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Criticality Based Optimal Power Restoration Method During Extreme Events

Adithya Melagoda
Faculty: Visvakumar Aravinthan
Department of Engineering, College of Engineering

Extreme events such as natural disasters, extreme weather and man-made attacks have the potential to disrupt the operation of the power grid and in turn impact the society at large. Although the power grid is built to withstand stochastic component failures, these events have the potential to affect multiple components and lead to sustained power outages, urging the power system planners and policy makers for improving grid resiliency. Further, there are different types of customers in an electrical distribution system ranging from more critical ones such as hospitals and emergency services to less critical such as residential customers. This requires the operators to seek more into methods that will take this difference into consideration and restore the power back on when the system is undergoing an extreme event. Since the Distributed Energy Resources (DERs) such as Solar PV plants and consumer owned diesel generators are emerging worldwide, the critical loads can be supplied using these resources by forming operable microgrids. As a preliminary step towards the big picture, this work aims to develop a load criticality-based power restoration model in electrical distribution systems during an extreme event by using optimization techniques. A new firefly search inspired metaheuristic algorithm is developed for microgrid formation with the objective of maximizing the critical load restoration with minimal switching operation. Numerical analysis is conducted on a small and a larger power distribution system and the results show the scalability and critical load restoration capabilities of the proposed algorithm.