Abstract

During the last years the development of HVDC connected offshore wind power plants increased. As the first wind farms of this type were commissioned, an unexpected phenomenon occurred. Electrical harmonic resonance in offshore AC grid led to outages of the HVDC transmission system. The thesis introduces the phenomenon and compare different methods of its analysis.

The study focuses on harmonic frequencies identification excited through the resonance phenomena between the elements within WPP's inner AC network. The analysis includes observations from three tested topology cases by different methods: frequency sweep and harmonic resonance modal analysis. The comparison is performed for diverse converter models: voltage source based, current source based and nonlinear impedance model obtained by harmonic linearization method. The results of the analysis are verified by the outcome attained in DIgSILENT Power Factory software. The study also includes the stability analysis based on Nyquist criterion and interpreted in Bode diagrams.

Furthermore, the result of investigation exposes the clues for possible subsequent implementation of harmonic filters as well as for beneficial control of converters. Feasible measures for resonance mitigation from literature are described and proposed.

Keywords:

1. Introduction

At the end of 2015 total wind power was estimated as 3.7% of Global Electricity Production. It gives the wind power sector the second position within RES production, behind hydro power. What is more important, in 2015 total renewable power generating capacity saw its largest annual increase ever, with en estimated 147 GW of renewable capacity added [**?**]. That gave an estimated 1849 GW of RES at 2015 year's end. 63.7 GW out of all installed RES capacity in 2015 comes from wind power. This number is wind installations record during one year ever. This power gives a global growth rate of 17.2% comparing to installed capacity at the end of 2014 [**?**]. Figure **??** from [**?**] clearly shows increasing global capacity as well as increasing yearly amount of installed capacity from 2005.

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