Active Islanding Detection Technique for Current Controlled Inverter in Distributed Generation

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Abstract— The Goal Islanding occurs when a portion of distributed power system becomes electrically isolated from the rest of the power system yet continues to be energized by distributed generators. All such occurrences are needed to be detected as early as possible in order to safely shut down the distributed generators. This is because, continued operation of these generators under islanding can lead to multitude of operational hazards/challenges to the generators and to connected loads. The current industry practice is to disconnect all distributed generators immediately after the occurrence of islands. Typically, a distributed generator should be disconnected within 100 to 300 ms after loss of main supply. To achieve such a goal, each distributed generator must be equipped with an islanding detection device, which is also called anti islanding devices. In this study, an active islanding detection technique is proposed for grid connected inverters. Feasibility of the proposed technique. Proposed project run on MATLAB 2016 Simulink environment.

Keywords: Islanding Detection, Current Control, Inverter

I. INTRODUCTION

In modern utility, uncertainties surrounding fuel availability and financing requirements have made it increasingly difficult to add large-scale capacities or new interconnections to the power supply and delivery system. A variety of new technologies are either under development or being implemented to satisfy the load demand. The installed Distribution Generation (DG) may make a contribution to improve quality of power, minimize peak loads and eliminate the need for reserve margin. Moreover, trends in power system planning and operation are towards maximum utilization of existing infrastructures with tight operating margins due to the constraints placed by economical, political, and environmental factors. The Distributed Generation (DG) system is one of the most possible solutions to deal with the aforementioned problems. The DG is based on the renewable energy sources such as fuel cells, photo-voltaic, and wind power, as well as combined heat and power gas turbine, micro turbine, etc. The most of distributed resources may be connected in parallel and supply power to the power grids as well as local loads. Therefore, DG must be operated in such an inherently safe manner that the DG should supply the generated power to the network loads only if the utility power supply is present. Integration of distributed generations (DGs) in the distribution network is expected to play an increasingly important role in the electric power system infrastructure and market. As more DG systems become part of the power grid, feeding the power island without the utility supply produces several negative impacts to utility power system and DG itself: there is an increase safety hazard for personnel and the public, the quality problems of electric service to the utility customers, and an increased risk of damage to the power system and the serious damages to DG if utility power is wrongly restored. An islanding operation is said to when the DG continues supplying power into the network after power from the main utility is interrupted. If islanding occurs, the entire distribution network becomes out of the utility's control. The occurrence of islanding complicates the orderly restoration of the utility supply to the network. Therefore the detection and protection against islanding for Distributed Generators (DG) becomes an important and emerging issue in power system and networks since the distributed resource installations are increasing rapidly and most of the newly installed systems are interconnected with distribution network. An inbuilt control system should provide the islanding detection in addition to its normal function of protection and control of the DG. In this project different methods of islanding detection are studied and analyzed.

II. LITERATURE SURVEY

A. SM In [1] Shyh Jier Huang and Fu Sheng Pai

It describe a new method for islanding detection based on deviation of magnitude and sign change ∂ f/ ∂ p Even with small power mismatch, this method works effectively. This method is immune to disturbances such as load changes or three phase faults.

B. In [2] Sung-Jang and Kwang-ho kim routing tree

In [2] Sung-Jang and Kwang-ho kim introduced a new index for islanding detection by introducing a total harmonic distortion in DG output current and also a novel logical rule-based detection algorithm, which combines the detection results of four of the system parameters including newly proposed one: voltage magnitude, phase, frequency, and total harmonic distortion of current was presented. This method is tested for both islanding and non-islanding conditions. This method is not affected by the variation of loading and can be actually implemented in distributed generators to improve the performance of the DG.

C. Guo-Kiang Hung, et.al

In [3] Guo-Kiang Hung, et.al described the method for islanding detection of grid connected PV inverters. But the method is not effective with parallel RLC loads. To alleviate this problem, automatic phase shift method was introduced. This method was based on phase shifting of sinusoidal inverter output current with respect to voltage. Therefore unity power factor operation of PV inverters is a challenge with frequency shift methods or automatic phase shift methods presented. This method is tested for both islanding and non-islanding conditions. This method is not affected by the variation of DG loading and can be actually implemented in distributed generators to improve the performance of the DG.

