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A Review on Grid Connected Voltage Source Inverter with Power Quality Improvement

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ABSTRACT: A voltage regulation and power flow control scheme for a wind energy system (WES) is proposed. A distribution static compensator (DSTATCOM) is utilized for voltage regulation and also for active power injection. The control scheme maintains the power balance at the grid terminal during the wind variations using sliding mode control. A multifunctional power electronic converter for the DG power system is described. This scheme has the capability to inject power generated by WES and also to perform as a harmonic compensator. Most of the reported literature in this area discuss the topologies and control algorithms to provide load compensation capability in the same inverter in addition to their active power injection. When a grid-connected inverter is used for active power injection as well as for load compensation, the inverter capacity that can be utilized for achieving the second objective is decided by the available instantaneous micro-grid real power. Considering the case of a grid-connected PV inverter, the available capacity of the inverter to supply the reactive power becomes less during the maximum solar insolation period. At the same instant, the reactive power to regulate the PCC voltage is very much needed during this period. It indicates that providing multi functionalities in a single inverter degrades either the real power injection or the load compensation capabilities.

KEYWORDS: Power quality improvement ,DVSI, Microgrid, Real power injected to power line.

I. INTRODUCTION

A dual voltage source inverter (DVSI) scheme, in which the power generated by the Microgrid is injected as real power by the main voltage source inverter (MVSI) and the reactive, harmonic, and unbalanced load compensation is performed by auxiliary voltage source inverter (AVSI). In the DVSI scheme, as total load power is supplied by two inverters, power losses across the semiconductor switches of each inverter are reduced. This increases its reliability as compared to a single inverter with multifunctional capabilities. Also, smaller size modular inverters can operate at high switching frequencies with a reduced size of interfacing inductor, the filter cost gets reduced. Moreover, as the main inverter is supplying real power, the inverter has to track the fundamental positive sequence of current. This reduces the bandwidth requirement of the main inverter. The inverters in the proposed scheme use two separate dc links. Since the auxiliary inverter is supplying zero sequence of load current, a three phase three-leg inverter topology with a single dc storage capacitor can be used for the main inverter. This in turn reduces the dc-link voltage requirement of the main inverter. Thus, the use of two separate inverters in the proposed DVSI scheme provides increased reliability, better utilization of microgrid power, reduced dc grid voltage rating, less bandwidth requirement of the main inverter, and reduced filter size.

Technological progress and environmental concerns drive the power system to a paradigm shift with more renewable energy sources integrated to the network by means of distributed generation (DG). These DG units with coordinated control of local generation and storage facilities form a micro grid. In a micro grid, power from different renewable energy sources such as fuel cells, photovoltaic (PV) systems, and wind energy systems are interfaced to grid and loads using power electronic converters. A grid interactive inverter plays an important role in exchanging power from the micro grid to the grid and the connected load. This micro grid inverter can either work in a grid sharing mode while supplying a part of local load or in grid injecting mode, by injecting power to the main grid. Maintaining power quality is another important aspect which has to be addressed while the micro grid system is connected to the main grid. The proliferation of power electronics devices and electrical loads with unbalanced nonlinear currents has degraded the power quality in the power distribution network. Moreover, if there is a considerable amount of feeder impedance in the distribution systems, the propagation of these harmonic currents distorts the voltage at the point of common coupling (PCC).

II.ELECTRIC POWER QUALITY

Electric power quality (EPQ), or simply Power quality, refers to "maintaining the near sinusoidal waveform of power distribution bus voltages and currents at rated magnitude and frequency.",[1] determining the fitness of electric power to consumer devices. Synchronization of the voltage frequency and phase allows electrical systems to function in their intended manner without significant loss of performance or life. The term is used to describe electric power that drives an electrical load and the load's ability to function properly. Without the proper power, an electrical device (or load) may malfunction, fail prematurely or not operate at all. There are many ways in which electric power can be of poor quality and many more causes of such poor quality power. The electric power industry comprises electricity generation (AC power), electric power transmission and ultimately electric power distribution to an electricity meter located at the premises of the end user of the electric power. The electricity then moves through the wiring system of the end user until it reaches the load. The complexity of the system to move electric energy from the point of production to the point of consumption combined with variations in weather, generation, demand and other factors provide many opportunities for the quality of supply to be compromised. While "power quality" is a convenient term for many, it is the quality of the voltage rather than power or electric current that is actually described by the term. Power is simply the flow of energy and the current demanded by a load is largely uncontrollable.

