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Fault Tolerant (n, k)-Star Power Network Topology for Multi-Agent Communication in Automated Power Distribution Systems

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Abstract : This paper investigates the joint effect of the interconnected (n,k)-star network topology and Multi-Agent automated control on restoration and reconfiguration of power systems. With the increasing trend in development in Multi-Agent control technologies applied to power system reconfiguration in presence of faulty components or nodes. Fault tolerance is becoming an important challenge in the design processes of the distributed power system topology. Since the reconfiguration of a power system is performed by agent communication, the (n,k)-star interconnected network topology is studied and modeled in this paper to optimize the process of power reconfiguration. In this paper, we discuss the recently proposed (n,k)-star topology and examine its properties and advantages as compared to the traditional multi-bus power topologies. We design and simulate the topology model for distributed power system test cases. A related lemma based on the fault tolerance and conditional diagnosability properties is presented and proved both theoretically and practically. The conclusion is reached that (n,k)-star topology model has measurable advantages compared to standard bus power systems while exhibiting fault tolerance properties in power restoration, as well as showing efficiency when applied to power system route discovery.

Keywords : (n, k)-star topology, fault tolerance, conditional diagnosability, multi-agent system, automated power system
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