D. Kwang-Ho Kim and Sung-Jang

In [4] Kwang-Ho Kim and Sung-Jang proposed new monitoring a new set of parameters for islanding detection i.e. THD of the current and voltage imbalance of DG terminal output. This method was proposed for both islanding and non-islanding conditions and was not affected by variation of DG loading and proved to be an effective island in detection technique that could also improve the performance of distributed generators.

III. Proposed Method

1) Implementing a Current controlled based inverter system.
2) Design the control strategy for system
3) Implementation will be the desirable operation of the system for undesirable conditions for example harmonics reduction and all.
4) Simulation of the model can be done in MATLAB software. Evaluation of the performance.

A simple active islanding detection suitable for current controlled inverters in which the DC link control is decoupled from the ac line current control is developed. The system considered for study involves a grid interfaced inverter, a parallel RLC load connected at the PCC and the grid and the schematic of the system is shown in Fig. 1. The current control of the inverter is achieved by using a hysteresis current controller and the reference signal for the hysteresis current controller is generated as a function of the phase of the grid voltage.

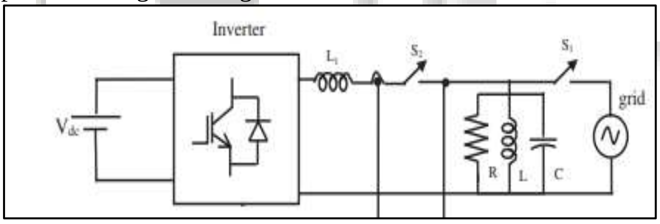

Fig. 1: Schematic of the system with islanding detection.

Fig.2 shows flowchart of active islanding detection methods. As can be seen a disturbance Signal is injected into PCC continuously or periodically depending on the working principle of particular method. Then the parameter variation is observed and if the threshold for voltage/frequency is crossed, islanding flag is raised which alerts the DG and disconnects it from the load.

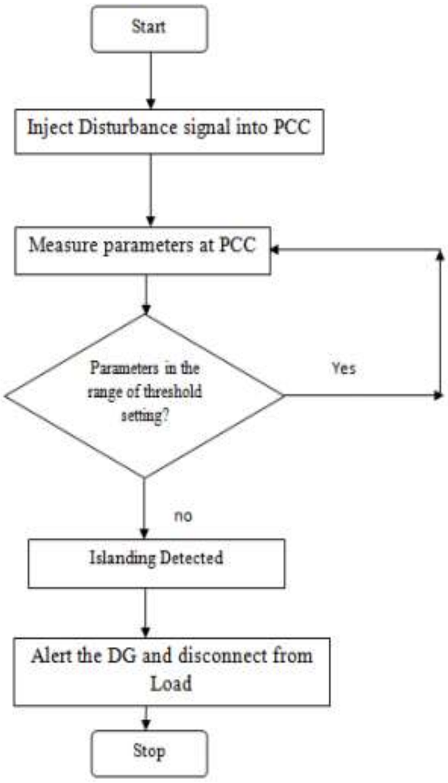

Fig. 2: shows flowchart of active islanding detection

IV. Proposed Control Strategy

To detect the islanding effectively, the change in the PCC voltage during the current perturbation period is calculated. The ratio of the percentage change in the voltage to the percentage change in current is monitored and is compared with a threshold (TH) to generate a trip signal to shut down the inverter as shown in Fig. 3. The change in PCC voltage and current are represented by DV and DI respectively and the constant C refers to the reference PCC voltage

