Abstract

Topic: Assessing Uncertainties in Wellhead System Fatigue Life Prediction
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This paper examines sources of uncertainty in present analysis methodologies used for the prediction of wellhead system fatigue lives. For this study, the sources of uncertainty are classified as those parameters that affect the prediction of loads and stresses (the demand) and those parameters that affect the calculation of fatigue damage (the capacity). The combined effects of demand and capacity uncertainties are then considered to qualitatively examine the resulting uncertainty in fatigue life predictions and how uncertainty in the results can drive design and operational decisions in order to achieve the desired reliability.

Calculations, test results, and experience show that any number of factors on the demand and capacity aspects of wellhead design can result in considerable uncertainty in the prediction of fatigue performance. This makes the task of determining rational and justified safety factors, design requirements, and operational limits extremely difficult. Reduction of uncertainty is required in order to maintain or improve the reliability (i.e., reduce probability of failure) of the wellhead system while allowing design and operational flexibility without having to resort to impractical safety factors. Progress towards this goal can be achieved, in part, by: (a) developing technically sound and consistent analysis methods, (b) refining analysis inputs through complementary advanced analyses and sub- and full-scale testing of systems and components, (c) qualifying welds and components to existing design S-N curves or developing appropriate design S-N curves from material and full-scale fatigue testing in applicable environments, and (d) developing benchmarks for analytical model validation through wellhead fatigue monitoring in real time.