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Effectiveness of Polyethylene Helical Strakes in Suppressing VIV Responses after Sustaining High Roller Load Deformation during S-Lay Installation

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Abstract

Helical strakes are an important Vortex Induced Vibration (VIV) suppression device for Steel Catenary Risers (SCR's). This paper presents the results of two sets of hydrodynamic tests performed at MARIN, on a 12" pipe fitted with 16D Helical Polyethylene strakes. The first set of tests established the suppression efficiency of the strakes for the Intact Configuration (no deformation). The second set of tests established the performance of the same strakes after undergoing a roller test in which the fins and the body of the strakes have sustained permanent deformations due to a simulated high contact load on the roller of a stinger during an S-lay installation. The type of permanent deformations sustained by the strakes can be described as bulging of the strake body, and permanent folding of the fins. Both configurations of the strakes (Intact and Deformed) were tested at high and low Reynolds numbers (velocities of 2.5 m/s and 0.5 m/s) and at different reduced velocities V_r. The results show that for the Deformed strakes configuration, there was no appreciable decrease in the VIV suppression efficiency of the strakes from a design consideration. The test results indicated that both Intact and Deformed strakes were at least 90% efficient in suppressing VIV. Therefore, based on the tests reported in this paper, the Polyethylene strakes were deemed acceptable to use on the SCR's even when using the S-Lay installation method.

INTRODUCTION

As the world energy demand drives Oil companies to seek and to produce oil from offshore fields located in ever deeper water depths, the loads resulting on the Steel Catenary Risers (SCR's) become ever larger. In this particular case, concerns have been raised by the Thunder Hawk Integrated Project Team (THIPT) with respect to the structural integrity of the VIV suppression device, in this case Helical Strakes, as far as the relatively high contact load on the SCR's/Strakes during an S-lay installation. Thunder Hawk is a deep water offshore subsea development field with a Semi Submersible as a dedicated Floating Production Unit (FPU) in 6,060 ft of water depth. The S-lay installation contractor estimated that the maximum contact load on the SCR's/Strakes is 110 kips per roller box as the SCR goes over the stinger. Two types of helical strakes material had been considered for the Thunder Hawk SCR's. The first strake type considered was the Polyurethane strakes which had been previously used on other deep water projects. The Polyurethane strakes are specifically designed for high installation roller loads. They are well suited for deep water S-lay installation methods, since they are designed to sustain little damage and deformations of their fins and sheath as they go over the many roller boxes along the stinger. The second strake type considered was the Polyethylene strakes. Polyethylene strakes have been previously known to perform poorly in terms of their structural integrity when subjected to relatively high contact loads during an S-lay installation. Historically, Polyethylene strakes sustained considerable damage as they went over the stinger in deep waters such as, tearing of the fins, deep gouges in the sheath, severe bulging of the sheath, etc. These severe damages raised concerns and doubts as to their long term performance in suppressing Vortex Induced Vibrations (VIV); however, to the authors' knowledge, the deformed strakes configurations had never been previously subjected to a set of hydrodynamic tests to establish their VIV suppression performance. Lankhorst Mouldings proposed a new Polyethylene strake design for the Thunder Hawk SCR's that was