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Power Quality Stabilization Using VSI and Control Strategy of Energy Storage and Micro Source For Microgrid

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Abstract **–** The islanding capability of Microgrids (MGs), when a fault happens in the grid, is seen as one major driver in enhancing the reliable of MGs. However, the use of power electronic interfaces based-MGs faces some difficulties in maintaining stability in an islanding mode due to the low capacity of installed DGs as well as the low speed response of MGs to any load changes. In fact, the lack of availability of spinning reserves makes fast response to load changes, as well as balancing between power generation and load demand difficult. This leads to deviation in voltage and frequency from their (pre-determined) permitted values. In this paper, a new MG's topology along with a novel control strategy is proposed for stabilizing MGs in different operation modes. Battery storage is used to address the slow response problem of micro sources (MSs) to load changes, and to balance load demands and power generation in the islanding mode of MGs. A droop control idea is adopted in the lowest level of a hierarchy controller to enhance cooperation between power electronic inverters, and to improve load dispatch and voltage regulation. The voltage variation of the MG's main bus is considered as a load change criterion, instead of the output power of converters, to increase the response speed of the control system. The effectiveness of the proposed con- trol strategy is assessed using MATLA/SIMULINK. It is shown that the proposed control strategy improves the operation of MGs in grid connected and islanding modes where soft transient between these two modes are achieved.

1 . INTRODUCTION

The New and Renewable Energy assets are proposed by Ministry of New also, Renewable Energy sources and Energy Development offices to adjust the need for the energy in the pending years. The abuse and improvement of different types of energy and making energy accessible at reasonable rates is one of the major push zones. Transformation of energy assets, ecological security and supportable improvements are the three noteworthy changes of the world. One significant issue is to fulfill the energy needs of individuals without causing fast exhaustion of characteristic energy assets and debasement of nature. Presently a-days wind energy has the most exploitable capability of sustainable power source and has pulled in extraordinary interests in later a long time. Enormous wind ranches have been introduced or arranged the world over and the power rating of the wind turbines are expanding. Wind generator is the essential hardware to utilize wind energy. Age of power has developed as the most significant utilization of wind energy around the world. The idea is basic; blowing wind turns the sharp edges of a turbine and makes power be delivered in generator unit. It is earth favorable and does not transmit ozone harming substances. Acceptance generators are all the more usually utilized in Wind Energy Conversion Systems (WECS). An enlistment generator is an enlistment engine working over its synchronous speed. Because of its basic development the acceptance generator is appropriate for some modern co-age applications. Voltage soundness is a generally later and testing issue in power frameworks designing. Serious and expanding strain has been seen in the power framework as of late due to incongruence between the age and transmission foundation. Natural issues, change in energy portfolio and deregulated energy markets are a portion of the prime elements. The sort of stress created in the framework has caused worries for voltage flimsiness. Voltage solidness alludes to the capacity of a power framework to keep up consistent voltages at all transports in the framework after being exposed to an unsettling influence.

An electrical system that includes multiple loads and distributed energy resources that can be operated in parallel with in the border utility grid is called micro grid. Many countries generate electricity in large centralized facilities; these plants have excellent economies of scale, but usually transmit electricity long distances and can negatively affect the environment. Distributed generation allows collection of energy from many sources and may give lower environmental impacts and improved security

of supply. Distributed generation reduces the amount of energy lost in transmitting electricity because the electricity is generated very near where it is used, perhaps even in the same building. This also reduces the size and number of power lines that must be constructed. Micro grid generation resources can include fuel cells, wind, solar, or other energy sources. In recent years, electricity generation by photovoltaic (PV) or wind power (WP) has received considerable attention worldwide.[1] The combination of wind and solar energy leads to reduced local storage requirements.

The combination of battery energy storage system and super capacitor technologies in turn can form multilevel energy storage. The battery energy storage system employs for balancing the supply and demand where as super capacitor provides cache control to compensate for fast power fluctuations and smoothen the transients encountered by a battery with higher energy capacity. Micro grids or hybrid energy systems have been shown to be an effective structure for local interconnection of distributed renewable generation, loads and storage. With the ongoing and increasing demand for improved reliability and energy efficiency across all commercial buildings, a tremendous opportunity exists to capitalize on the benefits of DC micro grids.[6]

The matrix associated cross breed PV-Wind-battery based for the most part framework for family applications, which may work either in total or network associated mode. This technique is fitting for oversee applications, where a modest, simple and minimal topology fit for self-ruling activity is fascinating. The focal point of the foreseen structure is that the multi-input transformer coupled bidirectional dc-dc convertor that interconnects distinctive power sources and in this way the limit part.

