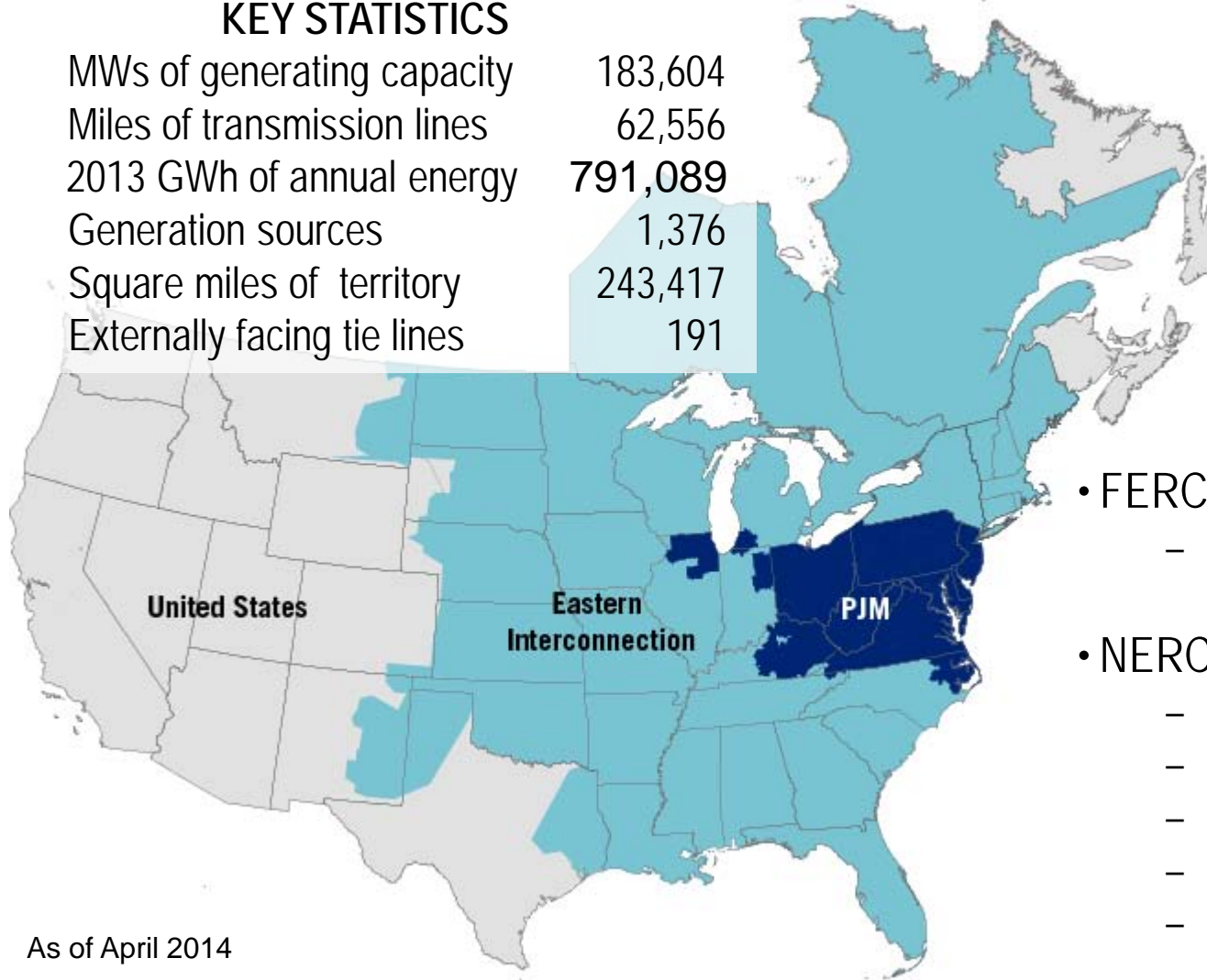


Event Detection & Phasor Analysis

Brad Gordon – PJM Interconnection
CIGRE USNC & EPRI
Grid of the Future Symposium
Houston, TX - October 2014

