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# Experimental stand-alone self-excited induction generator driven by a diesel motor

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## Abstract

This paper presents an experimental work to design and size a diesel generator (DG). The basic system is equipped with a 1.5 kW self-excited induction generator (SEIG), a diesel motor (DM), a static voltage compensator (SVC) and controllers. A proportional integral controller is used to meet the requirement of the SEIG frequency regulation. A controlled voltage source is performed by using an SVC with a fuzzy controller, which adjusts voltage by varying the amount of the injected reactive power. An experimental set-up is used to identify the SEIG parameters and select the convenient bank of capacitors that minimize the SEIG starting up time and fix the convenient margin of voltage. The system has been tested by simulation using models implemented by Matlab/Simulink software. The simulation results confirm the efficiency of the proposed strategy of voltage regulation.


*Keywords:* Diesel motor; SEIG; SVC; Voltage regulation; Frequency regulation

## 1. Introduction

The design process of DG requires the selection and sizing of its components. SEIG appears to be the right candidate to generate an electric power for remote areas applications (Dheeraj et al., 2009; Gao et al., 2010; Kostić, 2012; Ouchbel et al., 2012; Lan et al., 2015; López et al., 2011; Maleki and Askarzeda, 2014; Updhyay et al., 2014). It is robust, and there is an absence of a separate DC source for excitation. It is a simple of construction, reliable, efficient, and rugged, brush-less rotor construction with an ease of maintenance. Moreover we are dealing with high power density (W/Kg) and a self-protection (Faria et al., 2006; Kishore et al., 2006; Elhafyani et al., 2006; Ouchbel et al., 2010; Seyoum et al., 2002). The terminal voltage and frequency are affected by the prime mover speed, the bank of capacitor value, and the load profile (Mohamed et al., 2014; Chauhan et al., 2010). The SEIG exhibits poor voltage regulation. Various

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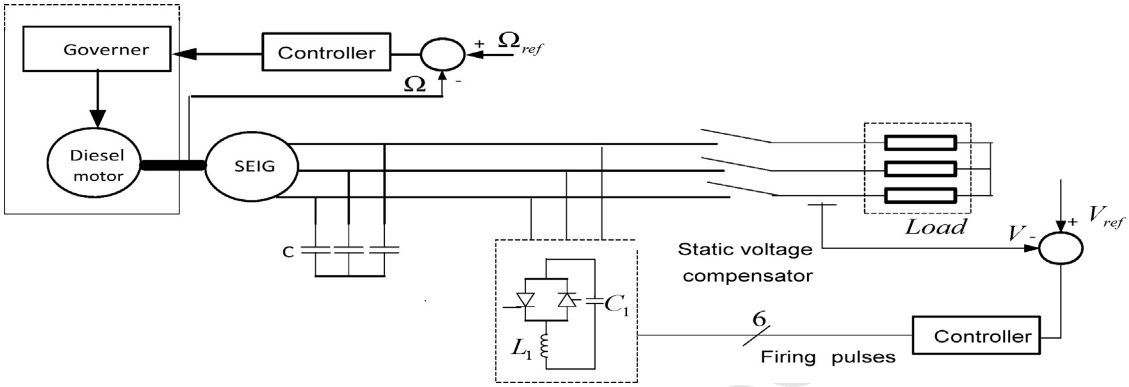


Fig. 1. The proposed system.

schemes like short shunt and long shunt configurations, saturable core reactors, switched shunt capacitors, SVC and voltage or current source converter based static compensator (STATCOM) are done for achieving improved voltage regulation (Ahmed et al., 2004, 2005; Dalei and Mohanty, 2015; Singh et al., 2004). The stability analysis, control and diagnostic of DG need accurate modeling of its main components. The *d-q* axis based on conventional model is used to analyze the transient behavior (Kumsuwan et al., 2008; Sharaf-Eldin et al., 2004). The design process of the voltage regulator for the SEIG is implemented in two phases. Firstly, the voltage control strategy is developed to permit SEIG to operate as a stand-alone generator supplying any type of load. Then this controller is implemented after calculating parameters. A prototype is built for experimentation. The International Electro technical Commission (IEC) 60038 standard is the result of an international agreement aimed at reducing the number of voltage values for power supply system, electric power networks, load installations and equipment. IEC specifies a global unique value normalized 230 V/400 V. The Tolerance range is limited to ±10%. The line frequency is 50 Hz. The configuration of the system is presented in Fig. 1.

The system components are a DM, a SEIG, a capacitor bank, a SVC and two separated loops, the first adjusts the frequency related to the diesel motor speed, the second adjusts the voltage related to the reactive power injected.

## 2. Test bed configuration

A test execution platform is used to identify the system components parameters and experiment the operation, it is represented in Fig. 2. A separately excited DC motor SEDCM (Table 1) is used as a prime mover, a SEIG (Table 2), a capacitor bank, SVC and equipment's for control.

Fig. 2. The operated system.



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