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Effect of Taut and Catenary Mooring on Spar Platform with 5MW Wind Turbine

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ABSTRACT

The behavior of spar platform with 5MW wind turbine due to the interaction of regular and random waves is studied experimentally. A 1:100 scale model of the spar is studied in the wave basin. The studies are carried out for the wave height of about 6m and wave periods in the range of 6s to 28s. The effect of square plate of size 24x24m at the bottom of the spar on the vertical and horizontal acceleration at the top of the wind tower in regular and random waves is reported. The effect of taut and catenary mooring on spar platform is also studied. The horizontal and vertical response amplitude operators (RAO) for the regular and random wave tests are compared.

KEYWORDS: Spar platform; wind turbine; Counter-weight square plate; Mooring; regular waves; random waves.

INTRODUCTION

The estimation of acceleration responses of floating structure in random waves is closer to reality and hence, would lead to an optimal design resulting in considerable savings in the cost. The regular wave test predicts resonant motions and in most of the design practice, this result would suffice for checking in extreme conditions. The test of random wave reflects the wave fields in nature. There have been many studies dealing with the basic design of offshore windmills, their economic feasibility and response analysis of floating systems supporting wind towers. Agarwal and Jain [2003] studied the dynamic behavior of spar platforms under regular sea waves. Chitrapu et al [1998] studied the motion response of a spar platform in different environmental conditions using time domain simulation. Henderson et al [2004] studied floating wind farms for shallow offshore sites. Mekha and Rosset [1998] studied the statistical response of spar platforms subjected to irregular waves. Musial et al [2004] provided a framework for the classification of floating wind turbine platforms and first-order economic analysis on a wide range of platform architectures. Ran et al [1998] studied the nonlinear response of a tethered/moored spar platform in random waves and currents. Sannasiraj et al [1998] studied the response amplitude operator of motions of a freely floating long structure subjected to regular and random oblique waves. Sclavounos et al [2007] presented a parametric design study of a few floating wind turbine concepts and mooring systems based on coupled dynamic analysis. Wayman [2006] took some early steps towards the development of innovative and cost effective floating platforms to support a 5MW wind turbine for deployment in water depths of 30-300 meters. The main scope of this paper is to present the design and model study of a spar platform with taut and catenary mooring, supporting 5MW wind turbine with and without bottom square counter weight in regular and random waves.

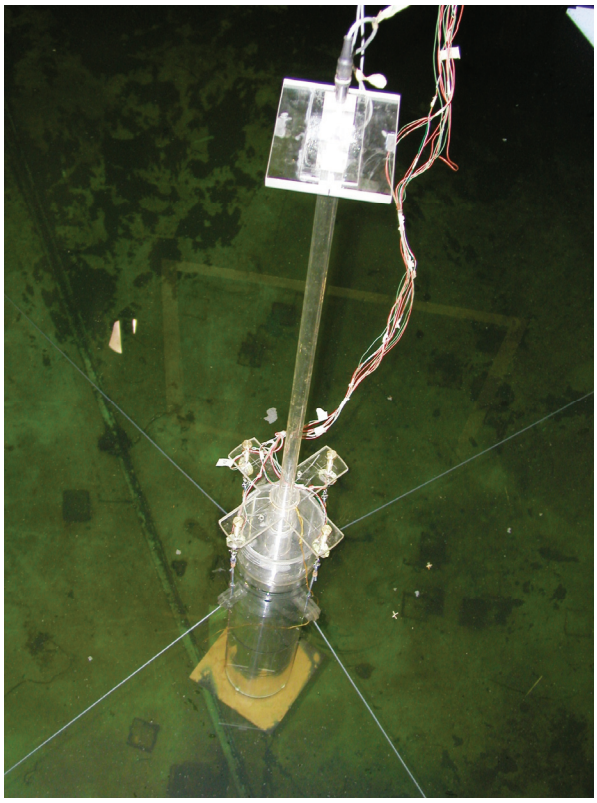

Fig. 1a Photo of spar model with Square plate at bottom