ETCC Late Breaking News Session

Phasor Measurement Unit (PMU) Applications at Entergy

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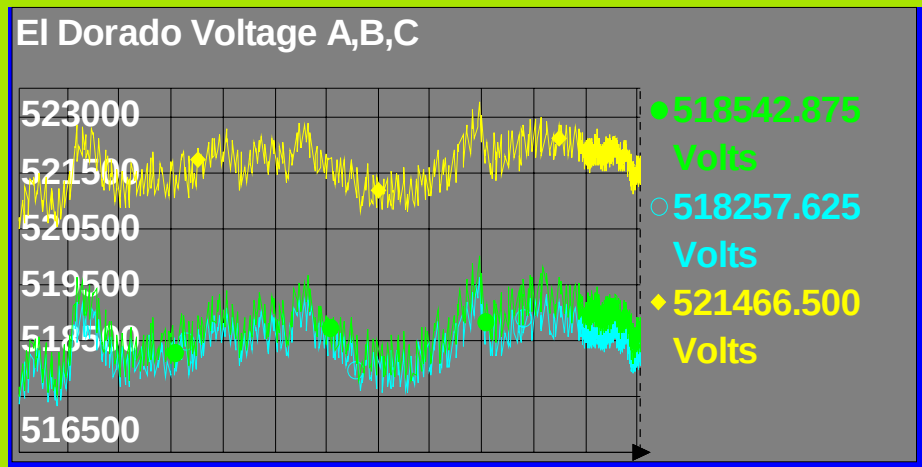
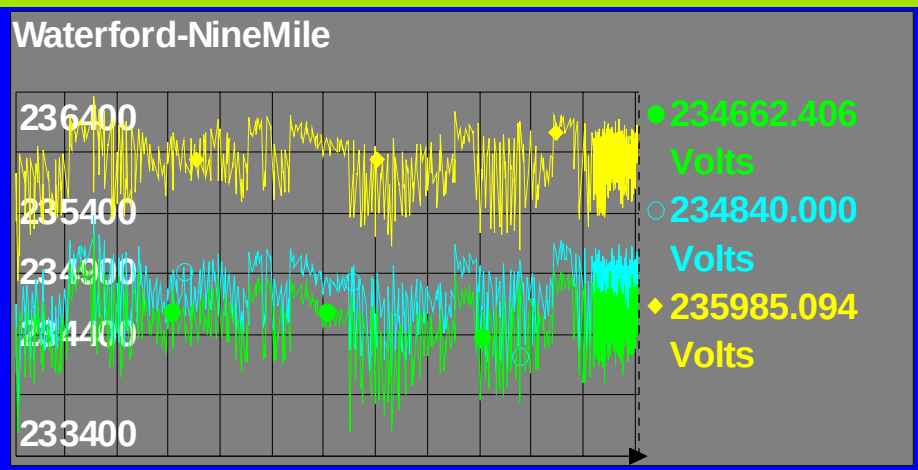
Entergy PMU Locations

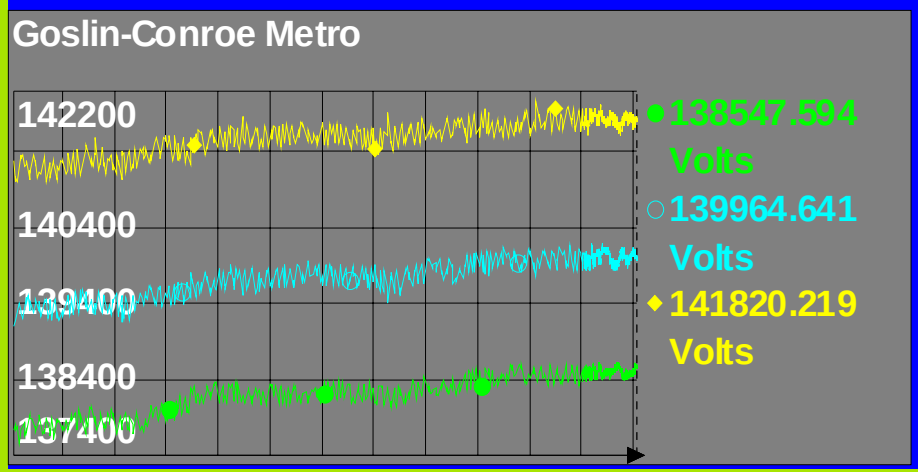
- 22 PMUs are installed across Entergy
- PMU – ARBITER 1133A, Power Sentinal
- PDC – OSIsoft PI
- Enterprise Horizons – MAGMA Suite-Visualization

