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Energy Procedia 14 (2012) 81 – 86

Energy Procedia

A New Algorithm to Detection of Anti-Islanding Based on dqo Transform

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Abstract

Nowadays, renewable energies have taken a special role in power systems and most of distributed generations (DGs) in power systems also utilize these types of energy resources. Their advantage , including the use of renewable energies which are not polluting environment and owning endless nature, the use of these resources to produce electrical energy in the world is increasing. A problem with such generators is the unwanted islanding phenomenon. In this paper, a new technique to detect islanding conditions has been proposed. The performance of the proposed method based on passive methods is much more appropriate than that of previous methods. The simulation results performed in MATLAB, clearly show improved operation of this method.

Keywords: renewable energies, distributed generation, islanding

1. Introduction

Nowadays, most countries consume fossil fuel resources to produce energy. Howerver, in this regard, they have faced many problems including environmental pollution and the end of fossil resources. To solve this problem, countries are interested in renewable energy to supply their required energy consumption. Renewable energy mostly includes solar energy, wind energy, the energy produced by burning urban waste, biomass and stream line water flow. The European Union (EU) aims to provide Europe's 20% of energy consumption by renewable energy by 2020. Utilities in California would have to get a third of their power from renewable energy sources by 2020, up from a fifth. Distributed generation (DG) with its various distributed resource (DR) technologies has many advantages when connected to the power system [1]. Depending on the distributed generations, their production can be AC or DC. Anyway, most of these products are connected through an electronic power converter to the network [2]. Nevertheless, wind turbines and, generally, all DGs will affect the network like an islanding phenomenon. Islanding happens when one or more DGs supply local loads without getting connected to a power grid [2]. In most cases, this phenomenon can occur unintentionally, which causes problems due to the instability in consumer voltage and frequency and inconsistency in the reconnection to the power system such as creating the hazard for line repair technicians and equipment damages. Therefore, according to IEEE1547 standard, islanding state should be identified and disconnected within 2 seconds [3] and [4].
To detect Islanding state many methods have been proposed so far. These methods can be classified in two broad categories of active and passive classifications [5]. The following techniques can be mentioned as the active methods: Impedance measurement method [6], Frequency domain analysis [7], Changing voltage amplitude and reactive power method [8], The mid-harmonic method [9]. And, here are the techniques which can be mentioned as the passive

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doi:10.1016/j.egypro.2011.12.887

methods: Voltage and frequency relays [10], Rate of change of frequency relay (df/dt) [11], Output power speed changes [10], Unbalanced voltage and total current (or voltage) harmonic distortion (THD) [12].
One of the parameters that can be changed in islanding mode is d-component of the load voltage. In this paper an algorithm has been proposed that can detect the islanding condition based on load voltage. But in order to detect the islanding condition from the other switching conditions, q-component of local load voltage added to this algorithm and detection will be doing with d-component and q-component of local load voltage. In order to make sure of islanding condition, the threshold value of d-component will be taken higher and q-component of local load will be analysed after analysing d-component. This algorithm is based on the quantity of d-component value and q-component value.

2. Test System

Single line diagram of the system studied in this paper is shown in Fig.1. As depicted in this figure, the DG has been shown by a wind turbine, a gearbox and a self excited induction generator. A capacitor bank is located in the end of induction generator in order to correct the power factor. A step-up transformer is located between the DG unit with its local loads and the utility grid. The utility grid is simulated with an ideal source and a Resistance R_s and an Inductance L_s. Connection between the utility grid and the DG is done with a Circuit Breaker (CB). The system parameters are given in Table. 1.

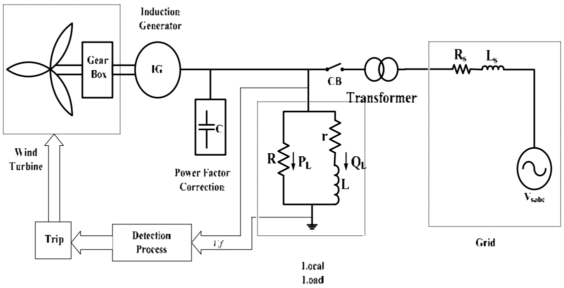

Fig.1 Test system to detect islanding conditions including a local load, a power grid and a wind turbine

When the circuit breaker (CB) is closed as shown in Fig 1, the DG with local load is connecting to power grids, and the power produced by DG is injected to the network. When the CB is opened, islanding state occurs in this mode, and the DG with a local load constitutes an islanding state together which creates an independent power grid in which just the DG supplies loads demand. In this condition, islanding state should be identified and power production should entirely be disconnected from the power grid and it started again to produce power after reconnection to the network.To detect the islanding state, a measuring system is installed at the head of a local load and output of the mentioned system ended in a central processor in which measured signals are being processed and a fast decision should be made in the islanding state and a command to disconnect the system will be exported.

Table.1 Test system parameters, including the local load, power grid and the wind turbine

Parameter	Value
Turbine Rated Power	(660KVA)
R_s	(1 Ω)
L_s	(1mH)
Rated Voltage of local load	(0.4 KV)
Nominal Grid Voltage	(20 KV)
Transformer Voltage Power	(0.4/20 KV)
Transformer Rated Power	(660 KVA)
Frequency	(50 HZ)