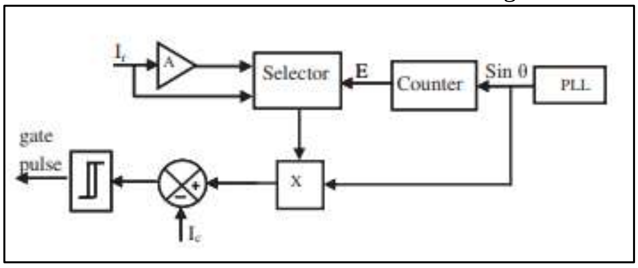

Fig. 3: Control circuit for periodic current perturbation

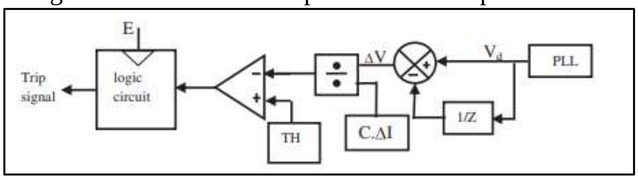

Fig. 4: Control circuit for islanding detection

V. Simulation Results

The proposed technique is verified by conducting simulation studies on MATLAB/Simulink environment. The system consists of a grid connected inverter with Resistive and parallel RLC load. The DC link voltage is maintained constant at 110 V The control algorithm including the hysteresis current control the proposed islanding detection technique has been tested under two cases. In case 1, only R load is used while an RLC load is

