ISSN: 2277-3754
ISO 9001:2008 Certified
International Journal of Engineering and Innovative Technology (IJEIT)
Volume 5, Special Issue 1, February 2024

# Review and Applications of the SEIG in Electric Applications

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***Abstract:*** ***This paper is aimed to preset the review of the most frequent used self-excited induction generators (SEIG) and its applications to the high power generation especially having the focus on wind turbine based SEIG. Paper initially presented the applications of the SEIG generators then operational principal is discussed considering wind turbine application. Finally the extended survey is presented including the future scopes and findings are concluded.***

***Key words:*** **SEIG, Wind Turbine, Power generation, Induction generations, Compensators, Genetic algorithm.**

## I. INTRODUCTION

A high power renewable energy generation is the critical field of research in recent times. The solar PV and wind based energy systems are priority in today's reassert. The SEIG based generators are best suitable for such field of applications. When: Slip goes negative, which causes the rotor current as well as rotor EMF to reach negative values, a machine with induction will act as an induction generator. Prime mover torque turns into an electric torque opposite.

### *A. Application of SEIG in brake van system*

There is wide range of the applications where the SEIG based generators are employed now days. The most frequent applications are shown in the Figure 1. Provided that the conditions for self-excitation are satisfied the charged capacitors cause the terminal voltage to build up at the stator terminals of the induction generator.

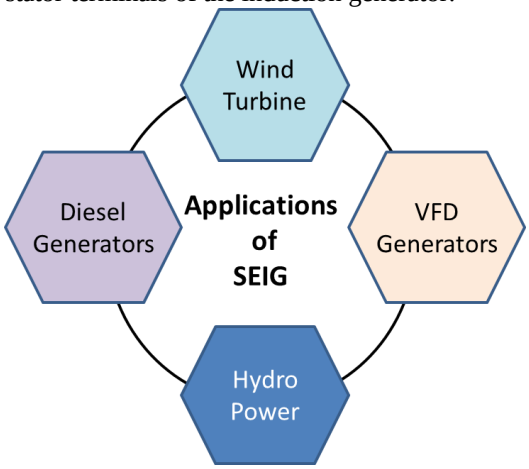


**Fig.1. Applications of most frequent SEIG based power generations systems.**

Whenever the charged capacitors are attached to the terminals, a transient excited current flows, resulting in a magnetic flux. The voltage generated by it magnetic flux shall be able to charge the capacitors. As the charge increases, more exciting current is injected into the induction generator. Because the magnetic flux is still increasing, the generated voltage is larger. Voltage is generated in this manner.

### *B. Wind Turbine*

Wind turbines administrative frameworks continue to play critical roles in assuring turbine stability and safety, as well as increasing wind vitality catch. The most well-known administration frameworks in a common turbine body pitch administration are slow down administrations (uninvolved as well as dynamic), yaw management and others. Under wind speed conditions, a turbine's capacity yield may exceed its appraised worth. Control administration is projected for controlling the capacity yield among suitable American state actuations in order to keep a strategic distance for rotating motor mischief as well as settle the capacity yield. Within power administration, there are two primary management paths: pitch administration and sluggish control. The turbine controlling framework is used to manage capacity yield within acceptable deviations. The basic building blocks of the wind based power generation using the SEIG are shown in the Figure 2. The initial prime mover is the wind turbine and is followed by the SEIG generator connected through shaft.

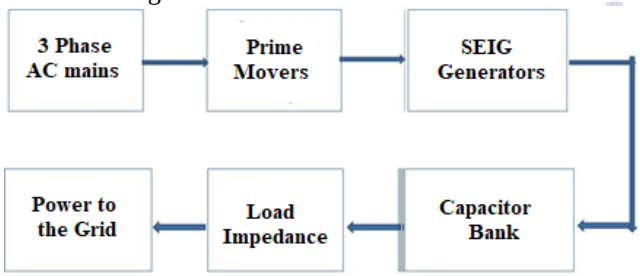


**Fig.2.Basic building blocks of the SEIG based Power generations**

### *C. Working Principal*

The respective working diagram schematic is shown in Figure 3.

