Smart Grid Investment Grant Project

Visualization and Phasor Enhanced State Estimator

Edwin Cano / Jim McNierney

New York Independent System Operator

NASPI Working Group Meeting
October 22-23, 2014
Houston, TX

Acknowledgment & Disclaimer

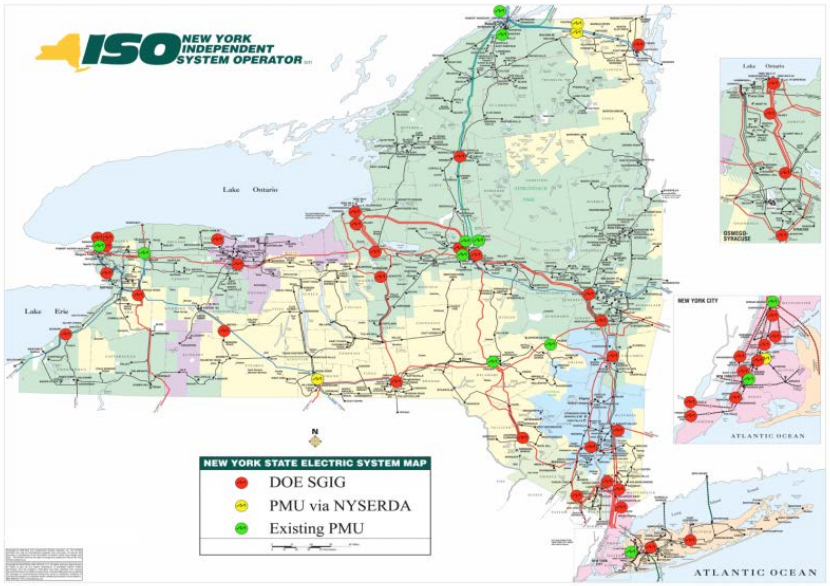
- **Acknowledgment:** This material is based upon work supported by the Department of Energy under Award Number(s) DE-OE0000368
- **Disclaimer:** This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

PMU Placement Criteria

- Critical interfaces, control area ties & zonal tie lines
- Generating stations above 500 MW
- Wind power plants above 100 MW
- Major load centers
- Thermal & voltage constraint
- Power system stabilizer location
- Phase angle regulator location
- FACTS devices
- Future wind installations

Synchrophasor Applications

- Phasor-Enhanced State Estimator
- Visualization / Situational Awareness



NASPI North American SynchroPhasor Initiative

Phasor Enhanced State Estimator

- The NYISO State Estimator was augmented to accept synchrophasor measurements
  - *Directly enters phasor magnitude and angle measurements for voltages and currents*
    - Synchronous measurements
    - Direct state measurements (angles)
    - Currents introduced as measurements
  - *Data down-sampled to SCADA rate*
  - *CIM database modified to account for synchrophasor data*
  - *Selected points are being used by SE*
  - *Monitor the actual values against SE solutions*

