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Review on FACT Based Wind Power System Power Quality Improvement Techniques

Harsha V. Hood[1], Mrunali Chikte[2]

PG Scholar, Dept. of EE, Wainganga College of Engg & Mang, Nagpur, Maharashtra, India[1]

Assistant Professor, Dept. of EE, Wainganga College of Engg & Mang, Nagpur, Maharashtra, India[2]

ABSTRACT: Due to the random nature of wind, electrical power generated by wind turbines is very erratic and will have an effect on each the facility quality and therefore the coming up with of power systems. Energy Storage Systems (ESSs) moreover as FACTs controllers could play a very important role in wind generation applications by dominant wind generation plant output and providing adjuvant services to the facility system and thus, facultative associate degree exaggerated penetration of wind generation within the system. This text deals with the review of many energy storage technologies and truth based mostly technology for wind generation applications. the most objectives of the article are the introduction of the operative principles, moreover because the presentation of the most characteristics of energy storage technologies and FACTS based mostly technologies appropriate for stationary applications, and therefore the definition and discussion of potential ESS applications in wind generation, consistent with an in depth literature review.

KEYWORDS: ESS, wind energy system, FACTs.

I.INTRODUCTION

Wind energy is one amongst the quickest growing sources of electricity these days. In fact, the additive wind generation installation within the EU at the top of 2010 was 84,074MW. Thus, 5.3% of European electricity consumption in 2010 came from wind turbines. The penetration of wind generation in some European countries has reached values around 2 hundredth, as within the case of Denmark (24%) [1]. Electrical power, generated by wind turbines, is very erratic, and so the wind generation penetration in power systems will result in issues connected system operation and also the designing of power systems [2]. These issues is also particularly vital in islanded grids. Therefore, wind power facilities area unit needed, in accordance with grid codes, to gift special management capabilities with output power and voltage, to face up to disturbances and short circuits within the network throughout outlined periods of your time [3]. During this means, wind farms area unit called wind generation plants.

In this situation, ESS play a vital role in wind generation applications by dominant wind generation plant output and providing supportive services to the facility system and therefore, facultative an inflated penetration of wind generation within the system. Various publications relating to the review of appropriate storage technologies for stationary applications square measure found in literature [4–6]. In [5,6], a outline of ESS main options is provided. Additionally, a revision of specific, worldwide ESS examples for renewable energy applications is elaborated in [4].

Accordingly, this text focuses on twlo main objectives; first, the introduction of operational principles and also the main characteristics of many storage and FACTs controller technologies appropriate for stationary applications; and, secondly, the definition and discussion of potential ESS and FACTs controller applications in wind generation.

For different regions and locations, atmospheric condition, together with solar PV irradiance, wind speed, temperature, then forth, are continuously dynamic. Thus, there exist instability shortcomings for wattage production from electrical phenomenon (PV) modules and wind turbines. So as to expeditiously and economically utilize renewable energy resources of wind and alternative energy applications, the optimum match style size is incredibly vital for solar-wind power generation systems with battery banks. The size optimization technique will facilitate to ensure very cheap investment with an affordable and full use of the PV system, wind system and battery bank, in order that the system will work on the optimum conditions with optimum configurations in terms of investment and dependableness demand of the demand load.

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II.WIND POWER SYSTEM TECHNOLOGIES

Dynamic system is carried on an isolated power system consisting of a diesel generator and a turbine generator [1]. The 150-kW turbine is operated in parallel with a diesel generator to serve a median load of 350-kW. A comprehensive computing machine model of the interconnected installation together with the diesel and alternative energy dynamics with superconducting magnetic energy storage (SMES) unit is developed. Time domain solutions are wont to study the performance of the facility system and management logic. supported a linear model of the system it's shown that changes on top of things system settings can be created to boost damping and optimization of gain parameters and stability studies are done victimization the Lyapunov technique and eigenvalue analysis.

