



Embracing a Smarter Grid

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Topics

- ◆ **NYISO Smart Grid Investment Grant (SGIG) Project**
- ◆ **New Functions in Control Rooms for Operations**
 - *Visualization*
 - *Situational Awareness*
 - *Voltage Stability Monitoring*
 - *Phasor Enhanced State Estimator*
- ◆ **Applications in Planning**
 - *Post-Mortem Analysis*
 - *Model Validation and Calibration*
 - *Major Disturbance Mitigation*
 - *Expedited Restoration*

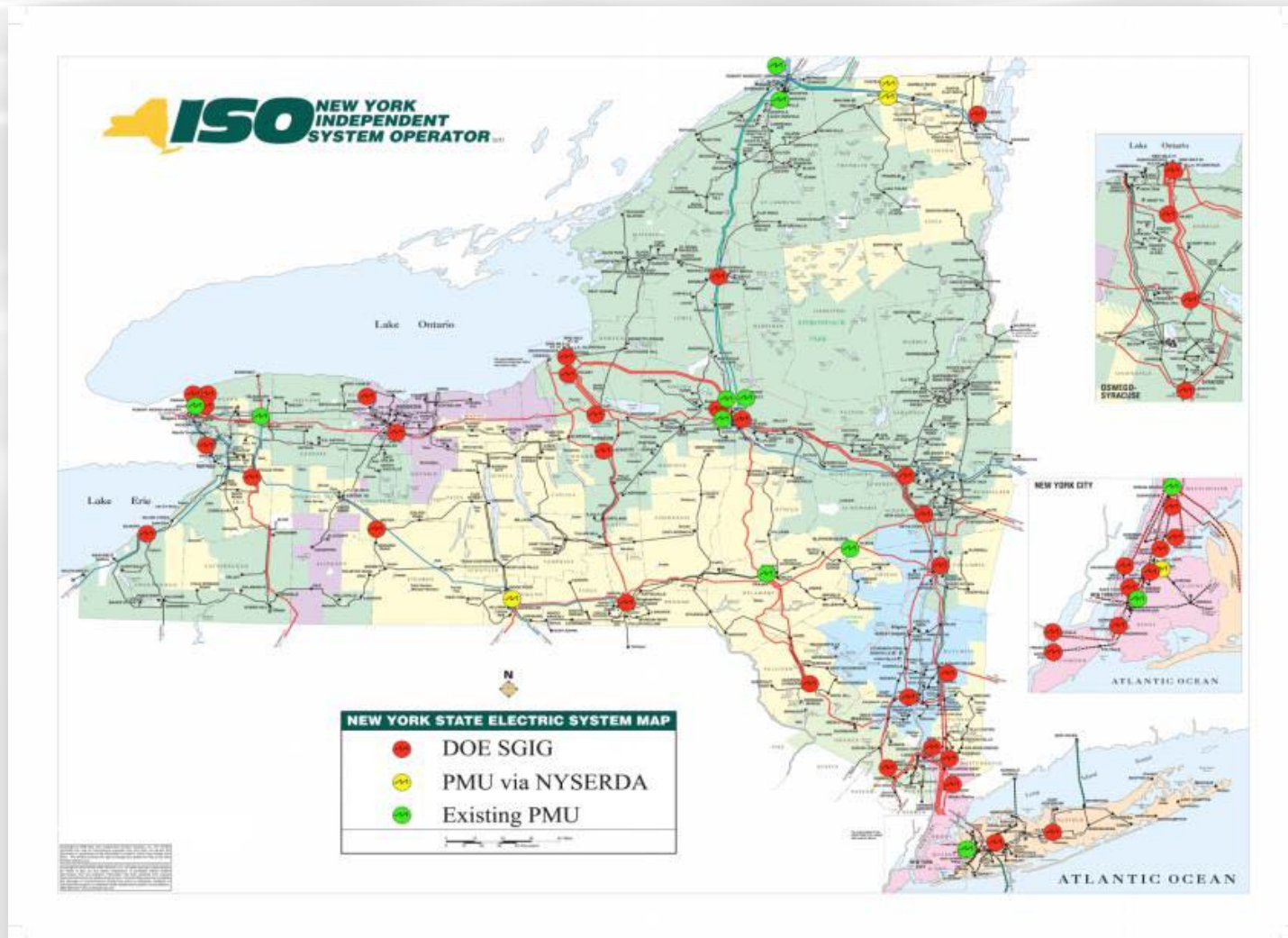
NYISO SGIG Project

- ◆ **Budget**
 - *\$75.7 million*
 - *(50% through DOE SGIG funding)*
- ◆ **Timeline**
 - *July 1, 2010 – June 30, 2013*
- ◆ **Partners**
 - *NYISO and New York Transmission Owners*
- ◆ **Equipment**
 - *Phasor Measurement Units (PMU)*
 - *Phasor Data Concentrators (PDC)*
 - *Phasor Measurement Network (PMN)*
 - *Capacitor Banks*



