

AC Transmission on large scale and remote Offshore Wind farms

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Today the majority of large scale and remote offshore wind farms (OWF's) say 800 – 1200 MW and more than 100 km from the onshore connection point are planned with HVDC solutions in mind. These are HVDC schemes with VSC converters and extruded XLPE DC export cables.

This paper gives a presentation of the opportunity to use AC transmission in various forms for these large scale offshore wind farms. The paper highlights and discusses the following main topics:

1. Low frequency AC (LFAC)
 2. 50 Hz AC with different compensation schemes
 3. AC transmission without offshore transformer station
 4. Extra High Voltage (EHV) AC transmission solutions
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- 1.) The LFAC solution takes advantage of the ability of modern OWTG's to produce the wind power at low frequency since they already incorporate a back-to-back converter system. The power is collected and transmitted to shore via inter-array cables, step-up transformers and export cables, an identical system concept as for 50- 60 Hz AC.
 - 2.) The 50 Hz transmission solution discusses utilization of conventional AC technology with different reactive compensation schemes.
 - 3.) Also platform-less transmission options are discussed to obtain the maximum transmission capabilities of layouts with power directly fed from the wind turbine generators. Both LFAC and 50 Hz solutions are discussed.
 - 4.) Last, but not least, the paper also looks into the possibility to use EHV voltages for the export cable transmissions. Here, insight is given to obtain the highest rated power pr. cable by use of 345 kV or 400 kV AC transmission systems. Both LFAC and 50 Hz solutions are discussed.

All options are collated and will give an indication of maximum transmission capabilities with respect to transmission lengths and rated power.

In addition some central topics are discussed to identify as correct as possible the cable parameters and the stress they are exposed to:

- Cable losses; including armour losses
- Intermittent loading; wind power output is not constant
- Dynamic rating; thermal time constants

where the latter will influence the conductor cross-section, number of cables, redundancy etc.

[1] "Low Frequency AC Transmission on large scale Offshore Wind Power Plants - Achieving the best from two worlds?", E. Olsen et. al., WIW Berlin 2014.