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# Survey Paper on Power quality Improvement of Grid in Photovoltaic Solar System

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**ABSTRACT:** A micro-grid approach plays an enormous role in the increased penetration of renewable energy resource into grid thus reducing the emissions due to large coal fired power plants. The energy management in micro-grid is a challenging task as a major share of the generation is from Renewable Energy Sources. Usually, there are Power electronic interfaces through which the local generators are connected to the micro-grid which enables the control capabilities such as generation-demand management through active reactive power control, synchronization of the inverter to grid, meeting the power quality standards for the injected currents, maximum power point tracking etc. The active-reactive power delivered by the inverter is controlled by current control with the objective of the steady state and transient state performance requirements.

**KEYWORDS:** - PV Array, Wind Power, Micro-grid

## I. INTRODUCTION

A well-known fact is that, in micro grids several renewable energy sources and conventional energy sources operate together. The switching in and switching out of any distributed generator will cause variation in the structure and model of the micro-grid at any point of time during the operation. So, it becomes necessary to ensure that the control structure and its action should be independent of the system and the operating conditions. From the discussions above, it is clear that intense testing of micro-grids in both the component level and configuration level is very important in the aspect of investigation and demonstration of the adequacy of the design. The testing is to be carried out both under steady state conditions and during transient conditions. To simulate various network configurations under specific input-output conditions, real-time simulators i.e. emulators are vital. Emulators give the flexibility of obtaining different energy flows, creating fault conditions, creating transient conditions help understanding the electricity distribution networks meticulously. For example, micro-grids working under islanded mode, the dynamics are very fast as there are no significant time constants present within the network. The unpredictability of supply and demand is very common under islanded condition, which puts the stability and efficiency of the network under threat and test. Most of the generators are nature driven, and so for consistent performance of the interfacing power converters and the control loops, the experiments need to be repeated for every load/grid condition at every possible input condition. With an actual renewable energy source, it is not practical to repeatedly set the steady state and transient ambient conditions at all ambient values as required. Thus, emulators representing any renewable energy source are primarily intended as a power source to the converters in experiments to verify the 18 reliability and repeatability of operation of the converter in steady state as well as in transient conditions of all possible input/grid conditions. Such a hardware simulator has to produce outputs effectively as will be given by a renewable energy source at any operating condition. Besides the renewable source emulator, the system emulators are also very much crucial in the development of fail-safe micro-grids. System emulators will have the network parameters for the actual spread length corresponding to micro-grids represented by lumped circuit parameters, thus allows the testing of various generators operating on it in a synchronized manner under various conditions. By the use of these emulators the smart grid system designers will get



the response from low cost, safe, and easily configurable simulators and emulators instead of waiting for expensive and hardwired deployments for their testing. This will make the micro-grids to be operator-centered and operator-friendly.

## II. LITERATURE REVIEW

**Waseem Sultana et al. [1]**, a quick developing of occupants giving power to the humankind is prime face for electrical designing. Execution of ages mounting really fast generally which makes power go about as a spine to maintain any business. A Contemporary origination of utilizing sunlight based PV board inverter as STATCOM, named as PV-STATCOM, in interconnected transmission framework to work on the constraints of stable power move. To further develop stable power transmission limitations, the unblemished inverter assessment of sun based PV ranch which remains aestivating in the long periods of murkiness is sent with voltage. The above objective is achieved for use of the inverter limit in day time which is abandoned the creation of genuine power. In the constantly even while creating enormous amounts of genuine power, improvement is finished by PV-STATCOM under which transmission limits are steady. Assuming there is no hang happens in the transmission line. It tends to be acted in both voltage droop and swell state of activities.

