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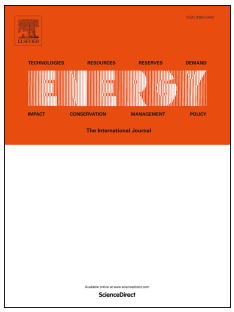

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Blackout risk mitigation by using medium size gas turbines

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Abstract

This paper aims to analyze the economic aspects of the network power at risk mitigation by using gas turbine distributed generation. Two different Mixed-Integer Programming optimization models are proposed with the goal of selecting both, the most appropriate turbine models and the year of installation. The first model considers the existence of a global network agreement among generation companies and distributor in order to cover at least partially all the points at risk. The second one leaves the distributed generators full freedom to choose among the locations proposed by the distributor. Since electricity distribution is a regulated activity and manages public resources, one of the decisions that must be taken is how much the generators should be economically encouraged to install the appropriate generation power at the points at risk. To this end, a possible regulated remuneration that compensates for the power installation at certain points is considered. The proposed approach is illustrated by applying both models in a big scenario concerning approximately the half of the Spanish distribution network. A sensitivity analysis considering different values of remuneration and gas price is carried out. The analysis demonstrates the importance of gas price in order to apply the distributed generation mechanism.

Keywords: Distribution Network, Power at Risk, Distributed Generation, Electricity and Gas Market, Mixed Integer Linear Programming

1. Introduction.

The main attributes to evaluate an electric utility are the quality of service and the security of supply, which are negatively related with the frequency (rate of failure) and intensity (power at risk) of blackouts that they cause to their users. A blackout usually occurs when a network element fails, with the rest of the system not having sufficient capacity to meet the demand. As the network is composed of physical elements exposed to the outdoor, they suffer faults, which depend on the applied maintenance policies. Traditionally, the risk has been reduced by providing redundancy through the construction of new lines and substations, which are often expensive and complicated. The main motivation of this article is to contribute to the quality of the electrical system by proposing an alternative efficient way of solving power at risk problems in the network. The main idea of the paper is that distributed generation can be seen as a network risk mitigation tool which is able to provide backup capacity, generating at the same time, net savings for the electricity distribution system. The proposed mechanism is fully compatible with the current unbundled regulation.

'Distributed Generation' or 'Decentralized Generation' (DG) terms have been used to describe the electricity generation on a small scale. This generation technology can be connected either to the distribution network or to the point of consumption (on the side of residential or industrial consumers). DG can be seen as a tool to complement the traditional centralized large-scale generation and distribution system. According to Alanne and Saari [1] and Bayod-Rújula [2], an energy system is hardly going to be completely centralized or completely decentralized; it is expected that centralized and decentralized sub-systems operate in parallel.

From the beginning of the electrical industry, DG has been used to improve the efficiency level of the system. Utilities engineers determine the most adequate decisions about how to maintain an adequate quality of the distribution service. Even when the sector began to operate as an integrated business, utilities engineers were in charge of selecting the best solution for each risk situation; choosing in each case between

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