STAND ALONE POWER GENERATION BY
3φ ASYNCHRONOUS GENERATOR: A COMPREHENSIVE SURVEY

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ABSTRACT

This paper presents a literature survey on the stand alone power generation using three phase asynchronous generator. Induction generators are increasingly being used in non-conventional energy systems such as wind, micro/mini hydro, etc. The advantages of using an induction generator instead of a synchronous generator are well known. Some of them are reduced unit cost and size, ruggedness, brushless (in squirrel cage construction), absence of separate dc source, ease of maintenance, self-protection against severe overloads and short circuits, etc. In isolated systems, squirrel cage induction generators with capacitor excitation, known as Self-Excited Induction Generators (SEIGs), also presented the importance of renewable source of energy (solar energy, wind energy, geothermal energy, tidal energy) in energy crisis. Author strongly believe that the survey article will be very much useful to the research for finding out the relevant references in regarding with self excited induction generator network and it is also helpful for power generation in remote area.

Keywords: Stand Alone Power Generation, Wind Energy, Induction Generator, Isolated System, Self-Excited Induction Generator, AC/DC/AC Converter, Power Factor, PWM-Techniques

1. INTRODUCTION

Here are still a considerable number of people living in remote area, without power supply from the large grid currently. It’s expensive and difficult to extend the large grid in order to solve the power supply problem for remote areas. In the recent year, owing to the increased emphasis on renewable energy sources (solar energy, wind energy, geothermal energy, tidal energy etc), the development of renewable energy technology, the construction of isolated renewable power systems for power supply in remote and island residents is a feasible proposal which according to the trends of energy development. So it significant to study on isolated renewable power systems in order to solve power supply problems in remote areas. The suitability of the self excited induction generator (SEIG) has made it to be widely employed for different applications such as wind, tidal, and small hydroelectric renewable energy conversion. Such generator is usually utilized as isolated power sources at the remote-site or developing countries. The induction generator is always associated with alternative sources of energy. Particularly for small power plants, it has great economic appeal. The induction machine offers advantages for hydro and wind power plants because of its easy operation as a motor or a generator, its robust construction, its natural protection against short circuits, and its low cost compared to other generators. If an appropriate 3-phase capacitor bank is connected across the terminals of an externally driven induction machine, an e.m.f tends to be generated. This phenomenon is known as "capacitor self-excitation". Induced e.m.f and current in the windings will increase up to a level governed by magnetic saturation in the machine. The capacitors provide the magnetizing VAR's and, in the event of an external lagging power factor load, also the reactive load requirement. In order to reach a steady state generating mode, some re magnetism must be present in the machine core initially. A capacitor self-excited induction generator offers certain advantages over a conventional synchronous
generator as a source of isolated power supply. Reduced unit cost, brushless rotor (squirrel cage construction), absence of a separate d.c. source, and ease of maintenance are among the advantages. Due to changed emphasis on energy problems, development of suitable isolated power generators driven by unconventional energy sources such as wind, biogas etc., has recently assumed greater importance. The development of static power convertors facilitates control of self-excited generators in terms of output voltage and frequency. The current drawn by the rectifier circuit due to changes in the inverter frequency and their effects on the terminal voltage of the generator. A device that converts d.c power to a.c. power at desired output voltage and frequency is called as inverters. The a. c. output voltage could be fixed at a fixed or variable frequency. This conversion can be obtained either by controlled turn on and turn off devices (e.g., BJTs, MOSFETs, IGBTs, MCTs, SITs, GTOs, SITHs) or by force commutated thyristors, depending upon applications. For low and medium power outputs, the above mentioned power devices are suitable but for high power outputs, thyristors are used. The output voltage waveforms of an ideal inverter should be sinusoidal. The output stage waveform of practical inverters are, however, non sinusoidal and contain certain harmonics. For the control of electrical power or power conditioning, the conversion of electric power from one form to another is necessary and switching characteristics of the power devices permits these conversions. A new technique for high-frequency conversion has been proposed to reduce the component stress of voltage and current and the switching losses in the traditional PWM converter. The PWM inverter driving the machine is then required to excite the machine with these current commands. Various techniques have been devised by many researchers for controlling the output current of a PWM voltage-fed inverter. A current control technique has also been devised for three-phase PWM ac/dc converters. Switching frequency should be increased by decreasing switching losses to achieve higher power density and faster transient response in well known PWM dc-dc converters.

This paper has been organized as follows: Section-II has been discussed the details of a literature survey on asynchronous generator. : Section-III introduced the classification of induction generators; Section-IV has been addressed the details of self excited asynchronous generators (SEIGs). : Section-V has been suggested the fundamentals of AC/DC/AC converter. : Section-VI has been presented the summery of paper. : Section-VII has been discussed the conclusion of paper.