**Sayantam Sarkar et al. [2]**, discusses on solar PV systems which includes power electronic devices, they have an influence on the efficient energy of the microgrid grid in the form of harmonic distortion and it have impact on distribution networks. A comprehensive harmonic behavior investigation has been performed on the appropriation network with high sun based PV frameworks entrance. A specific degree of sounds is likewise embedded into the organization through nonlinear burdens to look like a practical situation. The review have been brought out through reproductions of three contextual investigations, specifically sunlight based PV framework reconciliations at a solitary hub specifically with and without the presence of foundation deceptions in the stockpile lastly sun powered PV entrance at numerous hubs with supply contortions. Furthermore, an assessment concentrate on has been displayed at the University of Queensland sun powered PV site to approve reproduction results. This study has underlined the sunlight based PV frameworks consonant effects on genuine conveyance organizations and the effect of music spread on transformer K-factor. Results show that the all out symphonious contortions of current and voltage are surpassing the cutoff points when the quantity of sun powered PV frameworks rises, chief to transformer over-burdening and warming.

**Mostefa Kermadi et al. [3]**, talks about the execution of an energy the executives regulator (EMC) for matrix associated PV framework utilizing the State flow approach. This approach gives a quick plan of the regulator and productive code age for target equipment execution. An ordinary miniature network is viewed as in this study incorporates a PV generator, an energy stockpiling framework made out of battery and the EMC to adjust the power stream between the various parts of the framework. PV systems are being employed in diverse applications of energy generation systems including both stand-alone and grid-connected systems. Due to the progress in power electronics technology, the penetration of PV systems in the utility distribution grid is greatly increased. The stochastic nature of the PV power injected into the utility grid involves large fluctuations of its frequency, power and voltage. From that point, the different activity methods of this regulator and its advancement utilizing the State-stream apparatus are nitty gritty. Reenactment is completed utilizing a 20 second weather conditions profile to demonstrate the viability of the proposed EMC. It additionally showed the straightforwardness of the regulator improvement utilizing the Stateflow device.

**Yashi Singh et al. [4]**, gives a joining of battery a PV network tied based single stage microgrid with complex offices. The proposed PV-battery matrix attached framework has ability to act in double mode for example matrix coordinated mode and islanded mode, as per the accessibility of framework. The proposed microgrid topology has multifunctional VSC and with an adaptive controller. At grid-trying mode, it deliveries solar peak power to the grid and load connected at the PCC. When the grid is absent, the control adjusts to standalone mode and adapts to continuous supply the load. A smart control algorithm is used with some logic control, for checking the availability of the grid. This framework is displayed in MATLAB and created model is utilized to reproduce its exhibition. Reenactment results are examined the presentation and the reaction of microgrid with a versatile calculation with recurrence and voltage control under mode change condition.

**Mohamad-Amin et al. [5]**, have reserve constraints based on hybrid diesel generators and PV system were formulated. Various case studies based on realistic data from an offgrid system were used to demonstrate the effectiveness of the integration of PV system considering spinning reserves constraints. There are numerous specialized difficulties in the





reconciliation of environmentally friendly power assets with regards to microgrid. Among the various issues related with miniature lattices, framework activity considering turning hold the board ought to be appropriately contemplated to permit a superior comprehension of the framework execution and expected investment funds because of environmentally friendly power reconciliations at arranging stages. Spinning reserve constraints in PV hybrid systems was considered for investigation of fuel consumptions at the planning stage. The results demonstrated a significant fuel saving due to integration of PV system into off-grid systems.

**Deepak Singh et al., [6]**, have DC microgrids permit adaptable activity in carrying out control plot, to such an extent that the DC microgrid voltages are inside OK breaking point and equipped for keeping up with framework power balance in both islanded as well as lattice associated mode. The different methods of bidirectional DC-AC converter control are discussed. State of charge (SOC) of battery storage unit is used as an indicator for deciding the safe charge / discharge limits. Framework is partitioned parts which incorporates, sun oriented PV greatest power point following (MPPT) through support converter, bi-directional DC converter for battery charging applications, and bidirectional AC-DC converter for taking care of AC loads, and so on.. Framework is tried by means of PSCAD based recreation stage, for activity in differing working modes with the end goal that the power could be taken care of from DC to AC microgrid as well as the other way around. DC-AC converter working in shut circle sine beat width regulation (SPWM) plot, is utilized to control AC side voltage while working in islanded mode. It works in amendment mode during lattice associated mode. In day time, framework is in islanded mode where overabundance/deficiency power is traded with energy capacity unit (ESU). In night or evening, it works in framework associated mode to charge the ESU.