A mathematical model of every part of the Stand - Alone Wind Energy Conversion System is developed [2]. The model variables are expressed within the d-q rotor organization. The turbine was thought-about because the solely supply of power during this study. victimization this model the system response to a recorded wind blow is investigated by scheming the generator current, the rectifier current, the load current, the battery charging current, and also the battery voltage. The calculated results are then verified by scrutiny them with the particular values obtained from the info acquisition system. a decent agreement was achieved between the experimental and also the analytical results.

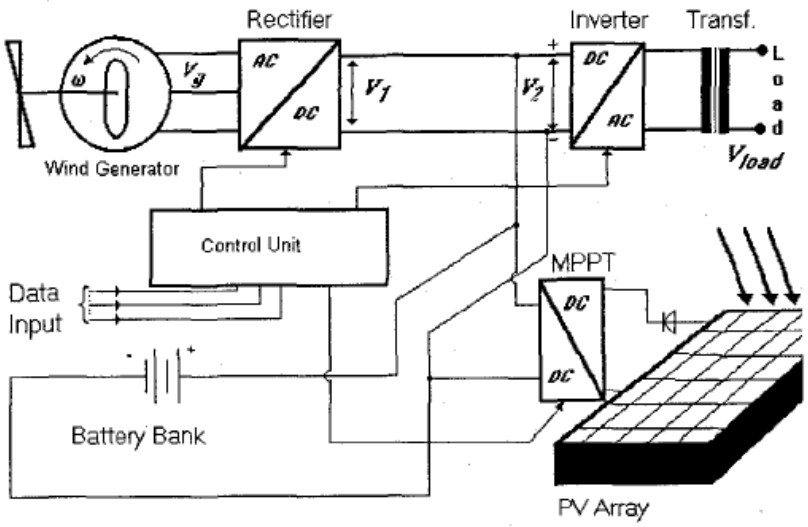

Fig.1 Wind lPV Hybrid Stand-Alone System [1].

Author develops the Hybrid Solar-Wind System improvement filler (HSWSO) model [3], to optimize the capability sizes of various elements of hybrid solar-wind power generation systems using electric battery bank. The HSWSO model consists of three main parts: the model of the hybrid system, the model of Loss of Power provide likelihood (LPSP) and therefore the model of the Levelised value of Energy (LCE). The flow chart of the HSWSO model is additionally illustrated. With the incorporated HSWSO model, the filler improvement of hybrid solar-wind power generation systems will be achieved technically and economically in step with the system liableness needs. A case study is according to point out the importance of the HSWSO model for filler the capacities of wind turbines, PV panel and battery banks of a hybrid solar-wind renewable energy system.

As wind energy reaches higher penetration levels, there's a bigger have to be compelled to manage un-regularity related to the individual turbine generators. Author considers the mixing of a short-run energy storage system (ESS) device in an exceedingly doubly fed induction generator [4] style so as to sleek the quick wind-induced power variations. This ESS device also can be wont to reinforce the dc bus throughout transients, thereby enhancing its low-tension ride through (LVRT) capability

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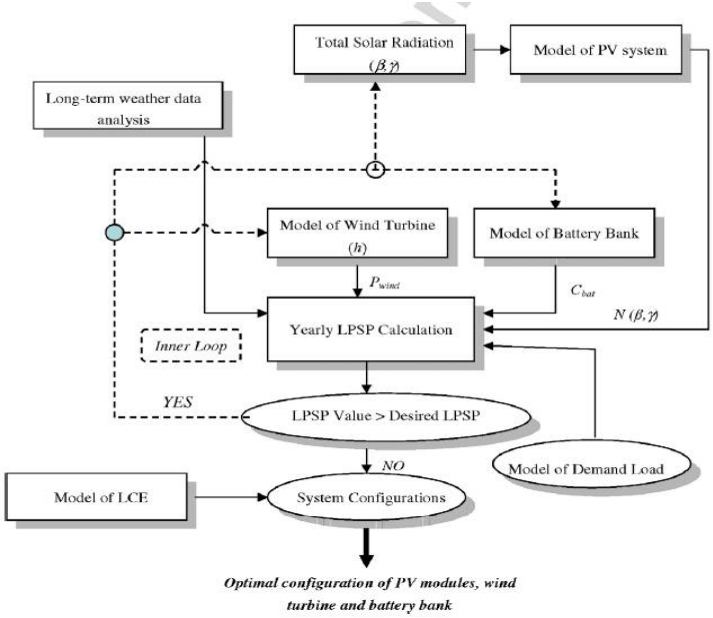

Fig.2 Flow chart of the HSWSO method [3].

