

Florida Power & Light Smart Grid Investment Grant Update

North American Synchrophasor Project Initiative
NASPI Work Group Meeting
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Overview

- **Utilize Phasor Measurement Units (PMUs) as part of Energy Smart Florida (ESF) project for disturbance monitoring, event analysis, verification of system models and enhanced situational awareness**
- **Install 45 PMUs at 13 Transmission stations**
 - Two previously installed PMUs currently in service
- **Phasor Data Concentrators (PDCs)**
 - Several PDCs, one super PDC
- **Employ a Transmission Line Type Relay as a dedicated PMU**
 - Monitoring, no protection or control functions
- **Funded by the Smart Grid Investment Grant Program from the DOE**

Expected Benefits of PMUs

- Provides wide-area situational awareness for system operators
- Aids in determining available system margins
- Helps determine stress points of the Transmission system by monitoring phasor quantities
- Detects and aids in restoring an islanded section of the grid after a storm or major outage disturbance
- Provides post-disturbance analysis capability
- Enables visualization of PMU data for system operations to be incorporated into the Energy Management System (EMS)
- Supports distributed generation
- Provides data to be added to FPL's existing participation in the North American Synchrophasor Project Initiative (NASPI)
- Improves state estimation and accuracy of EMS applications as direct data is more accurate and overcomes modeling delays

Project Plan

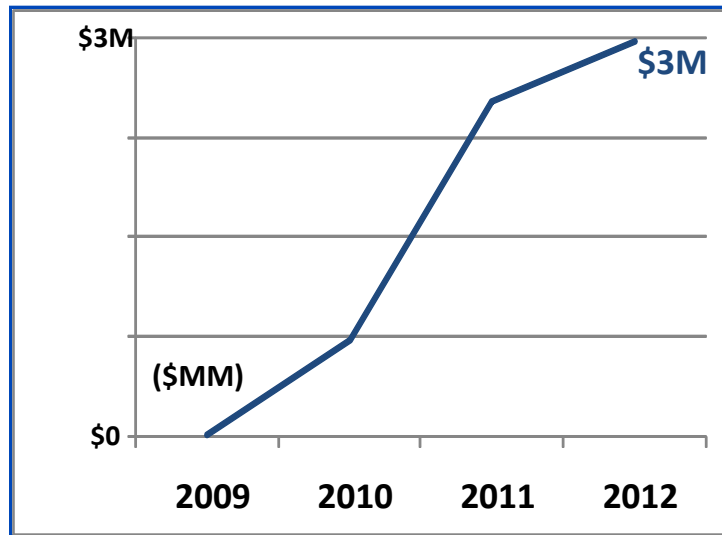
Phasor Measurement Installations part of ESF

2010: 7 units

2011: 25 units

2012: 13 units

Projected Phasor Measurement Expenditures



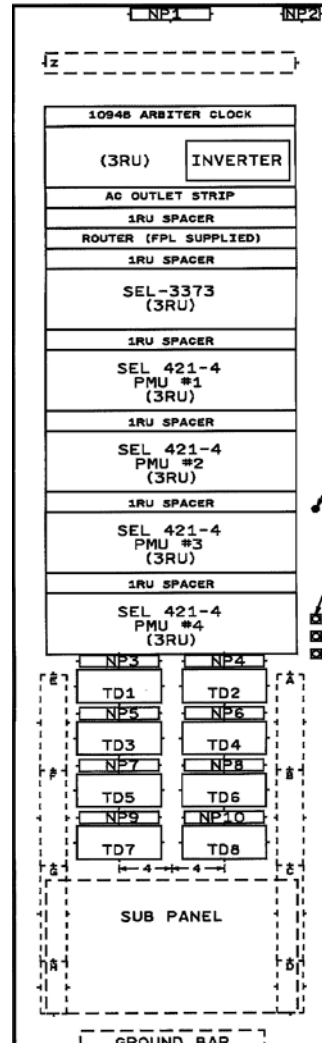
Phasor Measurement Units (PMUs)

