Study of Challenges Associated with Hybrid Renewable Energy Resources

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***Abstract*: Due to the fact that solar and wind energy are intermittent and unpredictable, greater penetration of their types into existing power systems, especially weak grids or island systems without adequate and sufficient storage capacity, could cause and create high technical problems . By integrating the two renewable resources in an optimal combination, the effects of the different nature of solar and wind resources can be partially offset and the overall system becomes more reliable and economical to use. This article discusses grid quality problems with grid connected renewable energy sources and grid quality problems are harmonics and voltage and frequency fluctuations as well as a description of grid connected PV generation system in this article.**

Keywords: PV system, DC, Maximal Power Point Tracking, Renewable Energy System.

I. INTRODUCTION

In recent years, there has been a growing interest in moving from large-scale centralized power generation to decentralized energy resources. Hybrid solar and wind power generation offers numerous benefits for use as a decentralized power source, particularly as a peak power source. In the past, one of the disadvantages of solar energy sources was the need to store energy for the system, which had to be used for a significant percentage of the day. One way to overcome these drawbacks is to use the inverter and its control circuits for PV-based DG units during the day and night to perform reactive power compensation and harmonic removal on neighboring DG units and the grid. correctly exchanging the reactive power between them. . to improve sources. For this approach, linear controllers, proportional-integral (PI) controllers and predictive control methods already developed dominate the current error compensation [1]. But conventional PI controllers generally do not have adequate compensation from inverters for grid connected applications. Existing predictive control algorithms rely on dead time control to support voltage source inverters for power and voltage control of control parameters, but this method is not superior for PV-based DG units without DC-converters. A.D. This has been eliminated with SVPWM-based PI control. However, this controller does not respond to system parameters, since the algorithm does not contain the system model. DC current and voltage regulators are used to transfer the PV power and synchronize the output inverter with the grid. However, due to fluctuations in line impedance, it creates a power imbalance between the generated power and the load power and can damage the capacitor and protective devices. At the inverter output, there is a virtual inductor for decoupling the active and reactive power and controlling the reactive power with voltage drop characteristics as in. The online slope estimation algorithm introduces a delay in dynamic changes [2],[3].

II. LITERATURE REVIEW

NejibHamrouni et al. [4] This article means to acquaint a methodology with dealing with an average two-stage lattice associated PV framework working under typical and balanced network voltage plunges (SGVD) conditions. In typical working mode (NOM), the created control raises the moderately low sunlight based voltage to a suitable level which compares to greatest force point following (MPPT) and controls the transitional circuit voltage and the inverter yield flows. It is utilized to supply the lattice with energy with a solidarity power factor and a low consonant mutilation current. As per SGVD, the control technique approach ought to guarantee a steady association for as far as might be feasible and give receptive ability to withstand framework disappointments.

E. A. Amorim et al. [5] The proposed converter is the blend of a traditional three-stage converter and single-stage full-connect inverters associated in arrangement with each stage. With this geography it is feasible to create higher voltages in the rotor circuit, equipped for balancing the voltage actuated by the machine during the deficiency and restricting risky flows in the rotor circuit. The plan cycle and voltage guideline technique for the proposed drive geography are introduced. The reproduction results considering balanced and unbalanced issues are introduced for a 2 MW turbine.

The rotor flows are restricted near their ostensible qualities, which guarantees safe activity of the design, particularly of the force hardware.

Y. Venumadhavi et al. [6] In this article, a coordinated environmentally friendly power framework (IRES) associated with the matrix is planned in MATLAB/Simulink. The incorporated environmentally friendly power framework comprises of photovoltaic sunlight based boards, a breeze turbine and an energy component. The d-q coordinated edge of the reference regulator is utilized to control the voltage source inverter (VSI), which is the controlled current provided to the matrix. The incorporated environmentally friendly power framework is displayed and reproduced in MATLAB/ SIMULINK and the reenactment results are introduced.

