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Review of Disturbance Rejection Strategies for AC/DC Microgrids

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Abstract *– Disturbance rejection methods ought to be developed to mitigate transient disturbance and ensure stability of energy supply for distributed generation system. For such hybrid AC/DC microgrids, power management methods are one in all the most critical operation aspects. During this paper studied of disturbance rejection many various ways for AC/DC microgrids. For a DC/DC converter, an average current sharing (ACS) scheme for secondary control is introduced. Distributed generators are applicable for improving supply reliability with concerns of renewable energy, environmental protection, peak load shaving and deferred investments in network.*

Keywords*: microgrids; distributed power generation; power systems,*

I. Introduction

Smartgrids are being developed because the next generation power systems. These smart grids encompass interconnected microgrids, especially at the distribution level wherever distributed generations (DGs) are increasingly used. The dg technologies is classified into power generation from renewable energy (RE) resources like wind, photovoltaic, micro hydro, biomass, geothermal, ocean wave and tides, the clean alternative energy (AE) generation technologies like fuel cells and micro turbines, moreover because the traditional rotational machine based technologies like diesel generators. because of many advantages of those sources like cleanness and easy technologies, combined with increasing demands for electrical energy and also the exhaustible nature of fossil fuels, the RE and AE-based DGs play a very important role in microgrids.

Distributed generation (DG) is related to the use of small generating units installed at strategic points of the electrical power system or locations close to load centers. DG is used in an isolated mode or grid-connected ways, that is, supplying the consumer’s local demand, or integrated into the grid supplying energy to the electric power system. Distributed generation will run on renewable energy resources, fossil fuels or waste heat. Equipment ranges in size from but a kilowatt (kW) to tens of megawatts (MW). Distributed generation will meet all or a part of a customer’s power desires. Islanding native detection schemes are based on inverters that cannot work under different operating conditions; so, they adopt different inverters according to the DGs. If connected to a distribution or transmission system, power is sold to the utility or a 3rd party.

Distributed generation (DG) has several benefits for micro-grids. It’s expected that distributed generation can play an increasing role in electrical power systems [5]. It permits residents and businesses that have the potential to generate current to sell surplus power to the grid. The variation of grid voltage because of power flow causes the ability quality to decay. Consumers will suffer from the quality of power that's generated and transmitted via the AC grid. This reduction in power quality occur because of poor switching operations within the network, voltage dips, interruptions within the grid, transients and network disturbances from loads. The use of on-site power generation equipment can provide consumers reasonable power at high quality. With a nonradial system configuration because of the presence of decigram units, the power control complexity for a micro-grid is substantially increased, and also the “plug and play” feature is that the key to insure that the installation of further dg units won't change the control methods of dg units already within the micro-grid [6].

DC distribution systems are suggested lately as a better methodology for electric power delivery. this idea is inspired by the possibility of efficient integration of small distributed generation units which attract the attention of researchers everywhere the world [7]. Moreover, there are different benefits having electric power transmitted through DC distribution systems like the relatively higher efficiency, absence of reactive power element and also the fact that several appliances operate using a DC voltage. The feasibility of using DC distribution systems rather than AC ones is being investigated by several researchers. Their researches have resulted during a variety of publications within which bound aspects of the topic area unit developed.

II. Literature Survey

Po-Chun Liu et.al [1] "Disturbance Rejection Strategies for AC/DC Microgrids", in this paper compared different FRT schemes for the DFIG-based AC microgrid. During this it's stated that the wind plants might offer reactive power support also as voltage control so as to contribute to power system reliability. During this paper, the voltage stability is either achieved by active voltage compensation of the DVR or passive fault damping of the SDR, achieving voltage stability. Additionally, an alternative control strategy based on the scheme of ACS for the DC microgrid has been given. By applying the projected anti-windup and affine parameterization strategy, faster transient response and additional stable voltage output are obtained compared with the previous case study. Further, the optimized adaptability to load disturbances will increase flexibility of utilization.

