Seminar – Tuesday, May 16, in 109 Rhodes Annex **11:00 a.m. – 12:00 p.m.**

Holcombe Department of Electrical and Computer Engineering Seminar Series

Energy Storage Systems Operation & Control for Grid Resiliency and Enhancing Renewables Energy Penetration

Dr. Sherif Abdelrazek

Smart Grid Engineer
Duke Energy Carolinas

Abstract

The grid is facing new challenges. The proliferation of renewable energy generation on transmission and distribution networks is not only gradually intensifying previously wieldy grid complications but also creating new ones. In the past, utility assets like generators, voltage regulators, capacitor banks and transformers were exposed only to slow-changing voltage fluctuations resulting from the natural change in consumer load, be it residential or industrial. Now these traditional devices are tasked with addressing a new spectrum of grid dynamics caused by intermittent distributed renewable generation. For instance, voltage regulators are now reacting to at least two new dynamics, namely, voltage swells exhibited during peak distributed generation hours, and voltage spikes and transients caused by the intermittent nature of renewables' power profiles. Similarly, conventional peak generation units are increasingly being subjected now to far more severe ramp rates, caused mainly by the coincidence in times of decrement of renewable power (solar power ramp-down) and increment of load (load ramp-up) — also known as duck curves. Further, grid operators are anticipating and even experiencing reverse power flow at distribution substations that can significantly impact the utility's protection schemes because protection relays installed may not have directional capability. Exacerbating an already challenging scenario, the main generation device for most renewable energy resources, namely, inverters, create transients and harmonics that never existed on the grid.

Such thought-provoking challenges presented by increased renewable energy penetration can only be addressed with an equivalently powerful solution only as unique, in its capabilities, as energy storage. This research seminar aims to present a complete battery energy storage management scheme to maximize potential value that can be brought forth to utility medium voltage distribution systems, considering of course the penetration of renewable energy resources at the distribution level. Energy storage systems (ESSs) can accommodate a wide variety of applications, making them a viable solution to enhance grid resilience and enable further penetration of renewables on the grid. However, the current capital cost and cycle life of storage technologies, although improving, are still at a point where only stacked applications operation makes economic sense. The key is manipulation of the active and reactive power capabilities of energy storage systems to achieve multiple value streams and maximize total benefit while maintaining operational efficiency such that battery life is not being compromised. A new patented control methodology for including multiple grid value optimized applications within a single energy storage inverter system will be conferred.

Biography of Speaker

Dr. Sherif A. Abdelrazek is in Duke Energy's distributed energy technologies group supporting utility-scale photo-voltaics, microgrid, energy storage and combined heat and power projects. He received a bachelor's degree in electrical power and machines engineering from Ain-Shams University, Cairo, Egypt, and a MSEE degree and Ph.D. in electrical engineering from the University of North Carolina at Charlotte. Dr. Abdelrazek is currently leading Duke Energy's regulated energy storage integration technical group. He holds three patents, numerous journal and magazine publications, conference proceeding publications and professional presentations.