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Analysis of Remote Islanding Detection Methods for Distributed Resources

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Abstract. Penetration of distributed generation in the power grid is increasing. This situation leads to new possibilities but also new issues, such as anti-islanding protection. During a loss-of-mains or islanding situation, distributed generation (DG) units remain feeding a part of the electrical network without connection to the main power system. Currently, DG units have to be disconnected from the grid during islanding as soon as possible, due to potential risks for repair crews and components, poor power quality in the island and reclosing problems. A fast and reliable islanding detection method could avoid mentioned issues. Among the many existing methods, remote schemes could meet these requirements.

Hence, this paper presents the operating principles of remote islanding detection methods, as well as the current state of development of communication-based remote islanding detection methods to be applied in distributed power generation systems.

Key words: distributed generation, loss of mains protection, islanding detection, IEC 61850, synchrophasor, PMU.

1. Introduction

During an islanding situation a portion of the power system, which contains both load and distributed resources, remains energized, while it is isolated from the rest of the grid, forming an uncontrolled island. This operation can lead to hazardous situations. Therefore, it is important to detect unintended electric islands within a short time delay and to trip the islanded generators [1,2].

Islanding detection techniques are usually divided into local detection methods, when the detection is based on the DG side, and remote detection methods, when the detection is based on the utility side. Remote anti-islanding schemes allow disconnection decisions to be made by the utility company [3]. Most of the latter methods rely on external communication devices which link each feeder to the utility side.

Local detection methods, in turn, can be classified into passive and active techniques [4]:

- Passive methods rely on available local measurement to detect islanding situations. Actually, sudden islanding of a grid causes changes in some electrical parameters, such as frequency and voltage. The most used passive methods are therefore over/under voltage and frequency relays. Other techniques are based on harmonic distortion, voltage phase and rate of change of frequency measurements [5,7,8].
- Active methods directly interact with the power system operation by introducing small perturbations. These small perturbations result in a significant change in system parameters when the distributed generator is islanded, whereas the change is negligible when it is connected to the grid. Some active methods are phase shift methods, impedance measurement method and reactive power export method [6,7,8].

A proper evaluation of loss-of-mains detection methods should consider the following aspects [7, 9, 10], summarized in Table I:

- Dependability and security: they are related to the reliability of the island detection, which is normally assessed by non-detection zones (NDZ). NDZs are regions in a defined space in which the islanding detection scheme fails to detect islanding [1].
- Operating time: IEEE 1547 Std. defines maximum operation delays (2 s), which must include islanding detection latency and tripping time. Operating time must be shorter than the recloser acting time.
- Impact on the grid: the application of some techniques may degrade the power quality, and impact on the transient response of the power system.
- Cost of the solution.
- Adaptability to grid characteristics: islanding detection depends on grid topology, generator technology and distributed generation penetration level.