Effects of an electromagnetic shield and armature teeth on the short-circuit performance of a direct drive superconducting generator for 10 MW wind turbines - DTU Orbit (09/11/2017)

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To reduce the cost of energy of offshore wind energy conversion, large individual wind turbines of 10 MW or higher power levels are drawing more attention and expected to be desirable. Conventional wind generator systems would be rather large and costly if scaled up to 10 MW. Direct drive superconducting generators have been proposed to reduce the generator size, because the electrical machines with superconducting windings are capable of achieving a higher torque density. However, a superconducting machine is likely to produce an excessive torque during a short circuit because of its small reactance. An electromagnetic (EM) shield between the rotor and the stator as well as iron or non-magnetic composite (NMC) armature teeth affects the sub-transient reactance of a superconducting machine so that they play a role in the short-circuit performance of a superconducting wind generator. This paper presents a 10 MW superconducting generator design and studies the effects of material, thickness and position of an EM shield and the effects of NMC and iron armature teeth on the torque and the field current density during a three-phase short circuit at the generator terminal. One result shows that the short circuit torque is not able to be effectively reduced by varying the EM shield and the armature tooth material. The other result shows that the field current density is likely to exceed its critical value during a short circuit although the EM shield material and the armature tooth material take some effect.

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