alternatively termed strain-based design. No codified defect acceptance criteria yet exist for such service conditions. It is expected that the outcome of this project will form the technical basis for the revision of girth weld alternative acceptance criteria in North America, such as API 1104 Appendix A and CSA Z662 Appendix K.

### Progress of the Project

The major accomplishment to date is the production of the girth weld defect assessment procedures for stress-based design, i.e., pipelines with longitudinal strains less than 0.5%. This is the key deliverable of the first focus area. To facilitate code-making process, a self-contained separate report was completed and distributed to DOT, PRCI, and API 1104 committee. The report covers (1) technical basis for the development of the revised girth weld defect acceptance criteria, (2) validation of the acceptance criteria against experimental test data, and (3) recommended structure for the revision of API 1104 Appendix A.

The draft code language for the revision of API 1104 Appendix A was first submitted to the API 1104 committee in November 2005. The draft was discussed at the annual API 1104 committee meeting held in January 2006. Several revised versions have been produced and circulated among the Fracture Mechanics Subcommittee of the API 1104 committee since then. The latest revision incorporates a number of enhancements, including validated fatigue growth criteria, allowance for using other validated ECA procedures for unique cases, and description for the confirmation of inspection errors.

All planned 42 mini-wide plate specimens have been tested. Both room temperature and cold tests were done. The specimens had artificially introduced planar flaws in the HAZ and the weld centerline. The specimens were highly instrumented to measure nominal plastic strains, crack mouth opening displacement, temperature, and crack initiation and growth. The data produced in these tests provided validation to some previous predicted trends. Significant new understandings have been generated from these tests. The project team is focusing on correlating these test data with theoretical models to establish the defect acceptance criteria for strain-based design.