2. A LITERATURE SURVEY ON ASYNCHRONOUS GENERATOR

The renewable source of energy is used to extract the power from wind, solar, Mini/Micro hydro energy sources as a prime mover of induction generator. Figure 1 show that the energy conversion process in stand alone power generation.

Through gear box the rotation the speed of prime mover change according requirement of induction generator. Prime mover) is started and allowed to run till the rotor of an induction motor reaches to a speed above the synchronous speed ( $N_s = \frac{120f}{P}$ ) of the rotating m.m.f. Where, $N_s$ is the synchronous speed of the rotating m.m.f, $f$ is the frequency in cycle per second and P is the number of poles. Since, adequate 3-$\phi$ capacitor bank (calculated from the synchronous Speed test) is connected across the stator terminals of the induction machine; an e.m.f is generated in the rotor circuit. As rotor rotates consequently, voltage is induced across the stator terminals by induction principle. This process is known as self-excitation process and hence called as self excited asynchronous generator.

A. Wind Energy, Solar Energy, Geothermal Energy, Tidal Energy as a Prime Mover for Self Excited Induction Generator

H. Ibrahim, J. Lefebvre, J. F. Methot and J. S. Deschenes et al. [1], has been presented the various aspects must be taken into account when working with wind-diesel hybrid systems for the generation of electricity especially in remote areas. Massimo Canale, Lorenzo Fagiano and Mario Milanese et al. [2], has been introduced the simulation and experimental results regarding a new class of wind
energy kites, as KiteGen, which employ power kites to capture high altitude wind power. Nonlinear model predictive control techniques, together with an efficient implementation based on set membership function approximation theory, are employed to maximize the energy obtained by KiteGen, while satisfying input and state constraints. Yvonne Coughlan, Paul Smith, and Alan Mullane et al. [3], have been presented the computer models of wind turbines for power system stability studies have been developed and supplied to power system operators worldwide. The use of multiple wind turbine models for large-scale stability studies is also proving difficult. This paper will examine model development and use from the perspective of the Irish grid operator works, is also introduced. Ronan Doherty and Mark O’Malley et al. [4], have suggested a new methodology which quantifies the reserve needed on a system taking into account the uncertain nature of the wind power. Roberto Cárdenas, Ruben Pena, Jon Clare, Patrick Wheeler and Greg Asher et al. [5], has been addressed the performance of a grid-connected wind energy conversion system (WECS), based on a doubly fed induction generator (DFIG) fed by a matrix converter (MC). The MC replaces the back-to-back converters conventionally used to control DFIG. The MC is operated with close-to-unity power factor at the grid side. The performance of the system for variable speed generation is verified using the emulation of a variable speed wind turbine implemented with a digitally controlled dc machine. Ping-Kwan Keung, Pei Li, Hadi Banakar and Boon Teck Ooi et al. [6], has been discussed the wind power penetration increases and fossil plants are retired, it is feared that there will be insufficient kinetic energy (KE) from the plants to support the system frequency. This paper shows the fear is groundless because the high inertias of wind turbine-generators (WTGs) can be integrated to provide frequency support during generation outage. Kyoung-Jin Ko, Seok-Myeong Jang, Ji-Hoon Park, Han-Wook Cho, and Dae-Joon You I. S. Naser, Olimpo and Anaya-Lara et al. [7], has been addressed the wind generation penetration level in both transmission and distribution networks has been increasing. In this paper the P-V curve is studied at different penetration level of wind for investigating the impact of wind generation on voltage stability in transmission network. The study is concentrated at the voltage collapse point and the margin between it and the current operating point is used as a proximity indication. Miguel Castilla, Jaume Miret, José Matas, Angel Borrell, and Luis García de Vicuña et al. [8], has been suggested the direct rotor current-mode control (CMC) for the rotor-side converter of these induction generators, which is aimed to improve the transient response in relation to the dynamic performance achieved with the conventional (indirect) CMC. The theoretical study considers two grid fault scenarios, with balanced and unbalanced voltages, and presents a direct rotor CMC scheme for each situation. Poul Sørensen, Nikolaos Antonio Cutululis, Antonio Viguera-Rodriguez, Leo E. Jensen, Jesper Hjerrild, Martin Heyman Donovan, and Henrik Madsen et al. [9], has been introduced the power fluctuations from wind farms. Substantial power fluctuations have been observed during unstable weather conditions. A wind power fluctuation model is described, and measured times series from the first large offshore wind farm, Horns Rev in Denmark, are compared to simulated time series. Jing Shi, Yuejin Tang, Yajun Xia, Li Ren, and Jingdong Li et al. [10], this paper proposed a Superconducting Magnetic Energy Storage (SMES) based excitation system for doubly-fed induction generator (DFIG) used in wind power generation. The excitation system is composed of the rotor-side converter, the grid-side converter, the dc chopper and the superconducting magnet. Hany M. Jabr, Dongyun Lu, and Narayan C et al. [11], has been developed to control the