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UCT Journal of Research in Science, Engineering and Technology

UCT. J. Resea. Scien. Engineer.Techno. (UJRSET)

Volume 3,Issue3 ***27-35 (2015)*** *ISSN 2382-977X*

Efficient Method to Identify Islanding Condition for Wind Turbine as Distributed Generation

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ABSTRACT

Distributed generation is increasingly likely to play a major role in electricity supply systems. However, the integration of these units at distribution voltages is a major challenge for utilities. One of the problems of distributed generation working connected to the network is the unwanted islanding phenomenon causing physical or financial losses. Islanding is one important concern for grid connected distributed resources due to personnel and equipment safety. Several methods based on passive and active detection scheme have been proposed. While passive schemes have a large non detection zone (NDZ), concern has been raised on active method due to its degrading power quality effect. Reliably detecting this condition is regarded by many as an ongoing challenge as existing methods are not entirely satisfactory. The main emphasis of the proposed scheme is to reduce the NDZ to as close as possible and to keep the output power quality unchanged. In this paper, a developed algorithm is proposed based on passive methods to detect non-islanding protection for wind turbine which is connected to the network. The proposed algorithm is compared with the widely used rate of change of frequency relays (ROCOF) and total harmonic distortion (THD) and found working effectively in the situations where ROCOF and THD fails. The method is on the basis of the decisions of several parameters. These parameters are voltage changes, frequency changes, and active and reactive power changes. Different scenarios with various loads have been used at different wind conditions and many parameters have been studied in these experiments to propose the algorithm. Simulation results have been obtained using MATLAB/SIMULINK software and the effectiveness of the proposed algorithm is shown for the different performances.

Original Article:

Received:30 June2015
Accepted :28 Aug 2015
Published :30 Sep 2015

Keywords:
Islanding Detection, Distributed Generation (DG), Wind Turbine, Voltage Changes, Frequency Changes, Rate of Change of Active and Reactive Power

Introduction

Due to the increasing popularity of energy production facilities such as wind farms and solar cells, distributed generation is becoming more and more widespread. During recent years, utilizing renewable energies have been increased dramatically, especially, because of the problems such as environmental pollution, and limited fossil energy resources. Also, renewable based distributed generations are more advantageous than the conventional power plants made it more interesting and economical [1]. Moreover, renewable energies are of great importance than the other energy resources as they are endless and have no negative effects on the environment. The connection of generation at distribution voltages is seen as one of the most important challenges facing modern electricity supply systems. These units offer the potential to take advantage of local renewable or sustainable energy sources, whilst avoiding the high carbon emissions and losses associated with large fossil fuel thermal stations and long distance transmission respectively. These clean energies have many kinds such as wind energies, fuel cells, photovoltaics, bio-mass and so on [2]. Depending on the type of these energy resources they could deliver either AC or DC power. Some of these distributed generations are connected to the network through power electronic converters or without any interfaces [3], also among the DG resources, wind energy based DGs have great share, also wind turbines are classified into several categories [4].

The use of distributed generation resources has various effects on themselves as well as on the network which one of them is the islanding phenomenon. The islanding occurs when one or more distributed generations separately supply local loads which are not connected to the network. In most cases this phenomenon occurring unwanted that could cause hazard to technicians of electric line maintenance, damage to consumer devices due to the lack of voltage and frequency instabilities, and inconsistency incidence at reconnection to network. This is a particularly undesirable condition and therefore protection is required for its detection and the subsequent tripping of DG. Thus, according to the standard of IEEE 1547, islanding should be identified and disconnected in less than 2 seconds [3-5].

So far several methods to detect islanding mode have been proposed. Although many protection methods have been developed for this task, concern still exists with regard to their performance in terms of the highly interrelated criteria of sensitivity and stability. The two main criteria for comparison of the existing islanding detection methods are: 1) speed of detection or run-on time which is defined as the time interval between the actual islanding instant and the islanding detection instant and 2) non detection zone (NDZ) which is a region (or space) specified by the system parameters, in which