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Data based materials numerical modelling for FPSO safety and reliability optimization

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Abstract

Adequate modelling of material behaviour is required for the optimal operation and structural-environmental system safety and reliability of complex structural-mechanical systems. Herein floating production storage and offloading (FPSO) vessels are considered. These are used for offshore oil and gas exploration and exploitation activities. Critical components are the mooring lines, usually 8-12 per vessel. Typically they consist of a wire (or non-metallic) rope (some 100mm diam.) with steel chains at the upper (FPSO) end and on the seafloor. They are meant to keep an FPSO 'on-station' within close limits. Failure may result in rupture of oil production pipelines (risers) with possibly extreme environmental effects and high costs to operators and to industry. Recently the industry has funded ground-breaking research to improve understanding of the fatigue, wear and corrosion particularly of the upper chains. The present paper outlines the new mathematical-probabilistic models developed for prediction of chain corrosion and pitting, using data collected by the industry world-wide and in a set of major field research projects in Australia. Both forms of corrosion are functions of seawater temperature and local seawater pollution. The unique full-scale experimental work for the wear of full-scale chain links is outlined together with the on-going development of numerical models that will ultimately include associated finite element modelling. The outcomes provide much improved basic knowledge, and numerical and probabilistic modelling to permit improved optimisation of FPSO operations and overall risk management.

Keywords: materials; safety; reliability; modelling; optimization.