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POWER QUALITY ISSUES ON GRID DUE TO INTEGRATION OF RENEWABLE ENERGY SYSTEM: A REVIEW

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Abstract

The content of this paper provides an insight on power quality related disturbances encountered when the non-conventional energy sources are integrated to the grid. It also focuses on the vital role played by the power electronic devices and the FACTS devicesto nullify the power quality issues that are subjected to the integration to the grid. The paper, presents the current scenario in power electronics for the mixing of wind and solar power generators.Evaluationson the general and upcoming trends in non-conventional energy systems that are supported by the reliability and matureness of every technology are represented. Categorization of Power Quality disturbances employed by various researchers is studied and has been used as reference. The different methodologies that are applied to alleviate the various Power Quality issuesare also discussed for analysis. Not only the Power Electronics interface imparts a crucial role in coherent integration of Wind and photovoltaic energy system butits impacts on the operation of the power-system primarily when the non-conventional energy source plays a predominant part in the overall capacity of the system. NCSE integrated to grid imposes many power quality challenges with respect to listedaforesaid issuesand requires to evaluate the feasible and appropriate solutions for the mentioned challenges

Keywords: Non-conventional Energy Sources (NCES),Grid Connected PV, Permanent magnet Synchronous Generator,(PMSG)Doubly Fed Induction Generator (DFIG),Grid Connected Wind, Flexible ACTransmissionequipment,Power Quality (PQ)

I - INTRODUCTION

Non-conventional Energy Sources(NCSE)i.ephotovoltaic and wind are thought as a replacementfor the requirement of the ensuing energy. Our country India being of large dimensions contributes in stabilizing the fluctuating outputs of non-conventional energy sourcewhich are located in some states and integrating them into power grids in India. Statistics for the grid interactive power generatedby the NCSEby March 31,2020is 134.7GW which contributes to 35.86% of the gross energy installed capacity. Ministry of New and Renewable Energy (MNRE), Indian government is targeting to achieve 175GW by 2022 which includes 100GW from photovoltaic, 60 gigawatts from Wind, 10gigawatts from Biogas and 5gigawatts from small hydel powers. A target of 100GW of solar power by 2022 can be achieved so a capacity of 34,035 MW is installed on 31st January 2020. Energy from photovoltaic cells and windfarms, have been considered to be the prominent contributors of non-conventional energy for the generation of electricity, and have been expanding at faster pacesince the last few decades. Wind and solar as sources of non-conventional generation have been soaring significantly during past few years and are leading contributorsfor the total generation at the Power Grid.

Electricity generation by non-conventional resources are often taking place at a slower pace due to indefinite and variable feature of the resources. Thesizes of the generators generally vary betweensome hundreds of KW to several MW. The Photovoltaic's and Wind are interfaced to grid through Induction generator or Power electronics converter. The paper enlightens on the upcoming trends in integrating the gridby wind andphotovoltaic energy system is shown in fig. 1 depicts the solar electricity Generation in India and its growth in the recent years.

This paper is presented in Sections. Section II focuses on the distribution generation scenario. Section III emphasizes on the present technology that is implemented in the grid integration of non-conventional energy system like present wind turbine and solar technology. A special issue on integrationis talked during this section that has beenconferred by different researchers.SectionIV throws light on the different power quality issues encountered i.e, voltage sag/swell, harmonics, voltage regulationreal and reactive power. Also the flexible AC transmission equipment are applied to mitigate the related power quality issues are discussed V sectioncontains the different problems and the challenges encountered in integrating to the grid and power quality issues of photovoltaic and wind energy system. Section V also shows the possible solutionsfor integration of such grids and Power Quality issues and have been listed.

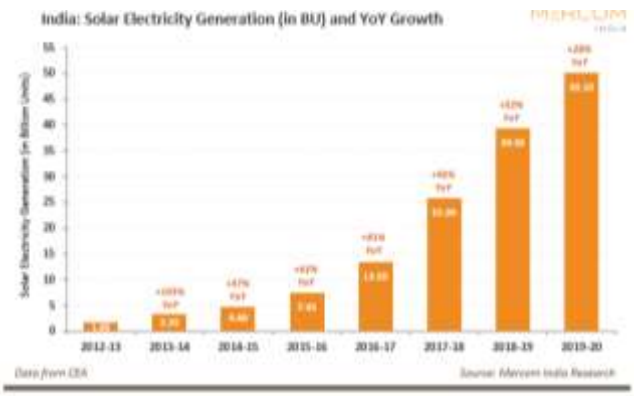

Fig. 1: Solar Electricity Generation in India (Source Mercom India)

