Stochastic optimization model for electric power system planning of offshore wind farms

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Abstract-

In the coming years, an extensive development of large-scale offshore wind farms (OWFs) is foreseen in Europe. Electric power systems of OWFs need to be optimized in order to minimize investment and operational costs. This paper proposes a comprehensive decision support model that covers the three key factors that characterize the design of ac electric power systems of OWFs: investment costs of the components, system efficiency, and system reliability. Stochasticity of wind speed and reliability of the main system components are also considered. The main decisions concern the layout and the cross-sections of cable connections and the location of the central collection point for the medium voltage cables. GAMS language has been used to implement the model. It has been validated using a real OWF. An application example has also been carried out to explain the extension of the model to OWFs with dc power systems. The proposed model is useful for basic engineering design and as a decision tool for planning the electric power system of OWFs.

Index Terms- DC power transmission, electrical engineering, optimization methods, power systems, stochastic processes, wind power generation.