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Network-reconfiguration-aware Power Oscillation Damping Controller for Converter- interfaced Generator Based Power Plants

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Abstract-

In recent years, transmission system operators have started requesting converter-interfaced generators (CIGs) to participate in grid services such as power oscillation damping (POD). As power systems are prone to topology changes because of connection and disconnection of generators and lines, one of the most important requirements in the design of POD controller is to account for these changes. This can be done by either adjusting the controller structure during the operation or applying a fixed structure designed to address changes in the system. The fixed structure is usually preferred by transmission system operators since it is easier to determine its impact on the system. In this paper, a design procedure is proposed for network-reconfiguration-aware POD controller with fixed structure for CIG-based power plants that considers network configurations with any one line disconnected. The design procedure is based on frequency-response techniques, so it is suitable for application in CIG-based power plants, even in cases when a detailed small-signal model of the system is not available. Designs of a POD controller for the damping of critical system modes can be obtained by using active power, reactive power, or both power components simultaneously. The application to the design of a POD controller for a CIG-based power plant connected to the IEEE 39-bus system is presented as an example. Simulations performed in MATLAB and SimPowerSystems are used to validate the proposed design procedure. The validation includes an analysis of system performance with changes considered in the proposed designed procedure. Also, the system performance under unconsidered changes is examined, covering variations in load and inertia values, as well as disconnection of synchronous generators.

Index Terms- Converter-interfaced generator ; transmission system ; frequency response ; network reconfiguration ; power oscillation damping

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