Improved Method for Calculating Power-Transfer Capability Curves of Offshore Wind Farms Cables

The power-transfer capability curve is widely used by Offshore Wind Farms (OWFs) planner when designing their grid connection. An improved method for calculating power-transfer capability curves of OWFs cables is presented in this paper. What differentiates this method compared to the traditional approach, is the consideration of the high power variability and low capacity factors of OWFs, instead of assuming continuous nominal conditions. The method is based on an iterative approach, aiming to determine the maximum total installed power of an OWF, that a cable can support in function of its total length (effective length from the Offshore Substation, OSS, to the Onshore Connection Point, OCP); in order to do so, operational constraints such as: voltage swing limit, Surge Impedance Limit (SIL), and thermal limit are taken into account. By means of this strategy, is possible to estimate more accurately and realistically the power limits and binding constraints, hence exploiting the cables’ capacities under particular installation and operating conditions. The translation from rated conditions towards dynamic behaviours, permits the inclusion of more realistic states of the system, for instance, accounting not only for the wind speeds fluctuations, but also the variation of boundary temperatures (seabed), and other thermal parameters which have strong influence over buried cables’ thermal performance. The transmission cables are modelled considering a uniform distribution of their electrical parameters, inductance and capacitance, by means of the attenuation constant and characteristic impedance. Likewise, A Thermo-Electrical Equivalent Model (TEE) is applied for the thermal analysis given its good solution quality-computation time balance. The proposed methodology is applied to a 800 mm2 cable, with the results showing an estimated increase of OWF total installed power of 110% for a total length of 120 km, when compared to the traditional method.

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