rotor side voltage source converter that allows independent control of the generated active and reactive power as well as the rotor speed to track the maximum wind power point. Andrew M. Knight and and Glenn E. Peters“Simpleel et al. [12], has been presented introduced the Small-scale stand-alone wind energy systems are an important alternative source of electrical energy, finding applications in locations where conventional generation is not practical. Ramteen Sioshansi and Walter Short et al. [13], has been suggested one of the impediments to large-scale use of wind generation within power systems is its nondispatchability and variable and uncertain real-time availability. Lie Xu and Phillip Cartwright et al. [14], has been used in this literature a new direct power control (DPC) strategy for a doubly fed induction generator (DFIG)-based wind energy generation system. The strategy is based on the direct control of stator active and reactive power by selecting appropriate voltage vectors on the rotor side. Toshiro Hirose and Hirofumi Matsuo et al. [15], has been proposed a unique standalone hybrid power generation system, applying advanced power control techniques, fed by four power sources: wind power, solar power, storage battery, and diesel engine generator, and which is not connected to a commercial power system. Kling, Arno J. Brand et
al. [16], has been introduced a new simulation method that can fully assess the impacts of large-scale wind power on system operations from cost, reliability, and environmental perspectives. The method uses a time series of observed and predicted 15-min average wind speeds at foreseen onshore- and offshore-wind farm locations result in wasted wind in amounts increasing with the wind power installed. Shailendra Sharma and Bhim Singh et al. [17], has been introduced a new control algorithm for a voltage and frequency controller (VFC) of an isolated wind energy conversion system (IWECS) using an isolated asynchronous generator to feed three-phase four-wire consumer loads. Stavros A. Papathanassiou and Michael P. Papadopoulos et al. [18], has been presented a case study for a 10-MW wind farm, intended to be connected to a network with extended high-voltage submarine cable lines. R. A. Schlueter, G. L. Park, M. Lotfalian, H. Shayanfar and J. Dorsey et al. [19], has been discussed the modification of unit commitment, economic dispatch, regulation and frequency regulation controls when the level of wind generation capacity is significant. A. Mota, L. Mota and F. Galiana et al. [20], has been presented an approach for economical assessment related to the penetration of wind power generators in electric power networks. The proposed method is based on analytical formulation that considers the uncertainties involved with wind speed and load demand. The results show that the methodology. Tao Zhou and Bruno François Tao Zhou and Bruno François et al. [21], has been addressed a Classical wind energy conversion systems are usually passive generators. The generated power does not depend on the grid requirement but entirely on the fluctuant wind condition. Maryam Ramezani, , Chanan Singh, and Mahmood-Reza Haghifam et al. [22], has been suggested to schedule future transactions between areas and arrange commercial activities in multi-area power systems. Probabilistic evaluation can provide more information about transfer capability than deterministic approaches, potentially leading to more efficient operation of the transmission network. Rajib Datta and V. T. Ranganathan et al. [23], has been presented the a wind energy conversion system (WECS) using grid-connected wound rotor induction machine. Controlled from the rotor side is compared with both fixed speed and variable speed systems using cage rotor induction machine. N.D Hatziargyriou, T. S Karakatsanis and M. Papadopoulos et al. [24], has been introduced a probabilistic model for the active power produced and the reactive power absorbed by Wind Turbines (WTs) equipped with induction generators is developed which takes into account the probabilistic nature of short-term wind velocity forecasts obtained. K. Trinadha, and A. Kumar et al. [25], has been suggested the performance of a stand-alone self-excited induction generator (SEIG) under balanced/unbalanced loads and excitation when SEIG is driven with wind energy system. Caisheng Wang, Christopher M. Colson et al. [26], has been addressed security issues continue to be complicated by growing electricity demand presents a hybrid wind-microturbine generation (MTG) system for standalone applications. A Pradeep Anjana, Dr. H. P. Tiwari et al. [27], has been used a analysis of power supply using Solar and Wind hybrid energy in south-west of Rajasthan. M. Zamani, G.H Riathy and N. Abdoghani et al. [28], has been suggested that combining of hybrid systems and Thermal Energy Storage (TES) has been proposed for lowering the costs of hybrid systems in hot climate. F. Michael Hughes, Olimpo Anaya-Lara, Nicholas Jenkins and Goran Strbac et al. [29], has been discussed a power system stabilizer (PSS) for a wind turbine employing a doubly fed induction generator (DFIG) is presented the performance capabilities superior to those provided by synchronous generation with automatic voltage regulator and PSS control are demonstrated. Tomas Petru and Torbjörn Thiringerel et al. [30], has been presented the modeling of wind turbines for power system studies are investigated. Complexities of various parts of a wind turbine model, such as aerodynamic conversion, drive train, and generator representation, are analyzed.