Farzam Nejabatkhah et. al [2] "Overview of Power Management Strategies of Hybrid AC/DC Microgrid", in this paper the topology and control schemes of hybrid AC/DC microgrids are reviewed. numerous structures of hybrid AC/DC microgrids (AC-coupled, DC-coupled, and AC-DC-coupled) are discussed, and real world samples of differing types of hybrid microgrid are presented. Within the operation of hybrid AC/DC microgrids, the control schemes and power management ways are one in all the most important concerns. Therefore, a thorough review and discussion of different control schemes and power management methods of various kinds of microgrids under different operation and loading conditions are conducted during this paper. Implementation samples of some representative control schemes are presented to better illustrate the power management ways. At last, discussion and recommendations about the future analysis directions on AC/DC hybrid microgrids and power management ways are provided.

Chengshan Wang et. al [3] "A Nonlinear-Disturbance-Observer-Based DC-Bus Voltage Control for a Hybrid AC/DC Microgrid", in this paper simple NDO-based dc-bus voltage control strategy was projected. During this paper, that is very suitable for a hybrid ac/dc microgrid or a dc microgrid? With the projected control strategy, high bandwidth communications between the dc source/loads and also the dc–ac converter may be avoided, that is essential for the system scalability and maintaining the plug-and-play feature of the DGs. based on the estimated results from NDO, the projected dc-bus voltage control methodology with improved feed forward and dead-time compensation will significantly reduce the dc-bus control settling time and mitigate the dc-bus voltage variations. The effects of equivalent dc-bus capacitance variation are considered during this paper. The experimental results from a 30 kVA dc subgrid have shown the effectiveness of the projected control strategy.

Fida Hasan Md Rafi et. al [4] "Reactive power management of a AC/DC microgrid system using a smart PV inverter", in this paper The designed PV system VSI certainly shows superior performance improvement within the AC/DC microgrid operations. The controller response speed and system damping capability improves in 10-15 milliseconds vary with the additional reactive power and improved passive damping options from the VSI. These options help to achieve correct decentralized control over real and reactive powers within the microgrid, and ensure strong stabilization recovery from externals disturbances. For future studies, multiple PV units with load sharing controls with dynamic loads are analyzed.

M. Elshaer et. al [5] "Grid Connected DC Distribution System for Efficient Integration of Sustainable Energy Sources", in this paper DC distribution system has been designed and implemented. Completely different aspects related to such design have like, DC bus voltage control grid property are addressed. The system under study depends mainly on sustainable energy sources.

L.L. Lai et. el [6] "Challenges to Implementing Distributed Generation in Area Electric Power System", in this paper dg is getting used increasingly around the world with the issues of renewable energy, environmental protection, provide reliability, and high initial value of new central generation plant. Impacts from offer side and demand side on dg are non-negligible. Challenges of implementation of dg on space electrical power system are described based on practical cases. Mitigations by means that of coordination, intensive design of protection and good metering are introduced.

Integration of large-scale renewable energy sources and little size generating facilities into the electricity structure will require novel electricity grid structures and new ways for their operation, control and management to confirm efficiency, security, property, reliability and high quality power provides. The longer term grid has to be sufficiently intelligent and flexible to control reliably with intermittent generation technologies like wind power, solar and with generation embedded within the distribution grids. A coordinated approach, to overcome each technical and non-technical issue is required.

III. Method

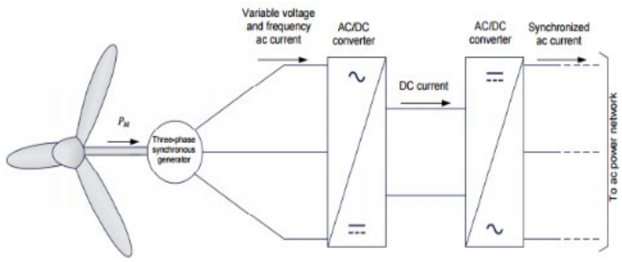
III.1. Doubly-fed induction generators

The doubly-fed induction generator (DFIG) system is a popular system in which the power electronic interface controls the rotor currents to achieve the variable speed necessary for maximum energy capture in variable winds.