II - DISTIBUTION GENERATION SCENARIO

Distributed energy systems are playing an important role. [54] Conventionally, electricity is produced in hugeenergy plants, which have the location nearer to the resources or at the optimum; then the transmission of electricity is carried out through a high-voltage transmission system. Further it isdistributed locally with the support ofMV distribution grids. Distributed Generationsmain motto is to multifaceted energy sources and takes care of reliable supply and diminishment of greenhouse gasses. DGs contribute in the decline of losses due to transmission and add their contribution in introducing noveltechnologies related to fuel cells and super-conducting equipment.

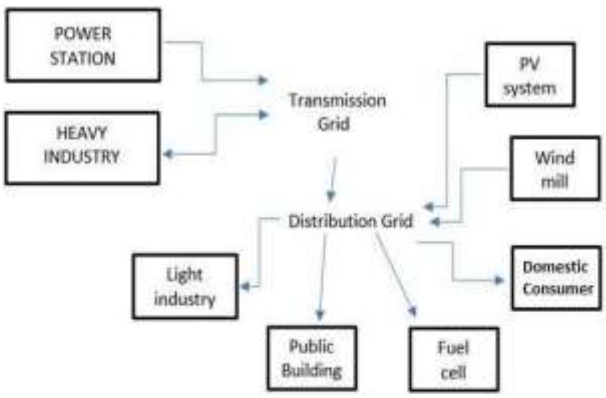

Fig. 2: Distributed generation schematics

III - NON-CONVENTIONAL ENERGY SOURCES(NCES) INTEGRATION

The literature of this paper is reviewed forthe integration of NCES to the grid. Many authors/researchers have listed the differentproblems, challenges and thefeasible methodologies related to grid integrated to non-conventional energy system, primarily energy of wind and photovoltaic energy system.

REVIEW ON THE WIND TURBINES

Wind energy for electricity production today is nubile, competent and non-pollutant technology extensively adopted in many parts of the world. The wind turbine technology underwent sizeable conversions during a last two decades. Have been emerging from edging science since early 1970 to the wind turbines in 21st century incorporating the modern power electronics, aeromechanics anddrives driven by mechanical trains design [1][2]. A conventional power generation through synchronous generator is substantially different from wind power. The wind power conversion system is an integration over the active vitality of the upcoming wind circulated into the electrical energy. The variable speed turbines trending the market has the upper hand over the conventional turbines where the annual energy capture is about 5-10% more. [53] Variable speed turbines are better than the fixed speed generators in various aspects listed below

They have optimum cost and also provide normal pitch control.as the speed is controlled it enablespitch-controlled time constant to be durable thereby easing the complexity associated with the control of pitch and maximum power required. The pitch angle is normally fixed at lower wind speeds. For higher wind speeds pitch angle control is performed for limiting the maximum power output.

- Torque pulsations are minimized to relieve the stresses as they can absorb the gustsof the wind i.e.kinetic energy is stored in the rotating parts as the turbine's inertia forming an elasticity.
- The back pressure caused by the tower induces torque and power pulsations which are dynamically compensated by the variable speed generators.
- They tend to improve the system efficiency as the turbine speed varies to catch up with the speed of the wind thereby maximizing the output power.

The power fluctuations are less yielding high energy but the disadvantage is the usage of power electronic devices that increases its complexity, harmonics& controlling thereby shorting their advantages.

1) For Fluctuating speed concept used Doubly fed Induction Generator (DFIG)

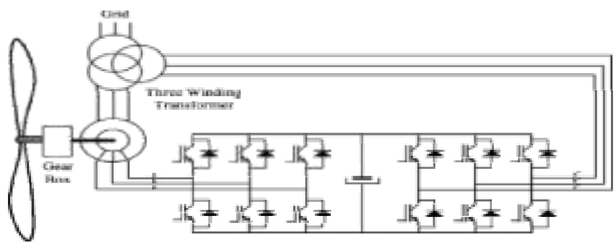

Fig. 3: Doubly fed Induction machine having two three phase fully controlled converters