3. CLASSIFICATION OF INDUCTION GENERATOR

On the basis of rotor construction, induction generators are two types (i.e., the wound rotor induction generator and squirrel cage induction generator). Depending upon the prime movers used (constant speed or variable speed) and their locations (near to the power network or at isolated places), generating schemes can be broadly classified as under [31]–[34]:

1. Constant-Speed Constant-Frequency (CSCF)
2. Variable-Speed Constant-Frequency (VSCF)
3. Variable-speed variable-frequency (VSVF)

1. Constant-Speed Constant Frequency
In this scheme, the prime mover speed is held constant by continuously adjusting the blade pitch and/or generator characteristics [31]. An induction generator can operate on an infinite bus bar at a slip of 1% to 5% above the synchronous speed. Induction generators are simpler than synchronous generators. They are easier to operate, control, and maintain, do not have any synchronization problems, and are economical.

2. Variable-Speed Constant Frequency

The variable-speed operation of wind electric system yields higher output for both low and high wind speeds [31], [35]–[28]. This results in higher annual energy yields per rated installed capacity. Both horizontal and vertical axis wind turbines exhibit this gain under variable-speed operation. Popular schemes to obtain constant frequency output from variable speed are as shown.

a) AC–DC–AC Link

With the advent of high-powered thyristors, the ac output of the three-phase alternator is rectified by using a bridge rectifier and then converted back to ac using line-commutated inverters. Since the frequency is automatically fixed by the power line, they are also known as synchronous inverters [34], [37].

b) Double Output Induction Generator (DOIG)

The DFIG consists of a three-phase wound rotor induction machine that is mechanically coupled to either a wind or hydro turbine, whose stator terminals are connected to a constant voltage constant frequency utility grid. The variable frequency output is fed into the ac supply by an ac–dc–ac link converter consisting of either a full-wave diode bridge rectifier and thyristor inverter combination or Current Source Inverter (CSI) thyristor converter link [34]. One of the outstanding advantages of DOIG in wind energy conversion systems is that it is the only scheme in which the generated power is more than the rating of the machine. However, due to operational disadvantages, the DOIG scheme could not be used extensively. The maintenance requirements are high, the power factor is low, and reliability is poor under dusty and abnormal conditions because of the sliding mechanical contacts in the rotor. This scheme is not suitable for isolated power generations because it needs grid supply to maintain excitation.

3. Variable-Speed Variable Frequency

With variable prime mover speed, the performance of synchronous generators can be affected. For variable speed corresponding to the changing derived speed, SEIG can be conveniently used for resistive heating loads, which are essentially frequency insensitive. The basic theme of this paper is to present an overview of SEIG in isolated applications. This scheme is gaining importance for stand-alone wind power applications.

