

# **Optimal allocation of D-STATCOM in distribution networks including correlated renewable energy sources**

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## **Abstract-**

Gradual depletion of fossil fuel resources, poor energy efficiency, and environmental pollution problems have led to the use of renewable energy sources (RESs) such as wind turbines (WTs) and solar photovoltaic (PV) cells in distribution networks all around the world. The uncertain nature of these sources, along with network power demands, necessitates probabilistic evaluation to extract results with high applicability and efficiency. Distribution network flexible AC transmission system (D-FACTS) devices such as distribution static compensator (D-STATCOM) can be efficiently used for making the modern distribution networks with high penetration of RESs more flexible.

This paper presents a probabilistic technique for optimal allocation of the D-STATCOM, considering the correlation between uncertain variables. The proposed solution method helps to mitigate expected active power losses, improve expected voltage deviation index (VDI), and decrease D-STATCOM expected installation cost for radial/mesh distribution networks. The k-means based data clustering method (DCM) and Latin hypercube sampling (LHS) method are used for probabilistic evaluation of distribution networks. In addition, the particle swarm optimization (PSO) algorithm is employed as the optimization tool. The proposed algorithm is applied to the IEEE 69 node test network, and the results are compared with the Monte Carlo simulation (MCS) method. Also, the efficacy of the proposed study method has been investigated for a real meshed distribution network.

**Index Terms-** Distribution network; Renewable energy sources; D-STATCOM; Probabilistic evaluation; Data clustering method

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