The figure 3 shows converter including3-ϕ rectifier and inverter that arecoupled by a capacitor battery. The above-mentionedtechniquepermits, a phasor control of the true and reactive powers of the machine, whereas on contrary, a decrementin the harmonics content by a large percentage that are produced by the power converter into grid. In the variable speed generator, which accommodates a doubly fed induction generator (DFIG) with a four-quadrant ac-to-ac converter consisting of insulated gate bipolar transistors (IGBTs) connected to rotor windings. Compared to direct inline systems DFIG offers the next advantages

- Reduction within the value of the inverter since the inverter rating holds 25% of the whole power system.
- The worth of the inverter filters and Electromagnetic interference filters are reduced. The rating of these filters is 0.25p.u of the whole system power, harmonics in the inverter forms little a neighborhood to the whole harmonics present in the system.
- Results in improvement of the efficiency of the system.
- Implementation of power factor control is simpler because the DFIG system generally works as aalternator. Therefore, the converter provides the required amount of excitation energy.

2) Variable-Speed concept utilizing power converter

SCIG, DFIG and synchronous generator generally uses the above-mentioned technology. Fig4 shows a simple diagram of variable speed wind turbines with a full converter. In this technology the generator and thus the grid are isolated which accounts for good quality of power because this power gets transmitted to the grid through the power converter system. Supremacy of making use of synchronous generator for changing speed wind turbines with the entire converter is that there is a liberty towhether or not to use a gear box. When an alternator operates at higher speeds then the gear box is includedwhereas at low speed with multiple poles the use of the gear box is discarded hence mentioned as direct driven synchronous generator.

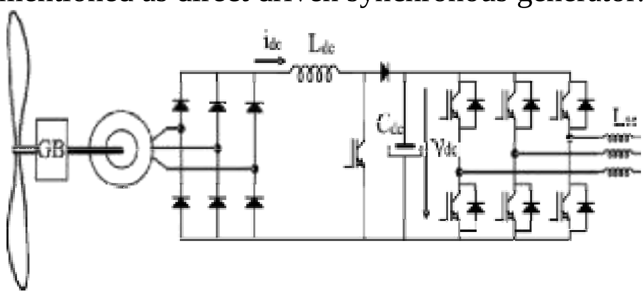

Fig. 4: Variable speed wind turbines with full converter

3) Semiconductor device technology In Variable wind concept

Enhancements within the characteristics, security and accuracy of power-electronic varying frequency drives used for wind- turbine employments are at first hand coupled to the presence of power electronicequipment with good electrical performance and at cheap prices due toequipment characteristics determines thedimensions, weight, and price of the whole power electronics devices that are used as couplers in wind turbines. Presently used full-fledged technology turn-on equipment that are adapted to a extremes of power (6 kV–1.2 kA), which they are in competition with high power application devices such as the gate turn-off thyristors (GTOs) [6].

Newly, the IGCT(Integrated Gated Control Thyristor) are evolved as the mechanical amalgamation of a GTO along with an intricate disc driving circuit which modifies the GTO in an updated high-geared components with an outsizedSOA(safe operation area), minimized switching losses, and quick time of storage[7]. IGBTs havemore switching frequency than IGCTs, so as that they introduce more distortion within the grid and also cooling problem is there with the IGCTs as they're made like disk devices. they have to be cooled with a cooling plate by contact on the high-voltage side which imposes a haul because they introduce high electromagnetic emission but the foremost advantage of IGCTs over IGBTs is that they have a less ON-state drop , which is about 3.0

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V for a 4500-V device. It might be concluded that at thistechnology of semiconductor, Insulated Gate Bipolar Transistors exhibit good performance for frequency converters generally and also primarily for applications with wind- turbine.

4) Incorporating the variable speed concept with Permanent magnet synchronous generator (PMSG)

PMSG is that the most well liked among synchronous and asynchronous generation thanks to its lower weight, size and self-excitation, low maintenance cost, no gear box leading to higher efficiency and power believe comparison with the wound rotor synchronous generator, cage induction generator and doubly fed induction generator. For the extraction of energy PMSG having double rectifier (AC/DC) boost converter and inverter (DC/AC) were suggested.