4. SELF EXCITED INDUCTION GENERATORS

Udaya K. Madawala, Tobias Geyer, Jonathan B. Bradshaw and D. Mahinda Vilathgamuwa et al. [38], has been introduced a novel cage induction generator and presents a mathematical model, through which its behavior can be accurately predicted. Mohamed S. El Moursi, Birgitte Bak-Jensen and Mansour H. Abdel-Rahman et al. [39], has been addressed implementation issues associated with primary voltage control and optimal tracking secondary voltage control for wind parks based on self-excited induction generators which comprise STATCOM and under-load tap changer (ULTC) substation transformers. The voltage controllers for the STATCOM and ULTC transformer are coordinated and ensure the voltage support. In steady-state operation, the voltage is controlled by only stepping the tap changer when the voltage is outside the dead band region of the ULTC to minimize the number of taps changes. T. F. Chan, Weimin Wang, and Loi Lei Lai“Fie et al. [40], has been presented a detailed study on the self-excitation phenomenon and load performances. The proposed analysis is vigorously tested on a three-phase, 1.8-kW slip-ring induction machine for various operating conditions. Yogesh K. Chauhan, Sanjay K. Jain, and Bhim Singh et al. [41], has been introduced Self-excited induction generators (SEIGs) are increasingly being used in small-capacity isolated applications for harnessing both conventional and renewable energy resources. These SEIGs suffer from poor voltage regulation even when driven by constant speed prime movers or fixed head hydro turbines. The suitability of these SEIGs to regulate the terminal voltage is a key factor in deciding its use in various applications. Kassa Idjdarene, Djamila Rekioua (ZIANI), Toufik Rekioua, and Abdelmouna`im Tounzi et al. [42], has been presented the performance of an isolated selfexcited induction generator driven by a wind
turbine under unbalanced loads is studied and the same model is used to study the performance of the isolated induction generator under unbalanced load cases. Bhim Singh, S. S. Murthy, Sushma Gupta et al. [43], has demonstrated a simple electricity generating system that can supply electricity in remote areas such as seashores, hilly regions, etc. Many coastal areas have layers of rock under the sea with considerable petroleum reserves. To extract the petroleum products, electricity is required. In such situations, stand-alone power generating system is preferred. M. H. Haque et al. [44], has been proposed a novel method of evaluating the steady-state performance characteristics of a SEIG under various operating conditions. The criteria for the constant terminal voltage and the constant-stator-current operations are also derived and embedded into the system of equations. J. Lodewyk Steyn, Sam H. Kendig, Ravi Khanna, and Stephen D. Umans, Fellow et al. [45], has been introduced a self-excited operation in which the generator resonates with an inductor and generates power without the use of external active drive electronics. The generator comprises five silicon layers, fusion-bonded together at 700°C. The stator is a platinum electrode structure formed on a thick (approximately 20 μm) recessed oxide island. The rotor is a thin film of lightly doped polysilicon also residing on a 10-μm-thick oxide island. F. Chan, Weimin Wang, and Loi Lei Lai et al. [46], has been dealt with a decoupled voltage and frequency controller (DVFC) for an isolated asynchronous generator (IAG), also known as the self-excited induction generator (SEIG), used in constant power applications such as pico hydro uncontrolled turbine driven IAG for feeding three-phase four-wire loads. Juan M. Ramirez and Emmanuel Torres et al. [47], has been aimed at designing an electronic load controller (ELC) for a self-excited induction generator (SEIG) on a standalone application. With constant input power and fixed value of capacitance, the induced voltage varies with the applied load. This paper proposes an ELC scheme whose control strategy is simple and reliable. Antiparallel insulated-gate bipolar transistor (IGBT) switches are used to control the dump load connection and disconnection. Dheeraj Joshi, Kanwarjit Singh Sandhu, and Mahender Kumar Soni et al. [48], has been suggested a algorithm-based technique estimate and analyze the steady-state performance of a self-excited induction generator (SEIG). The study reveals that the performance of the SEIG is greatly influenced by the operating speed, load, and excitation capacitance. Luiz A. C. Lopes and Rogério G. Almeida et al. [49], has been discussed the regulation of the voltage and frequency of a stand-alone fixed-pitch wind energy conversion system (WECS) based on a self-excited squirrel-cage induction machine. A shunt connected voltage source inverter (VSI) and a controllable dump load are used for regulation purposes, self-excited generator, and the ratings of the VSI are considered in order to determine the load range for which voltage and frequency can be regulated for a given wind speed range. T. F. Chan and L. L. Lai et al. [50], has been presented the operating principle and steady-state analysis of a novel excitation scheme for a stand-alone three-phase induction generator that supplies single-phase loads. The phase windings and excitation capacitances are arranged in the form of the Smith connection and the excitation scheme is referred to as the SMSEIGT. F. Chan and Loi Lei Lai et al. [51], has been presented a steady-state analysis of a novel single-phase self-regulated self-excited induction generator which employs a three-phase machine. Performance equations are derived using the method of symmetrical components, while the pattern search method of Hooke and Jeeves is used for the determination of the machine variables. The advantages of the generator include simple circuit configuration, small voltage regulation, good phase balance, and large power output. Li Wang and Ching-Huei Lee et al. [52], has been introduced a comparative study of long-shunt and short-shunt configurations on dynamic performance of an isolated self-excited induction generator (SEIG) feeding an induction motor (IM) load, the studied IM is suddenly connected to the output terminals of the studied configurations of the SEIG. Both simulated results and experimental results based on laboratory 1.1 kW induction machines are clearly compared to examine the effects of both connections on voltage variation of the studied SEIG Abdulrahman L. Alolah and Majeed A. Alkanhal et al. [53], has been introduced a steady state analysis of three phase self-excited induction generator. The problem is formulated as a multidimensional optimization problem. A constrained optimizer is used to minimize a cost function of the total impedance or admittance of the circuit of the generator to obtain the frequency and other performance of the machine. Enes Gonçalves Marra and Josè Antenor Pomilio et al. [54], has been concerned an application of a three-phase cage induction machine (IM) as a self-excited generator connected to the ac side of a voltage-source pulse width modulation bidirectional inverter. The generator is supposed to be driven by a low head