III. DUAL VOLTAGE SOURCE INVERTER

A. System Topology

The proposed DVSI topology is shown in Fig. 1. It consists of a neutral point clamped (NPC) inverter to realize AVSI and a three-leg inverter for MVSI. These are connected to grid at the PCC and supplying a nonlinear and unbalanced load. The function of the AVSI is to compensate the reactive, harmonics, and unbalance components in load currents. Here, load currents in three phases are represented by ila, ilb, and ilc, respectively. Also, ig(abc), iµgm(abc), and iµgx(abc) show grid currents, MVSI currents, and AVSI currents in three phases, respectively. The dc link of the AVSI utilizes a split capacitor topology, with two capacitors C1 and C2. The MVSI delivers the available power at distributed energy resource (DER) to grid. The DER can be a dc source or an ac source with rectifier coupled to dc link. Usually, renewable energy sources like fuel cell and PV generate power at variable low dc voltage, while the variable speed wind turbines generate power at variable ac voltage. Therefore, the power generated from these sources use a power conditioning stage before it is connected to the input of MVSI. In this study, DER is being represented as a dc source. An inductor filter is used to eliminate the high-frequency switching components generated due to the switching of power electronic switches in the inverters. The system considered in this study is assumed to have some amount of feeder resistance Rg and inductance Lg. Due to the presence of this feeder impedance, PCC voltage is affected with harmonics. Section III describes the extraction of fundamental positive sequence of PCC voltages and control strategy for the reference current generation of two inverters in DVSI scheme.

B. Advantages of the DVSI Scheme

The various advantages of the proposed DVSI scheme over a single inverter scheme with multifunctional capabilities are discussed here as follows:

1. Increased Reliability: DVSI scheme has increased reliability, due to the reduction in failure rate of components and the decrease in system down time cost. In this scheme, the total load current is shared between AVSI and MVSI and hence reduces the failure rate of inverter switches. Moreover, if one inverter fails, the other can continue its operation. This reduces the lost energy and hence the down time cost. The reduction in system down time cost improves the reliability.

