ABSTRACT

Estimation of the fatigue damage in the touchdown area of steel catenary risers is a time consuming process with hard computational efforts. The process includes applying various sea states on the system capturing the history of Von Mises stress. A quick approximation of the fatigue life based on the soil rigidity even in elastic seabed in the early stages of the projects is still an important need of industry. This paper further explores the origins of fatigue damage generation in the touchdown area achieving a simple methodology to link the seabed soil stiffness to peak fatigue damage in the touchdown area.

KEY WORDS: Steel catenary riser; SCR; fatigue life; pipeline-seabed interaction.

INTRODUCTION

The growing development of the offshore energy sector in deep water caused that new technologic economic competition be formed especially in the field of oil and gas transportation from deep water seabed to the vessel. Steel catenary risers (SCRs) are steel pipes with a thin wall thickness that in form of catenary curve are suspended from vessel from one side and tagged on seabed from another and play a part in transferring the hydrocarbon products from the wells drilled in deep water seabed. Utilization of SCRs is an economic suitable solution for material transfers with high capacity from the wells in the condition with high temperature and pressure applied on the system (Phifer et al., 1994; Quintin et al., 2007).

SCRs must be designed to confront with load effects and environmental condition considering the seabed geotechnical conditions. The SCRs operation life is strongly influenced by their fatigue performance in the area of contact with the seabed where the Leibniz traditional equations for the catenary shape have been applied and second the part resting on the seabed, where a relatively sophisticated boundary layer method predicting the stress distribution along the riser in the seabed has been applied to model the seabed interaction (Pesce et al., 1998). Then the fatigue life approximation linking the damage estimation to seabed soil rigidity has been conducted based on some mathematical simplification applicable in linear elastic seabed as will be discussed in coming sections.

To evaluate the accuracy and applicability of the proposed methodology, a generic spar system coupled with a SCR (Fig. 1) has been numerically simulated using ABAQUS and the fatigue damage analysis has been deterministically conducted for a wave scatter diagram of the Gulf of Mexico. The interesting correlation obtained comparing the results of proposed methodology and finite element analysis show that the presented methodology can be used by the industry as a quick option for fatigue life approximation based on seabed soil rigidity in the early stages of design.