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4MW 與 5MW 離岸風機本土化支撐結構強度設計之比較

A Study on the Structural Strength Design of Jacket-Type Support Structure of Localization- A Comparison between 4MW and 5MW Offshore wind Turbine

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摘要

本文之主要目的係探討 4MW 與 5MW 離岸風機 Jacket 支撐結構機組重量與可抵抗的外力之差異比較，以提供於概念設計階段，選擇適合我國離岸風機機組型式之參考。離岸風機結構系統設計需同時考量伺服控制、風、波浪及海流等極限條件之負載，因此依據中鋼公司提供 4MW 與 5MW 兩種風機型式資料給定之外力(F_x 、 F_y 、 F_z 、 M_x 、 M_y 、 M_z)條件施加於桁架式支撐結構頂部，並考慮土壤彈簧與結構間的互制效應，以及運用 RSPMATCH 2009 建立人工地震加速度歷時，輸入至 SAP2000 軟體對 Jacket 型式支撐結構進行結構分析，並依據 API RP 2A-WSD 設計標準進行強度檢核。結果顯示 5MW 與 4MW 離岸風機 Jacket 型式支撐結構皆符合 API RP 2A-WSD 設計標準，且 5MW 風機之重量相較於 4MW 僅約大 6% 之情況下，但可抵抗之外力大於 30% 以上。由此比較分析可知，考量安全性與降低成本之情形，5MW 風機結構系統有較佳之效益。

關鍵詞：離岸風機、桁架式支撐結構、地震力

Abstract

This work is primarily focused on comparative analysis of the weight of the Jacket-type support structure between 4MW and 5MW offshore wind turbines through structural strength design. The comparison of the weight and force resisting is suggested for referring to the appropriate use of offshore wind turbine type in the concept design. The tower top shears, axial forces and bending moments by China Steel Corporation (CSC) are prescribed at the wind turbine structural model as the input to the SAP2000 software to conduct support structural analysis and computed results are checked by API RP 2A-WSD for its structural adequacy. The analysis results show that both 5MW and 4MW Jacket support structures are in compliance with the API design standards under Taiwanese environmental conditions. In addition, the weight of the 5MW offshore wind turbine substructure is only larger than the turbine of 4MW by about 6%, but substructure of 5MW can be more resistant to forces by 30%. It can be thus shown that from considering the safety and cost effectiveness, 5MW offshore wind turbine with the analyzed jacket substructure has more benefits.

Keywords: Offshore wind turbine, Jacket-type support structure, Earthquake