



SMART GRID CENTER

TEXAS A&M ENGINEERING EXPERIMENT STATION



Annual Report September 2019 - August 2020

In this fiscal year, the TEES Smart Grid Center (SGC) focused mostly on four goals endorsed by its Advisory Board: 1) Pursuing research projects funded by the SGC partially based on its membership with companies; 2) Developing strategic large-scale research projects; 3) Developing short courses; and 4) Hosting SGC webinars.

The Director of TEES appointed Dr. Thomas Overbye, Professor, Electrical & Computer Engineering, O'Donnell Foundation Chair III Professor, TEES Eminent Professor, Member of National Academy of Engineering as the new SGC Director taking over from Dr. Mladen Kezunovic, E. E. Webb Chair Professor, Electrical & Computer Engineering, Regents Professor.

Membership of Smart Grid Center

The SGC Membership included the following companies:

- CenterPoint Energy, Full Member

- Entergy, Associate Member
- ERCOT, Full Member
- Texas Co-Op Power (United Cooperative Services, Bluebonnet EC, Farmer's EC, Grayson-Collin EC, Mid-South Synergy), Full Member.

Research Projects Funded by the Center

- "Predictive Outage and Asset Management Decision-making Tool Assisting Distribution Operators", PI: Mladen Kezunovic (ECE TAMU)
- "IoT and Demand Response Impact on Energy Efficiency", PI: Le Xie (ECE TAMU)
- "Application of Deep Learning for Electric Grid Problems", PI: B. Don Russell, Co-PIs: C. Benner, Thomas Overbye (ECE TAMU)
- "Application of Texas A&M Electric Grid Control Center", PI: Thomas Overbye, Co-PIs: Kate Davis and Komar Shetye (ECE TAMU)



Smart Grids Control Room Lab is located at the Center for Infrastructure (CIR) building at the RELIS campus of Texas A&M University System.

- "Impact of Customer Owned Battery Storage on the Grid", PIs: Miroslav Begovic and Chanan Singh (ECE TAMU)

Strategic Project Focus Areas

Cyber-physical security with emphasis on interactions between different critical infrastructures; Big data including weather impact analyses integrated into GIS framework; ... *Continued on the next page*

Smart Grid Center founded in August 2012

This year the focus was on starting Center funded projects partially based on its membership with companies, developing strategic projects and testbeds, hosting short courses and webinars.

Strategic Project Focus Areas, Cont.

Synchrophasors and synchronized sampling technology for Transmission & Distribution applications; Flexible loads including on-site energy storage and distributed generation at different scales; Renewables forecasting with focus on solar and wind generation at different voltage levels; Microgrids; Future whole sale ancillary service products and retail market participation strategies; Synthetic grids; Impact of geomagnetic disturbances on power grid.

New Large Research Projects

“Secure Monitoring and Control of Solar PV Systems through Dynamic Watermarking”, PI: Le Xie (ECE, TAMU); Co-PIs: P.R. Kumar and Prasad Enjeti (ECE, TAMU). DOE EERE awarded \$4.4M to the project for 4 years starting in Nov. 2019. Partners include MIT, CenterPoint Energy, Argonne National Laboratory, and Illinois Institute of Technology. The goal is to develop and demonstrate a cyber-resilient operation for power distribution systems integrating high levels of photovoltaic (PV) generation. An active defense mechanism of the PV distribution system operation will be developed by using a dynamic watermarking technique.

“Multi-layer Cybersecurity and Situational Awareness to Enhance Resiliency in Qatar’s Power Grids”, Lead PI: Haitham Abu-Rub (EE TAMU-Qatar), Co-PIs Narasihma Reddy (ECE TAMU) et al., Partners include Qatar University, TAMU, TAMU-Qatar, Kansas State University, University of Illinois at Chicago, Kahramaa, Hamad Bin Khelifa University. QNRF awarded \$3.2M to the project for 4 years starting in Jan. 2021.

