International Journal of Trend in Innovative Research (IJTIIR)
Available Online @ www.ijtiir.com | ISSN: 2582-0354

A Review On-Grid Integration and Power Quality Issues of Wind and Solar Energy System

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Abstract— This paper provides an analysis of on-grid deployment and high-quality energy problems related to the integration of renewable electricity systems into the grid and the position of digital electrical devices and Scalable AC Transmission Systems related to these issues. This paper discusses the new advances in electrical electronics for the integration of wind and photovoltaic (PV) power generators. Discussions are conducted on not uncommon and potential developments in green energy structures, largely focused on the efficiency and sophistication of each age. Classification of different Power Efficiency Problems used by one-of-a-kind researchers have been carried out and responded to. The use of different strategies as applied to minimise the distinct problems of Power Efficiency is often subject to attention. Power Electronics interface not only serves the utterly essential role of the unreliable incorporation of the Wind and Solar Power Gadget but also its results in the application of the electrical machinery, in particular when the supply of renewable energy constitutes a considerable part of the overall gadget capacity.

However there are various issues related to grid integration of RES keeping in the view of aforesaid trends it becomes necessary to investigate the possible solutions for these issues.

Keywords: Renewable Energy System, Doubly Fed Induction Generator (DFIG), Multilevel Converter Topologies, Power Quality (PQ), Grid Connected PV, Grid Connected Wind, FACTS Devices

I. Introduction

Renewable strength assets (RES) like solar and wind are going to emerge as an opportunity for destiny power needs. India is a rustic of continental size and this is helpful in balancing the variable output of renewable strength assets located in few states by using integrating them into all India grids. As of March 31, 2012, the grid-interactive energy generation from RES is 24914 MW i.E. Around 12.1 % of the total mounted strength capacity. Further Ministry of New and Renewable Energy (MNRE), Government of India is concentrated on achieving 20000 MW grid interactive powers via solar and 38500 MW from the wind with the aid of 2022. Wind energy and Solar energy,are considered to be the main attributes of renewable energy for electricity generation, and are growing at faster rate for the last two-three decades. Renewable generation from wind and solar has increased substantially during past few years and forms a significance proportion of the total generation in the grid.

According to the annual report of the Global Wind Energy Council (GWEC), over 40 GW of new wind power generation capability came online worldwide in 2011 attracting extra than $ sixty-eight billion. This brings the full global wind energy ability to over 238 GW via the end of 2011 as proven in Fig. 1. This shows that it's far a large and developing worldwide demand for emissions-free wind energy which may be mounted fast and surely everywhere inside the world.

Electricity technology using renewable sources is frequently taking area on a small scale due to the dispersed nature of the recourses. The size of those generators typically varies from some loads of kilowatts to several megawatts. The forms of grid interfaces used with Photovoltaic's and Wind are Power electronics converter & Induction generator/ Power electronics converter. In this paper, recent ongoing developments in grid integration of solar and wind power systems are offered.

This paper is organized as follows. Section II discusses the modern-day technology used in grid integration of renewable power systems like current wind turbine technology and PV era. And extraordinary integration problem has been discussed in this section which changed into presented via exclusive researchers. Section III is associated with power high-quality problems right here discuss distinct power excellent problems like voltage regulation, voltage sag/swell, harmonics, actual and reactive power has been discussing. And here the application of records gadgets associated with power satisfactory issues additionally presented. Section IV is set specific issues and demanding situations related to grid integration and electricity first-class troubles of sun and wind strength structures. In section V possible answer related to this grid integration and PQ problems and has been mentioned.

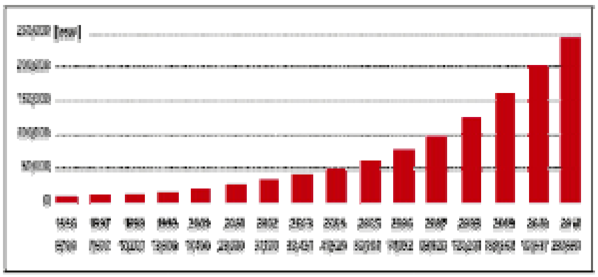

Fig. 1: Global Cumulative Installed Capacity 1996-2011
(*Source*: GWEC Annual Report)

II. Integration of Renewable Energy Systems

In this paper a literature review is carried out related to grid integration of RES. Number of authors/researchers has presented the various issues, challenges and their possible solutions related to grid integration of renewable energy system, mainly wind and solar energy system.

A. Wind Turbine Technology Review

Wind-turbine technology has undergone a dramatic transformation during the last 15 years, developing from a fringe science in the 1970s to the wind turbine of the 2000s using the latest in power electronics, aerodynamics, and mechanical drive train designs [1], [2].Wind power is quite different from the conventional electricity generation with synchronous generators.

Moreover, an introduction of variable speed turbine in the wind-power market is advantageous our conventional turbines. The advantages of variable-speed turbines are that their annual energy capture is about 5% greater than the fixed-speed technology, and the active and reactive powers problems can also be easily handled. There is also less mechanical stress, and rapid power fluctuations are scarce because the rotor acts as a flywheel (storing energy in kinetic form).The main disadvantage of variable-speed wind turbines that it need a power converter that increases the component count and make the control more complex. The overall cost of the power electronics is about 7% of the whole wind turbine.

1) Variable-speed concept utilizing doubly fed induction generator (DFIG)

The converter feeds the rotor winding, while the stator winding is connected directly to the grid in a variable-speed turbine with DFIG [3], [4]. This converter decoupling mechanical and electrical frequencies and thus making variable-speed operation possible. This turbine cannot operate in the full range from zero to the rated speed, but the speed range is quite sufficient. In addition to the fact that the converter is smaller, the losses are also lower. The control possibilities of the reactive power are similar to the full power-converter system. For instance, the Spanish company Gamesa supplies this kind of variable-speed wind turbines to the market.

