DOWNLOAD PDF AUTONOMOUS LOAD SHARING OF VOLTAGE SOURCE INVERTERS

Chapter 1 : "Smart Inverter Control and Operation for Distributed Energy Resources" by Ahmad F. Tazay

An autonomous load-sharing technique for parallel connected three-phase voltage source converters is presented. An improved power-frequency droop scheme computes and sets the phase angle of the.

This strategy is based on changing the gains of the controller that controls the output voltage of the inverter. With this approach, the output current of the inverter is change when the load dynamics or line impedance is change. The effectiveness of the proposed strategy is confirmed through simulation results. DG, Gain regulator, Load sharing. Introduction Distributed generation DG is seen as a solution for solving environmental concerns and the need to secure an electricity supply to support sustainable development Puttgen et al. The concept of a microgrid has been proposed in order to solve the common interconnection problems of individual DGs in various power systems Seon-Ju, A better way to realize the emerging potential of distributed generation is to take a system approach which views generation and associated loads as a subsystem or a microgrid. This approach allows for local control of distributed generation thereby reducing or eliminating the need for central dispatch. Intentional islanding of generation and loads has the potential to provide a higher local reliability than that provided by the power system as a whole. The size of emerging generation technologies permits generators to be placed optimally in relation to heat loads allow for use of waste heat. Such applications can more than double the overall efficiencies of the systems Lasseter, Maintaining the voltage and frequency of the system and supporting the required active and reactive powers is the main task in the autonomous microgrid. Conventional droop control is usually used for sharing powers between DGs connecting together when it is difficult to communicate between them especially if there are located far away from each other Pogaku et al. Due to the lack of inertial of the inverter-based DG, the autonomous microgrid stability is very important to provide ride through during transients Majumder et al. Several control techniques have been proposed to achieve accurate power sharing based on the droop method Majumder et al. A virtual frequency-voltage control was presented to achieve accurate control and to improve the microgrid stability. The frequency and voltage were transformed to virtual voltage and frequency to realize a decoupled real and reactive power control. A minimum current tracking control was given to improve the power sharing in a microgrid Lee et al. An improved droop controller was presented to obtain accurate power sharing Zhong, The load voltage drop was reduced due to the effects of the load and the droop coefficients. An improvement of reactive power sharing was presented using Q-V method Lee et al, High droop gains of conventional droop control were applied to stabilize the microgrid. Although most of these control schemes have tried to solve the problems of voltage regulation as well as power sharing, a slow dynamic response, transient oscillations and bad controllability are the main problems READ PAPER.

Chapter 2 : Load Sharing of Wind Based Microgrid in Autonomous Operation

Abstract: An autonomous load-sharing technique for parallel connected three-phase voltage source converters is presented. An improved power-frequency droop scheme computes and sets the phase angle of the voltage source converter (VSC) directly to yield more rapid real power sharing without sacrificing frequency regulation.

The main contribution of the research includes solving a couple of issues for smart grids by controlling and implementing multifunctions of VSC and smart inverter as well as improving the operational scheme of the microgrid. The work is mainly focused on controlling and operating of smart inverter since it promises a new technology for the future microgrid. Two major applications of the smart inverter will be investigated in this work based on the connection modes: However, the operational control of the microgrid still has a major issue on the operation of the microgrid. The dissertation is divided into two main sections which are: The first part investigates a comprehensive research for a smart inverter and VSC technology at the two major connections of the microgrid. This involves controlling and modeling single smart inverter and VSC to solve specific issues of microgrid as well as improve the operation of the system. The research provides developed features for smart inverter comparing with a conventional voltage sourced converter VSC. The two main connections for a microgrid have been deeply investigated to analyze a better way to develop and improve the operational procedure of the microgrid as well as solve specific issues of connecting the microgrid to the system. A detailed procedure for controlling VSC and designing an optimal operation of the controller is also covered in the first part of the dissertation. This section provides an optimal operation for controlling motor drive and demonstrates issues when motor load exists at an autonomous microgrid. It also provides a solution for specific issues at operating a microgrid at autonomous mode as well as improving the structural design for the grid-tied microgrid. The solution for autonomous microgrid includes changing the operational state of the switching pattern of the smart inverter to solve the issue of a common mode voltage CMV that appears across the motor load. It also solves the issue of power supplying to large loads, such as induction motors. The last section of the low-level section involves an improvement of the performance and operation of the PV charging station for a plug-in hybrid electric vehicle PHEV at grid-tied mode. This section provides a novel structure and smart controller for PV charging station using three-phase hybrid boost converter topology. It also provides a form of applications of a multifunction smart inverter using PV charging station. The second part of the research is focusing on improving the performance of the microgrid by integrating several smart inverters to form a microgrid. It investigates the issue of connecting DER units with the microgrid at real applications. One of the common issues of the microgrid is the circulating current which is caused by poor reactive power sharing accuracy. When more than two DER units are connected in parallel, a microgrid is forming be generating required power for the load. This section provides a smart and novel controlling technique to solve the issue of unequal power sharing. The feature of the smart inverter is realized by the communication link between smart inverters and the main operator. The analysis and derivation of the problem are presented in this section. The dissertation has led to two accepted conference papers, one accepted transaction IEEE manuscript, and one submitted IET transaction manuscript. The future work aims to improve the current work by investigating the performance of the smart inverter at real applications. Graduate Theses and Dissertations.