The topology is evaluated in terms of its ability to enhance the performance each throughout traditional operation and through transients. Results show that once storage is sized primarily based upon the LVRT demand, it will effectively damp short-run power oscillations, and it provides superior transient performance compared with standard topologies.

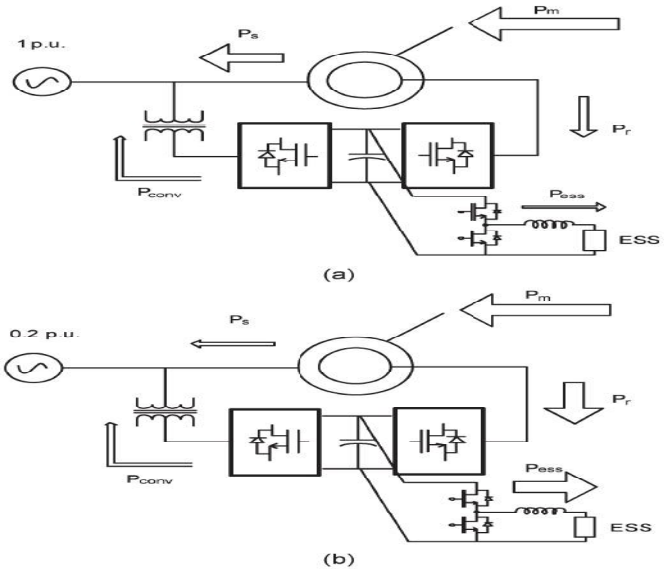

Fig.3 Energy flow diagram in the DFIG during (a) normal operation and (b) low-voltage conditions [4].

Wind power generation studies of slow phenomena employing a careful model is troublesome to perform with a standard offline simulation program. owing to the process power and high-speed input and output, a period of time machine is capable of conducting repetitive simulations of wind profiles in an exceedingly short time with careful models of crucial elements and permits testing of model controllers through hardware-in-the-loop (HIL). Author provide [5] strategies to beat the challenges of period of time simulation of wind systems, characterized by their quality

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and high-frequency change. A hybrid flow-battery super-capacitor energy storage system (ESS), coupled in an exceedingly turbine generator to swish wind generation, is studied by period of time HIL simulation. The model controller is embedded in one period of time machine, whereas the remainder of the system is enforced in another freelance machine. The simulation results of the careful wind system model show that the hybrid ESS incorporates a lower battery value, higher battery longevity, and improved overall potency over its reference ESS