Synchrophasor Panel

Phasor Data Concentrator



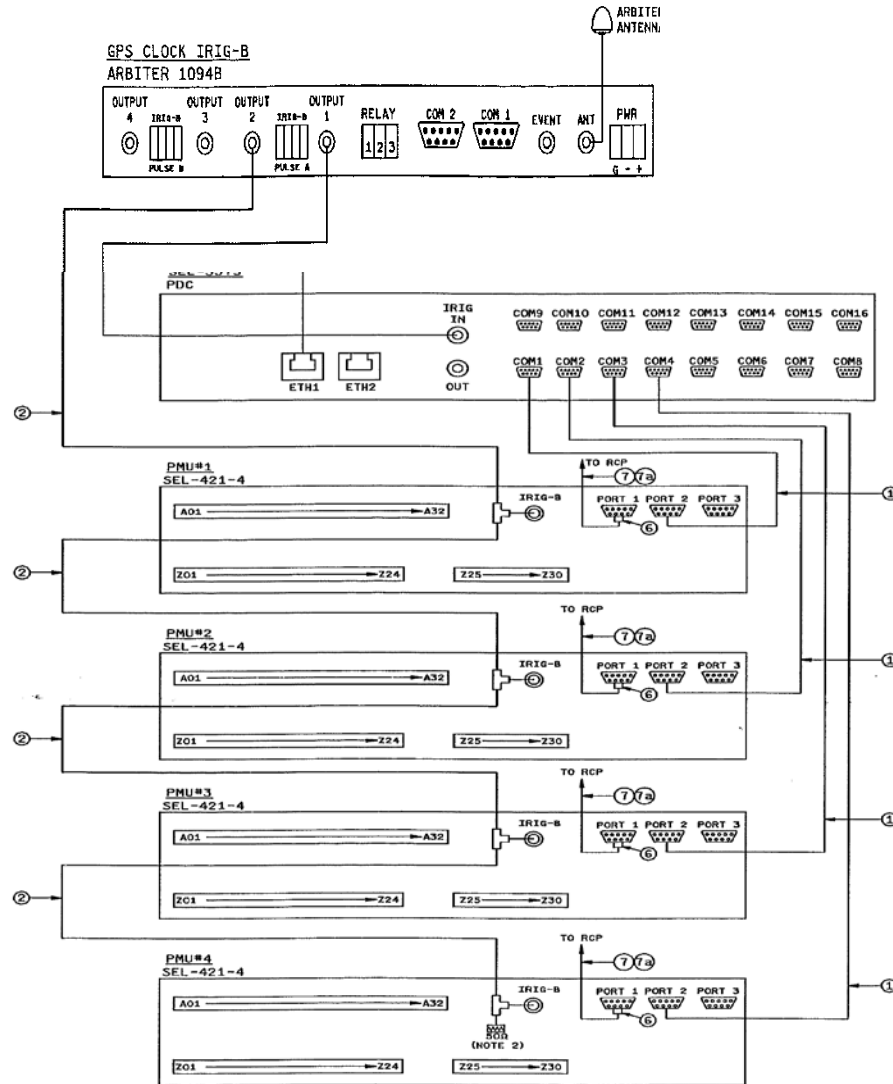
PMU Relay



Design Features

- 4 PMUs and 1 PDC
- Local archiving capability 60/120MB
- High-accuracy clock
- Inverter
- Router
- T1 CSU/DSU card
- Analogs V1(M,A), I1(M,A), F, dF
- Va, Vb, Vc, Ia, Ib, Ic (M,A)

Substation System Architecture



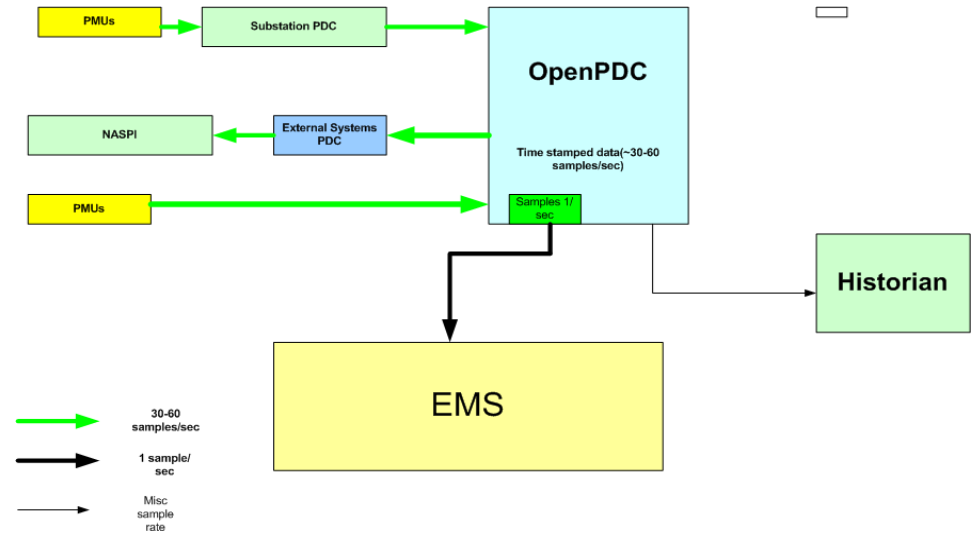
Super PDC

- **Connects individual PMUs and PDCs**
- **Substation PDCs feed the SPDC**
- **Central location near System Control Center (SCC)**
- **Data-archiving capability**
- **Redundant server**