Chapter 3 : Accurate power sharing for parallel DGs in microgrid with various-type loads

Autonomous load sharing of voltage source converters Abstract: An autonomous load-sharing technique for parallel connected three-phase voltage source converters is presented. An improved power-frequency droop scheme computes and sets the phase angle of the voltage source converter (VSC) directly to yield more rapid real power sharing without.

Received Aug 9; Accepted Oct 9. Abstract Power flow control is one of the most important issues for operating the inverter-dominated autonomous microgrid. P-F and Q-V droop control schemes have been widely used for power sharing in the past decades. But they suffer from the poor power sharing in the presence of unequal line impedance. In order to solve the problem, a comprehensive analysis of the power droop control is presented, and a new droop control based on the impedance match concept is proposed in this paper. In addition, the design guidelines of control coefficients and virtual impedance are provided. Finally, the performance evaluation is carried out, and the evaluation results verify the effectiveness of the proposed method. Introduction The environmental concerns and electric utility deregulation promote the development of distributed generation DG in a rapid pace. The high penetration of DG brings about a concept of the microgrid. It is defined as a cluster of DG units such as wind turbines and photovoltaics , storage devices, and loads, which can operate in the grid-connected mode or autonomous mode [1], and this paper focuses on the latter. For inverter-based autonomous microgrid, the droop control is widely used to regulate the power flow according to the local information with no need of communication [2 â€” 6]. Generally speaking, an ideal droop control should provide the fast and accurate power sharing without affecting the voltage and frequency at the point of common coupling PCC. In practice, however, the widely used droop control, which stems from the original philosophy of the synchronous generator control in power systems, fails to meet the above-mentioned requirements. In the past decades, many attempts have been made to improve the performance of the conventional droop control. A significant contribution from Josep Guerrero is the virtual impedance concept, which demonstrates that the inverter output impedance depends on not only the system parameters but also the inverter control scheme [7]. After that, the virtual impedance based droop control has gained more and more attention. For the accurate power sharing, the output impedance should be fixed as inductive, resistive, or complex impedances. On the other hand, the resistive output impedance is used [2], which ensures that the system is more damped and achieves better power sharing. In [9], the virtual complex impedance is designed to minimize the circulating current for the efficient power sharing. Another interesting solution reported in [11] is the virtual frequency and voltage frame droop control. Different from the former control, it can directly control the actual real and reactive power, but the frame transformation angle for each inverter should be the same e. Note that two aforementioned methods can get better performance from the viewpoint of power decoupling. However, power sharing is still a question, especially in the presence of unequal line impedance. In this paper, a comprehensive analysis is provided to clarify why the conventional droop control can achieve the accurate active power sharing but fail to get better reactive power sharing. And then a simple and accurate power sharing scheme is presented to solve the problem. Finally, the performance evaluation is carried out to verify the feasibility of the proposed method. Analysis and Design of Droop Control Figure 1 illustrates the schematic diagram of inverter-based microgrid [11]. The inverters can provide an interface for the flexible functions such as power flow control and power quality improvement. The inverter output may either feed the local loads independently in autonomous mode or in conjunction with the electric utility by static switch STS in grid-connected mode. This paper will focus on the former mode.

