



SMART GRID CENTER

TEXAS A&M ENGINEERING EXPERIMENT STATION



Integrated Smart Electrical Grid System



Annual Report

September 2012 - September 2013

Center Goals

The Center was formed with several goals in mind:

- Help expand government and private sector vision of the smart grid, the next generation of the electricity grid expected to offer enhanced opportunities for energy savings, reliability, security and efficiency in the nation's electricity supply;
- Conduct transformational research to generate new concepts, technologies, and integrated systems for electric energy utilization, conversion, storage, transmission and distribution, and efficient use and consumption in a smart grid;

- Train engineering students and professionals in electric energy related concepts and technologies and motivate TAMUS researchers to generate innovative ideas on how to train the next generation smart grid workforce;
- Study the public policy implications related to electric energy production, implementation of new energy technologies and environmental sustainability in smart grids;
- Initiate and support international collaborative programs with other smart grid initiatives around the world, which are profound and mission critical for economic and social development worldwide;



Director: Dr. Mladen Kezunovic

- Work with partners to seek the broad application of the Center's research, education and innovation for the public benefit; and
- Provide unbiased advice to industry, government and the public on smart grid-related matters.

Assessment Criteria

The Center's goals are:

- Engagement of researchers in the center activities and projects

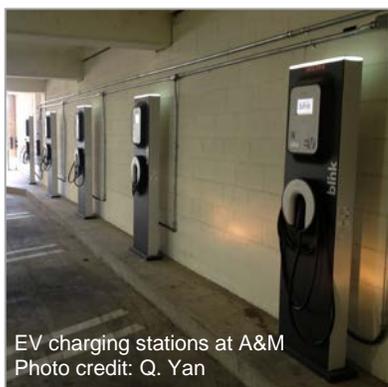
Smart Grid Center founded in August 2012

From September 2012

At present, the Center is ... an umbrella effort with the role to coordinate and facilitate faculty activity in the smart grid area.

- Placement of researchers on national and state advisory boards or committees;
- Journal publications and conference presentations at national and international meetings;
- Industry contacts and research contracts
- Distinguished lecture series and other notable visitors to campus;
- Collaborations to solve significant problems in smart grids;
- Technology transfer activities (disclosures, patents, etc.);
- Research proposals submitted for major funding opportunities.

At present, the Center is not an organization with formal structure and well defined faculty collaborative engagement, but it is rather an umbrella effort with the role to coordinate and facilitate faculty activity in the smart grid area. Hence, the center's goals should be interpreted in that context.



Major Accomplishments

New research awards to the Center

- Robert Balog, Le Xie and Steve Puller (Co-PIs) were awarded an interdisciplinary TAMU education grant to develop a student-oriented, experiential interdisciplinary approach to inspire future leaders in the energy sector and empower an educated, smart energy consumer to participate in the future smart electricity grid;
- PSerc Project, Mladen Kezunovic (PI) "Systematic Integration of Large Data Sets for Improved Decision Making";
- Le Xie (Co-PI), PSerc Project, M. Ilic (PI) "Towards Standards for Dynamics in Electric Energy Systems";
- Le Xie (PI), Evdokia Nikolova (Co-PI), NSF Grant. "CyberSEES: Coupon Incentive-based Risk Aware Demand Response in Smart Grid".

Existing awards

Three major existing collaborative efforts have been coordinated under the Center's umbrella:

- Mladen Kezunovic (PI) \$5.5 million ARPA-E RATC Project.
- Mladen Kezunovic (Co-PI) \$1.3 million subcontract award from ABB to TEES (\$4.3million DOE Award to ABB) for distribution automation project.
- Mladen Kezunovic (Co-PI) \$2 million, 5-year NSF I/UCRC award for EV-TEC consortium.

