Microgrids and Smart Grids for Sustainable and Efficient Energy Development

by
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Ever-increasing demand for energy and increasing concerns about manmade climate changes have called for changes in the ways of electricity being generated and delivered. High penetration of alternative (i.e., renewable and/or clean) energy generation systems and wide adoption of electric drive vehicles (EDVs) will create daunting challenges to the existing grid. The concepts of Smart Grid and Microgrid have been pushed forward as a new paradigm of electrical power generation and delivery in the future to address the challenges. Compared to today’s vertical and central controlled electric networks, a Smart Grid is visualized as an intelligent, automated, and highly distributed energy grid, which allows multiple ways of information and power flows and combines sensing/measurement, communication and control together.

Starting with the review of the challenges in today’s power systems, this presentation will introduce the concepts of Smart Grid and Microgrid and the research activities in the area. This talk will discuss the approaches that are being investigated at WSU to address the above challenges from the following four aspects: Modeling and Control of Smart Grids and Microgrids, Advanced Energy Storage Management, Interactive Demand Side Management (DSM), and Condition Based Maintenance (CBM). Modeling and control of a hybrid wind/photovoltaic/fuel cell system will be given as a case study in the talk. Related ongoing research projects at WSU are also to be addressed.

Dr. Wang received the BSEE and MSEE degrees from Chongqing University, China in 1994 and 1997, respectively, and the Ph.D. degree from Montana State University (MSU), Bozeman in 2006, all in electrical engineering. From 1997 to 2002, he worked as a research engineer and later the vice Chair of the Department of High Voltage Engineering at Zhejiang Electric Power Test & Research Institute, Hangzhou, China. Since August 2006, he has been an Assistant Professor in the Division of Engineering Technology and Electrical and Computer Engineering Department and at Wayne State University (WSU), Detroit, MI. Supported by NSF, DOE, Great Lake Protection Foundation (GLPF), WSU and other sources, he has been teaching and conducting research in the areas of renewable/alternative energy systems, distributed generation systems, Microgrids and Smart Grids, power electronics, plug-in hybrid electric vehicles, and power systems in general. He has authored or coauthored 19 journal papers, numerous conference papers, an invited book chapter, and a full book. He has won awards including an Excellence in Teaching of the Division of Engineering Technology at WSU, IEEE PES EDPG Prize Paper Award, an MSU Foundation Graduation Achievement Nomination Award, and an Honorary Citizenship, City of Bozeman, MT, Award. He is a Senior Member of IEEE, and a member of IEEE Power and Energy Society and Power Electronic Society.