

Florida Power & Light Company Smart Grid Investment Grant Update

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SynchroPhasor Initiative



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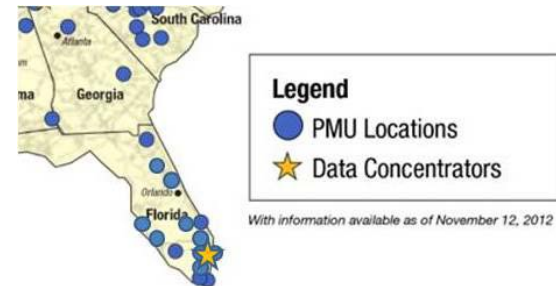
Project Participants

- Lead sponsor
 - Bob Triana, Bob.A.Triana@fpl.com
- Project TO
 - Florida Power & Light Company
- Other partners, consultants and contractors
 - Alstom

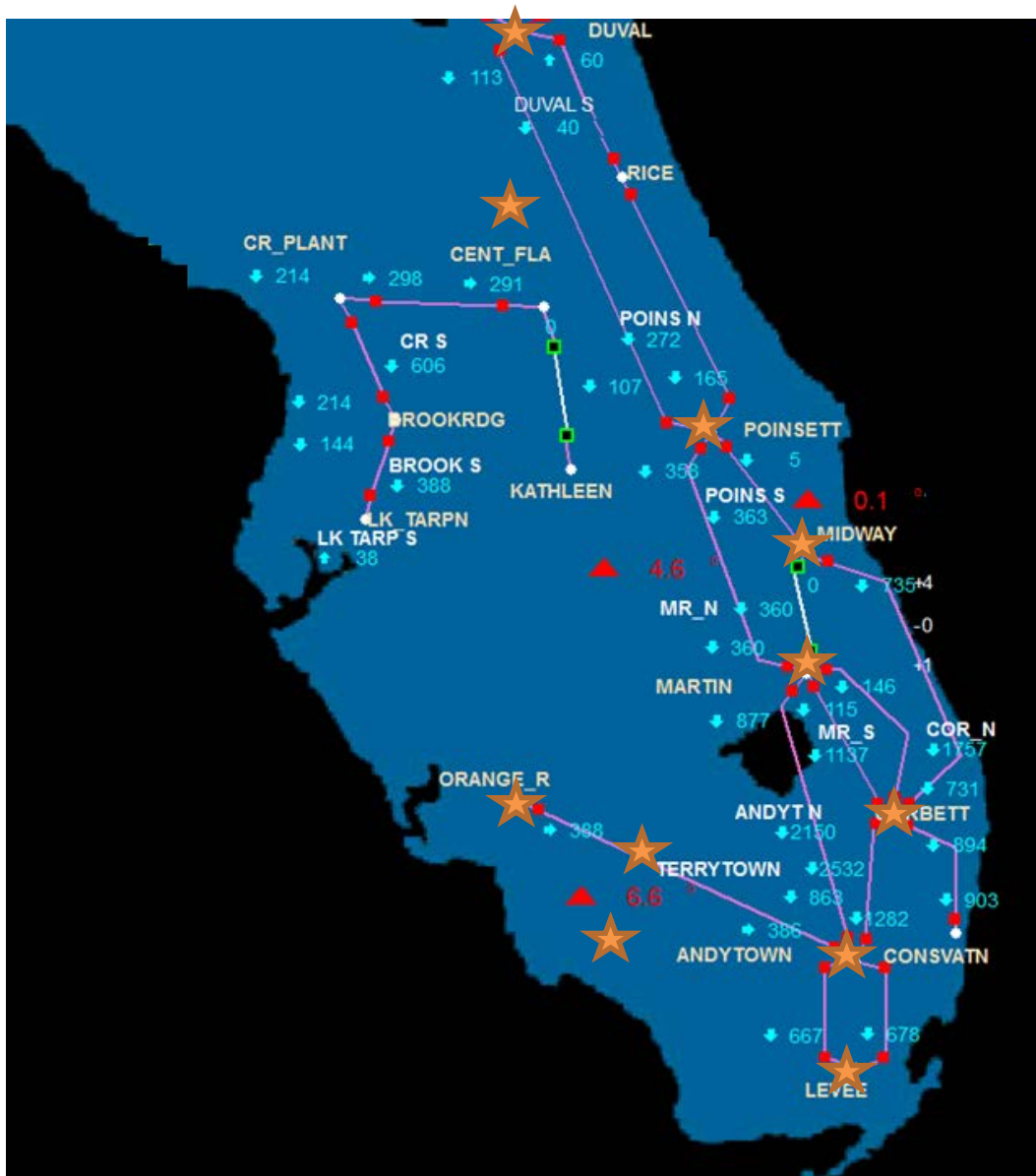
Project Timeline

- ❖ Executed 45 projects to install PMUs at 13 transmission substations throughout the system
- ❖ Deployment plan based on System Planning assessment of key grid locations
- ❖ Timeline