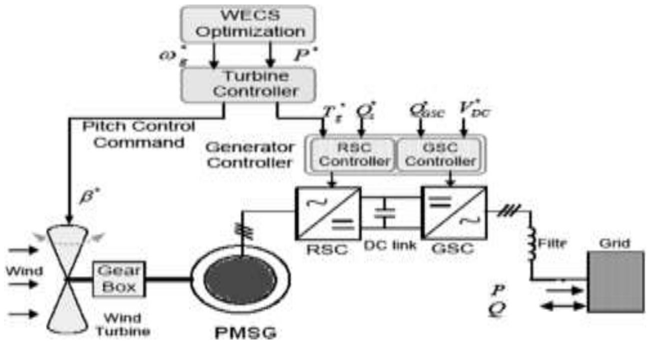

Fig. 5: Control diagram of PMSG based WECS

Figure 5 shows the diagram of PMSG Wind energy conversion system (WECS) with two stages as optimization and electrical controllers. the numerous techniques are discussed as below. Various techniques are proposed and implemented to intensify the performance of PMSG connected to variable speed WECS.(i) PMSG with controlled and uncontrolled rectifier for grid connected. (ii) standalone.

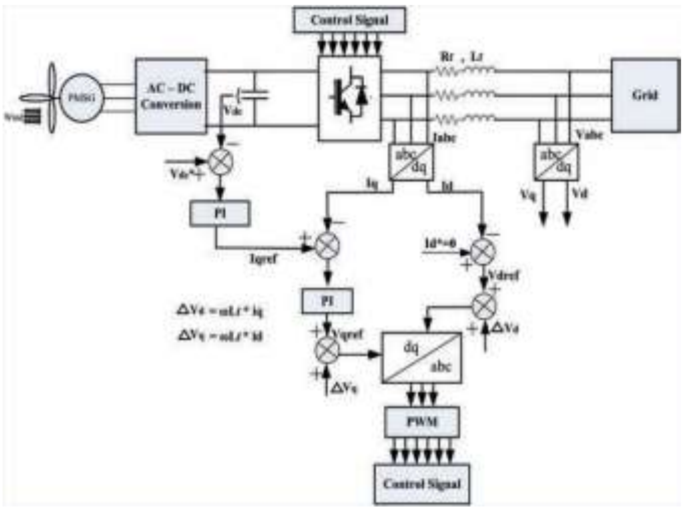

Fig.6 : Grid sided converter (GSC) control scheme

Switched reluctance generator (SRG) based WECS to extract maximum powerintelligent controllers are proposed for in [29]. Fuzzy logic (FL) and ANN techniques are taken into use by these controllers. To enhance the dynamic response and to provide permission for pliable operation ofgenerators connected in parallel by eliminating the dependency of frequency and voltage

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synchronization is discussed in a model predictive control [30]. For regulating matrix converter (MC) an enhanced quick dynamic system is presented along with altered Hysteresis current controller and optimum tuning PI controller [31]. Additionally, intensified BFO (bacterial Foraging Optimization) is used for true and reactive current of the Permanent Magnet Synchronous Generator for extracting utmost power. Using the algorithms active and reactive powers are often applied to the grid at the operational and faultedconditions.The system stability is enhanced and the injected reactive power supplied to the grid is controlled by the BFO controller. BFO-controller along with the dynamic limiteris used to control the reactive-power injected into thegrid and also ensures the improvement of system stability. The Pitch angle controller with rate limiter is designed for theprotection of WECS from any mechanical damage. Forfrequency and voltage control at the point of common coupling (PCC) a Meta heuristic Firefly algorithm (FA) based controllers is used. By the powerful FA the gains of the PID& PI controllers are enhanced and their characteristics can be examinedwhich shows that the dynamic response of PID controller is better than PI. For grid connected through PMSGbased WECS an algorithm Maximum power extraction algorithm (MEPA) was suggested andto implement it is possible in practice without using mechanical sensors for WECS through PMSG [33]. Comprehensive models are been suggested to analyze and the emissions could be reduced by activating the developed voltage regulation group [34]. The quadrature and direct axis current controls the real and the reactive powerrespectively. Software PLL in synchronous reference frame is used to identify the Utility voltage phase angle. The above stated method provides good quality and least expensive power conversion for WECS [35].