**R S Sreelekshmi et al. [7]**, have incorporating environmentally friendly power assets, for example, PV to a microgrid there requires a proficient energy the board system because of the irregular idea of environmentally friendly power assets. An energy stockpiling framework, for example, battery capacity framework is constantly utilized alongside PV as a helper energy source. They propose a fluffy based regulator for the energy the board in a PV-Battery based microgrid. Contingent upon the accessibility of PV power, Battery State of Charge (SoC), Load the fluffy rationale regulator will take the choice and comparing exchanging signs will be delivered.

**A. Kadam et al., [8]**, for the protected activity of transformer-less network associated photovoltaic (PV) inverters, the issue of common mode (CM) spillage current should be tended to painstakingly. Novel staggered transformer-less inverter geography was proposed, which totally disposes of CM spillage current by associating network nonpartisan point straightforwardly to the PV adverse terminal, subsequently bypassing the PV stray capacitance. It's anything but a minimal expense arrangement comprising of just four force switches, two capacitors, and a solitary channel inductor. When contrasted with half-connect geographies, with this inverter at least 27% and limit of 100% more yield voltage is acquired for a similar dc-interface voltage. The proposed inverter is dissected exhaustively and its changing example to create staggered yield while keeping up the capacitor voltage is examined. Reenactments and tests results affirm the possibility and great execution of the proposed inverter.

**S. Jain et al., [9]**, have presents an improved fell staggered inverter (CMLI) in light of a profoundly effective and solid arrangement for the minimization of the spillage current. Aside from a decreased switch tally, the proposed conspire has extra highlights of low exchanging and conduction misfortunes. The proposed geography with the given heartbeat width adjustment (PWM) method decreases the high-recurrence voltage advances in the terminal and normal mode voltages. Keeping away from high-recurrence voltage advances accomplishes the minimization of the spillage current and decrease in the size of electromagnetic obstruction channels. Besides, the augmentation of the proposed CMLI alongside the PWM method for  $2m + 1$  levels is additionally introduced, where  $m$  addresses the quantity of photovoltaic (PV) sources. The proposed PWM procedure requires just a solitary transporter wave for all  $2m + 1$  degrees of activity. Complete subtleties of the examination of PV terminal and normal mode voltages of the proposed CMLI utilizing exchanging capacity idea, recreations, and trial results.

### III. MICROGRID STRUCTURE

Microgrid sun powered PV and wind age framework become exceptionally alluring arrangement specifically for independent applications. Joining the two wellsprings of sun powered and wind can give better unwavering quality and their half and half framework turns out to be more affordable to run since the shortcoming of one framework can be supplemented by the strength of the other one. The mix of half breed sun based and wind power frameworks into the lattice can additionally help in working on the general economy and dependability of sustainable power age to supply its heap. Essentially, the joining of half and half sun based and wind power in an independent framework can decrease



