ABSTRACT

This paper presents results of a hydrodynamic model test of a monopile modeling the NREL 5 MW offshore wind turbine. This paper mainly introduces the test process of the monopile offshore wind turbine under the action of shallow water breaking waves and provides an analysis of the relevant test data. This experiment was carried out in the State Key Laboratory of coastal and offshore Engineering department of the Dalian University of Technology. The monopile model used in the experiment was the NREL 5 MW offshore wind turbine on a 1:80, scale. The physical model is rigid and made of steel. Breaking waves were examined. The wave run-up measurements of seven points are presented, and the experimental data are further processed and analyzed.

KEY WORDS: offshore wind energy; breaking waves; dynamic response; coupled analysis

INTRODUCTION

Compared with traditional energy, wind energy has many advantages: pollution-free, renewable and low risk. According to relevant studies, the amount of wind energy on earth is extremely abundant, and it can completely meet the human demand for electricity. China has abundant wind energy resources on land, especially in Inner Mongolia, coastal areas and Xinjiang, however, the offshore wind energy reserves are more abundant. The development of offshore wind power is an inevitable trend in the development of international wind power and China's wind power; however, considerable development is required. Currently, monopile foundations are widely used in shallow and medium water depths where offshore wind farms are widely developed because of its low cost, simple installation and lack of seabed preparation required. According to statistics of major offshore wind farms in China, a monopile foundation accounts for 46% of wind farms. With the development of offshore wind power construction, monopile foundation type accounts for an increasing proportion of offshore wind farms (Bi, 2019). The offshore turbine system is a strongly coupled system, which bears various loads such as aerodynamics, hydrodynamics and control loads. Wave load is one of the key environmental loads in the design of offshore turbine foundations, and it is also an important part of the turbine coupling calculation. The structures installed in shallow water regions with sloping bottoms are exposed to many nonlinear wave interactions such as breaking waves,