The forced switched power-converter scheme is shown in Fig. 2

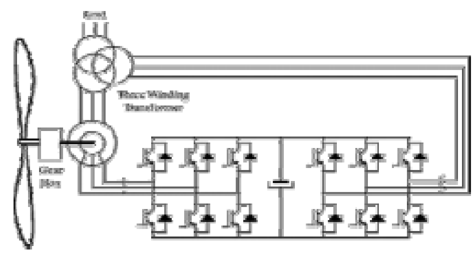

Fig. 2: Single Doubly Fed Induction Machine with Two Fully Controlled AC–DC Power Converters

Here converter consists of two three-section ac–dc converters connected by using a dc capacitor battery. This scheme permits, on one hand, vector manipulate of the lively and reactive powers of the gadget, and then again, a lower with the aid of a high percentage of the harmonic content material injected into the grid by means of the energy converter.

Vestas and Nordic Windpower deliver a version of this design, which is the semivariable-pace turbine, wherein the rotor resistance of the squirrel cage generator may be numerous instantly the use of speedy power electronics. So some distance, Vestas alone has succeeded in commercializing this machine below the trade call OptiSlip. A range of turbines, ranging from six hundred kW to 2.Seventy five MW, have now been geared up with this gadget, which lets in brief rotor speed will increase of up to 10% of the nominal value. In that case, the variable-velocity situations are finished dissipating the strength within a resistor placed inside the rotor, as proven in Fig. 3. Using that era, the efficiency of the system decreases when the slip will increase and the velocity manage is restrained to a narrow margin. This scheme consists of the electricity converter and the resistors within the rotor. Trigger alerts to the strength switches are done by way of optical coupling.

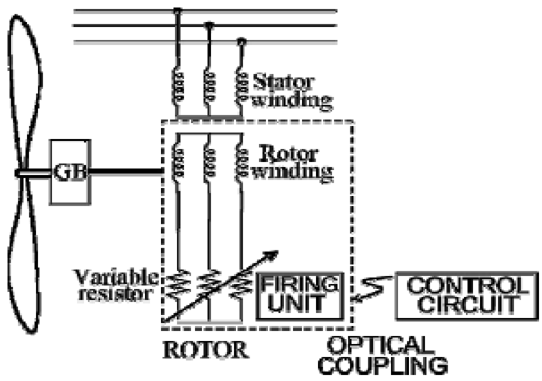

Fig. 3: Single Doubly Fed Induction Machine Controlled with Slip Power Dissipation in an Internal Resistor

2) Variable-Speed concept utilizing full-power converter

In Variable-Speed concept, the generator is completely decoupled from the grid [5]. Fig. 4 shows the scheme of a full power converter for a wind turbine. The energy from the generator is rectified to a dc link and after is converted to suitable ac energy for the grid. The majority of these wind turbines are equipped with a multipole synchronous generator, although it is quite possible (but rather rare) to use an induction generator and a gearbox. There are many advantage of removing the gearbox: lower losses, lower costs due to the elimination of this expensive component, and increased reliability due to the elimination of rotating mechanical components.

Enercon supplies such technology. In this scheme the machine-side three-phase converter works as a driver controlling the torque generator, using a vector control strategy. The grid-side three-phase converter permits wind-energy transfer into the grid and enables to control the amount of the active and reactive powers delivered to the grid. There are several benefits of this scheme such as total-harmonic-distortion (THD) coefficient as low as possible, improving the quality of the energy injected into the public grid. The objective of the dc link is to act as energy storage, so that the captured energy from the wind is stored as a charge in the capacitors and may be instantaneously injected into the grid. The control signal is set to maintain a constant reference to the voltage of the dc link V_{dc}.

Fig. 5 shows, alternative to the power-conditioning system of a wind turbine and here synchronous generator is used instead of an induction one. Three-phase converter (connected to the generator) replaced by a three-phase diode rectifier and a chopper. Such choice is based on the low cost as compared to an induction generator connected to a voltage-source inverter (VSI) used as a rectifier. When the speed of the synchronous generator alters, the voltage value on the dc side of the diode rectifier will change. A step-up chopper is used to adapt the rectifier voltage to the dc-link voltage of the inverter. When the inverter system is analyzed, the generator/rectifier system can be modeled as an ideal current source. The step-up chopper used as a rectifier utilizes a high switching frequency, so the bandwidth of these components is much higher than the band-width of the generator. Controlling the inductance current in the step-up converter can control the machine torque and, therefore, its speed. The Spanish Company MADE has marketed that design.

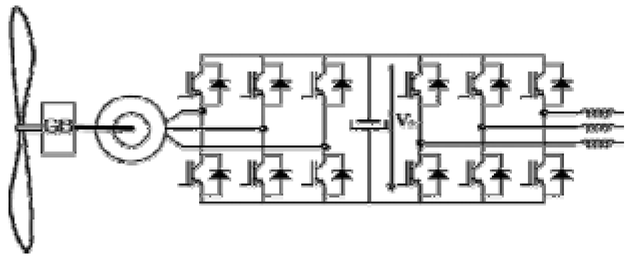

Fig. 4: Double Three-phase VSI

3) *Semiconductor device technology*

Improvements in the Performance and reliability of power-electronic variable frequency drives for windp turbine applications have been directly related to the availability of power semiconductor devices with better electrical characteristics and lower prices because the device performance determines the size, weight, and cost of the entire power electronics used as interfaces in wind turbines.

