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A security-aware dynamic hosting capacity approach to enhance the integration of renewable generation in distribution networks

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Abstract-

Hosting capacity (HC) describes the electricity network’s ability to accommodate distributed generation (DG) without deteriorating electrical performance indicators. Distribution system operators typically express their networks’ HC as a single threshold, called static hosting capacity (SHC). SHC is determined via conservative regulatory criteria, increasing connection costs and time. This paper explores the potential for additional energy injection into the network via dynamic hosting capacity (DHC). A network node’s DHC is derived from the hourly operation of the network, accounting for the time variability of existing distributed generation (DG) output and demand. The methodology considers the network assets’ N-1 contingencies and their probabilities, defining the security-aware DHC (SDHC). The SDHC definition is technologically neutral. Through a case study of a radial medium voltage distribution network, the paper highlights the significant limitations of SHC due to conservative calculation criteria mandated by regulators. Annual injectable energy is increased by 62% to 76% when comparing DHC to SHC. Variations between average DHC and SDHC are below 0.01% due to low N-1 probabilities. This finding points out the potential of dynamic hosting capacity definitions, allowing more efficient use of the existing network and facilitating the integration of new DG capacity with reduced connection costs and time.

Index Terms- Flexible connections; Dynamic hosting capacity; Probabilistic analysis; N-1 contingencies; Distributed generation; Distribution grids

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