## Wednesday, April 10

### Tutorial 1: Designing WBG Solid-State Circuit Breakers for Ultra-Fast Transient Protection

Advancement in ultra-low impedance battery storage and in WBG power electronic systems has rendered conventional circuit protection simply too slow. This seminar gives an in-depth exploration of Solid-State Circuit Breaker (SSCB) technology for Low and Medium Voltage systems and introduces a design approach to guide the practitioner in addressing ultra-fast transient protection. Special attention is given to both electrical and thermal energy absorption during a short circuit event. Attendees will review an SSCB design example utilizing a 6.5kV/100A/50ns WBG switch.

Presenters: [Doug Hopkins], [Bahji Ballard], [Utkarsh Mehrotra]

### Tutorial 2: Microgrid Hierarchical Controls

This tutorial covers the components and devices, system architectures and controls, ancillary services and grid support, and customer interactions and benefits in the context of microgrids and networked power electronics based systems. This tutorial begins with an overview of the basic power electronics components in a modern power system, and then presents system architecture, stability issues, primary and secondary control, grid synchronization techniques, and interconnection standards for DERs. Enabling communication technologies and few case studies are also presented. Finally, the tutorial will conclude with trends into the future for widespread industrial adoption.

Presenters: [Srdjan Lukic], [Iqbal Husain], [M A Awal], [Hui Yu]

## Thursday, April 11

### Keynote 1

Presenter: [Steven Boyd], US Department of Energy

### Keynote 2

Presenter: Sonja Glavaski, ARPA-E

### FREEDM Updates

Presenter: Iqbal Husain, Srdjan Lukic, Ning Lu

### Session 1A: Power Devices and Packaging

**NCSU Breakthroughs in SiC Power MOSFET Technology, Jay Baliga**

This presentation will cover recent work on creating a ‘national process’ for manufacturing SiC power devices at a 6 inch foundry and on enhancing the performance of SiC devices to encourage market
penetration. Topics covered include PRESiCE, Inversion Channel and Accumulation Channel for SiC power MOSFETs, the JBSFET with integrated Schottky diode, JFET optimization, and the BiDFET, a monolithic bi-directional field effect transistor.

Accelerating Commercialization of SiC Power Electronics, Victor Veliadis
Power electronics is central to the manufacturing economy. Silicon (Si) power devices have dominated power electronics due to their low cost volume production, excellent starting material quality, ease of processing, and proven reliability. Although Si power devices continue to make significant progress, they are approaching their operational limits primarily due to their relatively low bandgap, high conduction and switching losses, and poor high temperature performance. In this presentation, the favorable material properties of Silicon Carbide (SiC) devices will be highlighted with an emphasis on high impact application opportunities including: “more electric aerospace” with weight, volume, and cooling system reductions; automotive power electronics; more efficient, flexible, and reliable grid applications; variable frequency drives for efficient high power electric motors; and novel data center topologies. Cost reduction strategies will be outlined elucidating the path to the projected $1.5B SiC device market by 2023.

Session 1B: Power Systems
Mesut Baran, NC State
Arnie de Castro, SAS
Hong Wang, Oak Ridge National Lab

Session 2A: Microgrid and Renewables
Andy Haun, Schneider Electric
Neil Bhagat, Duke Energy
Jim Musilek, NCEMC

Session 2B: Power Electronics
Johan Enslin, Clemson University
Mike Mazzola, UNC Charlotte
Sandeep Bala, ABB
Subhashish Bhattacharya, NC State

Friday, April 12

Keynote 3

Marija Ilic, MIT

Keynote 4

Gabor Karsai, Vanderbilt

Panel Session on the Future of the Grid

Marija Ilic, MIT,
Sonja Glavaski, ARPA-E,
Gabor Karsai
Shuli Goodman, LF Energy
**Session 3A: Circuit Protection and Controls**

Anup Bhalla, United Silicon Carbide  
Mike Harris, Atom Power  
Patrick McGinnis, Office of Naval Research  
Debrup Das, ABB

**Session 3B: Controls for Next Generation Power Systems**

Brian Johnson, University of Washington

**Optimal Anomaly Detection and Dispatch Response in Transportation Networks, Abishek Dubey**

Much of the research on smart transportation systems has focused on optimal route planning for congestion reduction. However, optimal incident response and anomaly detection are also crucial challenges. This presentation will highlight the development of a decentralized rapid anomaly framework and a holistic approach for effective emergency response by predicting when and where incidents happen and understanding the changing environmental dynamics. Together, this framework describes a system that collectively deals with dynamic transportation problems with models that are updated via streaming data sources.