Standalone PMSG based WECS

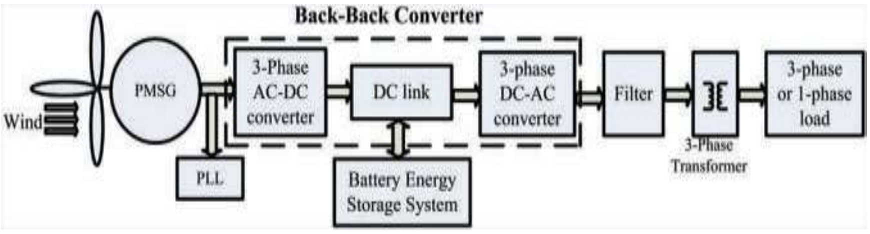

Fig. 7: PMSG for standalone WECS

Fig 7 shows a PMSG based standalone WECS. It can be seen that the load is connected toPMSGin a three phase AC/DC converter, a three phase DC/AC converter and a BESS.Normally, the BESS or Super or Ultra capacitor are used to provide assistance to the standalone WECS. In [38] for standalone PMSG which uses D C link voltage an impressive energy management algorithm was proposed. Frequency and voltage controlcan be implemented using battery energy storage system (BESS) which is suggested in [39].

In [40] for standalone PMSG based WECS a novel controller method that is based on neural networks identifier (NNI) for Maximum Point PowerTracking was suggested. The method above has the ability to provide accuracy inmechanical torque signal and it does not require any offline training to reach its optimum parameter values. In [41] Energy management algorithm (EMA) thathas the ability to enhance the characteristics of super capacitoralong with hybrid energy storage system is elaborated. The required reactive- power and inertial-aid is supplied by the synchronous condenser to the system. In this the developed coordinate-control controls the true & reactive power flow amongst the elements of the system. The solutions are obtained from the robustfrequency and voltage regulation, effective management and maximum wind-powerextraction. A hybrid system is suggested which has both the PMSG and DFIG in conjunction with the battery storage system are suggested in [42}. In [43] for standalone PMSG a parameter independent intelligent power management controller which incorporates the Maximum Power Point Tracking and Power Limiter search (PLS) algorithm was put forward. PLS algorithm is important in reducing excess energy produced and minimizing heat dissipation needed for determining the optimal workingresultant power at maximum power. Modern control techniques are also designed for PMSG based WECS.

A Review on PV Technology

These days non-conventional energy techniques for power generation are utmost and countable. Out of all PV is been considered thelikeliestmode of energy source because it is non-polluting, freely available in nature and abundance in nature without much cost involved. It finds most advantage in deserts or rural zones where it becomes tedious and difficult to transport fuel and also they are short of the grid lines making the use of non-renewable resources reach is difficult.

In the literature survey [18] various Maximum Point Power Tracking techniquesare illustrated such as incremental conductance, hill climbing and PSO. The above stated algorithms focus on the crisp values either positive or negative toggling atnormal operating point of the photo voltaic generator (PVG). The new point on the trajectory is attained from the previous power point the algorithm helps to reach the new output value from its former power point position onthe trajectory. These algorithms might fail accuracy to reach Maximum Point Power Tracking because of the crisp values chosen or the size of the step taken which is mostlydetermined by trial-and-error method. Schemes for the reduction of current produced due to harmonics in the grid connected PV generated system were developed. The utilization of seven-level cascade H bridge multi-level inverter for grid connected PV system based on phase shift modulation. the equivalent model includes the panels connected in series to constitute the implemented PV/battery system integrated to the H bridge multi-level inverter. The system successfully provided a platform between the grid and the solar panels as the DC sources by regulating the battery performance based on MPPT and advanced control strategies. The DC bus voltage is held constant by regulating the battery performance though different disturbances occurred and also is showed a considerable reduction in harmonics as compared to conventional inverter with low THD voltage [56]. The DG systems mandates novel requirements for working and management of grid at the distribution end especially when the penetration levels that are achieved is high [20].

The paper presents improvised scheme of power conditioning system (PCS) for the solar system which is integrated with grid. The topology had a 3-level cascaded zero source DC/AC converter which allows the pliable authentic and systematic production of good-quality electrical power extracted from PV array. The novel models and their control schemes are validated by the use of digital simulation incorporating MATLAB/SIMULINK.

The new control scheme for derivingutmost benefits from the grid interlacing DC/AC converters when installed in three phasefour wire distribution system is illustrated [21].

