Steady state and dynamic analysis of three phase stand alone self excited induction generator driven by wind speed under different loading conditions

A thesis submitted to the Electrical
Engineering department – Faculty of Engineering
Alexandria University
In partial fulfillment of the requirements
For the degree of Master of Science
In Electrical Engineering

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July 2016

ABSTRACT

This thesis covers the dynamic analysis, modeling and control of three phase self excited induction generator. The process of voltage building up using capacitors is investigated.

The minimum value of capacitance required for successful self excitation of the 3φ-SEIG is calculated using a new simplified technique based on Routh-Herwitz stability criterion. The coefficients of the characteristic equation of the 3φ-SEIG for both cases; the loaded and unloaded conditions are derived for constructing Routh's array to find the minimum excitation requirements. The obtained theoretical results are simulated and verified experimentally.

The voltage, currents, magnetizing inductance and electromagnetic torque are shown for the balanced operating conditions of the generator.

The operation of the 3φ-SEIG feeding single phase loads is studied; the process of self excitation and phase current balancing of the 3φ-SEIG is carried out using only two capacitors.

A simple and direct formula is derived to calculate the values of the two capacitors based on the symmetrical components technique. The 3φ-SEIG is further modeled as a two port network for the steady state analysis where the value of the per unit frequency is calculated using the nodal admittance method. Also the dynamic modeling and analysis of the proposed configuration is presented in detail. The simulation results of the balanced 3φ stator currents are verified experimentally.

Finally, the performance of the 3φ-SEIG feeding various types of loads (1φ, 3φ balanced/unbalanced and linear/non linear loads) is improved using a shunt active power filter which works as a harmonic filter, VAR compensator and voltage regulator to obtain an outstanding performance of the 3φ-SEIG.