Vulnerable Node Identification Method for Distribution Networks Based on Complex Networks and Improved TOPSIS Theory

Enyu Jiang[1], Wentao Zhang[1], Ang Xue[1], Shunfu Lin[1], Yang Mi[1], and Dongdong Li[1]

[1]Shanghai University of Electric Power

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Abstract

A method for identifying vulnerable nodes in distribution networks is proposed, which is based on complex networks and optimized TOPSIS. This method aims to address the issues of one-sided evaluation indicators and inaccurate indicator weights that are present in existing methods for identifying vulnerable nodes in distribution networks. Based on the theory of complex networks, a comprehensive set of vulnerability indicators for distribution network nodes is constructed by considering both the topology structure and system operation status of the distribution network. The TOPSIS comprehensive evaluation model for optimization is proposed to enhance the selection process of optimal and worst indicator values. The advantages and disadvantages of each indicator are characterized using Mahalanobis distance. The calculation of proximity is optimized by establishing a virtual negative ideal solution, which makes the identification of vulnerable nodes more reasonable. The simulation results demonstrate that this method is more effective in identifying vulnerable nodes in the power grid compared to traditional methods, and has significant practical applications.

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