Photos courtesy of Central Hudson Gas & Electric and New York Power Authority

NYISO SGIG Project



New Control Center

- ◆ Enhance reliability & efficiency of the power system by improving situational awareness & control
- ◆ Real-time displays of wind & solar generation & natural gas pipeline flows
- ◆ Enable and improve consumers' understanding and control of their electricity use



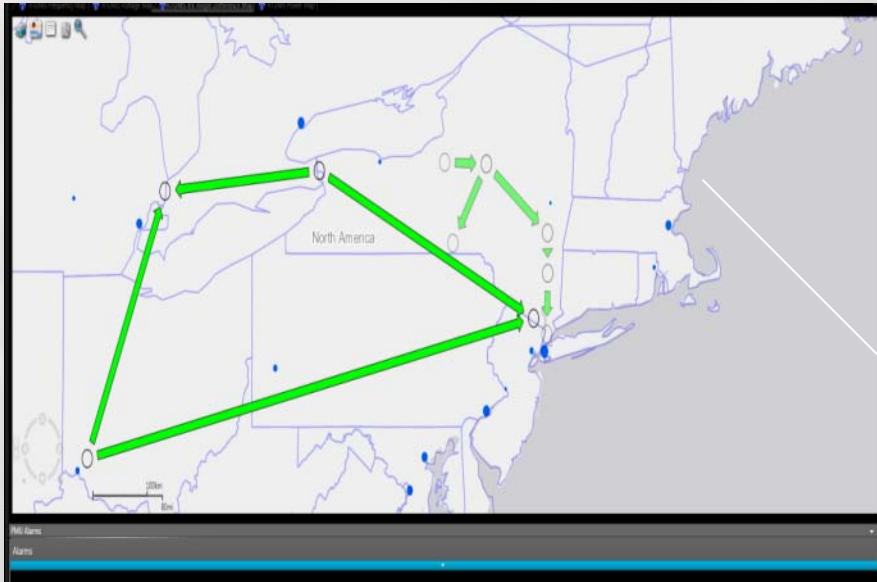
NYISO's new control center features a 2,300-square-foot video wall -- the largest utility installation in North America

Visualization

- ◆ **PMUs grouped by zones to reflect expected coherent generation response**
- ◆ **Visualization capabilities are key components of NYISO video wall**
- ◆ **Displays / dashboards organized by NYISO load zones and external neighboring control areas**



Situational Awareness



- ◆ **New Alarming Capability**
 - *Abnormal frequency*
 - *Abnormal oscillation detection*
 - *Abnormal angle differences across external regions*
 - *Abnormal voltage magnitude & angle*
- ◆ **Short-term View (minutes) and Long-term View (hours) for Wide Area Monitoring of angle differences among External Control Areas**

Voltage Stability Monitoring

- ◆ **For a given interface VSM provides**
 - *Proximity of voltage collapse under real-time conditions*
 - *Proximity of voltage collapse under contingencies*
- ◆ **VSM Program Execution**
 - *Every 30 seconds with SE data*
 - *Every 2 seconds with updated PMU data*

Phasor Enhanced State Estimator

- ◆ **NYISO state estimator was augmented to accept synchrophasor measurements**
 - *Voltage magnitudes and angles (220+)*
 - *Current magnitudes and angles (280+)*
 - *Line MW and Mvar flows (400+)*
- ◆ **More accurate results**