Student awards

- *Adolfo R. Escobedo-Pinto (Supervisor: Erick Moreno-Centeno, Industrial & Systems Engineering), Conoco-Phillips Fellowship from Texas A&M Energy Institute for his works titled "Efficient Algorithms for Load Shed Recovery with Transmission Switching" and "Revenue-adequate Financial Transmission Rights for Flexible Topologies".*



The First Smart Grid Workshop was held at the Annenberg Presidential Conference Center, TAMU



Engagement of researchers in center activities and projects

1. **Organizing A&M Faculty for collaboration on larger proposals/projects (First Smart Grid Workshop, April 17th, 2013).** The Workshop effort was initiated with the theme "Collaboration" to create a venue for A&M faculty, research staff and students to participate and exchange ideas relevant for future collaboration. With the support of many, the Workshop was organized under the auspices of the Dwight Look College of Engineering and Department of Electrical & Computer Engineering (ECE), as well as several A&M-wide administrative offices: resident/Provost, VPR, College of Engineering, and A&M Energy Institute.

Research and development initiatives of 58 faculty members were highlighted at the First Smart Grid Workshop, which brought together faculty, staff and students to increase awareness, facilitate scientific exchange leading to collaborative proposal teams and improve the teaching, research and development activities across disciplines in electric transmission, alternative generation sources, storage, grid monitoring, cyber-physical security, policy, economics and other related fields. There were more than 150 participants in the workshop.

The workshop included presentations by key governmental and private-sector leaders in the smart-grid: Dr. George W. Arnold, National Coordinator for Smart Grid Interoperability at the National Institute of Standards and Technology, John D. McDonald, Director for Technical Strategy and Policy Development at General Electric Company, Digital Energy, and Pat Wood, III, Principal of Wood3 Resources and Chairman of the Board for Dynegy Inc. The full program of talks and posters can be viewed [here](#). Further publicity on the event can be viewed [here](#) and [here](#).

To September 2013

Second Smart Grid Workshop is being planned to be held on April 8th, 2014.

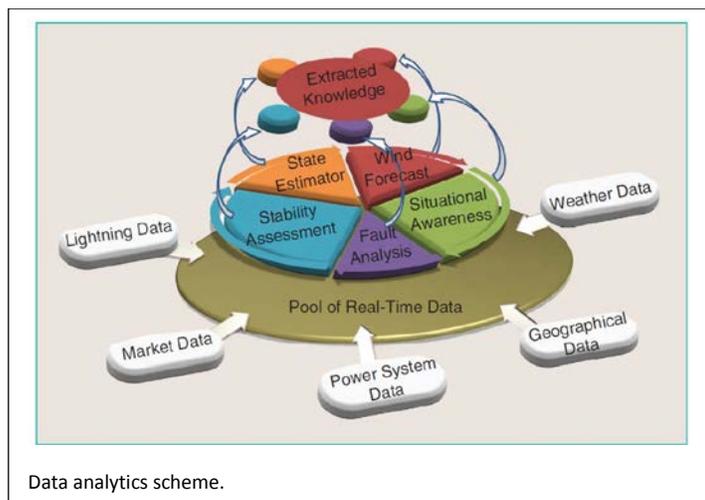
2. **Organizing A&M Faculty for partnership with industry, the Second Smart Grid Workshop is being planned to be held on April 8th, 2014.** The Director initiated this new event with the theme “Partnership” in particular to prepare white papers reflecting partnership of faculty members and industry.

Submitting collaborative research proposals for major funding opportunities.

A research pre-proposal titled “Engineering Research Center for Flexible Load Energy eXchange (FLEX)” was submitted to the NSF on July 30, 2013. This partnership proposal brings together 30 researchers from five universities (Texas A&M, Berkeley, GaTech, Howard and Smith), and two federal labs (LBNL and NREL). TEES is the leading institution and the Center Director is the PI.

Promoting A&M portfolio of SGC research (white papers and collaborative proposals)

1. PSERC proposals. Ten research proposals with involvement of six A&M faculty members have been developed and sent to the industrial partners of the Power Systems Engineering Research Center (PSERC) for reviews in 2013 solicitation.
2. Collaboration with National Instruments (NI). Several conference calls and visits took place where future collaboration in the smart grid area was discussed.
3. Collaboration with IBM. Six white papers on research topics of common interest are being developed jointly with IBM research staff for possible collaborative research proposal efforts.



