Liu, B., Wang, Y.-Y., Jia, D., Rapp, S., 2020, Rational Limits of High-low Misalignment in Girth Welds, Proceedings of the 13th International Pipeline Conference, Paper No. IPC2020-9685, September 28- October 1, 2020, Calgary, AB, Canada.

Abstract

High-low misalignment in girth welds introduces local bending stress and thus can potentially have detrimental effects on the stress capacity of girth welds. However, long-term pipeline service experience demonstrates that high levels of high-low misalignment do not always lead to reductions in the safety and integrity of pipelines. This paper discusses PRCI-funded work that aimed to understand the impacts of misalignment on the integrity of girth welds and develop rational limits for misalignment for incorporation into existing standards.

Two sets of recommendations were developed: (1) recommendations on the incorporation of rational limits for mis-alignment into workmanship criteria, and (2) recommendations on rational limits for misalignment for application in alternative flaw acceptance criteria, such that those in API 1104 Annex A and CSA Z662 Annex K.

The recommendations for the workmanship criteria utilize extra weld reinforcement to compensate for stress capacity reduction due to misalignment. The recommendations consist of minimum values for key weld dimensions for a wide range of pipe wall thicknesses. The recommendations were developed based on a cross-weld tensile (CWT) test program and were validated using targeted finite element analysis (FEA).

The recommendations for the application of the engineering critical assessment (ECA) procedures provide a maximum permissible misalignment level, up to which the ECA procedures produce sufficiently conservative flaw acceptance criteria without needing to correct for misalignment. The maximum permissible misalignment was based on comparisons between FEA and the API 1104 Annex A ECA procedures. A concept of a safety margin was introduced to quantify the conservatism built into the Annex A procedures and to derive a maximum allowable misalignment value.

Keywords

Construction, engineering assessments, flaw acceptance criteria, high-low misalignment