the size of energy stockpiling expected to supply consistent power. Sunlight based power age frameworks use either photovoltaics or concentrated sun powered power. The concentration in this paper will be on the photovoltaics type. Nitty gritty depictions of the various advancements, material science and rudiments of PV can be found in numerous course books and papers, for example, [4-7]. Kurtz [8] brought up that decade prior the concentrator cell was just ~30% proficient contrasted and over 40% today with the possibility to move toward half before long. Si cells have efficiencies of 26% and multi-junction III-V-compound cells have efficiencies above 45% (48% in the research facility) as brought up in reference [9]. PV modules produce yields that are resolved fundamentally by the degree of episode radiation. As the light force builds, photocurrent will be expanded and the open-circuit voltage will be diminished [10]. The proficiency of any photovoltaic cell diminishes with the rising temperature which is non-consistently dispersed across the cell [11]. The sunlight based yield power can be smoothed by the conveyance of sun oriented power in various geological regions [12]. Power from sunlight based PV and concentrated sun powered power plants is altogether costly and requires critical drop in cost or change in arrangements by either financing or driving the utilization of these advancements to have the option to accomplish huge market entrance [13]. Worldwide breeze report (2012) demonstrated that the yearly market became by around 10% to stretch around 45 GW and the aggregate market development was practically 19% [14]. Point by point depictions of the breeze energy can be found in references [4] and [15]. Wind turbines (WTs) are grouped into two kinds: flat hub WT (HAWT) and vertical-hub WT (VAWT). The most noteworthy reachable extraction of force by a WT is 59% of the all out hypothetical breeze power [15]. Mixture sun oriented breeze frameworks can be arranged into two sorts: network associated and independent. Writing surveys for crossover lattice associated and independent sun based PV and wind energies were directed overall by numerous scientists who have introduced different difficulties and proposed a few potential arrangements. Because of the idea of cross breed sunlight based PV and wind energies, streamlining strategies can assume a decent part in using them effectively. Realistic development strategies [16], direct programming [17-18], and probabilistic methodology [19] are not many instances of improvement procedures that have been created for techno-financially ideal mixture sustainable power framework for the two sorts. Luna-Rubio et al. [20] led a survey of existing exploration of ideal measuring of inexhaustible half and halves energy frameworks with energy capacity parts for both independent and network associated frameworks. The creators gave brief portrayals about those markers and the different estimating strategies. A survey of control methodologies for a cross breed environmentally friendly power framework was completed in [21] and one more survey was finished in [22] for enhancement of half and half sustainable power framework with more spotlight on wind and sun based PV frameworks. The surveys in [21] and [22] are pertinent for the two kinds; framework associated and independent frameworks.

#### IV. CONTROL OF MICROGRID

The control strategies for microgrid depend on the mode of its operation. The aim of control technique should be to stabilize the operation of microgrid. When designing a controller, operation mode of MG plays a vital role. Therefore, after modelling the key aspect of the microgrid is control.

##### 1. Control of Grid Connected

In grid connected mode, microgrid acts as a controllable load/source. It should not actively regulate the voltage at the point of common coupling (PCC). Its main function is to satisfy its load requirements with good citizen behavior towards main grid. The balance between generation and demand, control of the parameters of the system is taken care by the utility grid. The voltage and frequency reference of the microgrid is also set by the main grid. Therefore the main task of a DG unit is to control the output real power (P) and reactive power (Q).

##### 2. Control Islanded Microgrid

In islanded mode, the reactive power sharing is highly dependent on impedance of power line. Due to the different distances among DERs interface converters (DICs), the equivalent transmission line impedance could be unequal [51].  $P_f$  and  $Q_V$  droop characteristics are used in DER interface converters for power sharing operations. The  $P_f$  droop control provides an accurate real power sharing among the DIC's but the problem arises in  $Q_V$  droop control. Because of this unequal impedance load sharing performance of  $Q_V$  control can be affected.

#### V. GRID CONNECTED SYSTEM

The mix of joined sunlight based and wind power frameworks into the lattice can help in decreasing the general expense and further developing unwavering quality of sustainable power age to supply its heap. The matrix takes overabundance inexhaustible power from sustainable power site and supplies capacity to the site' loads when required.



Fig. 1 and Fig. 2 show the normal DC and normal AC transport matrix associated with sun powered PV and wind half and half framework, individually.

**Power electronics topologies and control**

There are two geographies for network associated sun based PV and wind crossover framework as should be visible from Fig. 1 and Fig. 2. Fig. 1 shows that the DC results' voltages from individual sun based PV, wind and battery bank stream, through individual DC/DC and AC/DC units, are coordinated on the DC side and go through one normal DC/AC inverter which goes about as a connection point between the power sources and the lattice to furnish the ideal power even with just a single source accessible. Subsequently, the environmentally friendly power sources go about as current sources and can trade power with the matrix and the normal DC/AC inverter controls the DC transport voltage. The singular units can be utilized for most extreme power point following (MPPT) frameworks to have the greatest power from the sun based PV and wind frameworks and the normal DC/AC inverter will control the DC transport voltage.

