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Analysis of Faults in Power Distribution Systems With Distributed Generation

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1. Introduction
Today worldwide distributed generation (DG) takes a very important role in the operation of distribution electric power systems [1]. However, the existence of distributed generation may have impacts on different topics such as fault protection, coordination schemes or fault location [[2]-[3]. If there is a short-circuit in the system, the presence of one or more distributed generators can affect the monitoring of voltages and currents at the substation. The main supply generation will not have to inject as much power to the line because of the DG and, therefore, voltages and currents at the substation will be different from the ones that would be measured without DG. This fact may have consequences if these magnitudes that are used to locate where the fault has occurred.

In this paper, the behaviour of the most significant parameters in power distribution systems, such as voltages, currents and apparent impedances at the substations, is studied depending on the values of fault resistance, the power supplied by DG and the relative location of DG and the fault. Different analysis are performed by varying the locations of the DG and the fault, in order to analyze the influence of DG together with the position where the fault has occurred. In addition, the sensitivity of impedance-based fault location methods, such as the presented in [4], is analysed taking into account the effect of DG.

2. Simulation Model
It has been developed an application in Matlab/Simulink that can obtain the electrical and topological data from a database, and that allows to simulate faults in those lines. The application is based on [5] and allows to modify all the parameters, such as the type of fault, the fault resistance, the location of the fault, and the location and parameters of DG buses. The application will allow to display waveforms of voltage and current, impedances, and make new graphics of the performance of the system, representing the state of fault and DG.

3. Simulation Tests
Two cases have been considered to analyse the influence of DG in the location of faults: a) Short line with DG at the beginning of the line and a single-phase-to-ground fault located at the end of the line; b) Long line with DG at the ending of the line and a single-phase-to-ground fault located at the beginning of the line.

4. Conclusion
The paper analyzes the impact of distributed generation in the location of faults. From the tests performed, different impacts can exist depending on the relative position of the DG and the fault. The presence of DG in a power distribution system gets to a decrease in the value of the apparent reactance seen from the main substation. Thus, the estimate locations calculated by using impedance-based fault location methodologies will be closer than the actual location of the fault, increasing the error. A preliminary study of the sensitivity of fault location algorithm, for the case of single-phase-to-ground faults, has been studied for two particular cases, taking into account the impact of the size of DG in the system.

References
[1] J.A. Peçar Lopes, N. Hatziargyriou et al., "Integrating distributed generation into electric power systems: A review of drivers, challenges and opportunities", Electric Power System Research, 77, 2007, pp. 1189 – 1203.

[2] J.I. Marvik, H.K. Hoidalen, A. Petterteig, "Localization of short-circuits on a medium voltage feeder with distributed generation", 20th Int. Conf. Electricity Distribution, 2009.

[3] L.K. Kumpulainen, K.T. Kauhaniemi, "Analysis of the impact of distributed generation on automatic reclosing", in IEEE PES Power Systems Conference and Exposition, Vol.1, Oct. 2004, pp. 603 – 608.

[4] R. Das, "Determining the location of faults in distribution systems", PhD Thesis, Canada, 1998.

[5] S. Herraiz, J. Meléndez, G. Ribugent, J. Sánchez, M. Castro, "Application for Fault Location in Electrical Power Distribution Systems", in 9th Int. Conf. Electrical Power Quality and Utilisation, 2007.