New Advisory Board Members

Three new members joined the Advisory Board of the Center this year:

- Ms. Jennifer Curran, Vice President of System Planning, Midcontinent Independent System Operator (MISO)
- Dr. Danielle Merfeld, Vice President and Chief Technology Officer, General Electric (GE) Renewable Energy, Member of National Academy of Engineering

- Mr. Khalil Shalabi, Executive Vice President, Strategic Initiatives & Transformation, Lower Colorado River Authority (LCRA)

All current Board Members are listed at <https://smartgridcenter.tamu.edu/index.php/advisory-board>

Advisory Board Meetings

- The 15th AB meeting was held at Oncor Electric Delivery in Dallas, TX, on November 4, 2019;



From left to right: Richard Medina, Cameron Smallwood, Gary Rackliffe, Bill Ablar, Miroslav Begovic, Pat Wood, Thomas Overbye, Jeenufer Curran, Kate Davis, Allen Nye, Le Xie, John Pappas, Kirkland Rivers, Khalil Shalabi, Valentine Emesih, Jorge Bermúdez, Mladen Kezunovic

- The 16th AB meeting was held via teleconferencing on April 27, 2020 due to the COVID-19 pandemic developments.

Short Courses

All short courses were held at CIR.

“Electric Grid Dynamics and Stability”, Course director: Thomas Overbye (ECE TAMU). Sep. 24-26, 2019;



Short course was held at Smart Grids Training Room at CIR on Sep. 25, 2019.

- “Big Data Analytics for Outage and Asset Management”, Course director: Mladen Kezunovic (ECE TAMU), Oct. 22-24, 2019;
- “Improving Grid Resilience”, Course directors: Mladen Kezunovic and Thomas Overbye (ECE TAMU). Nov. 12-14, 2019;
- “Automating PowerWorld with Python”, Course director: Thomas Overbye (ECE TAMU). Nov. 19-21, 2019;
- “Cyber, Physical, and Cyber-Physical Electric grid Analysis of Threats, Impact, and Defense”, Course director: Kate Davis (ECE TAMU), Feb. 18-20, 2020.

Webinars Held via Zoom

- “Tracking and Analyzing the Short-Run Impact of COVID-19 on the U.S. Electricity Sector”, Presenter: Le Xie (ECE TAMU), May 27, 2020;
- “New Developments in the Visualization of Wide-Area Electric Grid Information”, Presenter: Thomas Overbye (ECE TAMU). Jun. 24, 2020;
- “The Big Data Analytics: An Incremental Improvement or a Transformational Change”, Presenter: Mladen Kezunovic (ECE TAMU), Jul. 22, 2020;
- “Smart Grid Integration of Modern Distribution Systems”, Presenter: Miroslav Begovic (ECE TAMU), Aug. 26, 2020;

Conference, Workshop

- “Smart Grid and Renewable Energy” (SGRE 2019). The 2nd SGRE International Conference was held in Doha, Qatar on Nov. 19-21, 2019. The topics included renewable energy, power electronics, controls, manufacturing, communications, and computational intelligence.
- “Safe and Reliable Electrical Distribution Systems for Qatar”. The inaugural workshop chaired by Robert Balog, Director of REAPER Lab, was held in Doha, Qatar on Dec. 1-2, 2019.

Publications

- Research results were published in 15 peer-reviewed papers and 36 conference publications by SGC faculty collaborators (as first authors) at SGC main campus.
- SGC-Qatar faculty, staff, and students published (as first authors) 12 peer-reviewed papers, and 14 conference publications.

Selected publications can be downloaded at the Center’s websites.

SGC Websites

Expertise of collaborating faculty members, news on activities, selected publications and more can be viewed at <http://smartgridcenter.tamu.edu>.

For the SGC-Q, news and information on people, projects and publications are posted at <http://www.sgc-q.com>.

Future Plans

- Extending current testbeds for research, education, and industry training;
- Organizing short courses and webinars;
- Hosting a Research Day;
- Recruiting new companies to become SGC Members.