Year	2010	2011	2012	Total
PMUs	7	19	19	45



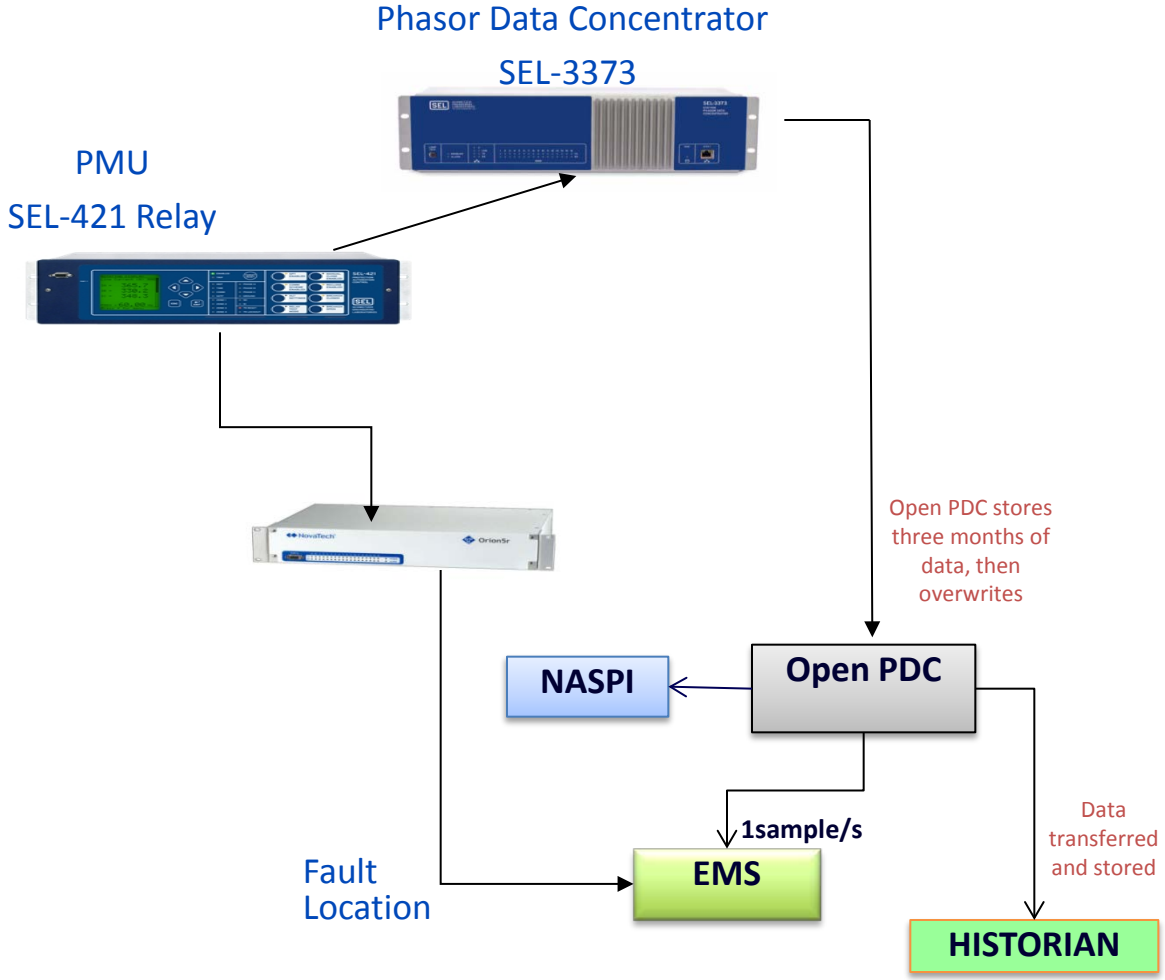
Project Map



★ PMU



PMU Data Communication Structure



Project Priorities From Here?

- What are the most important tasks and applications ahead for your project?
 - ❖ Control room Visualization;
 - ❖ PMU data integrated into EMS system.
- How are phasor data applications being used (or will be used) in your control room?
 - ❖ Frequency Response Application;
 - ❖ Validation of State Estimation;
 - ❖ Phase Angle Reclosing Monitoring;
 - ❖ Voltage Unbalance Checking;
 - ❖ Conservative operation (future EMS backup).
- How are phasor data applications being used (or will be used) by your planners?
 - ❖ Post-event Analysis;
 - ❖ Model Validation.