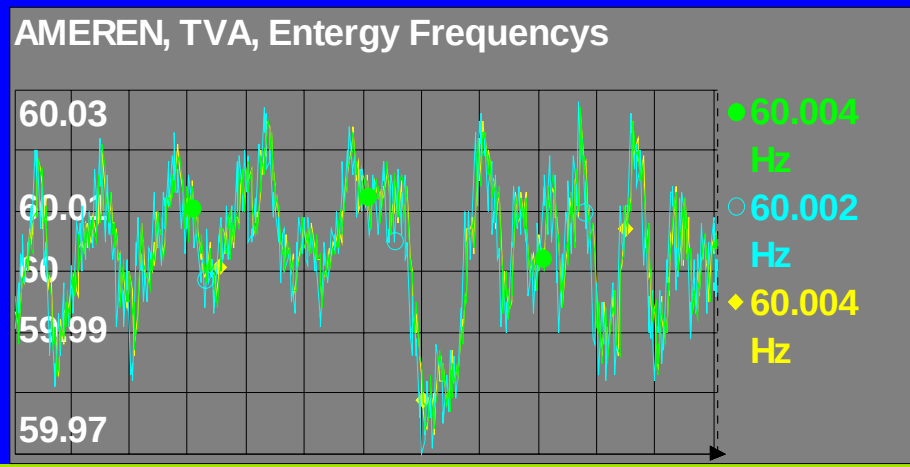
Phasor Data Applications

Improved real time monitoring tools for reliability coordinators and system operators



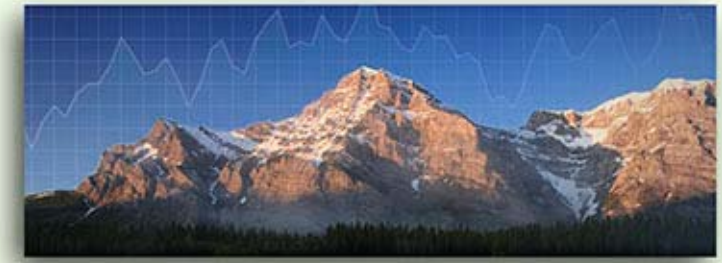






Smart Grid Investment Grant Benefits: A Secure Phasor Platform (SPP)

- Transform existing Research grade Phasor System to a Production Ready system
  - Install 20 SPP in the next 3 years
    - Substation Computer
    - Multiple PMUs
    - GPS Clock
    - Keyboard and Monitor Network Switches & Routers
    - Cabinet Enclosure with Magnetic Locks and Key Card Reader
- Implement a Cyber Security Plan and Efficiency Review of the PMU Infrastructure