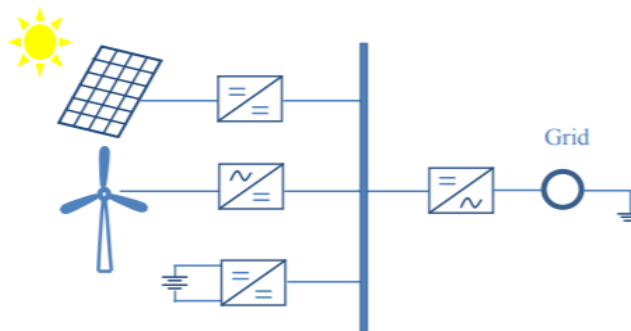


Figure 1: Grid-connected hybrid system at common DC bus

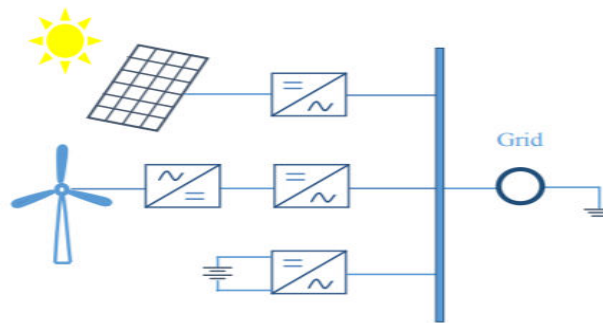


Figure 2: Grid-connected hybrid system at common AC bus

The battery bank is charged when there is an extra power and discharged (by supplying power) when there is shortage of power from the renewable energy sources. On the other hand, Fig. 2 shows that renewable energy sources are injecting power directly to the grid through individual DC/AC and AC/DC-DC/AC units.

**Power quality**

The expanded entrance of framework associated sustainable power sources affects the matrix power quality specifically frail networks. Voltage change, recurrence variance and sounds are significant power quality issues. Besides, irregular energy from sun based PV and wind colossally affects network dependability. Nonetheless, exact anticipating and planning frameworks can limit the effects. Different factual anticipating and relapse investigation approaches and calculations are utilized to estimate atmospheric condition, sunlight based radiation and wind speed [12-13]. Framework administrator can change other dispatch capable age somewhere else in a framework to manage any deficiency or excess power from sustainable power age [14]. This will diminish the effect of the variances from the age of the sustainable power sources. Furthermore, the conveyances of RES to bigger geological region in little units rather than huge unit moving in one region have some control over the irregularity impact of force age from RES [15]. Energy capacity gadgets like batteries or Uninterruptable Power Supply (UPS) can function as an adjusting devises that give power when there is a lack of energy in sustainable age and store overabundance energy when there is excess power



from sustainable age [16-17]. Dynamic power channels, for example, dynamic voltage controllers, static simultaneous compensators and bound together power quality conditioners can be utilized to determine voltage variance [18], [19]. Likewise, power compensators, for example, fixed or exchanged capacitor can be utilized to determine receptive power issue [20]. They are the most recent connecting gadgets among networks and purchaser apparatuses. Unexpected changes in dynamic power drawn by a heap could cause framework recurrence variance in AC matrices. These progressions address unbalance circumstances among burden and age. Considering the abovementioned, it is critical to configuration control circles for power and recurrence control to relieve quality issues [21]. Bae and Kwasinski highlighted that a primary goal of a pulse width modulation (PWM) inverter controller was to regulate three-phase local AC bus voltage and frequency in a microgrid. Harmonics are normally caused by power electronics devices and non-linear appliances. Appropriate filters and PWM switching converter can be used to mitigate harmonic's distortion.

## VI. CONCLUSION

This paper has provided a review of challenges and opportunities on integrating solar PV and wind energy sources for electricity generation. The main challenge for grid-connected system as well as the stand-alone system is the intermittent nature of solar PV and wind sources. By integrating the two resources into an optimum combination, the impact of the variable nature of solar and wind resources can be partially resolved and the overall system becomes more reliable and economical to run. This definitely has bigger impact on the stand-alone generation. Integration of renewable energy generation with battery storage and diesel generator back-up systems is becoming a cost-effective solution for stand-alone type. The wind-battery-diesel hybrid configuration can meet the system load including peak times. Energy management strategies should ensure high system efficiency along with high reliability and least cost. Good planning with accurate forecasting of weather pattern, solar radiation and wind speed can help in reducing the impact of intermittent energy.

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