Success Stories So Far

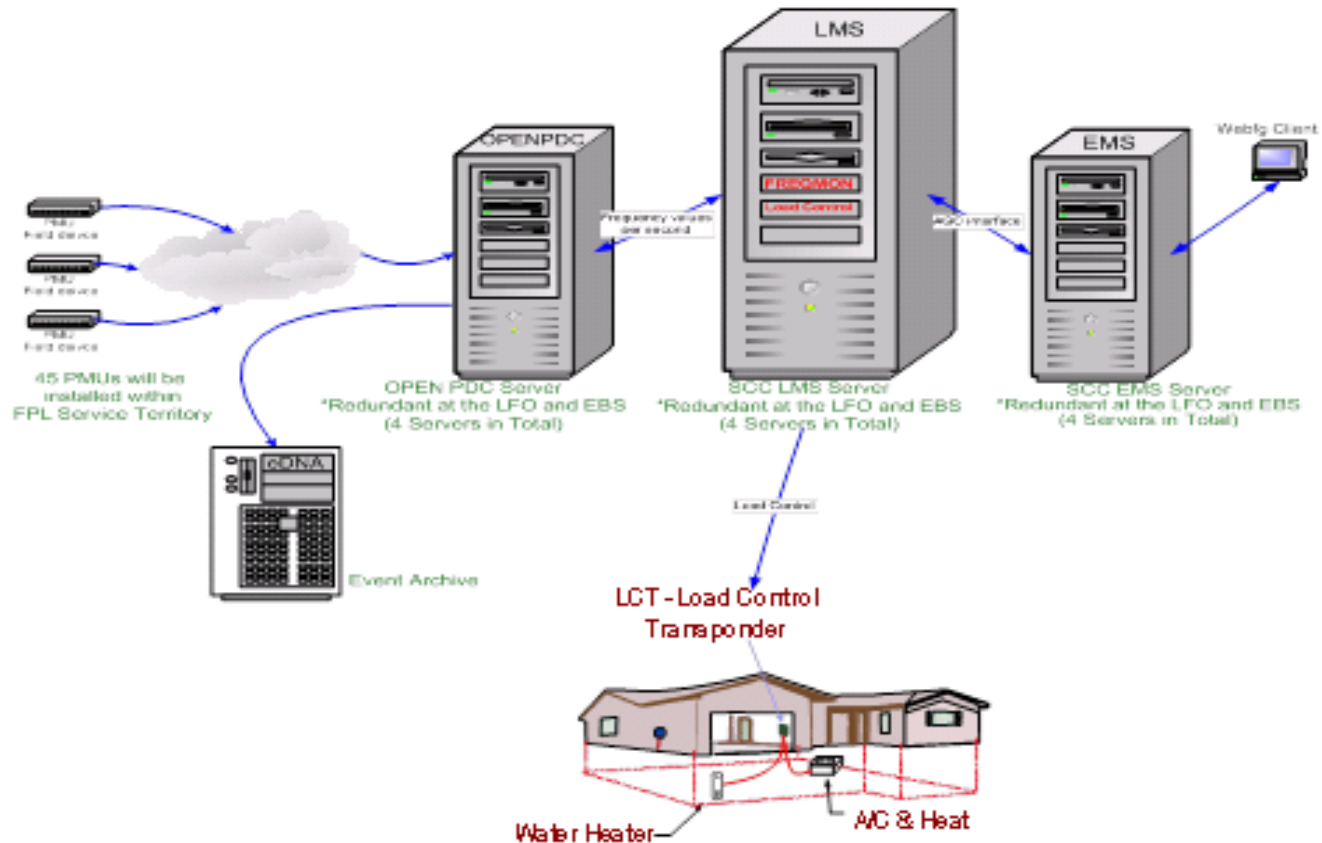
PMU measurements enhance situational awareness for operators especially during high load conditions that require large power transfers using the transmission network; PMU measurements can be used in other reliability analysis applications to warn of potential power system problems or instabilities developing in the transmission grid.