unregulated shaft hydraulic turbine. The proposed system is intended to be applied in rural plants as a low-cost source of high quality ac sinusoidal regulated voltage with constant frequency. Oleg Chctchetinine et al. [55], has been discussed a problem of terminal voltage stabilization for self excited induction generator (SEIG) in standalone mode is studied. Some means of SEIG terminal voltage stabilization implementing different designs of control schemes are observed. A method for tuning of digital control block by using optimization technique is proposed. Eduardo Suquez and Gustavo Bortolotto et al. [56], has been introduced a new strategy for controlling voltage and frequency of a self excited induction generator (SEIG). The SEIG operates in the linear region of the core magnetizing curve, so that efficiency and performance are upgraded. An external excitation circuit, comprising permanently connected capacitors and electronically switched inductances is used. The external circuit allows compensating for the generator reactive demand. Chandan Chakraborty and Apt K. Chattopadhyay et al. [57], has been presented the iterative solution for the problems related to steady state performance of self-excited induction generators operating in parallel. The analysis is based on voltage and current balance equations derived from an inverse model for steady state equivalent circuit of induction machines. The non-linearity in the magnetization characteristics has been taken into account by piecewise linearization. Li Wang and Ching-Huei Lee et al. [58], has been presented a novel approach based on eigenvalue circuit model was obtained from a steady-state condition and it eigenvalue sensitivity analyses to Predict dPanic Performances cannot be used for analyzing SEIG's transient characteristics. of parallel operated self-excited induction generator (SEIGs) From the viewpoint of practical applications, it is necessary to based on steady-state equivalent-circuit models have been proposed motor load. In wind power generating systems, the reasons for to find the performances of a SEIG connected to static loads. Tadashi Fukami, Yuichi Kaburaki, Satoru Kawahara, and Toshio Miyamoto et al. [59], has been discussed the performance analysis of a modified self-regulated self excited single-phase induction generator is presented. This generator consists of a three-phase squirrel-cage induction machine and three capacitors connected in series and parallel with a single-phase load. By utilizing this three-phase system as a single-phase generator, Li Wang and Jian-Yi Su et al. [60], has been presented dynamic performances of an isolated self-excited induction generator (SEIG) under different power-factor loading condition. Mohand A. Oulhouache, Xuan D. Do, Quang M. L.Cand Robert ChaimC et al. [61], has been presented the application of an induction generator (IC) in power systems. The Electromagnetic Transients Program (EMTP) is used to investigate the self-excitation phenomenon and the dynamic behaviour of the induction generator, resulting from the grid disconnection. Li Wang and Ching-Huei Lee et al. [62], has been presented a novel approach based on eigen value and eigenvalue sensitivity analyses to predict both minimum and maximum values of capacitance required for self excitation of a three-phase induction generator. Numerous -numerical methods based on steady-state equivalent circuit models have been proposed to find the minimum capacitance of self-excited induction generators by solving simultaneous non-linear equations. Li Wang and Jian-Yi Su et al. [63], has been presented a comparative study of steady-state performances of both long-shunt and short-shunt configurations of isolated self-excited induction generator under various loading conditions. Both simulated and experimental results are clearly compared to examine the effects of both connections on load voltage variation of the studied induction generator. Olorunfemi Ojo et al. [64], has been discussed the influence of three capacitor excitation topologies (shunt, short-shunt and long-shunt) on the steady-state and dynamic performance of a single-phase, self excited induction generator is explored in this paper. Attention is focused on the influence of the different capacitor connections on the generator overload and output power capabilities. The generator voltage with shunt excitation connection collapses when overloaded while with either the long or short-shunt excitation connection the generator able to sustain the load at a lower operating voltage and larger load current. Olorunfemi et al. [65], has been presented the modeling and transient performance of a single-phase induction generator with series or parallel connected load is the theme of this paper. The systems of equations are expressed in terms of flux linkages and include the effect of magnetizing flux linkage saturation. Generator self-excitation and voltage collapse phenomena are simulated L. Shridhar, Bhim Singh and C. S. Jha et al. [66], has been presented the self regulated short shunt Self Excited Induction Generator (SEIG). A detailed investigation is carried out on the transient behaviour of the short shunt SEIG system subjected to different dynamic conditions. Analytical model
incorporating cross-saturation effect, has been used to predict performance of the SEIG. L. Shridhar, Bhim Singh and C. S. Jha et al. [67], has been presented the transient performance of the self-regulated short shunt self excited induction generator. S. M. Alghuwainem et al. [68], has been introduced Photovoltaic (PV) powered dc motors for industrial applications, owing to some serious drawbacks involving mainly the stacked bank of capacitors that constitutes their multilevel dc link. Sandro Bertini, Tommaso Ghiara, and Mario Marchesoni et al. [78] has been suggested a new GTO devices allow the design of forced commutated high power converters (up to several MVA’s). However, they cannot operate at high switching frequency, thus producing waveforms affected by remarkable harmonic distortion, especially if conventional converter topologies are used. A novel ac/dc/ac conversion structure has been developed referring to single-phase ac (25 kV/50 Hz) traction