B.Venkatasamy et al. [7] this work centers principally on the nearby planetary group and matrix associated inverter and their exhibition. Sun oriented radiation is just accessible during the day (for example 6-8 hours every day). Without sun based radiation, the photovoltaic framework and the inverter associated with the network shut down. To build the usage of the lattice associated inverter for one day, it very well may be utilized in responsive force infusion mode regardless of whether the PV power isn't accessible. This article reenacts the inverter, which can be utilized in dynamic and receptive force infusion mode. Productive outcomes and investigates are performed to improve the activity of the matrix associated inverter in the mixture framework.

III. POWER QUALITY PROBLEMS IN GRID CONNECTED RENEWABLE ENERGY SOURCES

Integrating wind and solar systems directly into the grid presents some challenges. To connect renewable energy sources to the grid, we use grid integration - grid-connected inverters. The inverter is used to draw energy from the grid when renewable energy is insufficient. And provide energy when more electricity is produced. The connection of the grid to renewable energy and disconnection occurs in 100ms. The block diagram of the photovoltaic generators connected to the grid is shown in fig. 1 (a),(b) shows the wind generator connected to the grid.

The main function of the converter in a grid system connected to a photovoltaic generator is to correct the size and phase of the power of the photovoltaic system by supporting the feedback from the electrical grid. And in the case of a grid system connected to wind turbines, it acts as an isolator from mechanical and electrical frequencies.

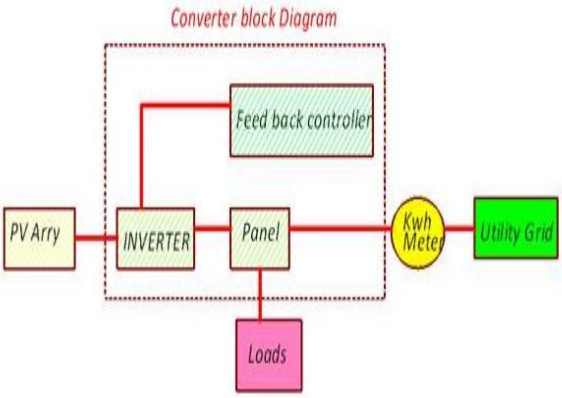

Fig. 1(a). Block Diagram for Grid connected PV Array.

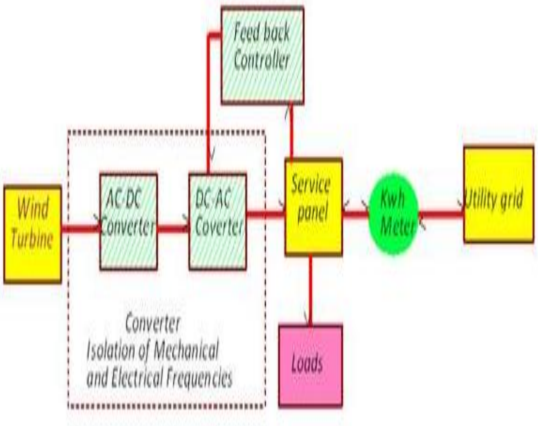

Fig. 1(b). Block Diagram for Grid connected Wind Turbine.

There are several technical problems related to grid connected systems, such as power quality problems, current and voltage fluctuations, storage, protection problems, insulation.

IV. POWER QUALITY ISSUES ARE HARMONICS AND VOLTAGE AND FREQUENCY FLUCTUATIONS.

A. Harmonics

Harmonics are currents or voltages whose frequencies are integer multiples of the base frequency of the network. Electrical equipment and generators generate harmonics and in large quantities (such as computers and compact fluorescent lights) can cause interference that leads to various power quality problems.

Most grid-connected inverters for DG applications generate very low harmonic currents and, due to their grid distribution, hardly cause harmonic problems even with high penetration values.