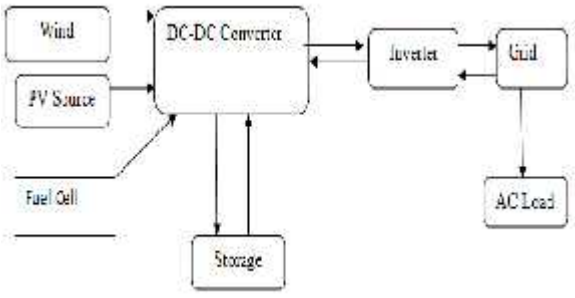

Fig.1 Grid-connected hybrid PV-Wind-battery and Fuel Cell based system for household applications

Hybrid PV-Wind primarily based generation of electricity and its interface with the ability grid area unit the necessary analysis areas. Chen et al. in [13], [14] have arranged a multi-input half breed PV-Wind control age framework that contains a buck/buck support intertwined multi-input dc-dc gadget and a full-connect dc air conditioning inverter. This structure is transcendently revolved around rising the Dc-interface voltage control. Inside the six-arm contraption topology Proposed by H. C. Chiang et al. [6], the yields of a PV gathering and Wind generators district unit upheld to a lift gadget to arrange the dc-transport voltage. The reliable state execution of a system related cross breed PV and Wind structure with battery storing is inspected in. This paper bases on system outlining, for instance, imperativeness creation, structure dependableness, unit size, and cost examination.

II. LITERATURE SURVEY

A. Cagnano et.al. (2018) "A cooperative control for the reserve management of isolated microgrids" A real-time coordinated control strategy able to ensure an adequate security level in islanded microgrids. The methodology can be applied to microgrids adopting the master-slave control architecture, where a specified generator takes the role of the isochronous generator for the overall system. The derived algorithm is able to regulate in the on-line environment active powers of microsources and energy storage systems of the isolated microgrid in accordance with their reserve margins and their technical limits. Control actions have been evaluated by solving a constrained dynamic optimization problem aimed at simultaneously maximizing the spinning reserve of the master unit and the duration of the regulation function of each energy storage system. The solution of this problem has been obtained by adopting an iterative algorithm involving a fictitious dynamic system in which the state variables are the active powers of microgrid sources and storage devices. The solution has been attained by adopting the direct Lyapunov theorem applied to the sensitivity theory, giving rise to an ever stable algorithm. Essentially, the adoption of the Lyapunov theorem ensured the convergence of the dynamic system to an equilibrium point corresponding to the minimum of the given multi-objective function [1].

Fujun Bao et.al. (2018) "Cooperative Control Strategy of Multiple VSGs in Microgrid Based on Adjacent Information" In microgrid, each single VSG obtains adjacent information through intercommunication, thereby the local VSG output control is improved to make each VSG tend to have the same output frequency at any time. This strategy alleviates the problem of uneven instantaneous active power distribution among VSGs and overshoot of instantaneous frequency in microgrid under

disturbance, thereby it can effectively suppress system oscillation. By constructing the energy function of the microgrid with multiple VSGs, the stability of the proposed control strategy is theoretically proved by Lyapunov stability analysis method. Finally, through MATLAB simulation, it is verified that the control strategy proposed in this paper can significantly improve and optimize the dynamic response performance of the system. For possible communication failures, the superiority of the proposed strategy is verified by comparing the simulation results under different control strategies [2].