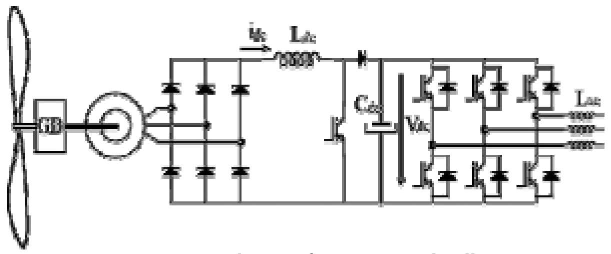

Fig. 5: Step-up Converter in the Rectifier Circuit and Full Power Inverter Topology Used in Wind-turbine Applications

They are now mature technology turn-on components adapted to a very high power (6 kV–1.2 kA), and they are in competition with gate turn-off thyristors (GTOs) for high-power applications [6].

Recently, the integrated gated control thyristor (IGCT) has been developed as a mechanical integration of a GTO plus a delicate hard drive circuit that transforms the GTO into a modern high-performance component with a large safe operation area (SOA), lower switching losses, and a short storage time [7]. IGBTs have higher switching frequency than IGCTs, so they introduce less distortion in the grid. There is also cooling problem in IGCTs as they are made like disk devices. They have to be cooled with a cooling plate by electrical contact on the high-voltage side. This is a problem because high electromagnetic emission will occur. The main advantage of IGCTs over IGBTs is that they have a less ON-state voltage drop, which is about 3.0 V for a 4500-V device.

In conclusion, with the present semiconductor technology, IGBTs present better characteristics for frequency converters in general and especially for windf turbine applications

4) *Variable-Speed concept utilizing permanent magnet synchronous generator (PMSG)*

Figure 6 shows the block diagram of PMSG Wind energy conversion system (WECS) with two stages as optimization and electrical controllers. The various techniques are discussed as below.

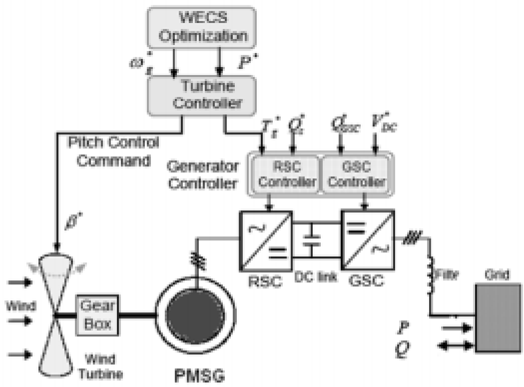

Fig. 6: Control Block Diagram of PMSG based WECS

Kelvin Tan and Syed Islam [8] proposed a sensor less optimal control strategy using fuzzy power mapping technique. Using the result of power mapping loop and alternator frequency derivative loop, the controller allows the bus voltage to vary to maximum power operating point. Jemaa Brahmi *et al.*, [9] compares three control methods for PMSG based WECS. In the first model MRAS observer is used to estimate the parameters of the controller by comparing output of reference model and adaptive model. Secondly artificial neural network (ANN) based observer were trained to produce desired output correction to the estimated speed. And lastly, sliding mode observer (SMO) based control is discussed. Among these three techniques SMO and ANN observer gives good results when static resistance varies and chattering phenomenon is observed with SMO. The static resistance causes a static error in case of MRAS observer. The SMO is more robust than the other two methods.

Jordi Zaragoza et al. [10] discusses the control of PMSG based Wind energy conversion system (WECS) using field oriented control (FOC) for controlling speed regulation and generating current. A PI controller is used for this purpose and the tuning parameters are determined through zero-pole cancellation (ZPC) strategy

The common and future trends for renewable energy systems have been described by author [11]. As a current energy source, wind energy is the most advanced technology due to its installed power and the recent improvements of the power electronics and control. In addition, the applicable regulations favor the increasing number of wind farms due to the attractive economical reliability. On the other hand, the trend of the PV energy leads to consider that it will be an interesting alternative in the near future when the current problems and disadvantages of this technology (high cost and low efficiency) are solved.

New trends in power-electronic technology for the integration of renewable energy sources and energyi storage systems are demonstrated.

This paper [12] presents research on improving wind energy integration through more effective coordination of traditional generation resources and energy storage systems that can optimize wind energy production while also increasing the predictability of wind farm output. The increasing use of the Renewable Energy Sources (RES) and the intermittency of the power generated by them create stability, reliability and power quality problems in the main electrical grid [13]. The micro grid is called to be a feasible alternative to solve these issues. As it is a weak electrical grid, the micro grid is very sensitive to load or generation changes. To reduce the effect of these variations and to better harness the energy generated by RES, the Energy Storage Systems (ESS) are used. As the different ESS technologies that are currently available are not enough to satisfy the wide frequency spectrum of the generated energy, the use of a Hybrid Energy Storage System (HESS) is necessary. A HESS is usually formed by two complementary storage devices that can be associated in many different topologies. Of course, the two devices have to be coordinated by an Energy Management System (EMS). In this work the different topologies and energy management algorithms that have been applied in the RES and microgrid contexts have been analyzed and compared. The micro grid can operate both connected to the main grid and in islanding mode. This system is used to overcome the intermittency and uncertainty of the RES.

A novel control scheme using a variable frequency transformer (VFT) of 100 MW to effectively reduce power fluctuations of an equivalent SO-MW aggregated doubly-fed induction generator (DFIG)- based offshore wind farm (OWF) connected to an onshore 120-kV utility grid is presented [14]. A frequency-domain approach based on a linearized system model using eigen techniques and a time-domain scheme based on a nonlinear system model subject to disturbance conditions are both performed to examine the effectiveness of the proposed control scheme. It can be concluded from the simulation results that the proposed VFT is effective to smooth the fluctuating active power of the OWF injected into the power grid while the damping of the studied OWF can also be improved.

