Florida State University

The Future Florida Grid: Ensuring a Reliable and Resilient Electrical Energy Transmission and Delivery System in a Changing Environment

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Description: The project research 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 (including storage and electric vehicles), emergence of microgrids, possible expansion of new very-large centralized baseload (nuclear), and incorporation of new power conversion, transmission, measurement, communication and control technologies (smart grid).

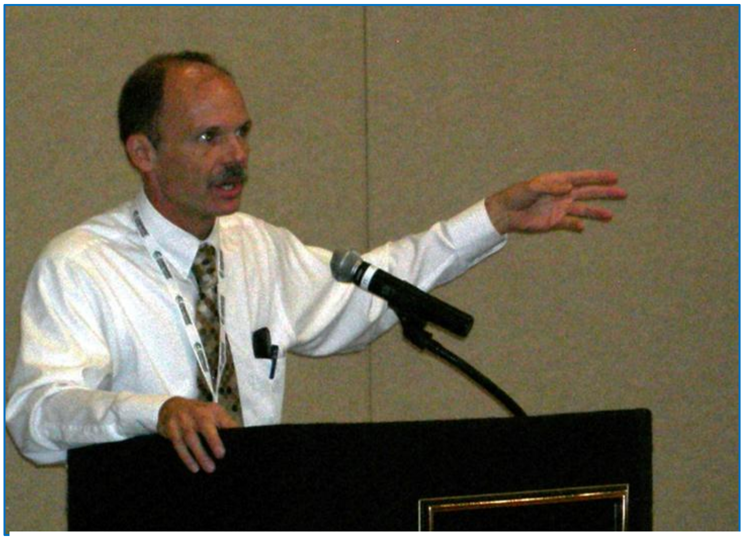
This project has also supported ongoing participation and contributions in national, state, and local power and energy stakeholder groups, including the Gridwise Alliance, the North American Synchrophasor Initiative (NASPI), the American Society of Mechanical Engineers' (ASME) National Energy Committee, the Institute of Electrical and Electronics Engineers (IEEE) Power Engineering Society (PES), Florida's Great Northwest Alternative Energy Advisory Council, and the Tallahassee-Leon Economic Development Council (EDC) Energy and Environment Roundtable.

Budget: $359,642
Universities: FSU
External Collaborators:

- Florida Reliability Coordinating Council (FRCC)
  - Florida Grid Modeling and Simulation, Utility-University Engagement, including Collaborative Proposals
- FRCC member utilities (most FL utilities, through FRCC committees)
  - Florida Grid Modeling and Simulation, Utility-University Engagement, including Collaborative Proposals
- City of Tallahassee Electric Utility
  - System Restoration Simulation and Analysis

Progress Summary

There has been substantial progress in the development of research-oriented models of the Florida electric power grid, the ultimate aim being models with sufficiently representative in behavior for investigation of wide-ranging scenarios and options in future development of the grid. The analysis of the Florida Power Grid Disturbance has been used as a means for comparing and validating behavior against real grid response. This approach has been demonstrated using an aggregated 14-Bus dynamic model with refinements in the data and protection related switching events, with results matching the recorded data observed in the incident report with minor discrepancies. Results suggest that the reduced, 14-bus model version may be useful, 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.



Rick Meeker of the FSU Center for Advanced Power Systems presenting the Florida Grid project at the FESC Summit.

Though the 14-bus Florida grid model may be sufficient for some simple studies, the project's objective requires a more detailed benchmark system of the Florida grid. Therefore, a 154-bus notional electrical grid of Florida was built with detail representation using data available in the public domain. Reasonable model power flow results have been produced, and, efforts have proceeded 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. Development of a notional dynamic model of the Florida gird is underway, with most of the dynamic data obtained from a variety of public resources. Where lacking complete details on each power 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 model parameters.

The development of a dynamic solar PV model with Maximum Power Point Tracking 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. The depicted bus frequency traces after tripping of a solar PV-power plant at different penetration levels reveal unacceptable frequency deviations.

A simulation effort was completed for a major municipal electric utility in the state to examine power system restoration from a complete system outage. This is expected to continue with further examination of system dynamics under different scenarios and possible development of simulation-assisted training.

Proposals: FOA 313 Smart Grid Topic 3 Voltage Regulation