三相不平衡配電系統の最適電圧制御

Form 3

論　文　要　旨

Abstract

論 文 題 目

Title

Voltage Control and Optimization of Three Phase Unbalanced Distribution Systems

（ 三相不平衡配電系統の最適電圧制御 ）

In recent years, the use of renewable energy sources in form of Distributed Generators (DGs) such as photovoltaic (PV) and Wind Energy Conversion Systems (WECSs) in distribution systems has increased considerably. However, voltage deviations resulting from the high integration of this kind of fluctuating and intermittent power into conventional distribution systems is one of the important technical challenges. Moreover, distribution systems are inherently characterized with both system and load unbalances which make scheduling methods reported in the literature not suitable for practical distribution systems. Furthermore, the high integration of DGs in distribution systems will likely increase the voltage unbalance which can severely harm the end user's devices. Therefore, it is thought that voltage control and optimization of three phase unbalanced distribution systems is worth being a topic of research.

For that, an optimal scheduling method of DGs and the existing tap changing transformers in unbalanced distribution systems is proposed. The voltage references and tap positions are optimized by Genetic Algorithms based on the forecasted power generation and load demand to reduce the power losses. The optimized voltage references are then adjusted aside with the voltage droop slope in real time using a proposed fuzzy logic controllers which takes into considerations the voltage unbalance. The positive sequence components of the three phase voltages are chosen to deal with the unbalanced components in the system. The DGs considered are supposed to be PV generators; however the existing integrated WECSs based on induction generators can cause more unbalance effect in the system. Thus, the effect of the integration of this kind of DGs in the unbalanced systems is assessed and a voltage control method is also proposed to control smooth the voltage fluctuations at the point of common coupling. Moreover, another technique of balancing the unbalanced load is suggested where the placement of the DGs has to be in Delta connection next to the load, then the reactive power injected from DGs will play a role of load compensator. Simulations have been conducted on a 14 bus distribution system where all the proposed methods where applied, depending on each case, to prove the effectiveness of each proposed method. The results showed that the unbalanced voltages could be regulated to be within the acceptable range beside other objectives which were achieved.

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