Transactions of the Indian National Academy of Engineering (2023) 8:149–159
https://doi.org/10.1007/s41403-022-00385-5

ORIGINAL ARTICLE

A Novel Islanding Detection Method in a Distributed Generation Using Change in Phase Angle Difference Between Positive Sequence Current and Voltage

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Received: 24 July 2022 / Accepted: 26 December 2022 / Published online: 4 January 2023
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Abstract
This paper describes a localized islanding detection approach based on a passive method for distributed generation (DG) coupled to the main power source. In the suggested approach, the change in phase angle difference (CIPA) between the positive sequence current and voltage is obtained at the DG side and is used to identify the islanding situation. The prevailing active detection techniques introduce deliberately disturbances into the system which might lead to problems related to power quality, stability, and reliability of the existing power system. On the contrary, passive methods based islanding detection techniques has the issue of large non-detection zone (NDZ). The proposed technique tries to overcome the NDZ problem and does not introduce any disturbances. PSCAD/EMTDC is used to simulate the two different systems. Various tests are carried out on these systems to access the execution of the proposed method and it was found that the suggested method has least NDZ and can detect the islanding in about 10 to 15 ms well below the time required by a recloser which is 150 ms.

Keywords Real power difference · Microgrid · Distributed generation (DG) · Rate of change of frequency (ROCOF) · Change in positive sequence phase angle (CIPA) between current and voltage

Introduction

With increased price of fossil fuels, natural gases and environmental issues, existing power network has gone through considerable changes in structure building, operation, regulation and planning. The power network is forced to operate close to its operational margin and utilize the maximum infrastructure, owing to the new restrictions set up by political, economic and environmental concerns. This situation leads to the proliferation of distributed generation systems. It has become necessary to integrate the distributed generation (DG) to the utility as it reduces the line losses, reliance on fossil fuel for energy generation and hence improves the distribution system efficiency and reliability. Along with these advantages, it has got certain disadvantages as well. The main problem is the islanding condition (Faqhruldin and Zeineldin 2013). The islanding phenomenon occurs when the main source is interrupted but the DG continues to deliver electricity to the network. (Zeineldin and Kirtley 2009). The islanding process may be intentional (Mishra and Jena 2021) (due to maintenance outage) or unintentional (due to fault and subsequent switching actions) in nature. Energized islanding network (unintentional islanding) has got certain issues. The main problems are safety hazards; extreme transient stresses when reconnected to the grid, inadequate and uncoordinated grounding, customers, equipment and utility workers may be endangered because of wild behavior of the voltage and frequency (Mazloomzadeh and Mohammad 2013). Current practice dictates that the DG be removed from the main source as soon as reasonably possible, within 2 s according to IEEE Std. 1547.

It is essential to identify the islanding before taking any necessary measure. Islanding detection techniques are classified in three types: (1) active, (2) passive and (3) the methods based on communication. Passive methods observe the different system quantities such as impedance, current,

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