5. AC/DC/AC CONVERTER

Ahmed G. Abo-Khalil and Dong-Choon Lee et al. [75], has been presented a new online capacitance estimation method for dc-link capacitors in a three-phase ac/dc/ac pulsewidth-modulation converter are proposed. A controlled ac voltage with a lower frequency than the line frequency is injected into the dc-link voltage, which then causes ac power ripples at the dc output side. By extracting the ac power component on the dc output side using digital filters, the capacitance can then be calculated using a support vector regression method. Narain G. Hingorani and Philip Chadwick et al. [76], has been described the maximum utilization of an inverters’ capacity and minimum consumption of reactive power demands an accurate constant extinction angle control. A new scheme for such a control is presented that is based on the integration of each commutating voltage waveform, thereby obtaining a simulation of the steady state commutation equation. The resulting control is capable of fresh computation of the firing angle every cycle. The control is extended to cover the converter operation over its full range from a minimum permissible angle of delay to the minimum permissible extinction angle. Mario Marchesoni and Pierluigi Tenca et al. [77] has been presented a converter topologies identified as diode-clamped multilevel (DCM) or, equivalently, as multipoint clamped (MPC), are rarely used in industrial applications, owing to some serious drawbacks involving mainly the stacked bank of capacitors that constitutes their multilevel dc link. Sandro Bertini, Tommaso Ghiara, and Mario Marchesoni et al. [78] has been suggested a new GTO devices allow the design of forced commutated
systems; high voltage converters delivering multilevel voltage waveforms with lower harmonic content have been employed on both the line-side and the motor-side. High performance techniques have been studied to control the whole system. Robert J. Thomas, Arun G. Phadke and Christopher Pottle et al. [79] has been presented the assimilation of large numbers of large wind turbine generators into utility grids poses significant operational questions. And also discussed the explores design and operational issues associated with the interconnection of wind farms using a controllable AC/DC/AC series connected interface. The study is in terms of steady-state operation of and transient effects on both the power network and the wind system. BOR-REN LIN et al. [80] has been described the three-level pulse width modulation (PWM) technique for ac/dc/ac converter is proposed. Single-phase three-level rectifier based on double boost configuration with power factor correction is used in the input side. Three-phase three-level voltage source inverter based on diode clamped scheme is employed in order to reduce the harmonic content of the inverter output voltages. Ahmed G. Abo-Khalil and Dong-Choon et al.[81] has been presented a new online capacitance estimation method for dc-link capacitors in a three-phase ac/dc/ac pulse-width-modulation converter. A controlled ac voltage with a lower frequency than the line frequency is injected into the dc-link voltage, which then causes ac power ripples at the dc output side. By extracting the ac power component on the dc output side using digital filters, the capacitance can then be calculated using a support vector regression method. Luigi Malesani, Paolo Tentiand and Paolo Tomasin et al. [82] has been introduced the family of quasi-direct converters, i.e., forced-commutated converters including small energy storage devices in the dc link. In particular, the case of three-phase to three-phase quasi-direct converter is considered. Since energy storage minimization calls for instantaneous input/output power balance; a proper control strategy is needed, and also described a simple and effective control technique which also provides high-power factor and small distortion of the supply currents. Rosario Carbone, Francesco De Rosa, Roberto Langella and Alfredo Testa et al. [83] has been suggested a new approach for modeling line-commutated ac/dc/ac conversion systems. It is based on the modulation function theory taking advantage of a two-step procedure in which two different models are used. The goal is to achieve a reduction of the computational burden with respect to the time domain models and better modeling accuracy with respect to classical modulation function approaches. Thomas G. Habetler et al. [84], has been described the voltage-sourced rectifier control scheme for use with ac/dc/ac variable speed drives. A control scheme is derived that directly calculates the duration of time spent on the zero state and on each switching state adjacent to the reference vector, over a constant switching interval, in order to drive the line current vector to the reference vector. In addition, under transient conditions, when deadbeat control is not possible, a control scheme is presented that ensures that the line current vector is driven in the direction of the reference current vector. The current reference for the rectifier controller is derived from the bus voltage error and a feed forward term based on the estimated converter output power.