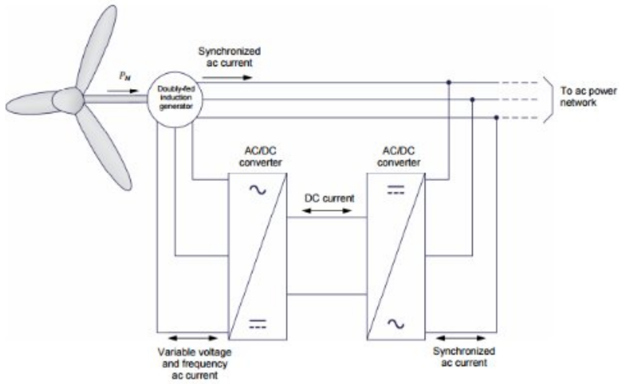
Most doubly-fed induction generators in industry nowadays are used to generate electric power in large (power-utility scale) wind turbines. This can be primarily due to the numerous benefits doubly-fed induction generators provide over different kinds of generators in applications wherever the mechanical power provided by the prime mover driving the generator varies greatly (e.g., wind blowing at variable speed on the bladed rotor of a wind turbine). To raised understand the benefits of using doubly-fed induction generators to generate electric power in wind turbines; however, it's necessary to understand a little about large-size wind turbines. Large-size wind turbines are primarily divided into 2 sorts that determine the behavior of the wind turbine throughout wind speed variations: fixed-speed wind turbines and variable-speed wind turbines. In fixed-speed wind turbines, 3 section asynchronous generators are usually used. Because the generator output is tied on to the grid (local ac power network), the rotation speed of the generator is fixed (in practice, it will usually vary a little, since the slip is allowed to vary over a spread of usually 2 to 3%), and then is the rotation speed of the wind turbine rotor. Any fluctuation in wind speed naturally causes the mechanical power at the wind turbine rotor to vary and, because the rotation speed is fixed, this causes the torque at the wind turbine rotor to vary accordingly. Whenever a wind gust occurs, the torque at the wind turbine rotor so will increase significantly whereas the rotor speed varies little. Therefore, each wind gust stresses the mechanical components (notably the gear box) within the wind turbine and causes a sudden increase in rotor torque, also as within the power at the wind turbine generator output. Any fluctuation within the output power of a wind turbine generator may be a source of instability within the power network to that it's connected.

In variable-speed wind turbines, the rotation speed of the wind turbine rotor is allowed to vary as the wind speed varies. This precludes the use of asynchronous generators in such wind turbines as the rotation speed of the generator is quasi-constant when its output is tied directly to the grid. The same is true for synchronous generators which operate at a strictly constant speed when tied directly to the grid.

It would be possible to obtain similar results in variable-speed wind turbines using a three-phase synchronous generator and power electronics, as shown in Figure 1a. In this setup, the generator rotates at a speed that is proportional to the wind speed. The ac currents produced by the generator are converted into dc current by an AC/DC converter, then converted by another AC/DC converter back to ac currents that are synchronous with the ac power network. It is therefore necessary for the power electronics devices used in such a circuit to have the size and capacity to process 100% of the generator output power. The power electronics devices used in doubly-fed induction generators, on the other hand, need only to process a fraction of the generator output power, i.e., the power that is supplied to or from the generator rotor windings, which is usually about 30% of the generator rated power. Therefore, the power electronics devices in variable-speed wind turbines using doubly-fed induction generators usually need only to be about 30% of the size of the power electronics devices used for comparatively sized three-phase synchronous generators, as illustrated in Figure 1b. This reduces the cost of the power electronics devices, as well as the power losses in these devices.



(a) Three-phase synchronous generator



(b) Doubly-fed induction generator

Fig.1 Circuit topologies for two types of generators found in variable-speed wind turbines.

III.2. Microgrids

A microgrid may be a small-scale power grid that may operate severally or in conjunction with the area's main electrical grid.

Any small-scale localized station with its own power resources, generation and loads and definable boundaries qualifies as a microgrid. Microgrids are intended as back-up power or to bolster the main power grid during times of heavy demand. Often, microgrids involve multiple energy sources as the way of incorporating renewable power. Different functions include reducing prices and enhancing reliability.

The modular nature of microgrids may build the main grid less susceptible to localized disaster. Modularity additionally means microgrids are used, piece by piece, to gradually modernize the present grid.

The practice of using microgrids is known as distributed, dispersed, decentralized, district or embedded energy generation.

A microgrid may be a small energy system capable of balancing captive provide and demand resources to maintain stable service within a defined boundary.

IV. Conclusion

This paper has reviewed the mainly latest research trends and proposed the disturbance rejection strategies for ac/dc microgrids. In this paper survey of alternative control strategy based on the scheme of ACS for the DC microgrid has been presented. In this paper we have presented studied of Doubly-fed induction generator (DFIG). In this paper different disturbance rejection methods are studied for AC/DC microgrids.

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