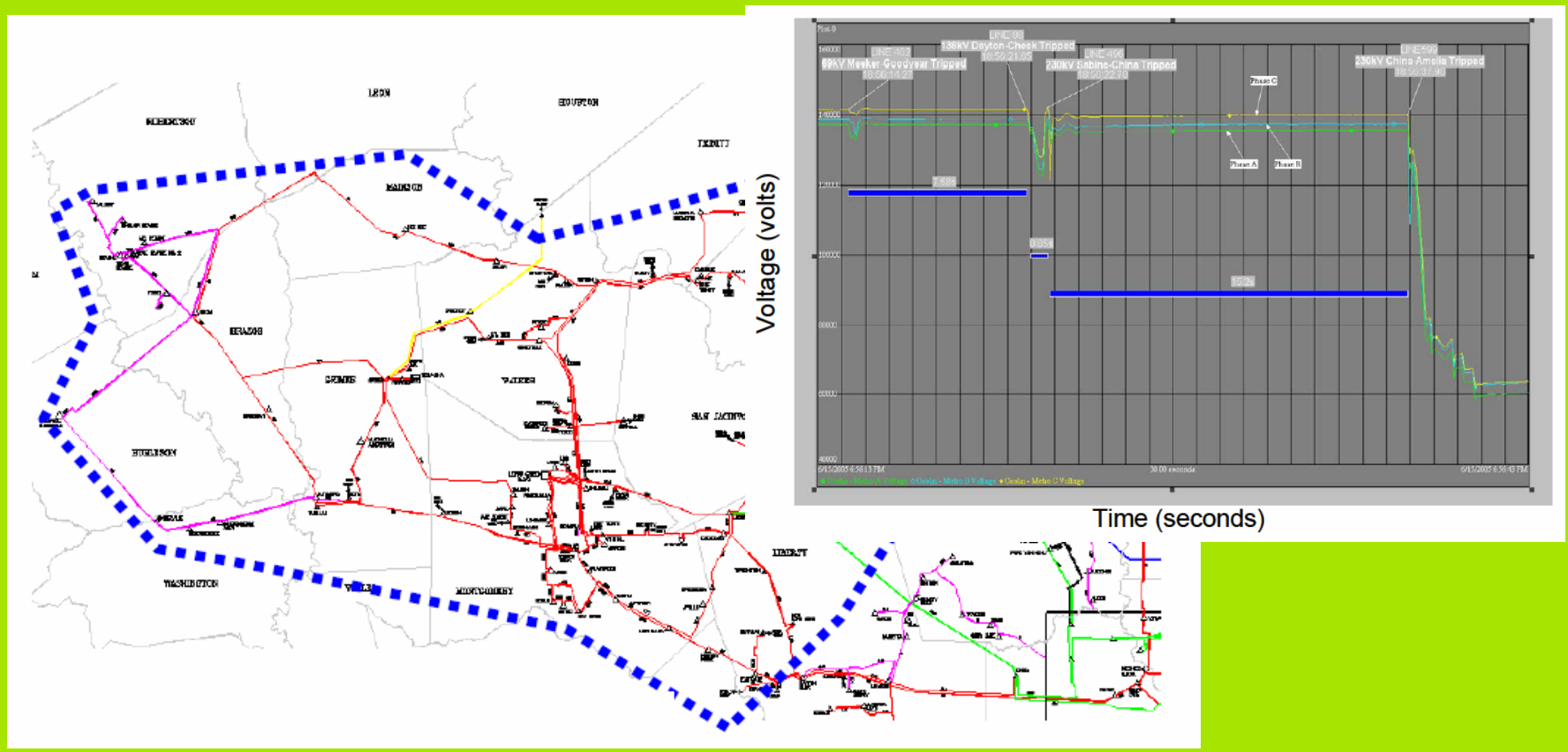





Synchrophasors Based Voltage Stability Monitoring for Entergy Western Region

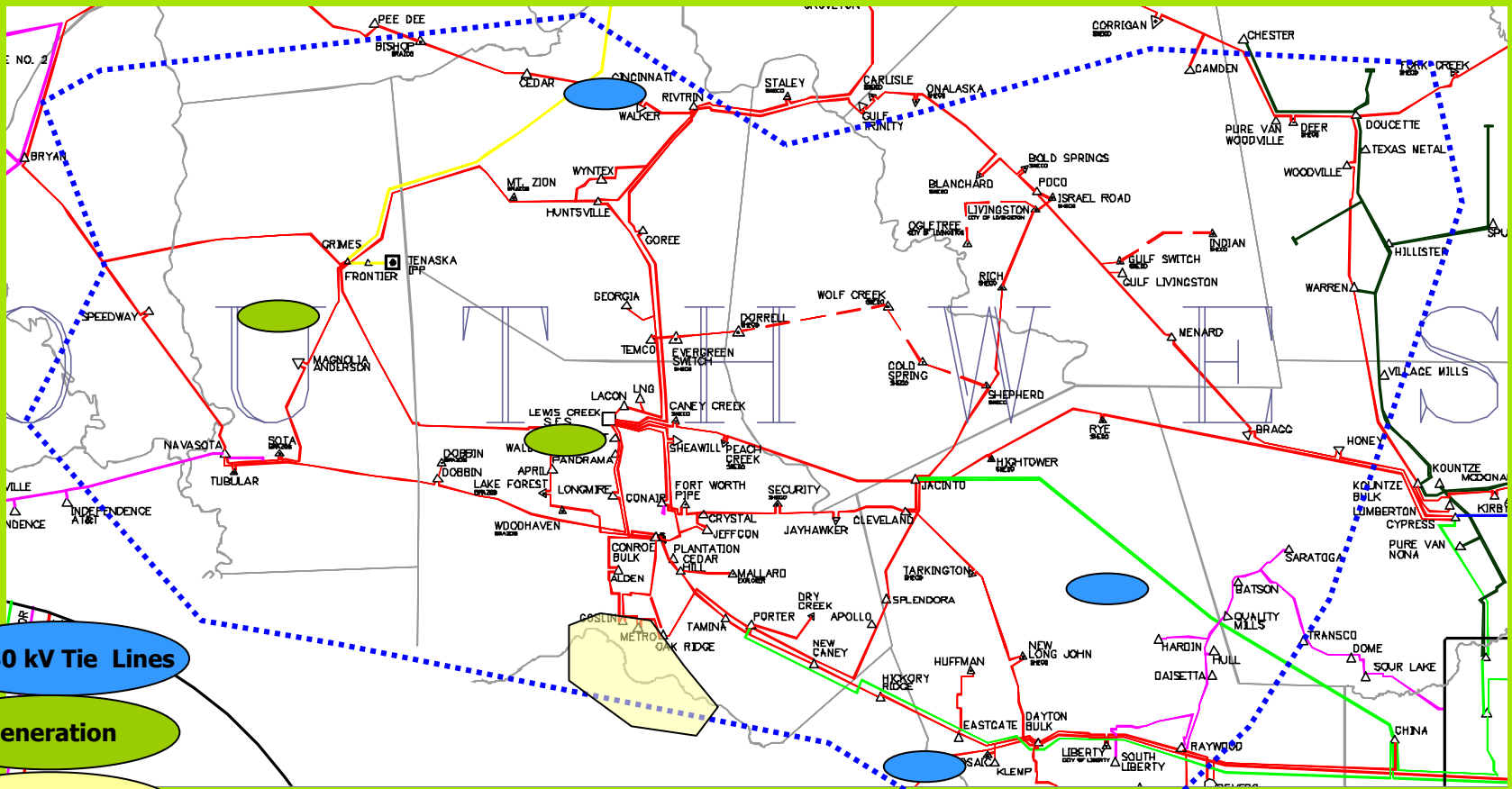
Voltage collapse scenario within the western region

Phasor voltages at Goslin 138 kV station as recorded by the PMU



“Simulation and Analysis of a Major Disturbance in Entergy system that resulted in Voltage Collapse”, V.S. Kolluri, et al., IEEE PES General Meeting 2006, © IEEE

