DOE/OE Transmission Reliability Program

Real Time Applications Using Linear State Estimation Technology (RTA/LSE)

Ken Martin & Lin Zhang
Electric Power Group
martin@electricpowergroup.com
zhang@electricpowergroup.com
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Presentation

- Introduction & background
- Objective
- Project plan & diagrams
- Timeline
- Past & future planned activity

Introduction

- Project: Real Time Applications Using Linear State Estimation Technology
  - DOE Grant Award DE-OE0000849
- Primary recipient: Electric Power Group, LLC
  - Principal Investigators: Ken Martin & Lin Zhang
- Project Partners (cost-share & host site):
  - Bonneville Power Administration
    - Project lead – Tony Faris/Thong Trinh
  - New York Power Authority
    - Project lead – Atena Darvishi/Alan Ettlinger

Advisors & observers

- Project Advisors
  - Anjan Bose – Washington State University
  - Ian Dobson – Iowa State University
  - Dejan Sobajic – Grid Engineering
  - Anurag Srivastava – Washington State University
- Project Observers
  - Dominion Virginia Power (Dominion) - Kyle Thomas
  - Duke Energy - Megan Vutsinas, Tim Bradbury
  - Peak Reliability - Hongming Zhang
  - PJM - Emannual Bernabeu, Ryan Nice

Background

- Utility industry faced with increasing complexity from renewable resources, distributed generation, and market driven power exchanges
  - Power flows difficult to predict
  - Grid stability threatened by unusual configurations
- Utilities have a large investment in synchrophasor infrastructure through DoE & other programs
- Phasor measurement offers increased visibility, faster response, & reliable state estimation
- Phasor measurements can help address these problems with new applications

Project Objective

- Develop Real Time Applications Using Phasor Data and Linear State Estimator Technology
  - Provide operators with actionable intelligence on contingencies, voltage margins, & phase angle limits
- Applications include
  - Real Time Contingency Analysis
  - Area Angle Limit Monitoring
  - Voltage Stability Monitoring

Project Plan

- Technical approach:
  - Develop Real Time Applications Platform
  - Implement & test targeted applications
  - Demonstrate at participating utilities
- Implementation:
  - Survey utilities on RTCA use
    - Identify essential features & gaps in current technology
  - Develop implementation plans for new applications
    - Area angle & Corridor voltage stability
  - Develop applications & test
  - Develop marketing plan

Data Flow Diagram

Application Components

- R/T measurements are validated and conditioned through eLSE
- Voltage stability and angle across key corridors are assessed in real-time
- Stability is periodically assessed through a real-time contingency analysis program
- Results are communicated to system operators

Real-time Assessments

- Area angle
  - Define power transfer area – input & output points
  - Compute and monitor angle
- Voltage transfer corridor
  - Define corridor – input & output points
  - Collapse multiple lines into single equivalent through phasor values
- Both techniques rely on phasor measurements to simplify problem for real-time action

Unique Benefits

- Real-time contingency analysis (RTCA)
  - Used extensively, an essential utility activity
  - Phasor measurement based RTCA:
    - Uses output from LSE which always solves
    - Independent solution, backs up EMS based RTCA
    - Couples into phasor based stability applications
- Angle limit & voltage stability applications
  - Take advantage of phasors to increase reliability
  - Bring research into utility tool set
  - Support electric power system development

Project Timeline

Task	Deliverable	Completion Date	Submission Method
1	**Project Management Plan**	4/12/2017	Project management plan document
2	**Research, Design & Development of Prototype**		
2.1	*RTA/LSE Design & enhanced LSE implementation*	7/28/2017	Design specification document
2.2	*Offline study*	9/6/2017	Offline study report
2.3	*Real time applications prototype, and development and testing*	1/19/2018	Test cases and test results documents
2.4	*Prototype Demonstration for DoE and all the participants*	3/16/2018	Demonstration at EPG
3	**Deployment, Testing & Acceptance**		
3.1	*Factory Acceptance Test*	5/4/2018	Test cases and test results documents
3.2	*Site Acceptance Test*	9/28/2018	Test cases and test results documents
4	**Demonstration at utility host site, training and a report**	12/7/2018	Demonstration, training and report
5	**Marketing and Outreach**		
5.1	*Marketing Plan*	2/1/2019	Marketing plan
5.2	*Outreach*	3/14/2019	Industry presentations and briefing documents

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Accomplishments

- Project signed March 15, 2017
- Official kick-off meeting April 13, 2017
- PMP updated and approved
- Project Design under development
  - Site visits to BPA and SCE for review of RTCA
  - Requirements specified
  - Development of voltage stability and area angle applications including discussion with Prof. Ian Dobson
  - Reviews and discussions with project advisors

Project Activity Plans

- Activities through FY 2017 (Oct – Sept)
  - Complete project design document
    - Underway, completion by July 28
  - Design Real-Time monitor applications
    - Test with sample data
  - Obtain & convert host utility system models for LSE
    - Perform off-line studies for RTCA
- Future activities
  - FY 2018: Complete application development & deploy at host sites
  - FY 2019: Host site demonstrations with real-time operation & produce commercialization plan

Questions?