4. Optimization of energy resources on A&M Campus. A white paper is being developed to be submitted to the Kresge Foundation. The targeted focus area is “Supporting next-generation approaches” in “Energy efficiency and renewable energy”. Several faculty members are involved in this area. Originally, this effort was initiated, coordinated and facilitated by the SGC Director under the Smart Energy Campus Initiative: <http://smartgridcenter.tamu.edu/seci/>. Donations have been attracted for installation of over 30 EV charging stations at the A&M campus so far.



5. Strategic smart grid roadmap including education. Two SGC researchers, Dr. Chanan Singh and the SGC Director were involved in the DOE/PSERC initiative titled “The future grid to enable sustainable energy systems”. Further details are available on the PSERC website <http://www.pserc.wisc.edu/>. This DOE/PSERC project is a \$2.5 million initiative that involves over 20 PSERC researchers. The SGC Director also acts as the Site Director for the PSERC NSF I/UCRC and actively participates in PSERC’s Executive Committee (EC) meetings representing A&M. The EC is responsible for setting the direction and making major decisions for PSERC.
6. Stormwater harvesting and irrigation water recycling while using green energy and flexible loads of water pumps. An interdisciplinary pre-proposal has been submitted for a TAMU seed funding program “Research, Engineering, and Deployment of Water-Use Efficient Technology Platforms”. This pre-proposal is a joint effort of faculty members from ECE (Smart Grid Center), Civil Engineering, Biological and Agricultural Engineering and Soil & Crop Sciences with co-lead of the Center Director.
7. Promotion of SGC efforts within A&M. The Center Director has given presentations to four COE departments (ECE, Nuclear Engineering, Computer Science and Engineering Technology), the staff members of the Office of President/Provost, VPR, and CPI, and to government liaisons representing A&M in Washington DC and Austin.

Facilitating industry contacts and research contracts.

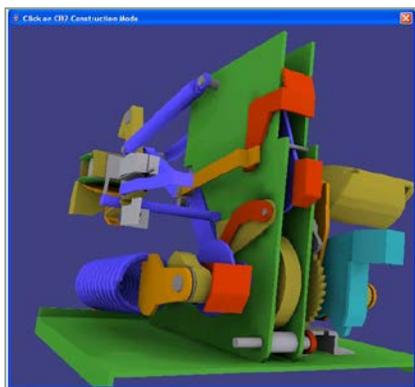
The Director has established contacts with several prospective partners that may be critical for future collaborations:

Domestic

- National Renewable Energy Laboratory (NREL). The Center Director visited NREL in October, 2012 and gave a comprehensive presentation about A&M faculty capabilities in the smart grid area and engaged in day-long discussions how to foster collaboration between NREL and A&M. As a result, the NREL management team is expected to visit A&M in the near future.



Display of calculated fault location on a Google Earth satellite map.



Animation of circuit breaker operation using data analytics results.

Automated data analytics solution is the key to efficient use of intelligent electronic device (IED) data.

-Popovic & Kezunovic, 2012

IEEE Power & Energy, September/October 2012, 59 – 69.

Establishing SGC Advisory Board

Seven key persons have been identified and their commitments to serve on the Board have been received. The search for five more Board members is underway.

(Continued from page 3)

- Lawrence Livermore National Laboratory (LLNL). The Center Director visited LLNL in February, 2013 and engaged in a discussion of how to possibly sign a partner agreement between LLNL and TEES.
- IBM. The Center Director visited the T.J. Watson Research Center and gave a talk about A&M capabilities, and discussed ways how the two centers may develop collaborative efforts in the future. Prior to this, a visit of technical staff from IBM Center in Austin to A&M was arranged and possible joint efforts were discussed with several ECE faculty. After that, IBM research team from Austin visited A&M and discussed few specific projects as candidates for collaborative efforts. Discussion with IBM corporate team will continue to define research themes of joint interest.
- National Instruments. The Center Director invited NI management team to visit A&M and several conference calls were conducted as a result of an agreement to pursue further collaboration in preparation for joint proposal opportunities.
- Southwest Research Institute. The Center Director visited Southwest Research (SRI) in San Antonio and discussed future collaborative efforts.

