

CIGRE/EPRI SYMPOSIUM: GRID OF THE FUTURE

Chicago, Illinois - October 11, 2015

Tutorial #1

Electric Grid Resiliency Modeling

Dr. Emanuel Bernabeu, PJM Interconnection
Dr. Yilu Liu, Oak Ridge National Laboratory (ORNL)/University of Tennessee (Knoxville)
Kyle Thomas, Dominion Virginia Power

Tutorial Abstract

This tutorial is designed to provide an overview of probabilistic risk-based modeling and analysis techniques for assessing power system resiliency. The applicability of these techniques spans the electric transmission domain, ranging from power system planning, to system operations, and ultimately to NERC compliance. The tutorial includes content addressing techniques and analysis for both load flow simulations and dynamic simulations; including examples and case studies from a large interconnection-sized power system model.

Course contents include the following:

- Computer simulations of the resiliency of a power system to extreme contingencies, including the total loss of a substation or a defined geographic area.
- New modeling techniques that handle non-convergence of extreme contingencies.
- Simulation of feasible system operator actions during system events, including switching shunt devices, generation re-dispatch, and load shedding.
- Determination of tripping probabilities for transmission lines, transformers, and transmission line relay systems.
- In-depth analysis of new techniques for cascading failure analysis with probability mechanisms.
- Details of possible cascading failure outcomes, including cascading resulting in uncontrolled separation, and cascading resulting in system instability and collapse.

About the Instructors

Dr. Emanuel E. Bernabeu received the B.S. degree in Electronics Engineering from Universidad Católica de Córdoba, Córdoba, Argentina, in 2004, and the M.S. degree in Electrical Engineering, the M.S. degree in Applied Economics, and the Ph.D. degree in Electrical Engineering from Virginia Tech, Blacksburg, in 2009. Currently, he is the manager of Applied Solutions at PJM interconnection. He is also a founding member of mc2 Technical Solutions.

Dr. Yilu Liu is the UT-ORNL Governor's Chair and deputy director of the NSF/DOE engineering research center, CURENT. She is an IEEE fellow and led the effort to create the North American power grid monitoring network (FNET/GridEye) at the University of Tennessee and Oak Ridge National Lab. Dr. Liu is an expert in grid monitoring, modeling, and control. She helped DOE construct the 2030 dynamic model for the Eastern Interconnection and led a number of large system studies in grid frequency response and oscillation control using renewables.

Kyle Thomas received his M.S. degree in Electrical Engineering from Virginia Tech in 2011 and is currently pursuing his Ph.D. while working for Dominion Virginia Power's Electric Transmission Operations Research group. He has technical expertise in power system protection/control, wide-area measurements, fault analysis, cascading analysis/physical security, and system simulations. Kyle is a technical lead of Dominion's synchrophasor installations, applications, and training, and is actively involved in the North American Synchrophasor Initiative (NASPI), IEEE, and CIGRE organizations.