Predictive Rating Models for Wind Farm Export Cables

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With plans for future offshore wind farms having larger power ratings and being situated much further offshore, there will be a growing trend towards the usage of High-Voltage Direct Current (HVDC) transmission technology for submarine cables [1]. HVDC submarine cables provide lower investment cost for long-haul transmission, higher operating voltages and have no reactive power consumption, thus they have less losses than AC lines. DC transmission schemes may consist of a single polarity cable (monopole) carrying full circuit power with sea return, but there is a preference for having two cables of positive and negative polarity (bipole) each carrying half circuit power.

The power output generated by these wind farms is not constant, fluctuating with wind speed [2]. They generate a lot of electricity when they are working at their maximum, but most of the time they generate at a much lower rate. The conventional rules for calculating cable ratings use thermal models based on steady state conditions with maximum load. This approach often leads to cables being oversized compared to real requirement. Incorrectly rated subsea cables can lead to poor asset utilisation. Therefore, new modelling techniques are essential to drive down the cost of connecting offshore renewable energy projects to the grid. Using predictive rating modelling to assess cable requirements more accurately, should result in a smaller and (therefore cheaper) cable; thus reducing the cost of connecting wind farms to the electricity grid.

This research project uses Finite Element Analysis (FEA) to create a 2D predictive model a pair of extruded XLPE HVDC submarine cables, laid side by side in a trench on the seabed. Historical wind farm output data will be used to compare the performance of cables using conventional assumptions with those using the predictive model. Adoption of such approaches by the industry could lead to substantial savings on wind farm export cable systems, improving the viability of offshore wind and delivering long term cost savings to the consumers.

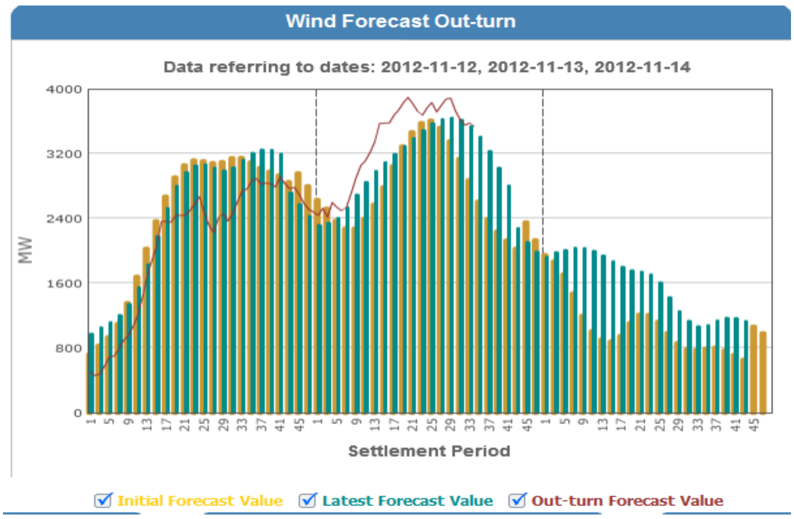

Figure 1: Wind Forecast Out-turn Plot [2]

[1] W.L Kling, R.L Hendriks and J.H.den Boon, "Advanced Transmission Solutions for Offshore Wind Farms", *IEEE Power and Energy Society General Meeting - Conversion and Delivery of Electrical Energy in the 21st Century,* 2008

[2] National Grid and Elexon Neta, "Neta Electricity Summary,"2012 [Online]. Available: http://www.bmreports.com/bsp/bsp_home.htm