Open Phasor Data Collection

Objectives:

1. Provide a flexible framework for the collection, processing, concentration and archiving of PMU data
2. Develop integration of PMU data to interface with EMS state estimator, NASPI project and historian



PMU/PDC Network Diagram

Benefits:

- Improves State Estimation in Energy Management System
- Enables System Health Check for small perturbations
- Enables post-event data analysis
- Provides select PMU data to NASPI project

Security Approach

- **Dedicated and isolated from any control and tripping functions**
- **On its own network**
- **Within electronic security perimeter**
- **Within physical security perimeter**
- **Multiple layers of encryption**

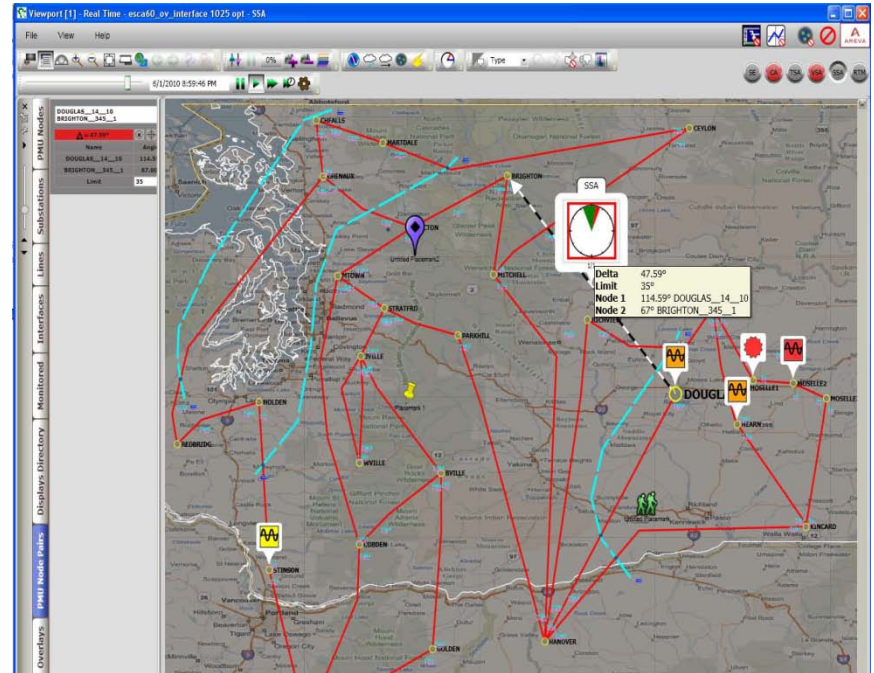
Development Phase

- **Dashboard display for system operators**
- **Islanding detection**
- **Aid in determining System Margins**
- **Visualization is the Key/Start - e-terra vision**
 - Apply applications as experience is gained
 - Interface with EMS
 - Enhance State Estimator
 - Strengthen contingency analysis
- **Monitoring**
 - Server sets flag for non-report of data and QoS
- **Wide area view application is “off the shelf”**
 - Vendor-supported training

Wide Area Monitoring Tool

Objectives:

1. Improved capability for wide-area monitoring
2. More comprehensive view of grid conditions that provide alarming and GIS-based visualization
3. Allow system operators to monitor abnormal grid conditions utilizing PMU data in conjunction with other applications for a GIS-based visualization



Monitoring Phase Angle Differences

Benefit: Improved situational awareness and system monitoring

Voltage Stability Analysis Solutions

Objectives:

1. Integration of model-based dynamic security assessment applications
2. Anticipate instability (e.g. how close the system is to voltage or small-signal instability based on the level of congestion and contingencies)
3. Allow the operators to issue preventive or corrective controls to mitigate instability



Voltage Monitoring

Benefits:

- Improved visualization of system's voltage profile
- Improved analysis of voltage conditions across system

Challenges

- **Pathway to other operating entities**
- **Network expenses**
- **Coordinating equipment outages**

Project Participants

Project Manager

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Questions?