A. Case-1 Simulation with R load

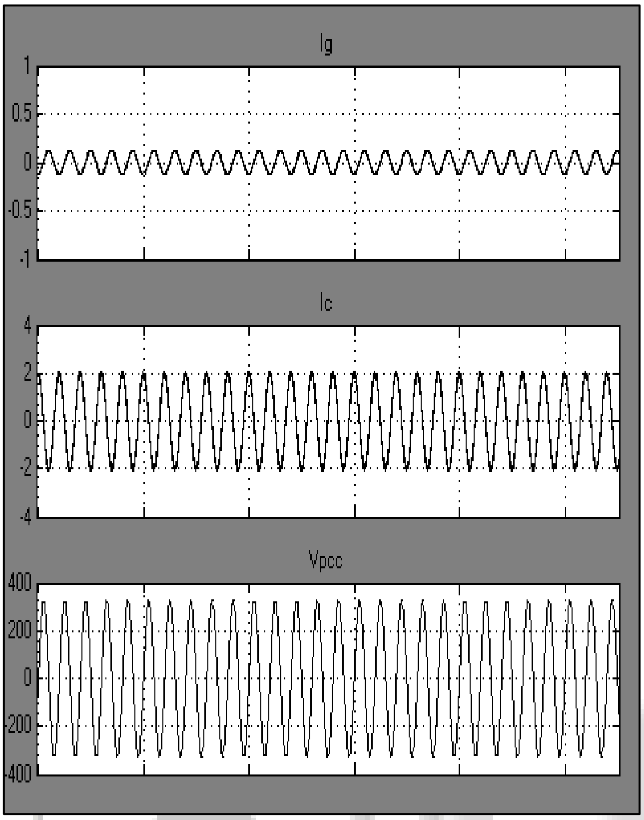

Fig. 6: Performance under resistive Load

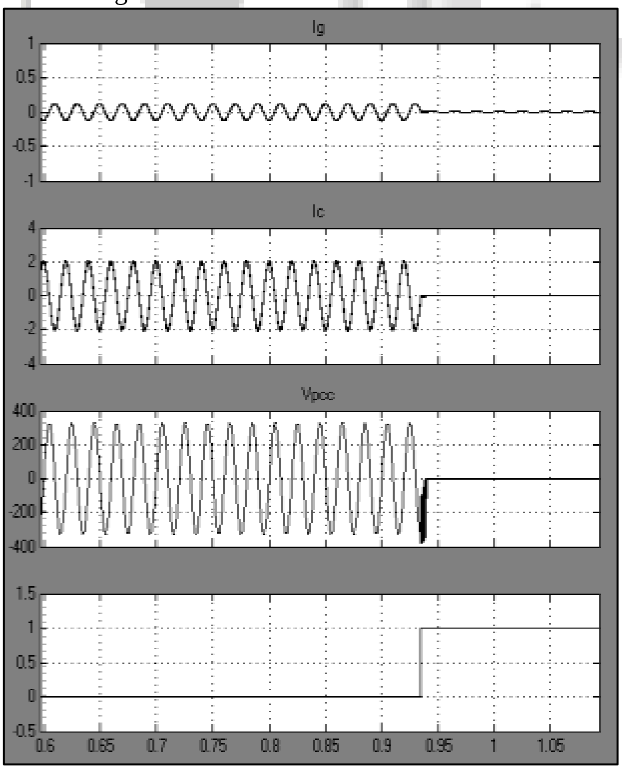

Fig. 7: Performance under resistive Load Islanding detection

B. Case-2 Simulation with R load

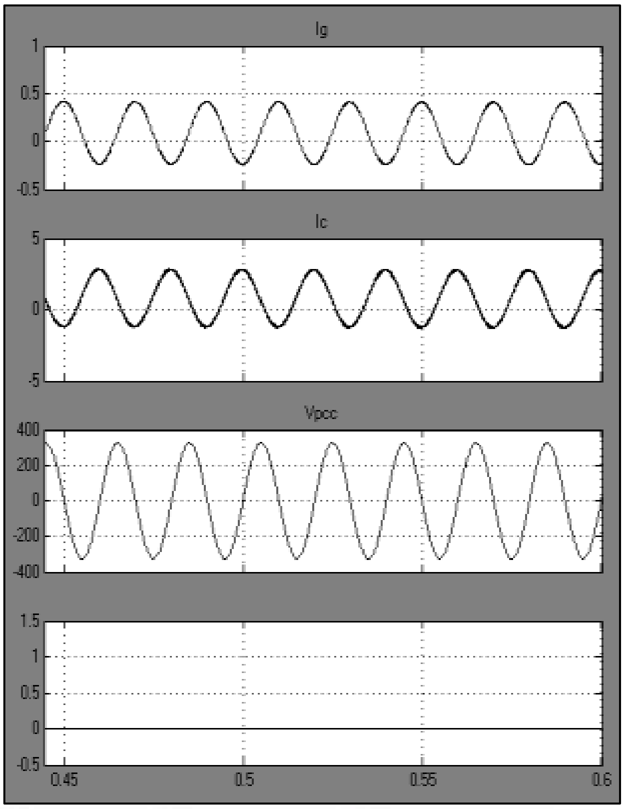

Fig. 8: Performance under RLC load (a) simulation

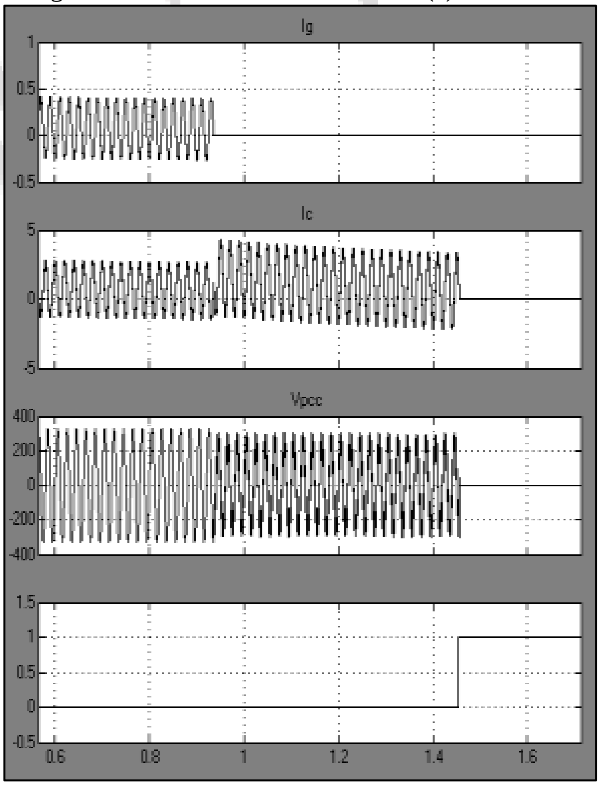

Fig. 9: Performance under RLC load islanding detection

VI. Conclusion

This paper presents an active islanding detection technique suitable for current controlled inverters. The method is based on changing the magnitude of the injected current and monitoring the voltage at the point of common coupling (PCC). Under grid failure, the change in voltage at the PCC exceeds the allowable range and islanding is detected. The perturbation caused by this method does not affect the zero crossing of the converter current nor introduce any distortion as in case of other active anti islanding techniques. The performance of the proposed technique applied to a current controlled inverter is simulated in MATLAB/Simulink environment.

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