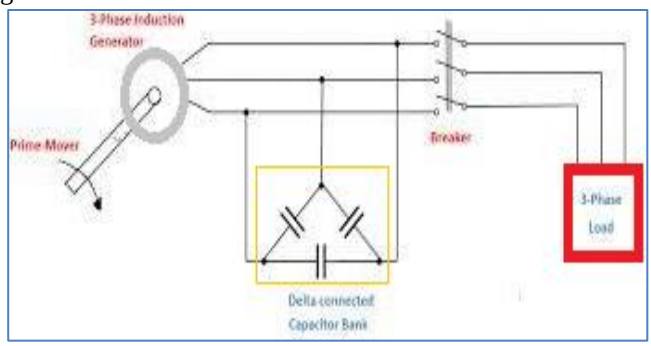


**Fig.3. SEIG based generators operation**

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## II. LITERATURE REVIEW OF SEIG

There are many recent researchers who have designed sophisticated new modified design of the SEIG based generators for power improvement.Hanafy and co. research has described the steady-state and dynamic behaviors of a suggested connection for the two-winding single-phase self-excited induction generator (TWSPSEIG) fitted with a stimulation capacitor and a compensating capacitor for operation at constant load voltage and frequency regardless of the no-load or various load conditions. By utilizing the loop impedance approach through the accurate equivalent circuit model of the TWSPSEIG based on the double rotating field theory, the performance equations at steady-state circumstances are obtained.

Dagang and other proposed a decentralized wind energy production system with a broad operating range of wind speed fluctuations, a new direct fuzzy control approach is presented in this study. To enhance system performance and more specifically the caliber energy injected into the electrical grid, the suggested strategy make usage of continuous fuzz torque and power control rules. On the generator side, the direct fuzzy torque control law is applied for generating the control signal of the converter in order to extract the maximum amount of power available at the turbine and to keep the machine's stater flux at a manageable level. On the grid side, the direct fuzzy power regulation law of the converter is used to achieve a power efficiency that is close to unity. Mousavi and co. numerous control strategies have been devised to cope with the simultaneous improvement of productivity and dependability of WECS as a result of extensive research on this subject in the literature. Due to its inbuilt resistance to parametric uncertainty and disturbances as well as its simplicity in design and execution, sliding mode control (SMC) has, however, shown to have the most reliable and best performance among most control strategies. In order to address various control design issues for WECS, this study provides a thorough overview of the literature that has already been published on the use of SMC and its recently developed modifications.

Seyoum and other In order to enhance the dynamics of cane bin rides and to aid in train braking, the sugar cane business uses brake vans that are connected to the ends of cane trains. Cane bins frequently lack both suspension and brakes, in contrast to other railway vehicles. At the moment, brake vans work by activating a brake caliper, which clamps a vented disc rotor on every of the four wheels sets, using compressed air provided by an onboard compressor. Due to rotor and brake pad wear, this system needs maintenance. It is suggested to build an electrical braking system employing a self-excited induction generator. When an electrical brake is applied, energy is lost in adequately ventilated resistors. A brush-less design further reduces maintenance.

Erhab et al. has designed a wind farms operate as a sink and produced reactive electricity as a result. To prevent low-voltage problems in the wind power system, reactive power management is necessary. Devices used in flexible AC transmission systems, such as static synchronous compensator (STATCOM), which may provide the reactive power needed for stabilization voltage, improve the performance of the electric power.

For the purpose of operating wind-driven Doubly-Fed Induction Generators (DFIGs) for independently power supplies, A. K. Tandon et al. developed a hybrid-excited system. In this instance, the generator is partially stimulated by constant capacitors at the stator terminals in addition to the rotor side excitation of the DFIG using an SPWM inverter powered by a set of batteries. For the suggested system, a steady-state corresponding circuit and its evaluation have been developed and presented. The choice of stator capacitors has been made very clear. Additionally, an effort is made to size various components, including batteries and inverters, for the specified machines rating and other circumstances of operation.

