Abstract

Absence of dc excitation, low maintenance, low cost, high torque/weight ratio, no synchronization requirement etc. are some of the advantages of and induction generator over the conventional synchronous generator. The induction generators are increasingly being used in wind energy and in mini hydro systems. Induction generator requires VAR to be supplied by the grid to magnetize the generator, unlike the synchronous generator which has a dc excited field.

If an appropriate capacitor bank is connected across the terminals of an externally driven induction machine, a voltage is induced in machine winding due to the excitation provided by the capacitor. The induced voltage and current will rise until VAR supplied by capacitor is balanced by VAR demanded by the machine, a condition which is essentially decided by the saturation of the magnetic circuit. The machine now operates as Self Excited Induction Generator and can feed a load, at a voltage and frequency decided by value of capacitor, speed of the prime mover, parameters of the machine and load.

For self excitation to occur, the following two conditions must be satisfied:

1. The rotor should have sufficient residual magnetism.
2. The three phase capacitor bank should be of sufficient value.

If the rotor has sufficient residual magnetism, a small e.m.f. is developed in the stator winding. The e.m.f. if sufficient in magnitude would circulate leading current in the capacitors. The flux produced due to these currents would assist the residual magnetism. This would increase the machine's flux .This process is thus cumulative and the induced voltage keeps on rising until saturation is reached. As saturation occurs, the flux becomes constant and final steady state value of the voltage is obtained. This voltage continues to exist till value of capacitance and speed are maintained favorably. Also, the value of the three capacitor bank should be of sufficient magnitude in order to initiate self excitation and generate e.m.f. of suitable value.

A model of SEIG is developed for steady state and different transient conditions in MATLAB/SIMULINK and block sets are simulated with its waveforms for Current, Voltage, Speed and Torque in steady state conditions, load perturbation and in different transient conditions.

Also a program is developed to predict the steady state performance of the SEIG. Effect of capacitance and frequency on the performance of the SEIG is studied to enable selection of suitable capacitor for a given operating condition.

Following the steady state investigation, programming is carried out for an Induction Motor which is working as an Induction Generator for the different transient conditions. The conditions which are considered for the studies include operation of induction motor as induction generator and load perturbation and short circuit in generating conditions.