The DC/AC converters performance has been controlled by including the active power filter (APF).

The DC/AC converters serves as converters of power injecting power generation from NCES to grid and shunt APF compensates for the unbalance in the currents, harmonics in load current, load reactive power demand and load neutral currents. These all functions can be served one to one or simultaneously. linear balanced load at the grid is analyzed from the control combination of grid interfacing inverter and the 3-Ø, 4 wire linear or non-linear unbalanced load at the point of common coupling appears to be. SIMULINK/MATLAB are used to simulate the new control concept and are shown by using simulation studies and are validated by using digital signal processor-based laboratory experimentally.

For PV system connected to the gridusing storage an optimal power management is presented [55]. Arule basedJaya optimization-based control schemes are suggested to optimize a battery power flow in the grid connected to the PV battery system. From the forecasted loadand PV power, dynamic and optimal battery scheduling is obtained which in turn reduces the grid power and the cost of the electricity.

INTELLIGENT CONTROLLER METHODOLOGIES

Intelligent controller methodologies have the capability of better performances in tracking the maximum power point. They have higher efficiencies, effectiveness, adaptable and robust search schemeswhich produceapproximate optimal solutions and involvehuge amounts of parallelism. The modern techniques are Fuzzy Logic, Artificial Neural networks,Hybrid Genetic Algorithm, ANFIS,Ant Colony optimization, Intelligent P&O, Fuzzy PID, Fuzzy neural network. One and only drawback with intelligent controller techniques based Maximum Point Power Tracking algorithms is the involvement of large number of control parameters, their complexity and high computations.

A high-performance control methodfor the optimal power flow management of hybrid non-conventional energy source for a grid is designed. Spotted hyena optimization is utilizedto optimize the blend of the parameters of the controllerdepending up on the variations of voltage. The data sets from obtained from the spotted hyena optimization is used by elephant herding optimization to extract exact controlling signals to the system.MATLAB/SIMULINK are the working platform used to implement the above methods. The voltage sequence and the power sequences by using the above design are lessened is shown by the results of Simulink.

IV - ISSUES ENCOUNTERED DUE TO POOR POWER QUALITY

When distribution generations such as wind and solar are integrated to the grid various power quality issues are likely to occur such as sag, swell, harmonic distortion, flickers, voltage regulation, stability etc. previous studies carried out present that power quality problems might occur at any point whether it can be generation, distribution and transmission.

Power quality issues must be mitigated else the bad power quality might lead to unwanted lossesin power as well as economy. It becomes an additional onus on both economy as well as consumers. The most bothering power quality issues is the voltage fluctuations that means rapid changes in the voltage amplitude. Voltage sagsinfersin the decrement in the magnitude of the supply voltagecontrary to it is the voltage swell which means the increment in the level of voltage beyond its normal levels for less than few seconds.

Transients are the momentary variation in current, voltage or frequency lasting for few cycles. Long time voltage interruptions are another power quality issue. This issue may lead to complete interruption or decrement in load current or voltage for few ms to 1 or 2 seconds. Such issues might causeimproper functioning in equipment involved in processing of data[20]. When frequency signals superimpose with the main waveform of power system switching noise occurs, which might also lead to loss of data [5].

When voltage fluctuates between 90% to 110% of the actual value coming from the supply it is termed as flickers. These fluctuations can damage the equipment connected on the load side [21]. When the waveform deviates from the steady state ideal sinewave pf power frequency it is termed as wave distortion. The primary types of waveform distortion can be given asinter-harmonics, notching, DC offset harmonics, and noise. When the frequency deviates from its nominal value i.e 50Hz or 60Hz it is termed as power frequency variation. Harmonics occur when the current or voltage waveform are distorted due to nonlinear loads. The transient increase in the voltage abovethe given tolerance is termed as voltage spikes which lasts for less than very few seconds. The prominent power quality with pv cells is the high voltage. This high voltage can lead to the saturation of the core along with the excess heating in motors which creates larger than the nominal inrush currents in the induction motors that are found at utility ends i.e washing machine, air conditioners, dryers, refrigerators etc. the incandescent lights also start glowing brighter by leading to production of excess heat and reducing their life cycle.