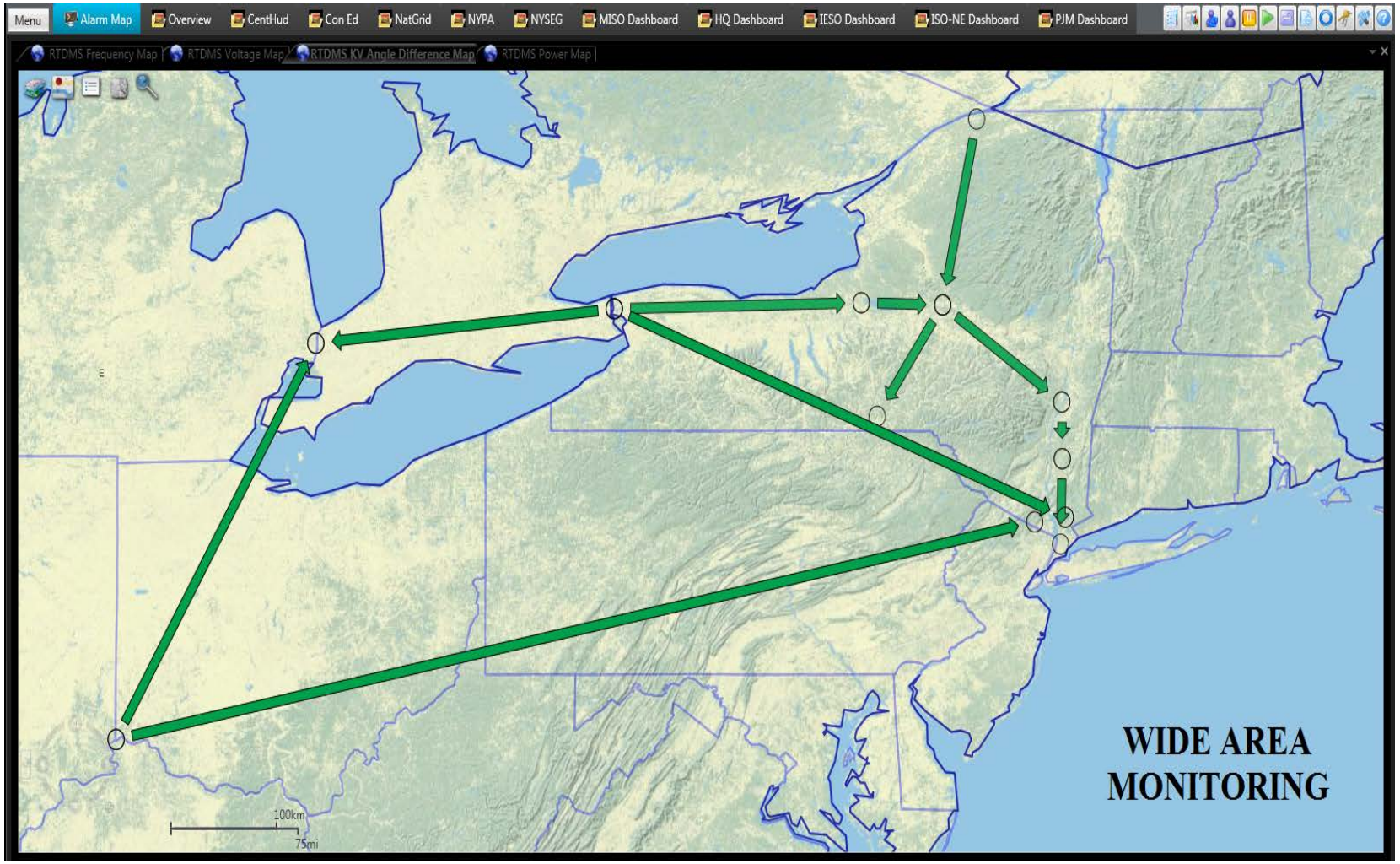
Phasor Enhanced State Estimator

- Receive a total of 659 signals. 374 within NYCA and 285 Outside of NY
- In development environments:
  - *Monitored against SCADA measurements and State Estimation (SE) solutions*
  - *Raw signals are used to calculate line flow MW & Mvar – 1327 being processed*
  - *Used as one of the sources in our Zonal ties and Control area tie lines monitoring applications*
  - *Select Voltage Magnitude, angles and current magnitude and angles used within SE*

New Control Center

- ***NYISO's new control center features a 2,300-square-foot video wall -- the largest utility installation in North America***
- ***Displays more than 3,000 live status points -- presenting line flows & limits, transformer loading, voltages, & generator output***
- ***Regional electric system information, weather and lightning-strike data, load forecasts, etc. -- customizable to address system dynamics***

Video Wall Dashboard



Video Wall Dashboard

Visualization & Situational Awareness

- Displays / dashboards organized by New York's electrical load zones, as well as by external neighboring electrical regions
- PMUs grouped by zones to reflect expected coherent generation response
- Visualization is part of NYISO control room video wall

Control Room Dashboard

- New alarming capability for NY Control Area
  - *Abnormal oscillation detection*
  - *Abnormal voltage magnitude & angle*
  - *Abnormal frequency*
- New alarming Capability for external regions
  - *Abnormal angle differences across external regions*
  - *Abnormal voltage magnitude*
  - *Abnormal frequency*
- Long-term view (hours) for Wide Area Monitoring (WAM) of angle differences of External Regions

The New York Independent System Operator (NYISO) is a not-for-profit corporation responsible for operating the state's bulk electricity grid, administering New York's competitive wholesale electricity markets, conducting comprehensive long-term planning for the state's electric power system, and advancing the technological infrastructure of the electric system serving the Empire State.

www.nyiso.com