Chapter 4 : New Power Sharing Control for Inverter-Dominated Microgrid Based on Impedance Match Con

A voltage-power droop/frequency-reactive power boost (VPD/FQB) control scheme which allows multiple voltage source converters (VSCs) to operate in parallel in MGs and to share a common load power.

 Abstract Autonomous wind energy conversion systems sharing a common load consist of a number of voltage source converters operating in parallel. A suitable control system should ensure desired load sharing among these as a number of these sources operating in parallel are required to meet the load demand and load excursions should not lead to instability of the system. In absence of the grid there is no reference angle for synchronization. Hence, a control scheme for parallel-connected three-phase converters incorporating the desirable features needs to be developed in order to exploit the renewable energy sources, which are intermittent in nature as effectively as possible in case of an autonomous microgrid. The need for communication link should also be avoided, hence reducing the system cost. The system is modelled using Matlab and the control is authenticated by simulation results. Introduction Due to increased penetration of renewable energy sources, particularly wind, the number of DG distributed generator units operating autonomously is on the rise. Islanded microgrids can find application in remote places where main grid is unavailable. In this configuration, the microgrid elements are responsible for voltage and power control. The microgrid consisting of supply, load, and storage is a fully controlled entity. A single autonomous unit is of low power capacity; hence operation of a cluster of DGs is responsible for feeding the load. Maintaining the balance of power in autonomous mode requires the participation of all DGs, and this has attracted the attention of several researchers. The DGs in a microgrid, which is operated in islanding mode, should share power between each other in an appropriate ratio to prevent circulating current and thermally overstressing or damaging of components [1]. In the conventional electrical network with synchronous generator, any alteration in active power balance causes change in synchronous frequency. Load frequency control is achieved by the active power regulation of the synchronous generators. In absence of a synchronous generator, this conventional method cannot work. In this situation, in absence of a regular grid, there are two methods to control voltage source converter- VSC- based microgrids. A well-planned coordinated control is required to utilize these resources efficiently. The first control technique employs communication links such as the master-slave approach which are used for microsources operating within a particular area. In the second case, power sharing is achieved by the real power-frequency droop - control and the reactive power-voltage droop - droop control in the droop-controlled renewable power system [1 â€" 3]. The elimination of communication link makes the generation truly distributive in nature and considerably reduces the cost of the system. The - droop control can achieve accurate real power sharing results while the - droop control helps to achieve better proportional sharing of reactive power [4 â€" 6]. Droop controllers are adopted in autonomously operated systems. The droop control uses the real power out of a generator to calculate the ideal operating frequency. This relaxing of a stiff frequency allows the microgrid to dampen the fast effects of changing loads, increasing the stability of the system. Droop power systems can be connected to highly intermittent supply like wind based energy sources [7 â€" 10]. The avoidance of communication link makes it a reliable and highly competitive option. Only components are used for control. Hence, the control scheme is simple yet effective. In most droop control systems the source is dynamically modelled or the DC voltage is assumed to be fixed [11]. Moreover, load perturbations lead to a change in DC link voltage affecting the PCC point of common coupling voltage. This method can also be further applied to many VSC connected generators feeding a common load. This paper is organized as follows. In Section 2 , the microgrid components are explained briefly. The control designs of the droop based power controller and voltage and current control controller are presented in Section 3. Section 4 presents the simulation results and related discussion of the paralleled two 15 kW inverter system. Finally, Section 5 concludes this paper. The schematic of the proposed system is shown in Figure 1. The output voltage of each inverter is related to DC voltage by modulation index MI. Schematic of back to back three-phase parallel converter in autonomous operation. The inverter controllers MI have a maximum allowable value based on inverter structure and switching strategy.

Chapter 5 : Voltage and Frequency Droop Control in an Autonomous Microgrid

sharing, prevention of voltage collapse, and so on. A microgrid is a part of a power distribution system [1,2] that constitutes a localized group of distributed generation (DG) units and loads that are usually interconnected and synchronous with the conventional distri-.