A new control strategy for a grid connected doubly fed induction generator (DFIG)-based wind energy conversion system (WECS) is presented [15]. Control strategies for the grid side and rotor side converters placed in the rotor circuit of the DFIG are presented along with the mathematical modeling of the employed configuration of WECS. Battery energy storage system (BESS) to reduce the power fluctuations on the grid due to the varying nature and unpredictability of wind is also presented. This strategy is simulated in MATLAB-SIMULINK and the developed model is used to predict the behavior.

A new variable-speed WECS with a PMSG and ZA source inverter is proposed [16].It is discussed here that the permanent magnet synchronous generator is controlled to obtain maximum power from the incident wind with maximum efficiency under different load conditions. Characteristics of Z-source inverter are used for maximum power tracking control and delivering power to the grid, simultaneously.

A novel hybrid adaptive fuzzy control scheme was presented in [17].That utilizes both the rotating mass of the DFIG and a super-capacitor bank as the virtual inertia sources for DFIG-Based wind energy applications to provide short-term frequency regulation support. In order to compensate the intermittent nature of the wind, a supert capacitor is connected to the DC link of the back-to-back converters and an additional adaptive fuzzy controller is added to the supper-capacitor system controller to realize the short-term frequency support.

B. PV Technology Review

Nowadays renewable energy techniques for power production are mature and reliable. The photovoltaic (PV) energy is the most promising source of energy since it is pollution free and abundantly available everywhere in the world. PV energy is especially beneficial in remote sites like deserts or rural zones where the difficulties to transport fuel and the lack of energy grid lines make the use of conventional resources impossible.

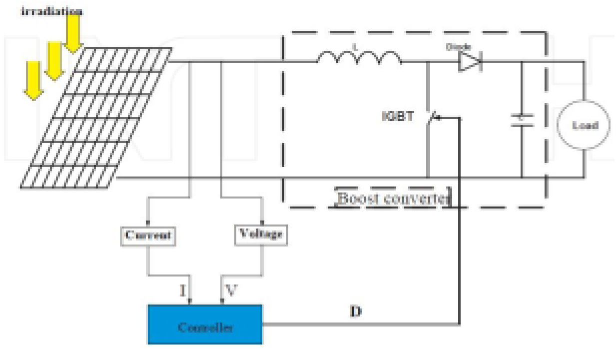

Fig. 7: Unified Diagram of PV System

Unified diagram of PV system is in fig 7. In the literature [18] numerous MPPT methods have been presented, such as the hill climbing, incremental conductance and the P&O. These algorithms consist of introducing a crisp values positive or negative (decrease or increase) all around the actual photovoltaic generator (PVG) operating point. From the previous power point position, the trajectory of the new one helps the algorithm to decide on the command output value. This algorithm may fail to act as an accurate MPPT because of the used crisp value (step size) that is mainly fixed by trial and tests running.

Scheme to reduce harmonic current for grid-connected PV generation system was developed [19]. This control scheme effectively reduced harmonic current in the grid current of the PV generation system caused by voltage distortions at the grid. Experiments using a prototype of the power conditioning system (PCS) showed its validity. 400 kW PCSs with the control scheme have been installed and have been in service since the end of 2009. In this project, three control methods were developed such as generation power control for fault ride through harmonic current reduction control scheme and grid voltage stabilization using optimal reactive power control. A high performance harmonic current reduction control scheme has been presented.

The distributed generation systems that impose new requirements for the operation and management of the distribution grid, especially when high penetration levels are achieved [20]. In this paper an improved structure of power conditioning system (PCS) for the grid integration of PV solar systems is presented. The topology employed consists of a three-level cascaded Z-source inverter and allows the flexible, efficient and reliable generation of high quality electric power from the PV array. Validation of models and control schemes is carried out through digital simulation using Matlab/Simulink environment.

A novel control strategy for achieving maximum benefits from these grid-interfacing inverters when installed in 3-phase 4-wire distribution systems is presented [21]. The inverter is controlled to perform as a multi-function device by incorporating active power filter (APF) functionality. The inverter can thus be utilized as:

1) Power converter to inject power generated from RES to the grid, and 2) shunt APF to compensate current unbalance, load current harmonics, load reactive power demand and load neutral current. All of these functions may be accomplished either individually or simultaneously. With such a control, the combination of grid-interfacing inverter and the 3-phase 4-wire linear/non-linear unbalanced load at point of common coupling appears as balanced linear load to the grid. This new control concept is demonstrated with extensive MATLAB/Simulink simulation studies and validated through digital signal processor-based laboratory experimental results.

An optimal power management mechanism for grid connected photovoltaic (PV) systems with storage is presented [22]. The objective is to help intensive penetration of PV production into the grid by proposing peak shaving service at the lowest cost. The structure of a power supervisor based on an optimal predictive power scheduling algorithm is proposed.

Some issues related to grid integration of PV systems have been presented [23]. Further some methods to reduce the fluctuations in PV power output are also discussed. The main issues related to PV systems integration with grid are the fluctuation of PV output power, these fluctuations can negatively impact the performance of the electric networks to which these systems are connected, especially if the penetration levels of these systems are high. In this paper three methods have been investigated such as the use of battery storage systems, the use of dump loads and curtailment of the generated power by operating the power- conditioning unit of the PV system below the maximum power point. The emphasis in the analysis presented in this paper is on investigating the impacts of implementing these methods on the economical benefits that the PV system owner gains.

The intelligent techniques have recently attracted the interest of engineers due to several facts: as self - Optimization of fast convergence and simplicity Optimization fast convergence and simplicity of combination with classical extremism seeking [24]. In this work the interest was focus on applying these techniques on the photovoltaic fields. In this work, the control strategy is described and tested in the context of a highly dynamic input.