Although the most common type of inverter (power source) may not provide the harmonic support that the grid needs, however, voltage source inverters can do so at an energy cost and there are a variety of harmonic compensators available that are probably cheaper. A label identifying the type of inverter (voltage or current source) would facilitate the purchase of inverters with voltage or current source as needed, as well as financial compensation to reduce energy loss when installing source inverters voltage. Note that photovoltaic inverters disconnect from the grid without special configuration if the solar irradiation is insufficient to cover the switching losses, e.g..

B. Frequency and Voltage Fluctuations

Frequency and voltage fluctuation again classified as

1. Grid-derived voltage fluctuations

2. Voltage imbalance

3. Voltage rise and reverse power flow

4. Power factor Correction

(i). Grid-Derived Voltage Fluctuations

The inverters are generally configured to operate in grid voltage monitoring mode and turn off the DG if the grid voltage goes beyond the defined parameters. With a large number of DG systems or large DG systems connected to a given power supply, their automatic shutdown due to line voltage outside the allowable range can be problematic, as other generators in the network suddenly have to supply additional power [8.9].

To avoid this, the tolerances for voltage dips could be extended and, if possible, low voltage switching techniques (LVRT) could be incorporated into the inverter design. LVRT allows inverters to continue to operate at moderately low grid voltage for a specified period of time, but are always quickly disconnected if the grid voltage drops below a set value. The inverters can also be configured to operate in "voltage regulation" mode, where they try to actively influence the grid voltage. Inverters operating in voltage regulation mode allow you to increase the grid voltage by providing reactive power in the event of a voltage drop and to reduce the grid voltage by drawing reactive power when the voltage rises. Therefore, interconnection standards need to be developed to allow inverters to provide reactive power, if needed, in a way that does not affect the island's sensing systems. Utility personnel may also need training on integrating these inverters with other voltage regulation options. [10].

(ii) Voltage Imbalance

A voltage imbalance occurs when the amplitude of each phase voltage in a three-phase system is different or the phase difference is not exactly 120 °. Single-phase systems installed disproportionately on a single-phase can cause highly asymmetrical networks that can damage controls, transformers, DGs, motors and power electronics. Therefore, with high PV penetrations, the cumulative size of all systems connected to each phase should be as equal as possible. All systems with a minimum output power between 5 and 10 kW should generally have a balanced three-phase output.

(iii) Voltage Rise and Reverse Power Flow

In conventional centralized power grids, electricity flows in one direction only: from the power plant to the transmission grid, to the distribution grid and to the load. To compensate for line losses, the voltage is typically supplied 5-10% more than the rated voltage of the end user. Voltage regulators are also used to compensate for the voltage drop and keep the voltage within the expected range along the line.

(iv) Power Factor Correction

Due to the low power factor, conduction losses increase and voltage regulation becomes difficult. A low power factor in the network increases line losses and makes voltage regulation more difficult. Inverters configured to track voltage have a power factor of unity, while inverters in voltage regulation mode supply power out of phase with the grid voltage, thus providing power factor correction. This can be, for example, a simple fixed power factor or a factor automatically controlled by the mains voltage.

There are a number of factors to consider when using inverters for power factor correction.

- To allow injection of reactive power at maximum active power, it is necessary to increase the size of the inverter.
- The provision of reactive power support is associated with energy costs, and how VAR compensation is assessed and who pays for energy has generally not been addressed.
- Simple reactive power support can probably be more conveniently provided by SVC or STATCOM, which have lower energy losses, but the inverter's VAR compensation is continuously adjustable and has very fast response times. A var converter compensator can be warranted in areas where rapid voltage changes occur due to large load transients (eg motor starts).
- While this type of reactive power compensation is effective for voltage regulation in most networks, the system impedances at the connection point in the peripheral areas of the network are much more ohmic, so VAR compensation is less effective for regulation of tension. In these situations, active power injection for voltage regulation is more efficient.

Studies on the use of inverters to regulate grid voltage with high photovoltaic penetrations have shown that some form of centralized control is also required for optimal operation of the entire grid. In addition, the supply of reactive power by inverters can be limited by the supply voltage limits, so coordinated control of power devices and inverters as well as additional power devices may be required.