International

- The Center Director was invited to give talks and discussed future collaborations in China, Croatia, England, Ireland, France, Korea, Mexico, Portugal, Serbia, and Sweden.
- Future visits are planned to Brazil and Qatar. The Center Director and Acting Department Head of ECE are planning to visit over half a dozen universities in Brazil that have strong power system programs. The visit is targeting future collaboration through exchange of students and preparation of joint proposals. The Center Director is planning to visit TAMUQ to discuss future collaborative research efforts between the Smart Grid Center in Qatar and the Center in College Station.

Developing relationships with Foundations.

The Kresge Foundation has been contacted to get pertinent information for a smart grid-related project.

Water Environment Research Foundation provided information on potential opportunities to fund projects to improve integrated water and energy conservation.

Working on industry outreach activity (consortia, distant education)

- Collaboration with IncSys. A joint proposal with IncSys, a private firm that specializes in training of power grid operators was submitted to DOE.
- Collaboration with University of Guanajuato, Mexico. Efforts are underway to organize a visit to this university and develop joint research and industry training effort in the energy area. This effort is also aimed at offering a joint training program for CFE (National utility company in Mexico).

The SGC speaker series. The SGC speaker series has two categories: distinguished speakers and invited seminar speakers.

- Distinguished speaker series. The SGC distinguished lecture series featured Dr. Gerald Heydt from Arizona State University, who gave a talk on September 4, 2013.
- Invited seminar speakers. This effort is jointly organized with the seminar coordinators for the Electric Power and Power Electronics (EPPE) group. A total of 9 speakers were featured last year.

Collaborations to solve significant problems in smart grids. Currently the Center is addressing three major questions raised in the industry as key problems that need better solutions than what is available today:

- Security and economic operation of the transmission grid under high penetration of intermittent renewable generation resources. The RATC project funded by ARPA-E is addressing this critical concern. Over 30 researchers from seven partner organizations are involved in this project. The PI for this project is the Center Director. The project website is: <http://smartgridcenter.tamu.edu/ratc/>
- Distribution automation capabilities to address outage recovery (restoration) in distribution networks. The subcontract from ABB is addressing this issue. The project involves over a dozen researchers from three partner organizations. The PI for the ABB subcontract is the Center Director. Final report was issued in 2013.



Future Plans

September 2013 - February 2014

Collaborations to solve significant problems in smart grid, continued.

- Energy sustainability and synergy between transportation and electricity networks. The NSF I/UCRC EV-TEC is addressing this concern. Two universities and over a dozen industry and university faculty members are involved in this research. The SGC Director is also the Deputy Director of this NSF Center. The Site Director is Dr. Merhdad Ehsani. The EV-TEC website is: <http://ev-tec.org/>

Publications

Peer-reviewed papers: 12; Book chapters: 2; Conference papers: 9; Project reports: 6.

Future Plans (Fiscal year 2014, 1 - 6 months)

- ERC Proposal Preparation. The Director has done the ground work in identifying the topic and partners. As of now, NSF has not yet responded to the ERC proposals.
- The Second SG Workshop. This effort is in its initial stage so major efforts on the part of the Director are needed with assistance of the Center Administrator.

- Contacts with Existing and New Partners. This is a continuous effort. The SGC Director will make such contacts as he travels around the USA as well as to Europe, and Far East.
- Exploration of New Funding Opportunities. The Director has identified two major funding opportunities for collaborative research (FOA 0000767-Synchrophasor Training and FOA 0000797-Cybersecurity for Energy Systems). White paper to the Kresge Foundation will be further developed. A preliminary proposal to the TAMU seed funding will be developed.
- Completion of Advisory Board. Five additional experts in the field will be selected, the list will be shared with the TEES Deputy Director for Research for final approval, and the first meeting will be held in December 2013.

More information can be found at the website of Smart Grid Center: <http://smartgridcenter.tamu.edu/sgc>