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Impacts of Distributed Generation on Distribution Networks with Voltage Regulator

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Abstract:

Distributed generation has become a reality. Its production is directly linked to the development of new sources of energy generation. The hydro, wind and solar sources made possible the reduction of energy costs to the consumer, with a low environmental impact [1]. The perspective of DG access in the distribution network brings with it a series of questions regarding its technical viability, influence on the electrical system and economic results. Among the impacts of its insertion, the profile of voltage, electrical losses and operation together of voltage regulators (VR) are some of the points that stand out. Thus, this work analyzes load flow conditions under different operating conditions in a radial distribution network with the presence of DG and VR. We present the impacts that the insertion of DG causes in the VR, configured in the cogeneration mode. In the results, was initially inserted a VR without DG, improving the performance of the network until 10% above the reduction of losses in the distribution system and in the initial insertion only of DG, the voltage profile of the bars near the DG increased. Succeed in the results joint both insertion of the VR and DG, a tendency was identified from the penetration percentage of the distributed generation. In the increase of penetration percentage above 70%, the electrical losses tend to be bigger than in the case with VR alone, without the DG addition. The tension profiles showed considerable improvements, especially in cases with medium and heavy load. At where load conditions were not ideal for the system, distributed generation relieved the substation, improving the voltage profile of the more peripheral buses. However, in the uncontrolled increase of 5 MW, the levels of voltage severity increase again. In what concerns the power flow of the network and the voltage regulator tape values under the flow inversion conditions, no malfunction of the voltage regulator was noticed, certainly by the used cogeneration control method, which only obtains an estimate less flow inversion [2]. Nevertheless, starting from works on the subject [3], the inversion of flow is a condition detrimental to the network, both in what involves the voltage regulator or in the other elements that involve the distribution network.

References:

[1] NORRIS, BANJAMIN L. Maine Public Utilities Commission. **Maine Distributed Solar Valuation Study**. Maine: PUC, 2015.

[2] SOUZA, Vanderson Carvalho de. **Controle local de potência reativa em geradores fotovoltaicos para a melhoria da regulação de tensão em redes de distribuição**. 2017. 95 f. Dissertação (Mestrado) - Curso de Engenharia Elétrica, Instituto de Tecnologia, Universidade Federal do Pará, Belém, 2017.

[3] PATIL, Ashwini; GIRGAONKAR, Rucha; MUSUNURI, Shravana Kumar. Impacts of increasing photovoltaic penetration on distribution grid — Voltage rise case study. **2014 International Conference On Advances In Green Energy (icage)**, [s.l.], p.100-105, dez. 2014. IEEE. <http://dx.doi.org/10.1109/icage.2014.7050150>.