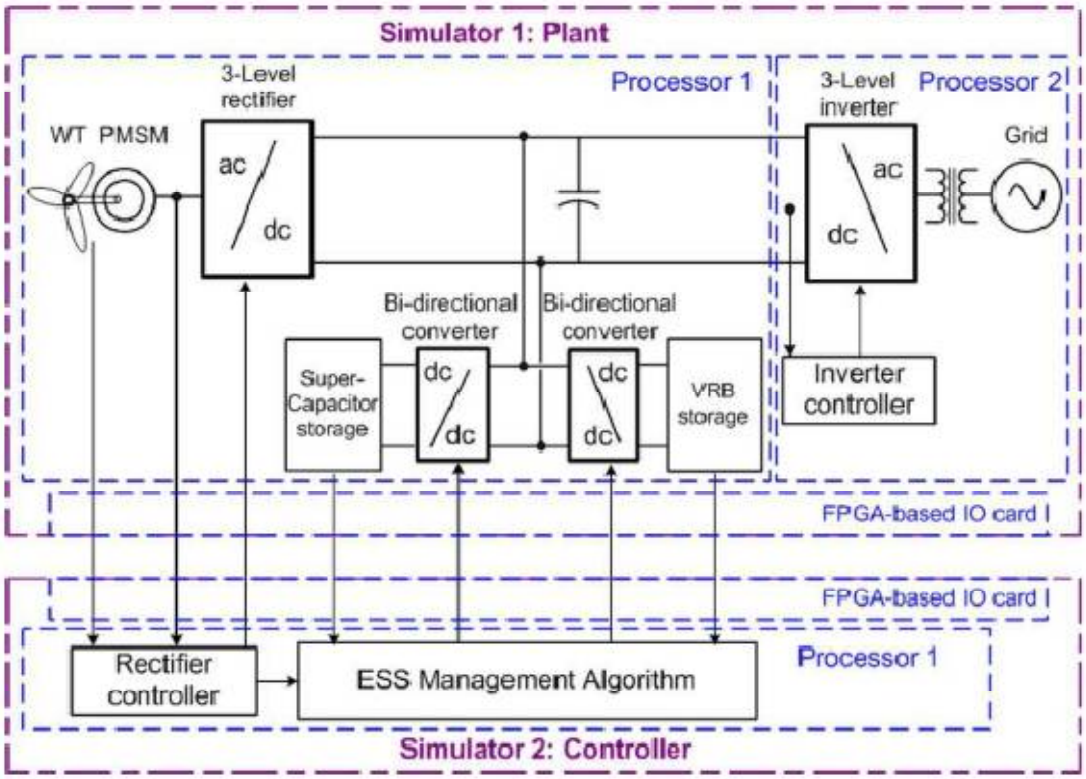

Fig.4 PMSM WTG integrated with a VRB super-capacitor ESS [5].

With the increasing penetration of alternative energy into wattage grids, energy storage devices are needed to dynamically match the irregularity of wind energy. Author proposes a completely unique two-layer constant power management theme for a power plant equipped with doubly fed induction generator (DFIG) wind turbines [6]. Every DFIG turbine is provided with a super-capacitor energy storage system (ESS) and is controlled by the low-layer turbine generator (WTG) controllers and coordinated by a high-layer power plant superordinate controller (WFSC). The WFSC generates the active power references for the low-layer WTG controllers in step with the active power demand from or generation commitment to the grid operator; the low-layer WTG controllers then regulate every DFIG turbine to get the required quantity of active power, wherever the deviations between the obtainable wind energy input and desired active power output area unit stipendiary by the ESS.

In electrical islands, frequency excursions square measure sizeable and automatic load shedding is usually needed in response to disturbances. Moreover, the displacement of typical generation with wind and solar plants, that sometimes don't give electrical power phenomenon response, additional weakens these power systems. Fast-acting storage, by injecting power at intervals instants when the loss of a generating unit, will duplicate typical generation assets throughout the activation of their primary reserve [7].

This technique depends on dynamic simulations to check the availability of such a dynamic frequency management support by energy storage systems within the French island of island with massive shares of wind or star generation.

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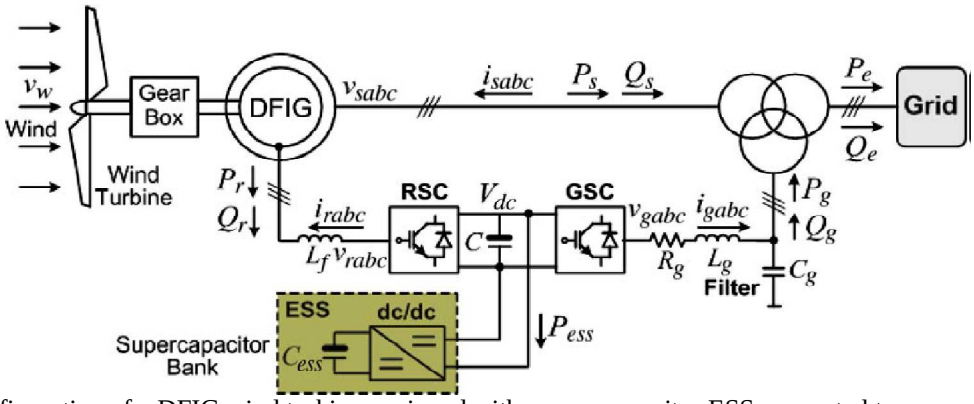