Self-Excited Induction Generators (SEIGs) by R.C. Bansal et al have been attempted twice using Genetic Algorithms (GA), in two nested loops. The outer loop is used to determine the stator winding's stator coil count and excitation capacitor value that would satisfy the generators stipulated performance requirements. For the first time, the inner loop utilized the GA tool to simply predict these performance quantities. Additional plans have also been incorporated, such as converting the stator connection from delta to star during periods of lesser wind speed and using a short shunt configuration that is appropriate for trailing power loads.

The research by Anurag et al. introduces a novel methodology to quantify the effects of 22 networks switching and/or reinforcement, ESS deployment, and the extent of renewable power integration in the 23 system. A changing and multi-objective stochastic mixed integer linear programming (S-MILP) 24 framework is created to conduct this analysis, which simultaneously considers the best placement of RES-based DGs and ESSs in cooperation with the strengthening and/or reconfiguring of distribution networks.

Self-excited induction generators (SEIGs) by Calgan et al. are among the finest solutions for providing electricity in rural regions due to their inexpensive cost, broad speed operating range, brushless construction, and low maintenance requirements. In spite of its benefits, it has weak voltage and frequency control that is influenced by the generator's speed, the load's impedance, the excitation capacitor, and the magnetizing reactance.

Hosseinzadeh and other In this paper, an induction generator dynamic model for MATLAB/Simulink is presented. This model enables simulation studies for the design of fuzzy logic controllers to control the generator's retarding torque output in an electrical brake application. In the literature, electrical breaking has been suggested as a mechanical braking system substitute with the benefit of requiring less maintenance. The kinetic energy of the

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vehicle is converted to electrical energy by an induction generator functioning as a brake. This electrical energy can then be utilized in a regenerative mode or dissipated in a resistor bank. The designed controllers for an efficient management of the torque that is generated of the electrical braking system will be tested using the Simulink model that was built.

et al., El Akhrif Using a self-excited induction generator (SEIG) powered by a regulated DC motor with variable speed and load, a novel method for maintaining the RMS voltage output constant is proposed in this study. The methodology employed in this study is based on a traditional proportional-integral regulator that regulates an SPWM switching. To keep the AC voltage at the desired level, a MATLAB Simulink model of the system is created. The findings of simulation and experiment are then compared using the SPACE board.

VB Murali Krishna and others In this situation, the induction generator's self-excitation process is primarily influenced by the quantity of reactive power, followed by the rotor's speed and the system's load. The functioning of the self-exciting inductive generator is experimentally investigated in this work to determine the impact of these three factors. The goal of the study is to determine the ideal generator operating configuration for carrying out the highest loading capacity and most cost-effective operation. The suggested study was expanded to include an additional initial excitation method, which confirmed performance under the identical source and load conditions and yielded some important conclusions for using the generator to its fullest capacity. In this experimental work, a micro-hydro source powered turbine simulation was used as a source of input to the SEIG.

Sedky et al. proposed a methodology for controlling the voltage and frequency (V-f) of a freestanding wind-driven self-excited reluctance generator (WDSERG) is presented in this study. The methodology is based on two alternative compensation configurations (short-shunt and long-shunt compensation) using two switching capacitors for (V-f) control. The two topologies' dynamic and a steady-state performances are discussed for various operating scenarios, including wind speeds, load currents, and power factors. To perform this analysis, a comprehensive dynamic model of the WDSERG, including the excitation capacitors and load, is created. As a result, full equivalent circuits are suggested. By modifying the operation cycle of H-bridge circuits with PI controllers, capacitor values can be regulated.

