Feasibility study of 5MW superconducting wind turbine generator

The feasibility of installing a direct drive superconducting generator in the 5MW reference offshore wind turbine of the National Renewable Energy Laboratory (NREL) has been examined. The engineering current densities $J_e$ obtained in a series of race track coils have been combined with magnetization measurements to estimate the properties of suitable field coils for a synchronous generator, which is more lightweight than the conventional used combination of a gear box and a fast rotating generator. An analytical model and finite element simulations have been used to estimate the active mass of generators with varying number of poles. A 24 pole machine with an outer diameter of 4.2m and active length and mass of 1.2m and 34 tons is suggested possible, if a $J_e=300A/mm^2$ can be obtained in B=4T pointing to an operation temperature around 40K.

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