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THREE PHASE SELF EXCITED INDUCTION GENERATOR ELECTRONIC LOAD CONTROLLER USING PI CONTROLLER

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Abstract: *A mathematical model of the Self-Excited Induction Generator is developed in this paper. The single point operation of these generators is realized. The voltage of generators remains constant under various operating loads conditions. The Electronic Load Controller is also modelled. The proposed electrical system are modelled and simulated in MATLAB using Simulink and Sim Power System set toolboxes. On the basis this model different characteristics of SEIG with ELC are analyzed.*

Keywords: *Self excited induction generation, electronic load controller, voltage satiability, frequency stability.*

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INTRODUCTION

The demand for green energy sources has lead to the development in the field of solar power and wind power but as both is dependent on external factors such as weather conditions; problems remain with assuring a stable energy supply. Wind power generated using a self-excited induction generator has a drawback in that generated voltage varies with wind velocity. Induction generators are widely used in generating energy from renewable energy resources because they have rugged construction. These generators are simple, reliable, and cost effective, require little maintenance; has self-protection feature against overload, and does not require a DC exciter. However, a great disadvantage of self-excited induction generators is poor voltage regulation and its value depends on the prime mover speed, capacitance, load current and power factor of the load. Another disadvantage is complex calculations for excitation capacitance. A stand-alone induction generator requires a capacitor bank to be connected across the generator terminals, which is the only source of magnetizing current. Also for build-up of voltage to occur, remnant magnetism must be present in the rotor. Therefore, we need a control system is to regulate the voltage to meet the constant voltage demand.

SELF-EXCITED INDUCTION GENERATOR

SEIG has cage rotor construction with shunt capacitors connected at its terminals for excitation; which may be either constant or variable. It is also called as an asynchronous generator because the speed during induction generator operation is not synchronous. With sufficient capacitors connected across each of induction motor terminals; 3 phase induction motor works as a Self-Excited Induction Generator. Self-excitation of the generator begins by the action of either a residual magnetism of the iron core or charge in the excitation capacitors. When the induction machine is driven by a prime mover, the residual magnetism of the iron core induces voltages in the stator windings at a frequency proportional to the rotor speed. With sufficient capacitor excitation and minimum load impedance, the process continues leading to increase in induced stator voltage. It settles to a steady state operating point determined by the air gap flux linkage-saturation. The machine now operates as a Self-excited Induction Generator.

ELECTRONIC LOAD CONTROL OF SELF-EXCITED INDUCTION GENERATORS

An electronic voltage regulator consists of a chopper switch (IGBT), a universal bridge, rectifier, a filtering capacitor and a PI controller. A dump load, controlled by an electronic load controller, is connected across the generator in parallel with the consumer load to keep the net power output across the generator constant. The amount of power required to be dumped in the dump load is decided by the controller. The uncontrolled rectifier is used to converts the SEIG ac terminal voltage into dc. This dc output has the ripples, which must be filtered out and, therefore, a filtering capacitor is used which smoothen the dc output voltage. A suitable gate driver circuit has been developed that turns on the chopper switch when the consumer load on SEIG is less than the rated load and turns off the chopper switch when consumer load on the SEIG is at a rated value. When the IGBT is switched on, the current flows through the dump load and consumes the difference power. It results in a constant load on the SEIG and, hence, constant voltage and frequency at the load terminal.

ELC has a drawback that the voltage rating of uncontrolled rectifier and chopper must be same. Another limitation of ELC is that it is introduce a lot of harmonics in the system.

SIMULATION RESULT

The power is almost constant at 7.5 KW. The speed of the generator is 1440 rpm and its terminal voltage is 400 Volts. Its RMS Voltage is 415 Volts.

CONCLUSION

The working of a three phase self excited induction generator electronic load controller using IGBT choppers and PI controller has been studied. The simulation of scheme has been successfully completed. The output voltage has been obtained as constant thus ensuring satisfactory operation. The power is almost constant at 7.5 KW. The variation in the consumer load is neutralized by diverting the extra power to a dump load. This permits the use of turbine with no flow regulating and their governor control system. Thus SEIG generates constant voltage and constant frequency; as the electrical load is maintained constant at its terminals.

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