A modeling study of the PV pumping system components is presented [25]. Moreover in order to improve PV system performance, different maximum power point controller was studied and investigated. The system behavior incorporating the P&O, Fuzzy, ANN and neuro fuzzy were investigated and compared based on an extensive simulation work. Finally the Maximum Power Point tracking of PV pumping system is ensured by using an ANFIS controller. Performed simulation tests for the complete system lead to two main conclusions.

The proposed PV system performances are highly boosted and the pumping flow rate benefit is going up to three times more

III. Power Quality Issues

The integration of wind and solar energy into existing power system presents technical challenges such as voltage regulation, flicker, harmonic distortion, stability etc, these power quality issues are to be confined to IEC and IEEE standards. A review of many papers of last few years shows that these power quality issues can occur at the generation, transmission and distribution.

The different power quality problems has been discussed in different papers and some of them is given below-

A. *Voltage Regulation*

The droop characteristics are used, particularly for DFIGs to control the voltage magnitude and frequency [26]. This can be extended to WECS by doing a voltage sensitivity analysis to achieve voltage regulation at PCC. The high DC bus ripple is a result of the voltage-drive mode to provide the best AC power quality [27] and concludes that the bidirectional power flow and the bottom-up decentralized control methods make DG systems are well controlled and organized. To overcome this problem in [28] author focuses on the grid-interfacing architecture, with fuzzy logic controllers to improve voltage quality. For wind generators is landed micro grid. Here, the complex power droop the unbalances control systems use a virtual impedance loop to compensate.

B. *Voltage Sags/ Swells*

The operation of Sensitive loads connected to the grid is influenced by the voltage dips. To overcome this disadvantage author presented power electronic converter in [29] using a series compensator, which requires considerably less active power and is able to restore the voltage at the load side. Grid-interfacing power quality compensator for three-phase four-wire micro-grid applications was developed using the sequence components to inject voltages as a complementary measure Under the Net-metering scenario a Power Quality Control Center (PQCC) would regulate voltage due to the reversal of power flows from the DG and the increase in short circuit current [30].

C. *Harmonics*

The grid interaction and grid impact of wind turbines have been focused on during the past few years. The reason behind this interest is that wind turbines are among the utilities considered to be potential sources of bad power quality. Especially, variable-speed wind turbines have some advantages concerning flicker. But, a new problem arose with variable-speed wind turbines. Modern forced-commutated inverters used in variable-speed wind turbines produce not only harmonics but also interharmonics. The International Electro technical Commission (IEC) initiated the standardization on the power quality for wind turbines in 1995 as part of the wind-turbine standardization in TC88, and ultimately 1998 IEC issued a draft IEC-61400-21 standard for “powerI quality requirements for Grid Connected Wind Turbines” [31]. Recently, high-frequency (HF) harmonics and interharmonics are treated in the IEC 61000-4-7 and IEC 61000-3-6 [32], [33]. The methods for summing harmonics and interharmonics in the IEC 61000-3-6 are applicable to wind turbines. In order to obtain a correct magnitude of the frequency components, the use of a wellm defined window width, according to the IEC 61000-4-7, Amendment 1, is of a great importance, as has been reported in [34]. In [35] author introduces a new Adaptive Notch Filtering (ANF) approach which can address issues like, extracting harmonics, voltage regulation, complex power control, suppressing frequency variations and noise contents using the sequential components of voltages as reference. Some methods for harmonic damping are presented in [36] such as (i) a shunt harmonic impedance method adaptable for islanded micro-grids application, (ii) The voltage-based droop control strategy to have controllable harmonic current and PQ (iii) heuristic Optimization techniques such as differential evolution algorithm (DEA) are used to obtain the switching states of CPDs, as a nonlinear optimization problem.

D. *Real and Reactive Power*

The seasonal patterns and the diurnal variations of wind are to be addressed for grid connected wind turbine (GCWT) systems to achieve high-quality power from inverters meeting the specifications of grid codes. A droop control method is proposed based on the reactive power produced by the negative-sequence current and the positive-sequence line voltage [37]. A variant of the droop control strategy is used in [38], which combines P/V droop control with voltage droops to control the active power. A Lyapunov-function-based current tracking controller is proposed to control both active and reactive power flow for parallel-connected inverter. The THD levels were found satisfactory even for nonlinear loads.

E. Power System Stability Problem

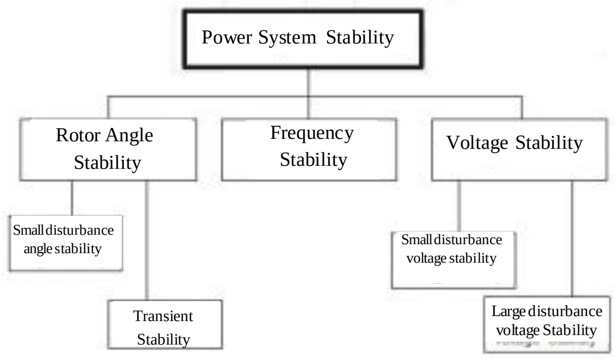

Fig. 7: Classification of Power System Stability

Referring to Fig. 7, the power system stability can be classified into: rotor (or power) angle stability; (ii) frequency stability; and (iii) voltage stability. Hence, different viewpoints are introduced concerning the stability issues raising different types of stability problems including "Rotor angle stability", "Frequency stability" and "Voltage stability". Rotor angle stability is concerned with the system ability to maintain the equilibrium between electromagnetic torque and mechanical torque of each generator in the system. Instability that may result occurs in the form of increasing angular swings of some generators leading to their loss of synchronism with other generators Voltage stability is concerned with the ability of a power system to maintain its steady voltage at all buses in the system under normal operating conditions, and after subjecting to a disturbance. [39]- [41].

