Analysis of Electromagnetic Behavior of Permanent Magnetized Electrical Machines in Fault Modes

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Abstract

The use of Permanent Magnet Synchronous Machines (PMSM) as shaft generators is not new in marine vessels propulsion drive trains. Due to risk of fires in stator windings by internal faults, DNV GL requires the shaft generator to be electrically dead without losing propulsion. This requires a need of a novel design for on shaft generator with the capability of flux weakening.

In this paper, a transient 3D finite element model using COMSOL Mulitphysics® is presented to test the flux weakening capabilities of Dual Rotor Permanent Magnet Synchronous Machine (DR-PMSM). The DR-PMSM has two rotors instead of one, with identical surface mounted magnets on both rotors. One of these rotors has the capacity to rotate with respect to the other, to reduce the flux or completely short the flux path by misalignment of rotors. The stator of DR-PMSM is just like a conventional PMSM with concentrated windings.

A 2D FEM model of a conventional PMSM was also built to check the validity and compare the power efficiency of the DR-PMSM. It is seen that torque is proportional to the active length of the machine, and if a gap is introduced between the rotors then the total length of the machine must be increased. Also, the axial flux component which induces eddy currents in the stator teeth was studied. By modeling anisotropy in the stator iron, certain hot spots could be seen in the middle part of the stator. The forces that were in the shifting mechanism were studied and it was concluded that the magnetic cogging can be reduced to reduce the effect of these forces.

Figures used in the abstract

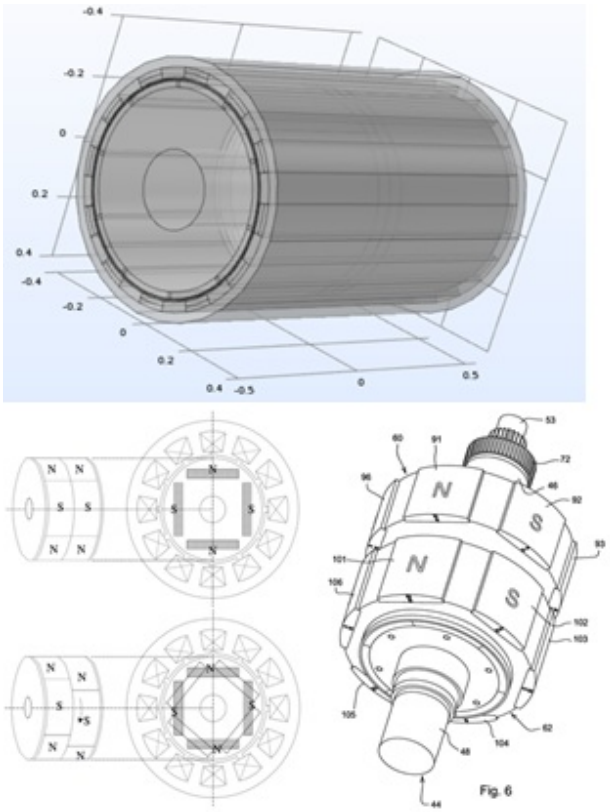

Figure 1: 3D model of DR-PMSM (top) and construction of DR-PMSM (bottom)