The other issues are imbalance in voltage or in between the phases. Unbalanced voltagesimpose quite significantproblem in three-phase motor**s.** The unbalance in the current that is

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created due to this unbalance in voltage is 6 to 10 times causing damage to the coils of the motors. Transients are among the other power quality issues incurred when solar panels are connected. Harmonics are also one of the issues encountered by the solar panels. High harmonic currents produce more eddy currents in the wires, which enhances the heat produced by skin effect and leads to premature failures in motors, transformers and sensitive electronics. According to the article presented in PV magazine even though the power quality issues carry on with striking thesolar equipment systems as well as the power grid as a whole, electrical testing equipment,analyzing the data properly can help the utilities and consumers with monitoring as well as controlling the problems beforehand else they result in calamitous results.

According to [60] the major power quality issues in the grid that effect the wind farms are the voltage harmonics and the short term rms variations whereas the grid experiences variations in voltage,variations in frequency along with the propagation in harmonics from wind farms. These issues can be mitigated by using series and shunt compensation devices. UPQC being the most appropriate custom power device to mitigate both grid side and source side issues. The prominent power quality issues when the grid has a connection from a fuel cell are the voltage sags, swells and the harmonics. According to Mohamed I Masood the MFPA modified form of flower pollination algorithm is used to improve the voltage profile.

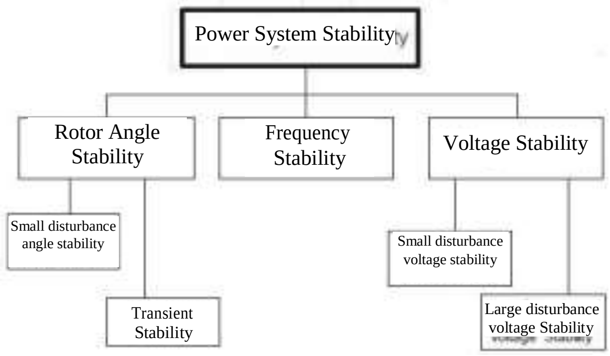

Fig. 8: Classification of Stability in Power Systems

Power system stability is characterized into rotor angle stability,voltage stability andfrequency stability. Rotor angle stability focuses on potential of the system to preservebalanceamongst the electromagnetic and mechanical torque in the system produced by each generator. Instability occurs when some generators may have increased angular swings which may leading to the loss in synchronism with the other generators connected. The power systems capability to retain its steady state voltage at each and every bus in the system under usual working conditions and subjected to anyvariation emphasizes the voltage stability.

ROLE OF FACTS DEVICES

The FACTS devices can be connected in series, Shunt, series-series or shunt series in order to provide better voltage and power stability. Series device are connected in order to inject voltage. Basing up on the angle in between the voltage that is injected and line current these devices controls active as well as reactive power flows. The SSSC might be considered to be a Flexible AC transmission conditioner acts as a controlled capacitor connected in series. The device can compensate the voltage drop due to inductance in line by adding voltage due to capacitor so as to bring down the overall inductive reactance of the transmission line. Comparing series capacitor, to the SSSC has the ability to sustainthe compensating voltage during fluctuatingline current/also can controlthe amplitude of the injected compensating voltage independent of amplitude of line current. The series capacitor serves as an appropriate voltage injector at AC system frequency to enhance the voltage across the inductive line impedance followed by increasing line current and transmitted

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power. If this voltage is injected in series with the line, fetches the same result as a series compensation provided by an equivalent series capacitor at fundamental frequency [58].

The split TCSC has the tendency to provide better power flow control services rather than a single TCSC. Power flow control and also enhances the power system transient stability is provided by an adaptive TSSC with discrete nonlinear control. An SSSC with an oscillating damping controller at the same time controls the power flow and in a system with a wind farm provides low frequency oscillation damping[59]. Shunt connected devices are generally variable impedance equipment connected at the point of common coupling. Depending on the phase angle between the injected current and the line voltage they control the power flow. For improving the power quality in grid connected wind and solar generating system with nonlinear load. FACTS devices such as STATCOM is used. On distribution side D STATCOM is used [57]. The problems due to power quality as well as its outcomes on the consumer and electrical utilities is also presented. The results are simulated by using SIMULINK/MATLAB. [52] This paper presents the basic structure of SVC and its operation and also its impact on power quality. A simple DG system with a typical solar plant is modelled with its characteristics and simulated. At different busses the voltage profile in the system is improved and also harmonic distortion caused by converters in distributed generations system is also reduced by using SVC.[53] This paper presented the performance analysis of DSTATCOM that has been used to regulate voltage on a 33KV distribution network for the plant absorbing continuously changing currents i.e arc furnace which are sources of flickers. A power quality issues due to the employment of UPQC was presented in [49].Further enhancement of the characteristics of UPQC, a new control scheme implementing Fuzzy logic Controller (FLC) which overcomes hitch in conventional PI controller of using fixed gains. [54] this paper has the combined operation of UPQC with Distributed generation. The system has series and shunt inverter wind energy system connected to the DC link through rectifier. The model’s ability to mitigate voltage sag, swell, interruptions and current harmonics in interconnecting and islanding mode. The performance of UPQC with Distributed Generation has been gauged through simulation studies using MATLAB/SIMULINK software.