F. Application of FACTS devices: The application of FACTS device (STATCOM) for power quality improvement in grid connected wind generating system and with nonlinear load is presented [42]. The power quality issues and its consequences on the consumer and electric utility are also presented. The operation of the control system developed for the STATCOM in MATLAB/SIMULINK for maintaining the power quality has been simulated. The system has the capability to cancel out the harmonic parts of the load current and maintains the source voltage and current in-phase and support the reactive power demand. The need for network management under dynamic state and to provide a cost effective solution for mitigating the PQ problems can be addressed using FACTS devices [43], introduced by N.G. Hingorani. In [44] authors present a novel night-time application of a PV solar farm powering a STATCOM for voltage control, improving power transmission capacity during nights.

In [45], a DSTATCOM are employed to compensate poor load power factors for low and medium power applications. A DSTATCOM can also be used for Reactive Power Compensation in 1Ø Operation of Micro grid.The placement and current ratings of these devices are optimization problems and various techniques are available for solving it.

A PQ problem with application of UPQC was presented in [46].

To improve the performance of UPQC, a novel control strategy using Fuzzy Logic Controller (FLC) is proposed which eliminates the drawback of using fixed gains in conventional PI controller. From the simulation results, by comparing controller performance, the proposed fuzzy controlled UPQC provides effective and efficient mitigation of both voltage sag and current harmonics than the conventional PI controlled UPQC, thus making the grid connected wind power system more reliable by providing good quality of power.

IV. Issues and Challenges

Renewable energy sources are intermittent in nature hence it is therefore a challenging task to integrate renewable energy resources into the power grid. Some of the challenges and issues associated with the grid integration of various renewable energy sources particularly solar photovoltaic and wind energy conversion systems. Further these challenges are broadly classified into technical and non-technical and described below.

A. Technical Issues

1. Gird Integration Issues for small scale generation:
- Cost, Reliability & Efficiency of Grid Interface
- Grid congestion, weak grids
- Variability of renewable production
- Low Power Quality
- Protection issues
  - Change of short circuit levels
  - Reverse power flow
  - Lack of sustained fault current
  - Islanding
- Bidirectional power flow in distribution network,
- localized voltage stability problems

2. Issues related to grid integration of large scale generation:

Recent rapid growth of wind energy generation has resulted in the development of large wind farms with capacities in excess of 100 MW. Such large scale wind farms are generally interconnected to the grid.

- The requirement of reactive power for voltage support is one the key issues related to wind power generation.
- Turbine power electronic design and controller optimization.
- Problems of wind farms connected into series compensated systems.
- Power quality issues including voltage flicker.
- Starting and synchronizing of wind farms to the grid.
- Sub synchronous resonance issues due to interaction of the electric network and the complex shaft/gear system of the wind turbine

Apart from aforesaid technical issues some of the non technical issues are also presented in this paper.

B. *Non-Technical Issues*

1. Lack of technical skilled man power
2. Less availability of transmission line to accommodate RES.
3. RES technologies are excluded from the competition by giving them priority to dispatch which discourage the installation of new power plant for reserve purpose.

V. Possible Solutions

The renewable energy sources such as solar, wind etc. has accelerated the transition towards greener energy sources. The increasing number of renewable energy sources and distributed generators requires new strategies for the operation and management of the electricity grid in order to maintain or even to improve the power-supply reliability and quality. Keeping in view of the aforesaid some of the possible solutions have been proposed by researchers.

1. The power-electronic technology plays an important role in distributed generation and in integration of renewable energy sources into the electrical grid, and it is widely used and rapidly expanding as these applications become more integrated with the grid- based systems. During the last few years, power electronics has undergone a fast evolution, which is mainly due to two factors. The first one is the development of fast semiconductor switches that are capable of switching quickly and handling high powers. The second factor is the introduction of real- time computer controllers that can implement advanced and complex control algorithms. These factors together have led to the development of cost- effective and grid-friendly converters.
2. Intermittence of power generation from the RES can be controlled by generating the power from distributing the RES to larger geographical area in small units instead of large unit concentrating in one area. For example output power of large solar PV system with rating of tens of mega watt can be change by 70% in five to ten minutes of time frame by the local phenomenon like cloud passing etc therefore large number of small solar PV system should be installed in larger geographical area. The fluctuation of total output power can be minimized because of local problem can affect only small unit power not the total output power.
3. In case of irrigation load the load is fed during the night time or off peak load time and this is fed by conventional grid. On other hand power generated by RES like solar PV is generated during day time so we can use this power for irrigation purposes instead of storing the energy for later time which increases the cost of the overall system. Using the solar water pumping for irrigation gives very high efficiency approx 80% to 90% and the cost of solar water pumping is much lesser than the induction motor pumping type.
4. In large solar PV plant output power is fluctuating during the whole day and this power is fed to the grid and continuously fluctuating power gives rise to the security concern to the grid for making stable grid. Solar PV plant owner have to install the different type of storage system which gives additional cost to the plant owner. Once the storage system is fully charged then this storage elements gives no profit to the system owner. Therefore solar based water pumping system may be installed instead of storage system.

VI. Conclusion

In this paper, grid integration and strength best issues of Wind and Solar strength System and their feasible answers to be had inside the literature had been presented. The reasons consequences, mitigation technology providing their topologies, highlighting the advantages of the grid incorporated solar, and in particular wind strength structures are tested.

To decrease the fluctuations and intermittent issues strength electronics gadgets are the feasible options. Further, power storage and use of sell offload and MPPT might be used for decreasing the electricity fluctuations in PV structures. In addition to the aforesaid, the up-gradation in the balance of systems by means of incorporating the brand new substances and garage elements could reduce the issues related to grid integration.

The price-powerful answers of custom strength devices and FACTS devices are highlighted to offer perception into the scope of studies in low and medium degree voltage networks and for 1Ø and 3Ø grids technologies.