S. Basak et al. [2016] "A new optimal current control technique for dual stator winding induction generator" author proposed double stator winding acceptance generator (DSWIG) to be one of the reasonable contender for this reason. This paper manages a one of a kind setup of DSWIG, which encourages concurrent power course through both the stator windings in expanded speed extend. Both the windings feed a similar dc-transport through comparing converters. An inactively tuned channel crosswise over uncontrolled winding has been acquainted with improve control quality and supply a piece of the responsive power dependent on an advancement foundation to amplify dynamic power yield from the framework. Another list called "control sharing proportion" is acquainted and a control procedure with disseminate control through both the windings is proposed. A calculation to locate the "ideal power sharing proportion" is created. This depends on most extreme yield per ampere of winding current. MATLAB/Simulink-based reproduction studies have affirmed the viability of the control calculation. Test examinations utilizing a dSPACE 1103-based research facility model have shown the handiness of the proposed framework [3].
K. Shi et al. [2016] "Grid-connected dual stator-winding induction generator wind power system for wide wind speed ranges" author proposed matrix associated double stator-winding acceptance generator (DWIG) wind control framework reasonable for wide wind speed ranges. The parallel association by means of a unidirectional diode between dc transports of both stator-winding sides is utilized in this DWIG framework, which can yield a high dc voltage over wide wind speed rangeS. Framework associated inverters (GCIs) don't require promoter converters; subsequently, the effectiveness of wind energy use increments, and the equipment topology and control system of GCIs are improved. In perspective on the particularities of the parallel topology and the received generator control methodology, we propose a novel excitation–capacitor enhancement answer for lessen the volume and weight of the static excitation controller. At the point when this excitation–capacitor enhancement is done, the greatest power following issue is likewise considered. All the issues are settled with the consolidated control of the DWIG and GCI. Exploratory outcomes on the foundation of a 37 kW/600 V model demonstrate that the proposed DWIG wind control framework can yield a consistent dc voltage over wide rotor speed ranges for lattice associated activities and that the proposed excitation enhancement plan is viable [4].

Mohammad H. Moradi et.al.(2015) “Cooperative control strategy of energy storage systems and micro sources for stabilizing microgrids in different operation modes” A novel control strategy for improving the stability of MGs, both during the MG’s transition time, from CM to IM, and during MG’s operation time in IM, was proposed. A droop control idea was adopted to rapidly fix unbalancing between power pro- duction and consumption while holding the voltage variable in its allowed range. FC, equipped by VSI, was employed for obtaining the reference voltage and frequency in the IM operation. CSI with a fast dynamic response was also employed to connect other RESs and battery to the main bus of MG in both CM and IM. Moreover, FC was equipped with a power control loop for delivering specified power and for keeping the MG voltage bus at its associated nomi- nal value in IM. Meanwhile, battery and CSI, equipped with the proposed power control loop, were considered to rapidly compen- sate the MG bus voltage deviation, caused by load variations. This gives enough time to FC to deliver load variations. Cooperation between control loops and fine tuning of droop gains of battery, with fast response, were captured to compensate FC slow response to load variation[5].

Chandan Kumar, et al. [2015] "Design of External Inductor for Improving Performance of Voltage Controlled DSTATCOM" author proposed distribution static compensator (DSTATCOM) is used for load voltage regulation and its performance mainly depends upon the feeder impedance and its nature (resistive, inductive, stiff, non-stiff). However, a study for analyzing voltage regulation performance of DSTATCOM depending upon network parameters is not well defined. This paper aims to provide a comprehensive study of design, operation, and flexible control of a DSTATCOM operating in

voltage control mode. A detailed analysis of the voltage regulation capability of DSTATCOM under various feeder impedances is presented. Then, a benchmark design procedure to compute the value of external inductor is presented. A dynamic reference load voltage generation scheme is also developed which allows DSTATCOM to compensate load reactive power during normal operation, in addition to providing voltage support during disturbances. Simulation and experimental results validate the effectiveness of the proposed scheme [6].

H. Xu, et al. [2015] "Control and performance of five-phase dual stator-winding induction generator DC generating system" author proposed the five-stage double stator-winding acceptance generator dc producing framework with the static excitation controller is introduced, and two sorts of control techniques for this framework are proposed. In this generator, the enclosure type rotor is utilized, and two arrangements of five-stage windings are set in the stator, specifically, the power winding and control winding. Utilizing the momentary power hypothesis, the control-winding-motion situated control (CWFOC) system without consonant infusion is gotten. To improve control thickness, the CWFOC with symphonious infusion is proposed too. For these two procedures, the nitty gritty usage is considered. The outcomes (reproduction and test) bolster the rightness and adequacy of the proposed control techniques, and the comparing results demonstrate that, utilizing the CWFOC methodology with consonant infusion, the yield intensity of this framework can be improved by about 11% [7].

