FLORIDA STATE UNIVERSITY
Reliable and Resilient Electrical Energy Transmission and Delivery Systems

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Description: The project goal is to address the challenges of the reliable movement of electrical energy throughout the state as the power system is transformed to include far more renewable and alternative sources, increased use of distributed energy resources and microgrids, possible expansion of new very-large centralized baseload (nuclear), and incorporation of new power conversion, transmission, measurement, communication and control technologies.

Budget: $235,991
Universities: FSU
External Collaborators: Florida Reliability Coordinating Council (FRCC), City of Tallahassee Electric Utility

Progress Summary

Research Objectives and Progress made for the Current Reporting Period: The analysis of the Florida Power Grid Disturbance of February 2008 using an aggregated 14-Bus dynamic model was continued to refine the data and protection related switching events. The results from the aggregated FPL 14 bus system were found to match the recorded data observed in the incident report with minor discrepancies. The reason for minor mismatch can be attributed to the use of generic data due to the unavailability of actual data. The matching of simulation data with the recorded data indicates that the reduced FPL system can be used for representing the FPL network with reasonable assumptions for some simplistic studies. Work is underway to construct parametric studies to determine the parameters sensitivity in the simulation using factor screening and other statistical techniques.

Data collection and development of a 154 Bus Florida Grid Model for dynamic analysis were continued. Despite the fact that 14 Bus Florida grid model was sufficient for some initial studies, the project's objective require a more detailed benchmark system of the Florid grid. Therefore, a 154 bus notional electrical grid of Florida was built with detail representation using data available in the public domain. The comparison of power flow results with available sources revealed a very close agreement with negligible mismatch.

Since, our objective includes the dynamic analysis of the Florida grid, in the next step, efforts were made to develop a dynamic model for the 154 Bus system. The dynamic model requires data for each unit of generators, exciters, turbine governors, power system stabilizers, automatic generation controls and all the required protective devices with accurate settings. This task is complicated by the requirement of data that is not publicly available. Nevertheless, development of a notional dynamic model of the Florida gird in PSS/E is underway and most of the dynamic data were obtained from various public resources. In case of unavailability of the sufficient information on the details breakdown in each plant's generation units, models for generators, exciters, and governors were chosen for the large plant or known plant at that bus. If information is available, models for the exact type of generation units are chosen. Typical data were assigned for the specified dynamic models for parameters.

The development of a dynamic solar PV model with Maximum Power Point Tracking (MPPT) has been initiated and completed in this period. The model will contribute to the general power system modeling and simulation community as we intend to make it publically available and to the envisioned Florida Grid studies of future load and generation growth specifically. Initial studies of the impact of solar PV-based resources have been undertaken, and significant implications for power system operation and stability have been observed, see Figure 1. The depicted bus frequency traces after tripping of a solar PV-power plant at different penetration levels reveal unacceptable frequency deviations.

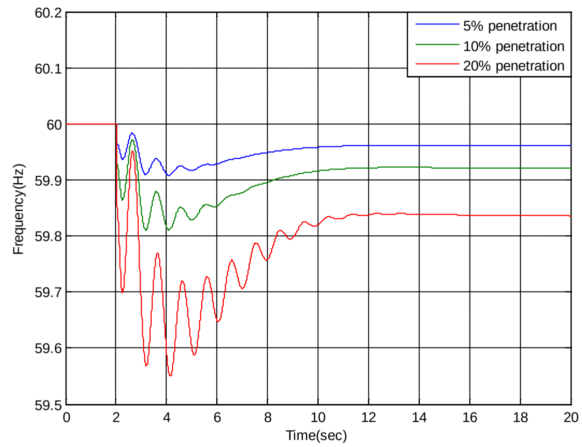

Figure 1. Frequency response after tripping PV

Research activities for the next reporting period: The next steps will focus on completing the dynamic model of the Florida grid, refining load and generation forecasting, and developing relevant case scenarios. Probabilistic analysis will be performed and uncertainty and sensitivity analyses will subsequently provide insight into the expected resiliency of the grid in the context of future developments in load and generation patterns.