

Magnetic End Leakage Flux in a Spoke Type Rotor Permanent Magnet Synchronous Generator

Authors : Petter Eklund, Jonathan Sjölund, Sandra Eriksson, Mats Leijon

Abstract : The spoke type rotor can be used to obtain magnetic flux concentration in permanent magnet machines. This allows the air gap magnetic flux density to exceed the remanent flux density of the permanent magnets but gives problems with leakage fluxes in the magnetic circuit. The end leakage flux of one spoke type permanent magnet rotor design is studied through measurements and finite element simulations. The measurements are performed in the end regions of a 12 kW prototype generator for a vertical axis wind turbine. The simulations are made using three dimensional finite elements to calculate the magnetic field distribution in the end regions of the machine. Also two dimensional finite element simulations are performed and the impact of the two dimensional approximation is studied. It is found that the magnetic leakage flux in the end regions of the machine is equal to about 20% of the flux in the permanent magnets. The overestimation of the performance by the two dimensional approximation is quantified and a curve-fitted expression for its behavior is suggested.

Keywords : end effects, end leakage flux, permanent magnet machine, spoke type rotor

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