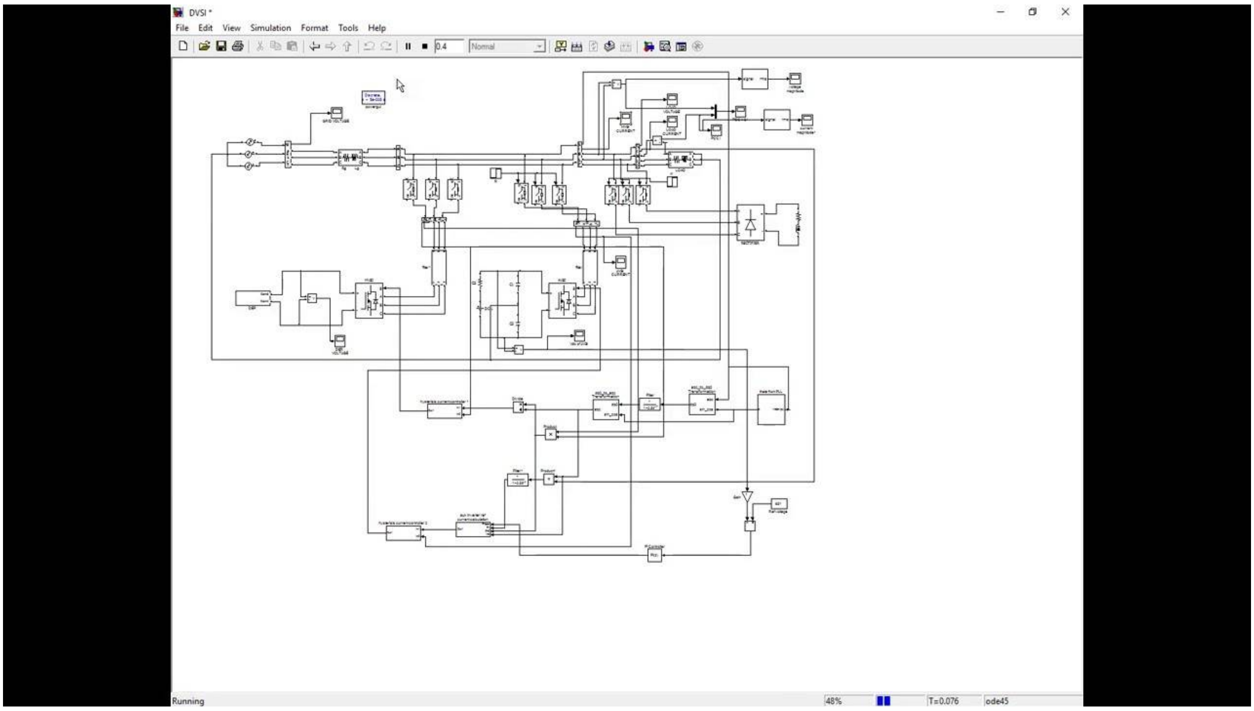
2. Reduction in Filter Size: In DVSI scheme, the current supplied by each inverter is reduced and hence the current rating of individual filter inductor reduces. This reduction in current rating reduces the filter size. Also, in this scheme, hysteresis current control is used to track the inverter reference currents. As given in (2), the filter inductance is decided by the inverter switching frequency. Since the lower current rated semiconductor device can be switched at higher switching frequency, the inductance of the filter can be lowered. This decrease in inductance further reduces the filter size.

3. Improved Flexibility: Both the inverters are fed from separate dc links which allow them to operate independently, thus increasing the flexibility of the system. For instance, if the dc link of the main inverter is disconnected from the system, the load compensation capability of the auxiliary inverter can still be utilized.

4. Better Utilization of Microgrid Power: DVSI scheme helps to utilize full capacity of MVSI to transfer the entire power generated by DG units as real power to ac bus, as there is AVSI for harmonic and reactive power compensation. This increases the active power injection capability of DGs in micro grid.

5. Reduced DC-Link Voltage Rating: Since, MVSI is not delivering zero sequence load current components, a single capacitor three-leg VSI topology can be used. Therefore, the dclink voltage rating of MVSI is reduced approximately by 38%, as compared to a single inverter system with split capacitor VSI topology.

IV. DIAGRAM



in above diagram they use passive filter but I want to use active filter. Because passive filter only reduce specific harmonics while active filter can be vanish maximum harmonics as compare to the LC filter.

V. CONCLUSION

A DVSI scheme is proposed for micro grid systems with enhanced power quality. Control algorithms are developed to generate reference currents for DVSI using ISCT. The proposed scheme has the capability to exchange power from distributed generators (DGs) and also to compensate the local unbalanced and nonlinear load. The performance of the proposed scheme has been validated through simulation and experimental studies. As compared to a single inverter with multifunctional capabilities, a DVSI has many advantages such as, increased reliability, lower cost due to the reduction in filter size, and more utilization of inverter capacity to inject real power from DGs to micro grid. Moreover, the use of three-phase, three wire topology for the main inverter reduces the dc-link voltage requirement. Thus, a DVSI scheme is a suitable interfacing option for micro grid supplying sensitive loads. We can conclude that if we use active filter instead of LC filter maximum harmonics can be reduced and power quality can be improve.

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