Electric Power Research Center (EPRC)

Overview: EPRC is a catalyst for collaboration among ISU faculty, the power industry, state agencies, national labs, federal agencies and national trade associations, on research and technology transfer to solve the most challenging problems of the electric grid. EPRC power industry members jointly select and fund projects of common interest to the group. EPRC and members also participate in DOE and NSF grants, as well as grants from non-profits and state agencies.

History: EPRC began in 1963 as the Power Affiliate Research Program, founded to advance education and research in electric power systems, and strengthen industry ties to the ISU power program.

Governance and Budget: EPRC is advised by a Technical Advisory Committee (TAC) of industry members. Its budget comes from member fees, grants and continuing education courses. Funds are used primarily to fund graduate student research and develop professional education for technology transfer.

Meetings: EPRC meets with its members twice a year to provide research updates and choose new projects.

Membership: Full Membership is an annual contribution of $25,000 or more and allows the member to appoint a representative to the TAC with one full vote per $25,000 block. A Contributing Membership level is flexible, typically at least $5,000. A Contributing Member has a representative at the TAC meetings and has a fractional vote proportional to their level of contribution.

Current Members: EPRC has nine industry members: Alliant Energy, the Central Iowa Power Cooperative, the City of Ames, the City of Bloomfield, the City of Cedar Falls, Corn Belt Power Cooperative, ITC Midwest, MidAmerican Energy, and the Midcontinent Independent System Operator (MISO).

Research teams: include faculty from Electrical and Computer Engineering (power engineering and cyber security), Industrial and Manufacturing Systems Engineering, Materials Science and Engineering, Mechanical Engineering, Civil, Construction and Environmental Engineering, Statistics, Economics, and Geological and Atmospheric Sciences. Industry advisors participate in developing and reviewing projects.

Research topics: Research reflects challenges arising from a rapidly changing power industry and changes in standards and markets. Recent projects include development of new tools to improve grid reliability and security, optimization of generation resource planning focusing on renewable integration, studies of risk management in wholesale and retail power markets, improvement of meteorological models for wind forecasting, design of new aluminum composite conductor, the impact of smart grid developments on markets and transmission planning, development of condition-based maintenance tools, and resiliency planning for distribution systems.
EPRC-funded Projects 2010-2019

**Power System Operation and Planning**

- **2010-2011** Generation Expansion Planning: Portfolio Optimization
- **2010-2012** Analysis of very low frequency oscillations
- **2010-2011** Optimal allocation of dynamic VAR sources for enhancing power system dynamic security
- **2010-2011** Embedded sensor network and decision algorithms for robust power system
- **2011-2013** Optimal online control strategies to maintain high voltage security in large scale power systems
- **2012-2014** Measuring stress across an area of a power system with area angles
- **2013-2015** PMU-based real time short term stability monitoring transmission planning and defense plans
- **2014-2016** Fast monitoring of voltage collapse and cascading outages with PMUs
- **2015-2017** Opportunities and Benefits for Deploying VSC-Based HVDC
- **2015-2017** Development of integrated software to study impact of distributed generation on grid reliability
- **2015-2018** Real-time monitoring and control of long-term voltage stability with high wind penetration via local linear regression
- **2016-2018** Power Grid Resilience: Assessment, Enhancement and Outage Management

**Ongoing projects FY19**

- **2015-2019** Assessing the impacts of geomagnetic disturbances on Midwest transmission system reliability
- **2017-2019** Impacts of power transformer overload ratings on transformer reliability and life
- **2018-2019** Coordinating Conventional Voltage Control Devices with Smart Inverters in Rural Distribution Networks with DER Penetration.
- **2018-2019** High-Fidelity Performance/Degradation Modelling of Utility-Scale Battery Energy Storage Systems

**Markets**

- **2010-2012** Financial and Operational Risk Management for Restructured Wholesale Markets
- **2010-2012** Forecasting sales of PHEVs and PHEV users’ recharging behavior
- **2010-2013** Integrated retail and wholesale power system operation with smart-grid functionality
- **2012-2014** Risk assessment of unit commitment cost under uncertainty
- **2015-2016** Integrated Distribution and Transmission Effects of Demand-Response Initiatives

**Wind modeling**

- **2010-2011** Impact of wind power on control performance standards and frequency regulation contributions of DFIG wind generators
- **2010-2011** Design of a meteorological model ensemble forecasting system for improved wind energy forecasting
- **2011-2013** Resource to backbone transmission design for very high wind penetration
- **2013-2015** Wind turbine generator and wind power plant modeling
- **2014-2016** Leveraging a geographic information system in high wind penetration transmission design

**Ongoing project FY19**

- **2016-2018** Functional assessment of DFIG and PMSG-based wind turbines for grid support applications.

**Materials**

- **2011-2013** Developing high conductivity, ultralight hi-strength aluminum composite conductor.
- **2013-2015** Phase 2 development of a stronger, lighter, more conductive high voltage transmission conductor material.