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Abstract

For typical cross-country pipelines not expected to experience ground movement hazards, the longitudinal stresses experienced during lifting and lowering-in are typically the highest that they experience in their entire service life. Vertical bending stresses are produced by the curvature created from the upward lifting forces of the sidebooms and the downward force of the pipe weight. Horizontal bending stresses are produced due to the lateral movement of the pipe when the pipe string is moved from its support position on the side of trench to the center of the trench. It is critical to limit the stresses during lifting and lowering-in so that potential damage to the pipeline is avoided. For pipelines constructed using an engineering critical assessment (ECA) based flaw acceptance criteria, stresses must be controlled below the limit established during the development of the flaw acceptance criteria. However, there is little in the way of formal guidance in current codes and standards for controlling stresses during the lifting and lowering-in process. This paper is part of a long-term effort being sponsored primarily by Pipeline Research Council International (PRCI) to develop general construction guidelines that can be used to manage lifting and lowering-in stresses during pipeline construction. In this paper, the stresses during lifting and lowering-in on normally flat terrain were studied. The component of stress due to bending in the horizontal plane was determined through an analytical method. The component of stress due to the bending in the vertical plane was studied by finite element analysis (FEA). The FEA determined the stresses under various profiles. Recommended lifting profiles in the format of lifting height ranges were developed. The combined stress was then determined from the two components. In addition, FEA was used to simulate the lifting and lowering-in process of a pipe string including a field side bend. The results show that the side bend produces a very slight increase in the stress level. More work is being performed to investigate various other scenarios of field and pipe string conditions.

Keywords

Pipeline, Construction, Lifting and lowering-in, Stress, Finite element analysis