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Distributed Generation Impact on Power System Transient Stability: a Stochastic Approach

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Abstract

This paper proposes a stochastic approach to investigate the impact of increasing distributed generation (DG) penetration levels on power system transient stability. The DG units are considered to be synchronous machines that are connected to the distribution networks. The DG units are customer-owned and can be connected or disconnected from the system by their owners at random, so that the DG units generate power in a stochastic way. The random behavior of the load is taken into account as well and the probability distribution of the aggregated generated power and the load demand of the distribution system are calculated using Monte Carlo Simulation (MCS). The DG penetration level is raised by increasing the number of DG units within the test system in steps, while the load is kept constant. The remaining power production is distributed among the centralized generators, inversely proportional to their fuel efficiency. The most inefficient units are shut down when the power output falls below their minimal generated power. The power system transient stability is examined by applying a permanent fault in one line of the test system. To assess the system stability, the following two indicators are used: the maximum rotor speed deviation and the oscillation duration of the centralized generators.