B Murali Krishna, V and others goal of the current study is to carefully examine the connection between emotional intelligence and commitment at a few Chennai-based home appliance companies. The study is of a descriptive kind. Using a straightforward random selection procedure, 200 employees were chosen as stakeholders, including staff members, supervisors, and casual workers from various departments. Structural Equation Model and the t test were utilized for analysis.

Rahim and co. In order to quantify the potential implications that inverter-interfaced PV dispersed generation may have on the quality of electric power; the results of a power quality (PQ) research conducted on a PV generator are summarized in this paper. Along with a comparison to the harmonic current restrictions set by BC Hydro, various interpretations of the IEEE 519-1992 standard's harmonic distortion limits are carried out. The results of a connection/disconnection test, a statistical analysis of all data taken using two PQ monitors, and harmonic simulation results are also included in this study.

Santolo Meo and others in their research paper designed a novel hybrid approach for the design optimization of direct-drive permanent-magnetic flux switch generator for low power wind applications is proposed. It combines multi-objective particle swarm optimization (PSO) and artificial neural networks (ANN). The suggested multi-objective optimizations aims to decrease the machine's expenses and weight while increasing the induced voltage's amplitude and decreasing its overall harmonic distortion. The search space for the optimization problem is defined by the permanent magnet width, stator and rotor tooth width, number of rotor teeth, and stator pole number of the device.

Bendjeddou and others presented a virtual flux orientated control (VFOC) based on nonlinear super-twisting sliding mode control (STSMC) is used in stand-alone wind energy systems (WES) to improve the robustness and dynamic performance of a self-excited induction generator (SEIG). The traditional proportional-integral-Fuzzy Logic Controller (PI-FLC) of the inner current control loops is replaced by STSMC. A PWM rectifier is used in conjunction with the suggested control method to achieve various benefits, including the reduction of harmonics and accurate and quick reference tracking. Simulated results are used to evaluate the performance of the suggested control method (STSMC-VFOC-SVM) to that of the established method (PI-FLC-VFOC-SVM). It demonstrates how the suggested approach enhances the system's dynamics with lower current harmonics..

Boubzizi and co. The Doubly-Fed Induction Generator (DFIG) is used in this study to propose an improved control technique for the Wind Energy Conversion System (WECS). To create the ideal aerodynamic torque and enhance the dynamic performance of the WECS, a strong Super-Twisting (STW) sliding mode control for variable speed wind turbines is created. To maximize power extraction, the electromagnetic torque of the DFIG is directly tracked using the suggested control. The performance and efficacy of the STW control method are contrasted with those of traditional proportional-integral (PI) and sliding mode (SM) controllers. In terms of chattering reduction, short convergence time, and resilience against parameter fluctuations and system disturbances, the suggested STW algorithm demonstrates remarkable features. Lokesh Varney and others The self-

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excited induction generator (SEIG) dependability estimation based on performance analysis is presented in this study utilizing the Monte-Carlo simulation (MCS) method and data from a self-excited induction motor functioning as a generator. The capacity of an SEIG to enhance the system's inadequate voltage regulation (VR) and frequency regulation (FR) determines whether or not it will be widely accepted. The performance characteristics of SEIG are constrained during system disruptions since SEIG is also able to handle the dynamic loadings. When an induction generator is grid-connected, the grid becomes weak because the magnetizing current is extracted from it. The SEIG's independent operation, in contrast. In order to get the minimal capacitor value necessary for SEIG excitation in isolated mode applications, such as stand-alone wind power generation, this study.

## III. CONCLUSION AND FUTURE SCOPE

With a focus on wind turbine-based SEIG, this study seeks to provide an overview of the most frequently used (SEIG) as well as their applications to high power generation. Before examining operating theories with reference to wind turbine applications, the paper first described the uses of SEIG generators. The enlarged survey is finally prepared, along with potential stipulations, and the results are given.

It is concluded that in recent times performance of the SEIG is elevated using the optimization methods like GA and is required to be evaluated in the near future. The combination of the PSO and ANN based approaches may also offers the edge over others.

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