H. Xu et al. [2015] "Analysis comparison and discussion of control strategies for dual stator-winding induction generator DC generating system" author proposed our kinds of control techniques for a double stator-winding acceptance generator DC creating framework just as their investigation, correlation, and talk. These four sorts of control systems incorporate control-winding motion direction control, control-winding voltage direction control, control-twisting direct power control, and momentary slip recurrence control (ISFC). The ISFC technique is portrayed in detail for previously utilized in dc producing application, and different systems are quickly presented and their exhibitions are likewise abridged for examination. The qualities of control procedures are analyzed from four viewpoints: 1) framework execution; 2) key segments; 3) control standards; and 4) applications. From the examination results, it tends to be surmised that all these four sorts of control techniques have a few focal points, particularly the ISFC. They can discover reasonable applications [8].

III. PROPOSED METHODOLOGY

In this project Hybrid PV-wind based generation of electricity and its interface with the power grid are the important research areas. The proposed multi-input hybrid PV-Wind power generation system which has a buck/buck boost fused multi-input dc-dc converter and a full-bridge dc-ac inverter. This system is mainly focused on improving the dc-link voltage regulation. In the six-arm converter topology proposed .The outputs of a PV array and Wind generators are fed to a boost converter to match the dc-bus voltage. The steady-state performance of a grid connected hybrid PV and Wind system with battery storage is analyzed.

The grid connected hybrid PV-Wind-battery based system for family unit applications, which can work either in remain solitary system associated mode. This system is appropriate for family applications, where a minimal effort, basic and conservative topology equipped for independent activity is attractive. The center of the proposed system is the multi-input transformer coupled bidirectional dc-dc converter that interconnects different power sources and the capacity component.

The proposed converter comprises of a transformer coupled boost double half-connect bidirectional converter intertwined with bidirectional buck boost converter and a solitary stage full-connect inverter. The proposed converter has decreased number of intensity transformation stages with less part compute and high proficiency contrasted with the current grid connected plans. The topology is basic and needs just six power switches. The boost double half-connect converter has two dc-interfaces on both sides of the high recurrence transformer. Controlling the voltage of one of the dc-joins guarantees controlling the voltage of the other. This makes the control methodology basic. Besides, extra converters can be coordinated with any of the two dc-joins. A bidirectional buck-support dc-dc converter is coordinated with the essential side dc-interface and single-phase full-connect bidirectional converter is associated with the dc-connection of the optional side.

The main components of hybrid are mini-hydro, solar cell, Wind energy, Wind and energy storage system. These are integrated for electricity generation, energy storage, and a load that normally operates connected to a main grid (macro grid). Hybrid can operate in two modes: one is grid-connected and the other is stand-alone mode. The main benefit of hybrid is that it can operate in standalone mode or main grid

disconnection mode. The hybrid can then function autonomously. Generation and loads in a hybrid are usually interconnected at low voltage. But one issue related to hybrid is that operator should be very vigilant because numbers of power system are connected to hybrid. In the past, there was single entity to control.

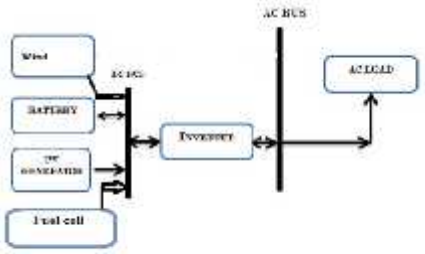

Figure 2 PV-Wind Fuel Cell hybrid systems.

In Hybrid generation resources can include such as Winds, Wind, solar, or other energy sources as shown in Figure 4.1. These multiple different electric power supply generation resources have absility to isolate the hybrid from a large network and will provide highly reliable electric power. Produced heat from generation sources such as micro turbines could be used for local process heating or space heating, allowing flexible tradeoff between the needs for heat and electric power.

The followings are parameters of Microgrid:

• Small Microgrid covers 30 - 50 km radius;

• The small hybrid can produce power of 5 - 10 MW to serve the customers;

• It is free from huge transmission losses and also free from dependencies on long-distance transmission lines.

IV. CONCLUSION

In this paper we are Design and Performance analysis of Buck-Boost converters controlled by PI-controlled MPPT with the help of Inverter and PWM for static and dynamic loading conditions have been performed in Photovoltaic panel in Matlab Simulink program. The Buck-Boost converter are supplied from the source through a MPPT technique The Buck-Boost converter output is fed to the inverter terminal. The Inverter is connected to PWM techniques to filter out the lower order harmonics voltage.

The power quality of the system is improved and optimized. The system voltage and current waveform is improved.

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