

Design and Simulation Issues for Secure Power Networks as Resilient Smart Grid Infrastructures

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Abstract: The increased penetration levels of renewables and distributed energy resources lead to increased challenges in maintaining reliable control and operation of the grid. Integrating a wide variety of systems governed by different regulations and owned by different entities to the grid increases the level of uncertainty not only on the demand side but also in terms of generation resource availability. This complicates the process of achieving generation versus demand balance. Renewable energy sources vary by nature and require intelligent forecasting and prediction systems to determine how and when this energy can be used. Controlling distributed resources that owned by customers which have enough capacity to support the grid during peak hours and provide ancillary service, is another challenge. Most of these distributed resources will be installed on the distribution network, which already in its current state, lacks the proper communication and control network necessary to control the applicable resources. Moreover, the large number and widespread use of these resources makes them difficult to control from a central location.

To overcome these problems, deep integration between intelligent measurement nodes, communication systems, IT technology, artificial intelligence, power electronics and physical power system components will be implemented to manage the modern smart grid resources. On one hand, this type of integration can dramatically improve grid performance and efficiency, but on the other, it can also introduce new types of vulnerability. The risk of vulnerability escalates when the level of integration between physical and cyber components of the power system increases. The design and optimization of such complex systems requires coordination between the cyber and physical components in order to obtain the best performance while minimizing the risk of vulnerability. In other words, the physical power system must be designed as a security-aware system.