CHALLENGES:

Due to intermittent nature of NCES it becomes hectic jobin integrating the NCES to the grid. Also, the usage of Power electronic devices to convert the output from distributed generations to integrate them with the grid imposes some problems. [48] So the challenges imposed in integrating NCES to grid are classified as non-technical and technical challenges and are listed underneath

Technically facedchallenges:

- Power quality degradation
- Economical aspects such as cost to interface with the grid
- Reliability, Security and Efficiency
- Inconsistent renewable energy production
- Power flow in both directions in distribution network.
- Protection Issues

The above listed issues can be associated for the grid integration for small scale generation. As the NCES generation is expanding at a large scale some other issues that are associated with it are

The Reactive power requirement for voltage support especially for wind power generation. Synchronizing the wind farms with the grid Active power, Reactive power and regulation. Turbine design with power electronics andoptimization controller. Power Quality issues like Flicker, regulation etc.

Non-Technical Issues

- Deficiency of technical skilled labor.

- Insufficient transmission lines to accommodate RES.
- NCES technologies have the highest priority for dispatch. So, installation of new power plant for surplus power is not considered.

FEASIBLE SOLUTIONS

The NCES like solar, wind, biomass, hydro and so on have been transiting generation towards energy sources that are clean and green. Due to this advantage the number of NCES rapidly multiplying and therefore account for the novel techniques that are used for the working and governance of the Power gridsuch that they retain/enhance the quality as well as reliability of the power supplied. Considering abovefeasible solutions are put forward by the analysts.

- Since few decades power electronic devices underwent a tremendous progressionby two major points. Primarily the evolution of quick semiconductors has the capability of switching rapidly and dealing with high power. Secondly the advent of real time computer controllers which have the potential to apply modern and complicated control algorithms. Aforesaid points have driven to the evolution of ecofriendly, grid friendly as well as economical converters.

Therefore, summing up that the power electronics imparts a vital role in the distributed generations and in integrating NCES to the power grid.

- Solar power generation should be distributed over the vast geographical area rather than concentrating at one place because any climate changes will impact the entire geographical area. If the generation is distributed then the overall generation is not hampered. If it is concentrated then the total generation would be reduced. Wind power generation also gets affected when large wind farms are concentrated.
- In large solar plantspower outputkeeps differing throughout the daytimewhich is then fed to the grid which leads tovarying power leading to security concern for the grid in order to make the grid stable. Solar plant landlord has to insert various storage system which will aggravate the cost of the power plant. If the storage system is charged fully then there is no gain to the landlord. Hence, instead of the storage system the water pumping system using solar-energy is incorporated.
- More effective and novel technologies using the FACTS devices should be designed so that highest amount of power can be derived from theNCES so that it can discourage the conventional methods as they are expensive and subjected to pollution, higher generating cost and limited resources which may be extinct if used at maximum.

CONCLUSION

In this paper integration of photovoltaic and wind power to grid and power quality issues related are sorted along with some possible solutions that are present in above literature. The causes, effects, improvement techniqueswith theirmerits of integratingphotovoltaic energy and wind energyto the grid are dealt with. To cut down the variations due to the irregular nature of the NCES power electronic devices are the appropriate options. The power fluctuations in PV systems can be mitigated by using energy storage, dump loads and MPPT. The economicalresults provided by the usage of Flexible AC transmission equipmentandcustom power devices are elaborated so that itinterprets the opportunity of research in mediumand low-levelvoltage networks in the current grid technologies.

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