Fig.5 Configuration of a DFIG wind turbine equipped with a supercapacitor ESS connected to a power grid [6].

The results show that fast-acting storage, by acting as an artificial inertia, will mitigate the impact of those sources on the dynamic performance of the studied island grid within the case of a serious generation outage. The opposite issues raised by renewables (e.g., variability, forecast accuracy, low voltage ride-through, etc.) haven't been self-addressed at intervals this project.

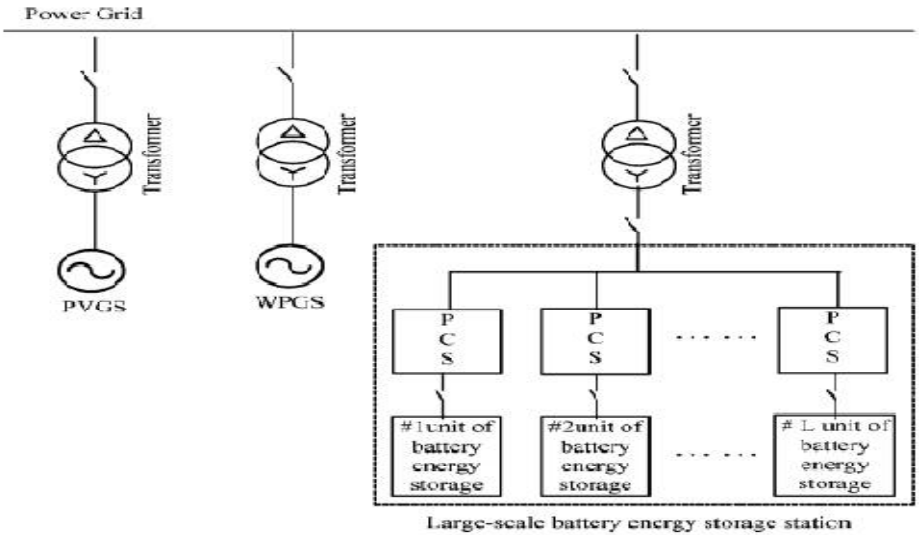

Fig. 6 Wind/PV/BESS hybrid power generation system [8].

The battery energy storage station (BESS) is that the current and typical means that of smoothing wind- or solar-power generation fluctuations. Such BESS-based hybrid power systems need an appropriate management strategy that may effectively regulate power output levels and battery state of charge (SOC). Author gift the results of a wind/photovoltaic (PV)/BESS hybrid installation simulation analysis undertaken to enhance the smoothing performance of wind/PV/BESS hybrid power generation and also the effectiveness of battery SOC management [8]. A smoothing management methodology for reducing wind/PV hybrid output power fluctuations and control battery SOC beneath the everyday conditions is planned. a completely unique time period BESS-based power allocation methodology is also planned. The effectiveness of those strategies was verified victimization MATLAB/SIMULINK software package.

III.CONCLUSION

This paper provides an overview of the current development of various types of EES technologies & FACTs controller, from the recent achievements in both the academic research community and industrial sectors. A comprehensive

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analysis is carried out based on the relevant technical and economic data, which leads to a number of tables and figures showing a detailed comparison of various EES technologies and FACTs controller from different perspectives. Further discussion on EES power system application potentials is given based on the current characteristics of EES and the relevant application specifications. The overview has shown a synthesis of the state-of-the-art in important EES technologies and FACTs controller, which can be used for supporting further research and development in this area and for assessing EES technologies for deployment.

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