REFERENCES

[1] S. Heier, Grid Integration of Wind Energy Conversion Systems. Hoboken, NJ: Wiley, 1998.

[2] G. L. Johnson, Wind Energy Systems. Englewood Cliffs, NJ: Prentice-Hall, 1985.

[3] S. Muller, M. Deicke, and R. W. De Doncker, "Doubly fed induction generator systems for wind turbines," IEEE Ind. Appl. Mag., vol. 8, no. 3, pp. 26–33, May/Jun. 2002.

[4] F. M. Hughes, O. Anaya-Lara, N. Jenkins, and G. Strbac, "Control of DFIG-based wind generation for power network support," IEEE Trans.Power Syst., vol. 20, no. 4, pp. 1958–1966, Nov. 2005.

[5] M. Orabi, F. El-Sousy, H. Godah, and M. Z. Youssef, "HighM performance induction generator-wind turbine connected to utility grid," in Proc 26thAnnu. INTELEC, Sep. 19–23, 2004, pp. 697–704.

[6] J. M. Peter, "Main future trends for power semiconductors from the state of the art to future trends," presented at the PCIM, Nürnberg, Germany, Jun. 1999, Paper R2 667-671.

[7] H. Grüning et al., "High power hard-driven GTO module for 4.5 kV/3 kA snubberless operations," in Proc. PCI Eur., 1996, pp. 169–183.

[8] Tan, K.; and Islam, S. (2004). Optimum control strategies in energy conversion of PMSG wind turbine system without mechanical sensors. IEEE Transactions on Energy Conversion, 19(2), 392-399

[9] Brahmi, J.; Krichen, L.; and Ouali, A. (2009). A comparative study between three sensor less control strategies for PMSG in wind energy conversion system. Applied Energy, 86(9), 1565-1573.

[10] Zaragoza, J.; Pou, J.; Arias, A.; Spiteri, C.; Robles, E.; and Ceballos, S.(2011). Study and experimental verification of control tuning strategies in avariable speed wind energy conversion system. Renewable Energy, 36(5), 1421-1430.

[11] Juan Manuel Carrasco, Leopoldo Garcia Franquelo, Jan T.Bialasiewicz, Eduardo Galvan, Ram6n C. Portillo Guisado, Ma. Angeles Martin Prats, Jose Ignacio Le6n, and Narciso Moreno-Alfonso, " Power-Electronic Systems for the Grid Integration of Renewable Energy Sources: A Survey", IEEE Transactions on Industrial Electronics, vol. 53, no. 4, pp 1002 -1017, August 2006.

[12] H. Hanl, T.K.A. Brekkenl, A von Jouannel, ABistrika2, A.Yokochi, "In-Lab Research Grid for Optimization and Control of Wind and Energy Storage Systems", 49th IEEE Conference on Decision and Control Hilton Atlanta Hotel, Atlanta, GA, USA, December 15-17, 2010.

[13] A Etxeberria, 1. Vechiu, A Etxeberria, JM. Vinassa,H.Camblong, "Hybrid Energy Storage Systems for Renewable Energy Sources Integration in Micro-grids: A Review", International Power Electronics Conference (IPEC), pp 532-537,

[14] Li Wang,and Long-Yi Chen, "Reduction of Power Fluctuations of a Large-Scale Grid-Connected Offshore Wind Farm Using a Variable Frequency Transformer", IEEE Transactions on Sustainable Energy, vol. 2, no. 3, pp 226-234, July 2011

[15] V. C. Ganti, Bhim Singh, S. K. Aggarwal, and T. C. Kandpal, "DFIG-based wind power conversion with grid power leveling for reduced gusts," IEEE Transactions on Sustainable Energy, vol. 3, no. I, pp 12-20, January 2012.

[16] Jegatheeswaran, R.; Rajesh, R., "Variable speed wind energy conversion system using PMSG & Z-Source inverter," in Innovations in Information, Embedded and Communication Systems (ICIIECS), 2015 International Conference on, vol., no., pp.1-7, 19-20 March 2015

[17] Xiang Hao; Tianpei Zhou; Jin Wang; Xu Yang, "A hybrid adaptive fuzzy control strategy for DFIG-based wind turbines with superf capacitor energy storage to realize short-term grid frequency support," in ECCE, 2015 IEEE, vol.no. Pp.1914-1918, 20-24Sept.2015.

[18] T. Esram, P. L. Chapman, Comparison of Photovoltaic Array Maximum Power Point Tracking Techniques. IEEE transactions on energy conversion, vol.22, 2007.

[19] T. Ito, H. Miyata, M. Taniguchi, T. Aihara, N. Uchiyama, and H. Konishi, "Harmonic current reduction control for grid-connected PV generation systems", International Power Electronics Conference, pp 1695-1700, 2010.

[20] Marcelo G. Molina, Euzeli C. dos Santos Jr., and Mario Pacas, "Improved Power Conditioning System for Grid Integration of Photovoltaic Solar Energy Conversion Systems", 2010 IEEE/PES Transmission and Distribution Conference and Exposition: Latin America, pp 163-170,2010.

[21] Singh Mukhtiar, Khadkikar Vinod, Chandra Ambrish, and Varma K. Rajiv, "Grid Interconnection of Renewable Energy Sources at the Distribution Level With Power-Quality Improvement Features", IEEE Transactions on Power Delivery, vol. 26, no.l, pp 307-315, January 2011.

[22] Yann Riffonneau, Seddik Bacha, Franck Barruel, and Stephane Ploix, "Optimal Power Flow Management for Grid Connected PV Systems with Batteries", IEEE Transactions on Sustainable Energy, vol. 2, no. 3, pp 309-320 July 2011.