V. GRID CONNECTED PV GENERATION SYSTEM

Figure 2 shows the configuration of the grid-connected PV / battery generation system. The photovoltaic generator and battery are each connected to the common DC bus via a DCIDC converter, then connected to the AC grid via a common DC / AC inverter. Battery energy storage devices can be charged and discharged to balance electricity between PV generation and load demand. When the production exceeds the demand, the photovoltaic system charges the battery to store the additional power, while when the production is lower than the demand, the battery discharges the stored power to power the loads. Each of the PV systems, battery storage system and inverter has its own independent control goal, and by controlling each part, the whole system works safely.

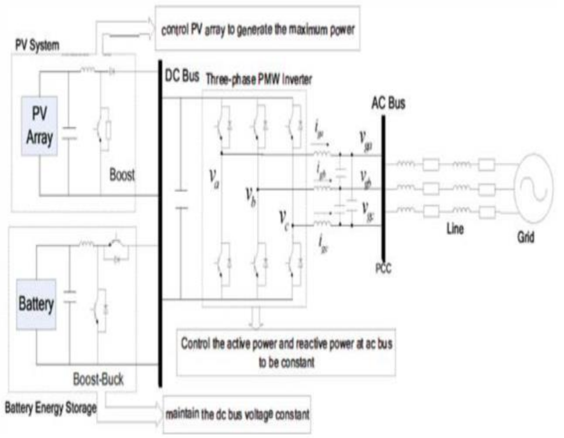

Fig. 2. Block diagram for Grid connected PV system.

VI. INTEGRATION OF RENEWABLE ENERGY SYSTEMS

Here, the most promising and important technologies from GCSPV and GCWT are only considered for discussion.

A. Solar Photovoltaic Systems

If the PV cell receives photon energy (= hμ) as a function of time, power electronic converters should be used to meet the load specifications [11], [12] with emphasis on PQ problems and anti-islanding PV systems (AII) connected to the low and medium voltage levels of the network. The overall performance of the SPV system, including PV module, inverter, filter control, etc. they must be optimized [13] to control voltage fluctuations and complex line performance, limited to directives. Depending on the type of network, the systems are designed to be single-phase or three-phase. Even when multiple PV panels are connected, the developed harmonics are observed to have higher frequency bandwidths ranging from sub-harmonics to multi-order harmonics. Custom Power Devices (CPDs) play a crucial role in many GCSPV connection topologies. These CPDs connected to non-linear loads introduce harmonics into the network. This should therefore be taken into consideration when designing the controller for CPD [14], [15] in order to stabilize the output at the common coupling point (CPP). Their applications are briefly discussed in [16]. The experimental result of a single-phase laboratory setup (2 kVA inverter) is presented in [17] to explain the phase-synchronized grid voltage using Kalman filters. Recently, multifunctional photovoltaic inverters for micro-grid applications have entered the market to introduce reliability as an additional goal. [18].

B. Wind Energy System

The causes of a reduced PQ in GCWT, which violates the regulatory framework, have been discussed in detail in [19], taking into account the voltage deviation and frequency fluctuations according to IEC 61400-12, -13 and -21. Fluctuations, flickers and harmonics were identified through simulations and experiments to explain the urgent need for CPD to improve PQ. Each GCWT affects the overall outcome and therefore a centralized approach has not been found to be successful, but decentralized mitigation of PQ problems should be performed regardless of the connection topology used. [20]-[21].

VII. CONCLUSION

The paper focused on the importance of renewable energy systems when integrated into the grid in their hybrid form. Researchers in this area have focused on grid quality problems with grid-connected renewable energy sources and grid quality problems on harmonics and voltage and frequency fluctuations. Network integration problems and network quality of wind and solar systems and their practicable solutions in the literature. The reasons, influences and mitigation techniques of solar and wind energy systems are presented.

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