1) Power Factor

B. T. Ooi, et al. [85], has been presented in rectifier input currents maintain near 60-Hz sinusoidal waveforms with unity factor. A two identical 3-phase, PWM power modulators are integrated so that one functions as a rectifier and the other as an inverter in an ac drive system. O. Stihi, et al. [86], has been suggested the analysis and test results are given of an experimental single-phase controlled-current PWM rectifier which operates at unity power factor with near sinusoidal current waveform. G. Choe, et al. [87], addressed a new PWM control technique for ac choppers is proposed that has the advantages of enabling linear control of the fundamental component of the output voltage and complete elimination. M. A. Rahman, et al. [88], introduced an analysis and implementation of delta modulation (DM) technique in the control of ac-dc converters. J. Yanchao, et al. [89], used in this literature three-phase ac/dc converter without a front-end filter. Because an adjustable triangular-wave PWM technique is adopted in this literature. V. Vlatkovic, et al. [90], presented in a literature three-phase, single stage, isolated PWM rectifier is proposed and in the same time realizing zero voltage switching for all power semiconductor devices. J. A. Pomilio, et al. [91], suggested a three-phase ac/dc converter based on isolated Cuk topology feeding an inductive load is presented in this literature. R. Torrico-Bascope, et al. [92], has been addressed in this an isolated dc–dc converter based on two ZVSPWM active-clamping forward converters connected in series and coupled by a single high-frequency transformer. Y. W. Li, et al. [93], has been introduced a in this literature power-
factor (PF) control strategy for a high-power pulsewidth-modulated inverter-fed motor drive system. K. Zhou, et al. [94], has been used in a digital repetitive control (RC) strategy is proposed to achieve zero tracking error for constant-voltage constant-frequency (CVCF) PWM convert Improvement of Power Factor and Reduction of Harmonics in Three-phase Induction Motor by PWM Techniques: A Literature Survey by R. Gurunathan, et al. [95], has been suggested in this a new three-phase rectifier that allows the operation as rectifier or as inverter. A Xu, et al. [96], has been suggested multipulse converters are suitable for high-power application with the merits of low switching frequency and perfect harmonic performance. C. A. Canesin, et al. [97], has been introduced in a single-phase high-power factor PWM boost rectifier featuring soft commutation of the active switches at zero current. X. Ruan, et al. [98], has been used in this literature a family of modulation strategies for PWM three-level (TL) converters. J. Wu, et al. [99], has been used in this literature a family of modulation strategies for PWM three-level (TL) converters. J. Wu, et al. [99], has been introduced in this literature a new concept for wireless PWM control of a parallel dc–dc buck converter. K. M. Smith, Jr, et al. [100], has been addressed in this literature a new nonlinear control technique that has one-cycle response and has nearly constant switching frequency. Y. Tzou, et al. [103], has been used in a new circuit realization of the novel SVPWM strategy. An SVPWM control integrated circuit (IC) has been developed. I. Boonyaroonate, et al. [104], has been presented in a class E isolated dc/dc converter for regulating the output voltage at a fixed switching frequency is presented verified in this literature. D. De Souza Oliveira, et al. [105], has been suggested in this literature the application of the asymmetrical duty cycle to the three-phase dc/dc PWM isolated converter. J. K. Steinke, Jr, et al. [106], has been addressed in this literature by putting an LC filter between a PWM VSI and induction motor, standard industrial motors can be utilized also for adjustable speed drive (ADS) applications. L. D. Reis Barbosa, et al. [107], has been introduced a high-switching frequency associated with soft commutation techniques is a trend in switching converter. P. K. Jain, et al. [108], has been used in this literature APWM dc/dc resonant converter topologies that exhibit near-zero switching losses while operating at constant and very high frequencies in this literature. K. Satyanarayana et al. [109], has been used in this literature two RPWM algorithms for voltage source inverter fed induction motor drives with fixed switching frequency for reduced harmonic distortion and acoustical noise.

6. SUMMARY OF THE PAPER

<table>
<thead>
<tr>
<th>Topics covered</th>
<th>Total No. of Literatures Reviews out of 109 Literatures</th>
<th>% of Literatures Reviews out of 84 Literatures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Renewable energy resources as a prime mover</td>
<td>30</td>
<td>27.52</td>
</tr>
<tr>
<td>Self Excited Induction Generator</td>
<td>34</td>
<td>31.19</td>
</tr>
<tr>
<td>AC/DC/AC Converter</td>
<td>9</td>
<td>8.25</td>
</tr>
<tr>
<td>Power Factor</td>
<td>14</td>
<td>12.84</td>
</tr>
<tr>
<td>Switching Frequency</td>
<td>10</td>
<td>9.74</td>
</tr>
</tbody>
</table>

From above table 1, it is concluded that the 27.52% of total literatures is reviews based on Renewable energy resources as a prime mover, 31.19% of total literatures are reviews based on Self Excited Induction Generator, and the 8.25% of total literatures are reviews based on AC/DC/AC Converter, 12.84% of total literatures are reviews based on Power Factor and 9.74 of total literatures are reviews based on Switching frequency.

7. CONCLUSIONS

This paper has been addressed a survey of several technical literature concerned with Stand alone Power Generation of Asynchronous Generator. A literature survey also show that the achieve significant improvements in performance parameters of the asynchronous generator in power conversion process such as power factor, switching frequency, and others parameters. Authors strongly
believe that this survey article will be very much useful to the researchers for finding out the relevant references as well as the previous work done in the field of Stand alone Power Generation with the help of Asynchronous Generator. So that further research work can be carried out.

REFERENCES:


Transactions on Industrial Electronics, vol. 59, No. 2, February 2012