[23] Omran A Walid, Kazerani M., and Salama M. M. A, "Investigation of Methods for Reduction of Power Fluctuations Generated From Large Grid-Connected Photovoltaic Systems", IEEE Transactions on Energy Conversion, vol. 26, no. 1, pp 318-327, March 201I.

[24] D. Nikhitha, J.N.C. Sekhar, Modeling and Simulation of IM Drive Performance Using PI, ANN and FLC, International Conference on IT Convergence and Security(ICITCS), 2013.

[25] Farhat Maissa and Sbita Lassâad Efficiency Boosting for PV Systems- MPPT Intelligent Control Based, Energy Efficiency Improvements in Smart Grid Components, Prof. Moustafa Eissa (Ed.), ISBN: 978-953-51-2038-4(2015).

[26] Meghdad Fazeli, Greg M. Asher, Christian Klumpner, and Liangzhong Yao"Novel Integration of DFIG-Based Wind Generators

[27] Andrew J. Roscoe, Stephen J. Finney, and Graeme M. Burt, "Tradeoffs Between AC Power Quality and DC Bus Ripple for 3-Phase 3-Wire Inverter-Connected Devices Within Microgrids", IEEE Transactions on power electronics, Vol. 26, No. 3, March 2011.

[28] Fei Wang, Jorge L. Duarte, and Marcel A. M. Hendrix, "Grid- Interfacing Converter Systems With Enhanced Voltage Quality for Microgrid Application—Concept and Implementation", IEEE Transactions on power electronics, Vol. 26, No. 12, December 2011.

[29] Koen J. P. Macken,Math H. J. Bollen and Ronnie J. M. Belmans, "Mitigation of Voltage Dips Through Distributed Generation Systems" IEEE Transactions on industrial aplications, Vol. 40, NO. 6,Nonember/December 2004.

[30] Y. Q. Zhan, S. S. Choi, and D. Mahinda Vilathgamuwa "A Voltage-Sag Compensation Scheme Based on the Concept of Power Quality Control Center", IEEE Transactions On Power Delivery, Vol. 21, No. 1, January 2006.

[31] D. Foussekis, F. Kokkalidis, S. Tentzevakis, and D. Agoris, "Power quality measurement on different type of wind turbines operating in the same wind farm," presented at the EWEC (Session BT2.1 Grid Integration), Madrid, Spain, Jun. 16–19, 2003.

[32] Electromagnetic Compatibility, General Guide on Harmonics and Interharmonics Measurements and Instrumentation, IEC Standard 61000-4-7, 1997.

[33] Electromagnetic Compatibility, Assessment of Emission Limits for Distorting Loads in MV and HV Power Systems, IEC Standard 61000-3.

[34] L. Ake, S. Poul, and S. Fritz, "Grid impact of variable speed wind turbines," in Proc. EWEC, 1999, pp. 786–789.

[35] Davood Yazdani, Alireza Bakhshai, Geza Joos, and M. Mojiri, "A Nonlinear Adaptive Synchronization Technique for GridN Connected Distributed Energy Sources" IEEE Transactions on power electronics Vol. 23, NO. 4, July 2008.

[36] Ine Vandoorn, Bart Meersman, Jeroen De Kooning, and Lieven Vandevelde, "Controllable Harmonic Current Sharing in Islanded Microgrids: DG Units With Programmable Resistive Behavior Toward Harmonics" IEEE Transactions on Power Delivery, Vol. 27, No. 2, April 2012.

[37] Po-Tai Cheng, Chien-An Chen, Tzung-Lin Lee, and Shen-Yuan Kuo "A Cooperative Imbalance Compensation Method for Distributed-Generation Interface Converters" IEEE Transactionson Industry Applications, Vol. 45, No. 2, March/April 2009.

[38] Tine L. Vandoorn Bert Renders,Lieven Degroote, Bart Meersman,, and Lieven Vandevelde, "Active Load Control in Islanded Microgrids Basedonthe Grid Voltage" IEEE Transactions on Smartgrid Vol. 2, No. 1, March 2011

[39] P.Vijayan and S.Sarkar, and V. Ajjarapu, "A Novel Voltage Stability Assessment Tool to Incorporate Wind Variability", Power & Energy Society General Meeting, 2009.PES '09. IEEE 26-30 July 2009.

[40] Mohsen Rahimi, Mostafa Parniani, "Dynamic behavior and transient stability analysis of fixed speed wind turbines", Renewable Energy 34 (2009) 2613–2624

[41] F. Wua, X.-P. Zhangb, P. Jua, "Small signal stability analysis and control of the wind turbine with the direct-drive permanent magnet generator integrated to the grid", Electric Power Systems Research 79 (2009) 1661–1667.

[42] Yuvaraj, S. N. Deepa, "Improving Grid Power Quality With FACTS Device on Integration of Wind Energy System", Student Pulse,www.studentpulse.com.vol. 3, issue 4, pp 1-8, April 2011.

[43] "FACTS devices in deregulated electric power systems: a review" IEEE DRPT 2004. Vol.1, April 2004, Pages337- 342 Vol.1

[44] S.Kokilavani,S.Shiny jasmine,"Regulation of Grid voltage by the application of Photo voltaic(PV) Solar farm as STATCOM",S.Kokilavani S.Shiny jasmine International Journal ofEngineering Research and Applications (IJERA), Vol. 2, Issue 3,May-Jun 2012.

[45] Ritwik Majumder," Reactive Power Compensation in Single-Phase Operation of Microgrid", IEEE Transactions On Industrial Electronics, Vol. 60, No. 4, April 2013.

[46] Bhavani, R.; Prabha, N.R.; Kanmani, C., "Fuzzy controlled UPQC for power quality enhancement in a DFIG based grid connected wind power system," in Circuit, Power and Computing Technologies (ICCPCT), 2015 International Conference on, vol., no., pp.1-7, 19-20 March 2015.