AN INVESTIGATION ON SOME OPERATIONAL ASPECTS OF A GENERALIZED IMPEDANCE CONTROLLER BASED SELF EXCITED INDUCTION GENERATOR

by

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1. Generator

2. Induction generator

3. Self excited induction generator (SEIG)

CERTIFICATE

This is to certify that the thesis entitled, **"An Investigation on Some Operational Aspects of A Generalized Impedance Controller Based Self Excited Induction Generator"** being submitted by **Mr. B.VenkatesaPerumal** for the award of the degree of **Doctor of Philosophy** is a record of bona-fide research work carried out by him in the Department of Electrical Engineering, Indian Institute of Technology, Delhi.

Mr. B.VenkatesaPerumal worked under my guidance and supervision and has fulfilled the requirements for the submission of this thesis, which to my knowledge has reached the requisite standard. The matter embodied in this thesis has not been submitted for the award of any degree or diploma elsewhere to the best of my knowledge.

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ABSTRACT

Brushless generation, using the Self Excited Induction Generator (SEIG), is becoming popular electric power generation scheme due to its ruggedness, low cost, low maintenance and reliable operation. These generators are commonly used in stand-alone power generation scheme mostly to electrify the isolated rural areas. The basic problems associated with such generation schemes are poor voltage and frequency regulation, which result in under-utilization of machine rating. For proper SEIG voltage and frequency regulation at the point of common coupling (PCC) of the generator and the load, both active and reactive power levels at PCC have to be perpetually maintained constant.

In order to meet such objectives, both active and reactive power levels are regulated by means of modern power electronic controllers. The survey of state of art in brushless generation control technology using modern power electronic controllers shows that the existing controllers provide either active power control or reactive power control only. Among the pure reactive power controllers, such as STATCON, which can provide only terminal voltage regulation for the SEIG, with these controllers the frequency regulation of the SEIG remains poor, under both electrical load output and mechanical speed input perturbations. Current state of the art show, that in order to regulate the electrical power at terminals of SEIG for the purpose of frequency regulation, when the active power controllers are used, which are mainly the dump loads, large amount of active power is wasted in form of heat loss in the dump resistive load. Moreover, such schemes support brushless power generation only under regulated speed prime mover operation. Till date, no efficient scheme exists to regulate the SEIG terminal frequency under both electrical load output and mechanical speed input perturbations, which are commonly encountered under

unregulated speed prime mover operation. Such operating conditions are typically observed with wind electric or micro hydro generation schemes.

The proposed Generalized Impedance controller (GIC) is an integrated active and reactive power controller. For the purpose of SEIG terminal voltage and frequency regulation the GIC is physically connected at the PCC. In the present scheme of SEIG terminal voltage and frequency regulation the active and reactive power flow in the GIC has been ingeniously regulated to provide a favorable system operating condition for robust terminal voltage and frequency regulation. Such operation of the GIC effectively regulates the active and reactive power flow in the SEIG, by suitably adjusting the magnitude and phase of the fundamental component of the fabricated GIC output voltage with respect to SEIG terminal voltage. Thus the desired condition for SEIG fundamental voltage and frequency regulation is achieved. The mechanism of novel strategy for the GIC operation for successful SEIG terminal voltage and frequency control the claim them as the prime novel features of the research work. In this form of control the voltage and frequency regulation of SEIG are achieved though a single controller with single-loop control algorithm. This can be highlighted as one of the novel features of the present research work. The proposed controller is capable to regulate SEIG terminal voltage and frequency under both electrical load output and prime mover speed input perturbation. The supporting hardware and software is developed to achieve operational prototype model.

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