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Ripple Field AC Losses in 10-MW Wind Turbine Generators With a MgB2 Superconducting Field Winding - DTU Orbit (09/11/2017)

Ripple Field AC Losses in 10-MW Wind Turbine Generators With a MgB2 Superconducting Field Winding

Superconducting (SC) synchronous generators are proposed as a promising candidate for 10-20-MW direct-drive wind turbines because they can have low weights and small sizes. A common way of designing an SC machine is to use SC wires with high current-carrying capability in the dc field winding and the ac armature winding is made with copper conductors. In such generators, the dc field winding is exposed to ac magnetic field ripples due to space harmonics from the armature. In generator design phases, the ac loss caused by these ripple fields needs to be evaluated to avoid local overheating and an excessive cooling budget. To determine the applicability of different design solutions in terms of ac losses, this paper estimates the ac loss level of 10-MW wind generator designs employing a MgB2 SC field winding. The effects on ac losses are compared between nonmagnetic and ferromagnetic teeth with different numbers of slots per pole per phase. The necessity of an electromagnetic shield is then discussed based on the obtained loss levels. The results show that the total ac loss is so small that ferromagnetic teeth can be applied in the generator design without using an electromagnetic shield.

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