Impact of Rotor Eccentricity and Current Harmonics on High-Speed Permanent Magnet Generator Performance for Microturbine Applications

Thanh-Anh Huynh, Min-Fu Hsieh

Abstract

- The effect of rotor eccentricity in the no-load and load conditions on the distributions of electromagnetic force in the HSPM generator is studied and the allowed tolerance of rotor eccentricity is determined.
- The current harmonics generated by the rectifier are injected into the generator armature to study the distribution of core loss, eddy current loss, and temperature rise (particularly on the rotor).
- The resonance impact of rotor eccentricity and current harmonics on the electromagnetic force distribution is also evaluated.
- The results show that the increase of losses, temperature, vibration, and mechanical strength in HSPMG depends on the amplitude and percentage of total current harmonic distortion injected into the HSPMG under an allowable rotor eccentricity.

Methodology Analysis

- Evaluation of electromagnetic force in the HSPM generator under the impact of current harmonics and rotor eccentricity.
- Evaluation of the losses and thermal in the HSPM generator under the impact of current harmonics.

Effect of Harmonic on Stator and Rotor Forces

The distribution of electromagnetic force on the stator and rotor of HSPM generator slightly increases under the effect of voltage and current harmonics.

Effect of Eccentricity and Harmonic on Stator and Rotor Forces

The distribution of electromagnetic force on the stator and rotor of HSPM generator significantly increases under the effect of rotor eccentricity, voltage and current harmonics.

Effect of Harmonics on Thermal

The temperature on the rotor core of HSPM generator increases about three times under the effect of voltage and current harmonics.

Acknowledgments

This work is supported by the Ministry of Science and Technology, Taiwan, under contract MOST 105-2221-E-009-214-FY11 and by National Science Council, Taiwan under contract NSC97-2218-E-009-015-MY3. The assistance of Y.C. Chang and S.J. Huang is greatly appreciated. JIE and BSTC Taiwan are acknowledged for supporting MUST and NUSTC.

Conclusions

- The rotor expansion increases to 40% with the effect of rotor eccentricity, voltage, and current harmonics when the rotor eccentricity is 50%.
- The rotor stress increases to 70% with the effect of rotor eccentricity, voltage, and current harmonics when the rotor eccentricity is 50%.