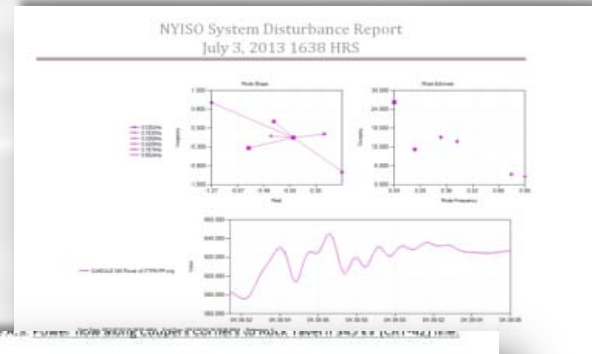
Rethinking Planning

- ◆ **System planning is about analyzing and designing the future system according to applicable criteria**
- ◆ **Challenges to Planning**
 - *Model accuracy*
 - *Risk associated with uncertainty*
 - *Adequate criteria*
 - *Optimal solutions*
- ◆ **Opportunities for Planning in a Smart Grid**
 - *Model validation and calibration*
 - *Risk assessment with expedited restoration*
 - *Improved planning criteria*
 - *Enhance the reliability and efficiency of the power system with Smart solutions*

Post-Mortem Analysis

- ◆ **NYISO uses the Phasor Grid Dynamics Analyzer (PGDA) for off-line analysis of system events**

- *Frequency response*
- *Transient voltage recovery*
- *Modal analysis*
- *Ringdown analysis*
- *System stress analysis*
- *Model validation*



NYISO System Disturbance Report
July 10, 2013 1207 HRS

V. Conclusion

On July 10, 2013 at 1207 HRS, according to the NYISO operators' logs, as Edic Capacitor 1 was switching out for voltage control, the following elements tripped: Edic Capacitor 1, Edic Bus A, Marcy Capacitor 2, Marcy bus South, Marcy Statcom and the Chateaugay HVDC pole #2 tripped while injecting about 425 MW into the NYCA. The NYISO operated at "Normal" state before the event and after reported multiple element outages. Based on dynamic frequency performance, steady state and transient voltage performance, and oscillatory performance, the NYCA transmission system performed within criteria and limits.

Dynamic Model Calibration

- ◆ **Model Calibration ensures faithful representation of the performance of the power system under consideration**
 - *Validate the major component level models*
 - EPRI's Power Plant Parameter Derivation (PPPD) tool
 - EPRI's Load Model Data Processing and Parameter Derivation (LMDPPD)
 - *The power system model is then refined with any adjustments to the component level models*
 - *The entire power system model is used to simulate major events for which measured disturbance data is available and an attempt is made to recreate the event in the simulation model*

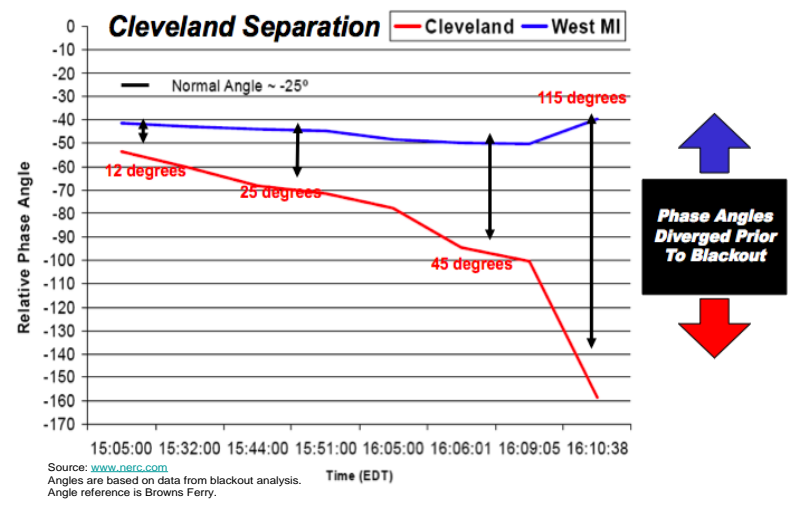
Major Disturbance Mitigation

◆ NYISO SGIG effort

- *Feasibility study on Controlled System Separation Scheme (CSSS)*
- *CSSS need to be triggered before the initiation of unintentional separation which occurs very fast, and therefore precise event-based indicators need to be considered*
- *CSSS primary focus was on “separation” as a solution*

◆ On-going effort

- *Develop enhanced scenarios, detection algorithms, stabilization measures (not limited to separation) and testing cases.*



Expedited Restoration

- ◆ **Understanding complex disturbances due to extreme faults or natural disasters**
 - *Use smart meter outages/measurements to identify path of storm damage*
 - *Use PMU measurements to identify system break-up and break-up points*
- ◆ **Grid Restoration**
 - *Quicker response following accurate detection of disturbance*
 - *Plan on using PMU measurements to help restore the system by mitigating instability risk or unsuccessful reclosing*



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.

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