A Novel Passive Method for Islanding Detection in Microgrids

F. Namdari*(C.A.), M. Parvizi* and E. Rokrok*

Abstract: Integration of Distributed Generations (DGs) in power grids is expected to play an essential role in the infrastructure and market of electrical power systems. Microgrids are small energy systems, capable of balancing captive supply and requesting resources to retain stable service within a specific boundary. Microgrids can operate in grid-connected or islanding modes. Effective islanding detection methods are essential for realizing the optimal operation of microgrids. In this paper, a new passive islanding detection method is presented according to the change rate of DG's voltage over active power index. This technique has been applied on inverter-based and synchronous-based microgrids. The efficiency of the proposed method is verified through a comprehensive set of simulation studies carried out in Matlab/Simulink.

Keywords: Islanding Detection, Microgrids, Non-Detection Zone, Passive Method.

1 Introduction

The integration of Distributed Energy Resources (DERs) into distribution networks has been increasing due to the advantages such as high efficiency, modified power quality, and less greenhouse gas emission [1]. Therefore, it has been proposed to demarcate areas of a distribution network (with sufficient generation) as a microgrid in order to help the network operation as a provisional island when the need arises.

According to IEEE1547 standard, islanding mode of operation happens when one or many resources continue to feed power to a part of the grid that is disconnected from the main utility [2]. Unplanned Islanding situations can damage the grid itself or equipment connected to the grid and can even compromise the security of the maintenance personnel. There are three main methods of islanding detection for microgrids; active, passive, and Communication-based methods [3]. Active detection methods intentionally introduce perturbations into the system and detect islanding according to the response of the system. The downside of active methods is that they are not as fast as passive methods and they degrade the power quality with the injected perturbations [4-6]. There are communication-based approaches which are based on direct communication between the utility and DGs in a microgrid. The only set-back is the additional cost of communication systems and their reliability [7].

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* The Authors are with the Department of Electrical and Electronic Engineering, Lorestan University, Khoramabad, Iran.
E-mails: namdari.f@lu.ac.ir, parvizi.ma@fe.lu.ac.ir and rokrok.e@lu.ac.ir.

Passive detection methods measure some local parameters such as voltage, frequency, total harmonic distortion, etc. By comparing these values with the predetermined thresholds, islanding is detected [8-12].

Passive detection methods detect islanding very fast and without disturbing the system. The challenge of setting suitable thresholds and the large non-detection zone are the major drawbacks of passive methods.

One of the most common passive approaches is ROCOV index. This method that measures voltage change rate over time has been investigated and implemented in [13-15].

This paper presents a new passive islanding detection approach on the foundation of DG's voltage change rate over active power. The proposed approach is based on ROCOV method that is not affected by power mismatch.

The paper is organized in four sections. The proposed approach is presented in Section 2. Performance of the proposed method is evaluated in Section 3 on the two case study systems, and conclusions are drawn in Section 4.

2 The Proposed Method

As was mentioned, non-desired islanding situations for microgrids and distributed generations can damage the grid or equipment connected to the grid. The common methods used for islanding detection recently are the adapted and modified forms of the under/over voltage and under/over frequency relays. Among these methods, those which are based on voltage variations are the most reliable devices by the industry so far. Change rate of voltage relay (ROCOVR) and vector surge relay (VSR) are common examples of such relays [15].