Overview of this application



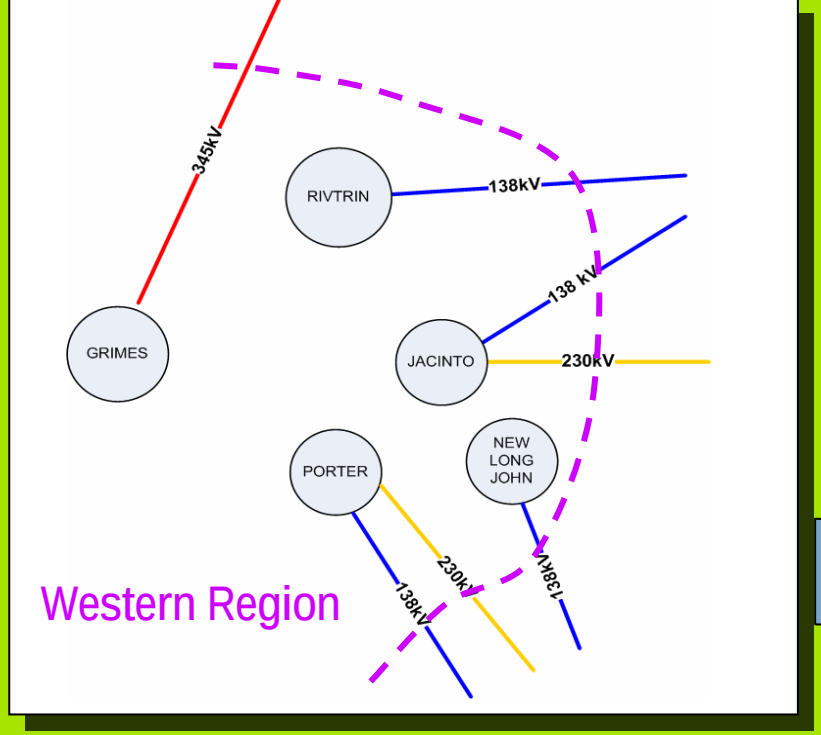
≤ 230 kV Tie Lines

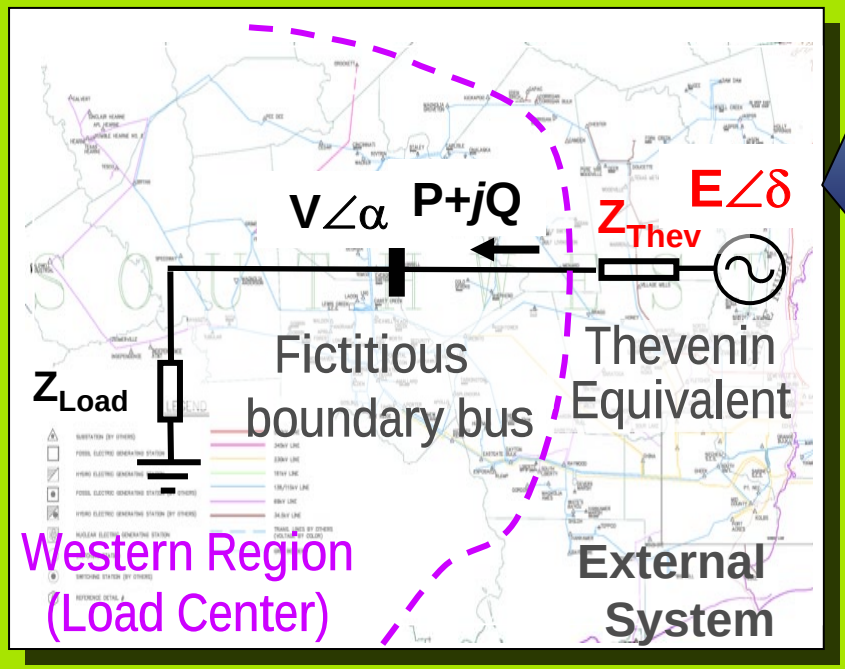
Generation

Load Center

Western Region – Overview

Overview of this application





Measure voltage and current waveforms at the boundary buses (key substations) of the load center

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Calculate V∠α, P and Q at the fictitious bus using **voltage and current waveforms**

↓

Calculate the external system's Thevenin Equivalent parameters:
V∠α, P, and Q → E∠δ and Z_{Thev}

↓

Calculate power transfer limits:
E∠δ and Z_{Thev} → P_{max} and Q_{max}

↓

Calculate voltage stability margin:
$P_{margin} = P_{max} - P$ and $Q_{margin} = | Q_{max} - Q |$

Other Applications

- Real-Time Applications
  - Situational awareness for operators
  - Power System Oscillation Damping & Control
- Off-line Applications
  - Power system performance and disturbance evaluation
  - System-wide model validation