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## A Novel Approach to Fatigue Life Assessment of Subsea Connectors


### Abstract

The capability to predict fatigue damage continues to be critical for determining the operational life and inspection intervals of connectors and components used in offshore applications. Subsea well intervention systems are subjected to wave induced cyclic bending moments and understanding the fatigue performance of equipment is essential for determining safe operating envelopes.

In this paper, a validated fatigue analysis methodology is presented for non-preloaded connectors that are used within subsea well intervention systems. The fatigue analysis methodology addresses limitations in current standards when calculating the fatigue capacities of non-preloaded connectors with different interacting component materials (i.e. low alloy steel and nickel based alloys). The methodology considers the effect on the fatigue life of both non-axisymmetric geometry/loading, FAT loading, as well as the interaction of different connector materials, capturing any potential change in hot spot locations.

Three different non-preloaded connections (i.e. consisting of threaded and load shoulder connectors) were analysed using 3-D finite element analysis models, where ΔM-N curves and the associated crack initiation locations were calculated for each connector. Full-scale resonance fatigue tests were successfully performed on the three different connector types, validating the ΔM-N curves calculated using the fatigue analysis methodology. Fatigue failure (i.e. through-wall crack) was achieved in all tests between 100,000 and 5,000,000 cycles matching the predicted crack initiation location from the analysis for each connection. The validated methodology provides accurate calculation of the fatigue life and correct identification of hot spot locations. Using the validated approach described in this paper within the design process can lead to significant improvements in future designs of connectors, enabling safer operational limits and extending the service life of subsea systems.