Kevin Chen, Duke Energy  
Aranya Chakrabortty, NC State
## Speaker Bios

### B. Jayant Baliga, NC State  
**Progress Energy Distinguished University Professor**

Jay Baliga was inducted into the National Inventors Hall of Fame as the sole inventor of the Insulated Gate Bipolar Transistor (IGBT) in 2016. He has authored 23 books, over 600 publications, and holds 120 U.S. Patents. Dr. Baliga received the National Medal of Technology and Innovation from President Obama in 2011 and the North Carolina Award for Science from Governor Purdue in 2012. He received the IEEE Medal of Honor in 2014.

### Steven Boyd, US Department of Energy, Vehicle Technologies Office  
**Batteries and Electrification Program Manager**

Steven Boyd has worked at the US Department of Energy since 2006. In his current position, he oversees research and development projects in hybrid and electric vehicle systems, focusing on electric drive system technologies. Steven received his Bachelor of Science and Master of Science degrees in Mechanical Engineering from Virginia Tech, and participated in DOE’s Advanced Technology Vehicle Competitions while a student.

### Abishek Dubey, Vanderbilt University  
**Assistant Professor, Electrical and Computer Engineering**

Dr. Dubey is co-lead for the Vanderbilt Initiative for Smart Cities Operations and Research (VISOR) as well as Senior Research Scientist at the Institute for Software-Integrated Systems. His research interest is secure and resilient operation of cyber-physical systems with an emphasis on transportation and power networks. He is a senior member of IEEE and has published over 100 peer-reviewed articles. Previously, Abishek developed techniques for diagnosing cyber-and physical faults in breaker assemblies in transmission lines and developed a privacy-preserving proof of concept-distributed system for peer-to-peer energy exchange. He earned his M.S. (2005) and Ph.D. (2009) in Electrical Engineering from Vanderbilt University and completed his undergraduate studies at the Indian Institute of Technology, Banaras Hindu University, India in May 2001.

### Andy Haun, Schneider Electric  
**SVP and CTO for Microgrids Business**
Andy is responsible for aligning Schneider Electric's product portfolio to enable the deployment of effective grid-edge solutions. This includes advanced battery storage solutions coupled with highly efficient inverters. Beginning with Square D Company in 1985, Andy has led a variety of key product development and technical innovations during his 30+ year tenure with Schneider Electric and holds 21 patents relating to circuit protection, relaying and power control. He has a Bachelor's Degree in Electrical Engineering from the University of Iowa and an MBA from Duke University.

**Doug Hopkins**

**Marija Ilic, Massachusetts Institute of Technology**  
**Senior Research Scientist, Laboratory for Information and Decision Systems**

Dr. Ilic is a world leader in electric power systems with hundreds of journal and conference publications. Her research interests span detailed dynamical models of the physical aspects of power systems to high-level issues involving coordination and economics. Her more recent research involves defining the next generation of SCADA systems for power networks that take advantage of new capabilities in sensing and communications. Her previous positions include faculty member at Drexel University, Cornell University, University of Illinois, MIT, and Carnegie Mellon University. She is an IEEE Life Fellow and former NSF Program Director in Power Systems. Marija received her doctorate in Systems Science and Mathematics from Washington University in 1980.

**Victor Veliadis, PowerAmerica**  
**Deputy Executive Director and CTO**

PowerAmerica is a U.S DOE wide bandgap power electronics public-private Manufacturing Institute whose mission is to enable US leadership in WBG power electronics manufacturing, workforce development, job creation, and energy savings. Dr. Veliadis has given over 60 invited presentations and is an IEEE Fellow and an IEEE EDS Distinguished Lecturer. He has 25 issued US patents, 3 book chapters, and 115 peer-reviewed technical publications to his credit. Dr. Veliadis is also Professor in Electrical and Computer Engineering at NC State. He received the five-year diploma degree from the National Technical University of Athens Greece in 1990, and the Masters and Ph.D. degrees from Johns Hopkins University in 1992 and 1995, respectively, all in Electrical and Computer Engineering. Prior to joining PowerAmerica in 2016, Dr. Veliadis spent 21 years in the semiconductor industry where his technical work included design, fabrication, and testing of 1-12 kV SiC SITs, JFETs, MOSFETs, Thyristors, and JBS and PiN diodes. Dr. Veliadis has worked for Lucent Technologies, Northrop Grumman Corporation, and a small startup. He taught at Johns Hopkins University, St. Joseph University, and Ursinus College.