Seabed Trench Formation And Its Impact On Fatigue Life Of Steel Catenary Risers In Touchdown Area

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ABSTRACT

Recent publications believe that sophisticated non-linear hysteretic seabed interaction models can provide a consistent way of trench modeling beneath the riser to study its impact on fatigue performance of steel catenary risers, a question with diverging answers in the literature. This paper utilizes a comprehensive seabed model for simulating the trench in combination with the vessel slow drifts. The results still show contradiction and divergence, concluding that even with sophisticated methodology for trench insertion it would not be simple to judge whether the peak fatigue value will be deducted due to trench presence beneath the riser or increased.

KEY WORDS: Steel catenary risers; seabed trench; pipe-soil interaction; non-linear response.

INTRODUCTION

The question that "how the trench formation beneath the riser affects the fatigue performance in touchdown area?" has been studied by various authors reporting contradictory results. Some authors report an increase in fatigue damage due to trench creation (Giertsen, Verley et al. 2004; Leira, Karunakaran et al. 2004) while others suggest fatigue damage reduction (Langner 2003; Clukey, Ghosh et al. 2007; Nakhaee and Zhang 2008). The impact of gradual embedment of the riser into the seabed in the TDZ on SCR fatigue performance was explored by Shiri and Randolph (2010) through a new and sophisticated methodology conducting series of fatigue analyses using a hysteretic non-linear seabed model proposed by Randolph and Quiggin (2009). They have concluded that the peak fatigue damage in touchdown area is increased moving towards the vessel as the trench beneath the riser is getting deeper, whilst the new results presented in this paper shows that even with sophisticated methodology for trench insertion avoiding the incompatibility of the natural riser catenary shape and longitudinal trench profile, it would not be simple to judge whether the peak fatigue value will be deducted due to trench presence beneath the riser or increased.

In this paper, using the normal range of seabed model parameters and extreme waves are applied over a large number of wave cycles which are resulted in trenches of less than 1D deep, compared with the 3 ~ 5D observed in practice from ROV surveys (Bridge and Howells 2007). Therefore, in order to study the influence of deep trenches on fatigue performance, it is considered providing a consistent method for creation of deep trenches and extreme relocations through adopting the slow drifts and its impact on trench morphology in the seabed. Then the fatigue analysis has been conducted in presence of various trench shapes coming to complex results.

The SCR configuration considered in this paper is shown in (Fig. 1) enabling the comparison of results with Shiri and Randolph (2010).

Fig. 1 Global geometry of SCR model