



# Minimising fatigue damage during FPSO transport

Using in-house tools, MARIN provides advice on minimising fatigue damage during FPSO transport. Ingo Drummen, i.drummen@marin.nl

A significant contribution to fatigue damage occurs when an FPSO is transported from the yard to the oil field. On arrival, accumulated fatigue damage can be as high as 25%! Two analysis methods, based on spectral fatigue analysis, have been developed. Wave spectral information is combined with the proper transfer function to obtain the structural response. A summation of the different sea states is done to come up with the fatigue damage. For the first, statistical approach, the sea state information is obtained directly from a scatter diagram. Although state-of-the-art and straightforward, it is not evident how to account for the joint occurrence of wind, sea, swell and current, for instance, or the reaction of the transport officer on large motions and

accelerations. Therefore another, more practical method is being used.

**Route scenario simulations** At MARIN software has been developed for performing route scenario simulations. A practical way around the limitations of the statistical approach is based on a deterministic, step-wise simulation of a given mission. The use of hindcast data as input for wind and waves solves the problem of accounting for the right coherence between wind and waves and the varying spectral characteristics of the waves. Route simulations also take typical human reactions such as heavy weather avoidance into account. By combining these simulations with structural information about the FPSO, an estimate of the fatigue damage can be achieved.

Both methods rely on structural information. In the early design stage limited information is available but at the end, a detailed three dimensional finite element model can be used to derive the necessary structural data. Tools developed at MARIN are capable of using different levels of detail in the structural analysis. This makes them useful in the early design stages when little information is available and during the final stage of the design process.

Using the proper transfer function both tools can be used to minimise fatigue damage accumulation during transportation. For instance, to determine the difference in fatigue damage when transporting in a towed configuration or on a heavy lift vessel. ▢