The 14th International Workshop on Electric Power Control Centers
Wiesloch, Germany, May 14-17, 2017

Impact of System Resiliency on Control Center Functions - An Architectural Approach

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Abstract: Reliable operation of power systems is under constant threat by various natural events, equipment and human failures, interdependency with other infrastructures, and ever increasing cyber and physical malicious acts. While preventive measures are critical to countering such threats, it is also essential to maintain a high level of grid resiliency to minimize the potential impacts of such threats. This presentation provides an overview of the resiliency concept and its construct in the context of power system operation. Threats to power systems are highlighted and their potential impact on control center applications are discussed. Relevant utility industry trends such as proliferation of distributed energy resources and their likely resiliency roles and impacts are pointed out. Considering the ever-increasing deployment of distributed energy resources and smarter grid infrastructures, it is argued that transformation of "control centers" from their conventional centralized IT architecture to a more distributed smart infrastructure can facilitate higher resiliency of the grid. Two non-exclusive approaches to a distributed architecture design are presented: 1) a top-down hierarchical framework where coordinated intelligent autonomous agents perform various functions of a "control center" in normal conditions while facilitating higher resiliency in emergencies; 2) A novel bottom-up approach utilizing a "nested model" with potential application in "Transactive Energy" distribution environments – to support normal as well as emergency operations with increased levels of resiliency.