Case 1: Frequency Response Application

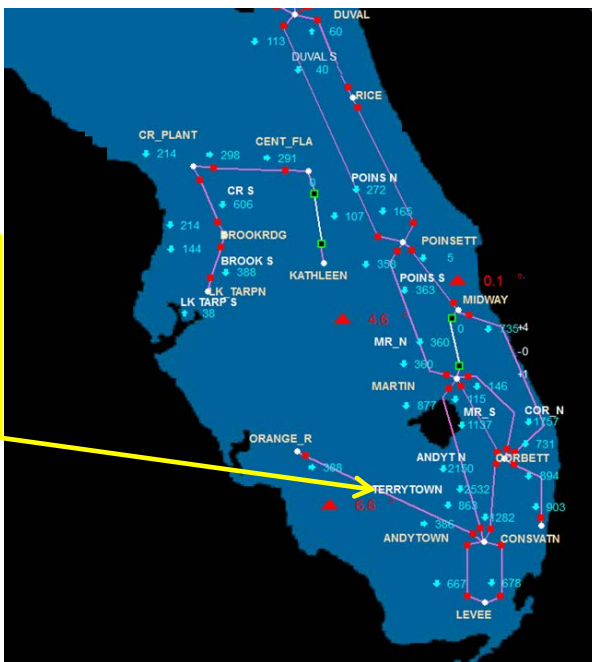
Case 2: State Estimation Validation

Case 3: Phase Angle Reclosing Monitoring

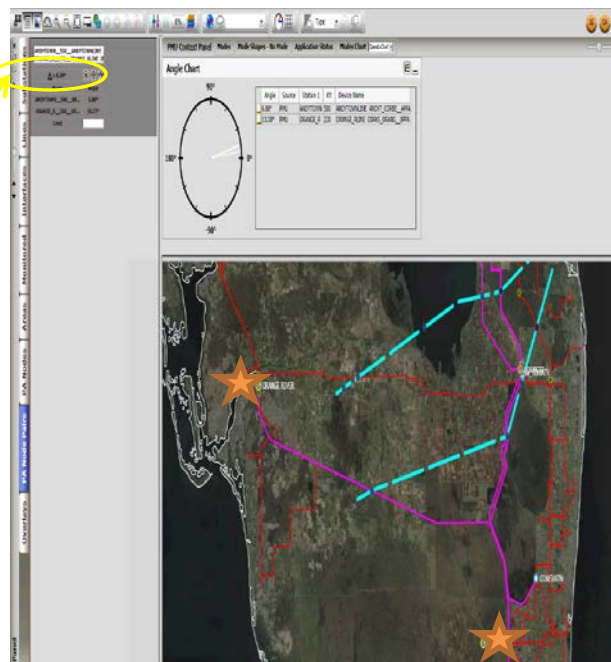
Case 1: Frequency Response Application



Case 2: State Estimation Validation



Angle difference calculated by State Estimator (SE) is 6.6°



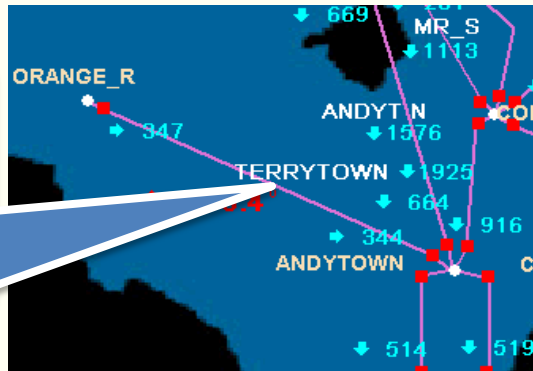
Real time PMU angle is 6.39°

❖ Compared Key 500kV Stations PMU measured angle difference V.S. State Estimator estimated

Case 3: Phase Angle Reclosing Monitoring

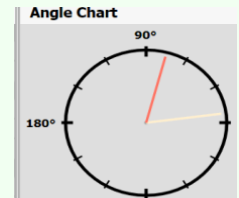
Before

Phase angles are estimated using the State Estimator application. Large power transfers will result in larger angle differences.



- Phase angles are **ESTIMATED** and dependent on accuracy of the State Estimator (SE) application within the Energy Management System (EMS)
- Phase angles are critical information for operators

Current



- Phase angles are **MEASURED** directly by PMU's
- Operators have the ability to see the phase angle data via enhanced graphical and dynamic displays

Challenges and Lessons Learned

- What have been your biggest technical challenges?
 - ❖ Communication: bring in real time data
- What have been your biggest programmatic or execution challenges?
 - ❖ Data Interface and visualization
- Research needs – what do we need to figure out next?
 - ❖ PMU data integrated into EMS system
 - ❖ Do we need more PMUs? Where?

Synchrophasor Training

- ❖ Treated as any other measurement
- ❖ Specialized training only on specific applications: i.e. determination of reclosing angles
- ❖ New applications introduced through weekly training or semi-annual RC certification training

Question?

