Modelling of the dynamic behaviour of a fall pipe system
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A special case of slender body dynamics

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Abstract

With offshore activities moving towards deep and even ultra-deep waters (>400 and >1500 m), the safety and control during rock installation operations are increasingly important aspects. Predicting the dynamic motions of the fall pipe system is complicated and is influenced by a combination of hydrodynamic forces from current and waves and ROV excursions. The deflection of the fall pipe system on the Tideway Rollingstone vessel is currently known to a limited degree, but it is a critical system parameter. The goal of this project was to develop and validate a detailed non-linear model of the Ø 0.5 m fall pipe system, to be used to determine typical motions and deflections under relevant input conditions.

Investigation of the environmental conditions and the mechanical system led to the selection of governing input conditions of the fall pipe dynamics. For each of these factors an Orcaflex model was set up and results were validated using multiple analytical models. The mathematic models used to compute pipe deflections from distributed hydrodynamic load and ROV excursion were based on the deflection theory of riser dynamics. The hydrodynamic force from fluid motion around the fall pipe was calculated using the Morison equation and for the effect of internal fluid flow, a balance of horizontal forces was set up taking into account gravity, Coriolis and centrifugal force, bending stiffness of the pipe and the systems mass and inertia. The axial dynamic amplification factor was calculated analytically to simulate the heave dynamics of the fall pipe string. Along with the RAO values of the Rollingstone, the heave response of the total system was determined.

The results from the validation of the models provided sufficient confidence for the development of the detailed fall pipe system. Along with the information and results from the investigations, this model was used to produce practical information on the dynamic behavior of the fall pipe and the limitations of the system; both operational and structural.
Acknowledgments

This report represents the final part of the MSc program Offshore and Dredging Engineering at the University of Technology in Delft, with specialization in dredging engineering. The research has been executed at Tideway Offshore Solutions in Breda and for a short period on one of Tideway’s vessels, the Rollingstone. This investigation into fall pipe dynamics would not have been possible without the help of my supervisors at the Tideway office: Connie Visser, Philip Scheers and Gowtham Natarajan. The information and knowledge received from Captain Rolf Baks and his crew and survey team on board of the Rollingstone was invaluable. The assistance and constructive advice from Sape Miedema and Cees van Rhee was appreciated greatly; turning initial sloppy thoughts into clear, sensible ideas and solutions, supported by good reason and evidence.
The contents of this report has been removed due to confidentiality. The original version can be requested through contacting the Tideway office in Breda.