MICROGRID CONTROLLERS AND THEIR INTERACTION WITH THE POWER GRID

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OVERVIEW

This presentation outlines a new approach to how microgrid controllers can be used to control distribution systems from the bottom up while providing maximum benefit to owners. Fast decoupled real and reactive power flow feedback control at the point of interconnection (POI) to the grid provides control authority over the grid: a concept unheard a few years ago. Microgrids include grid forming inverters, batteries, solar PV, EV charging, fossil generators and controllable loads. The microgrid should operate carbon free most of the time. Microgrids can be arranged in a hierarchy of identical controllers. The SOC profile of energy storage devices is controlled to allow continuous control authority while maximizing the life to the battery.

A local optimizing function determines the optimal SOC profiles for the batteries as well as the optimal PQ profile for the POI flow over a moving 24-hour window following a MPC approach for control. Multiple use cases of microgrids are outlined. The microgrids can be automatically islanded to provide high resiliency for the distribution grid. A method of angle tracking the main grid to providing seamlessly reconnection to the grid is reviewed. Eleven PXiSE microgrids have been installed since 2016 and more are currently being installed. The controller software architecture is a paradigm shift from traditional RTAC control software since it runs at 60 Hz sampling rates without using the traditional Block structures that are common today.

BIO

Chuck Wells is a founding member of PXiSE and has over 40 years of real-time control experience. A military veteran and professional chemical and electrical engineer, Chuck has over 18 U.S. patents, has published 60+ technical papers and has co-authored two books on advanced industrial control. He has founded Silicon Valley startups focused on real-time sensor-based industrial controls and is an expert in synchro-phasor measurements and their applications in the power industry
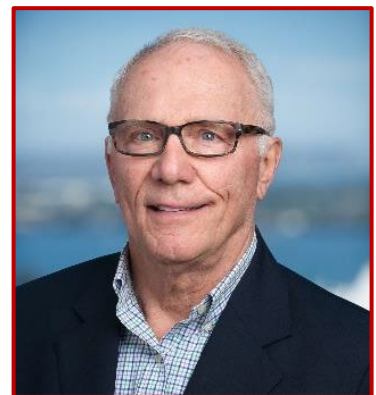
Early in his career Chuck worked on early versions of energy management systems for utility companies including state estimators and advanced SCADA systems. He spent 20 years developing advanced industrial real-time control systems for paper, steel, wastewater, nuclear reactor, and metals and mining applications, including developing advanced sensors for feedback control.

At the Electric Power Research Institute, Chuck worked on advanced distribution modeling and transmission power flow software. At OSIsoft, Chuck patented hierarchical microgrid control systems, grid failure detection, event detection, and wide area situational awareness tools.