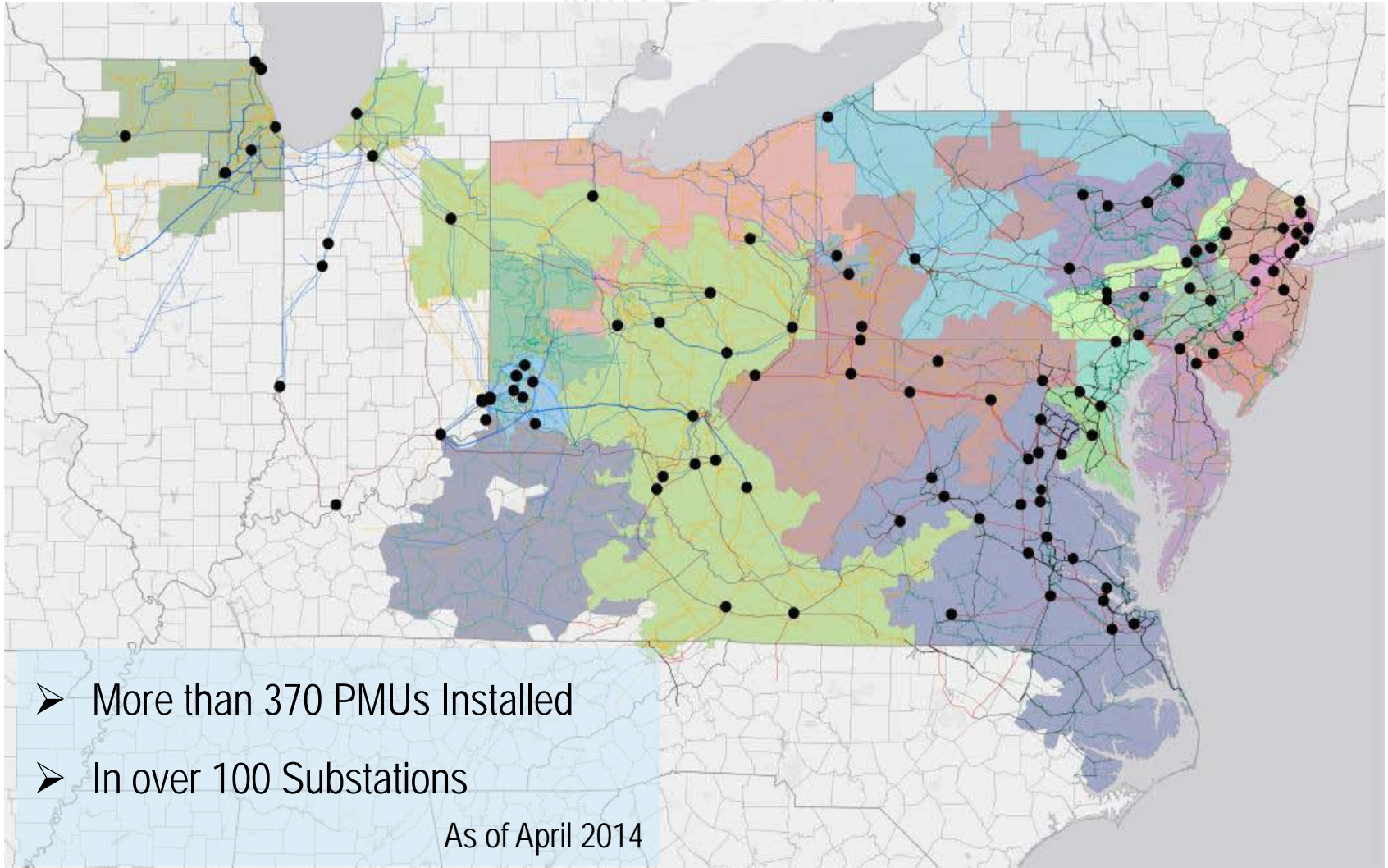
KEY STATISTICS

MWs of generating capacity	183,604
Miles of transmission lines	62,556
2013 GWh of annual energy	791,089
Generation sources	1,376
Square miles of territory	243,417
Externally facing tie lines	191



- FERC
 - Regional Transmission Organization
- NERC
 - Reliability Coordinator
 - Balancing Authority
 - Transmission Operator
 - Transmission Planner
 - Planning Coordinator

As of April 2014



- More than 370 PMUs Installed
- In over 100 Substations

As of April 2014

Event Detection & Post-Event Analysis

- Develop Event Criteria that Triggers Analysis
- Develop Process, Tools, & Training
- Integrate into Daily Review Team

Operations Integration

- Provide Enhanced Dispatcher Situational Awareness

Data Exchange

- Expand Exchange of PMU data with Neighbors

Identify Significant Disturbances on the Grid

- Leverage NERC Established Event Criteria
- Frequency Deviations ≥ 40 mHz in any rolling 16 second interval (BAL-003 Frequency Response)
- EHV Transmission Trips / Outages – Initially monitoring EHV lines that are components of IROL transfer interfaces
- Large Generator Trips ≥ 900 MW (BAL-002 Disturbance Control Performance)

Daily Review Team Morning Meeting

- Consists of Managers, Supervisors, Engineers, & Economists from Operations & Markets Divisions
- Review Daily Dashboard Metrics & Dispatcher Logs
- Discuss Previous Day's Operational Performance & System Events
- Discuss Events that had Market Impacts
- Discuss Anticipated Current Day & Day Ahead Operations



Dashboard Metrics

[How are the Metrics calculated?](#)

Operations Metrics Dashboard - Sunday, April 13, 2014			
Metric		Metric Value	Metric Rating
Load Forecast Shape - (RTO)		97.76%	Neutral
1200 Forecast Fit %	97.36%	Create New Report	
1800 Forecast Fit %	98.17%		
Transmission Actuals		100.00%	Good
Total BES Events	0	Create New Report	
IROL Exceedances		0	Good
Total IROL Exceedances > 10 Seconds	0	Create New Report	
IROL Exceedances > 30 Minutes	0		
Transmission Contingencies		100.00%	Good
Total BES Events	0	Create New Report	
MISO Flowgates > 20 Minutes	0		
Manual Dispatch		-	Good
Total Wind Units	2	Create New Report	
Grid Disturbances & PMU Analysis		-	Needs Review
Frequency Deviations (>=40mHz)	2	Create New Report	View Problem Reports (2)
EHV Transmission Trips (>= 500kV)	0		
Large Unit Trips (>= 900MW)	1		
Large Unit Trips (>= 900MW)	1		
BAAL		99.10%	Good
Total Minutes	13	Create New Report	View Problem Reports (1)
Longest Excursion (Mins)	6		
CPS-1	136.22 (Neutral)		



GRID DISTURBANCES & PMU ANALYSIS - 4/13/2014

Frequency Deviations

No	Event Start	Starting Freq	Freq Deviation	ACE Deviation	Gen Deviation
1	13APR14:13:25:02	60.0025	-0.0448	-1035	-677
No	Event Start	Starting Freq	Freq Deviation	ACE Deviation	Gen Deviation
2	13APR14:21:12:52	60.0208	-0.0611	-1100	-1171

EHV TransmissionTrips

No Data Available

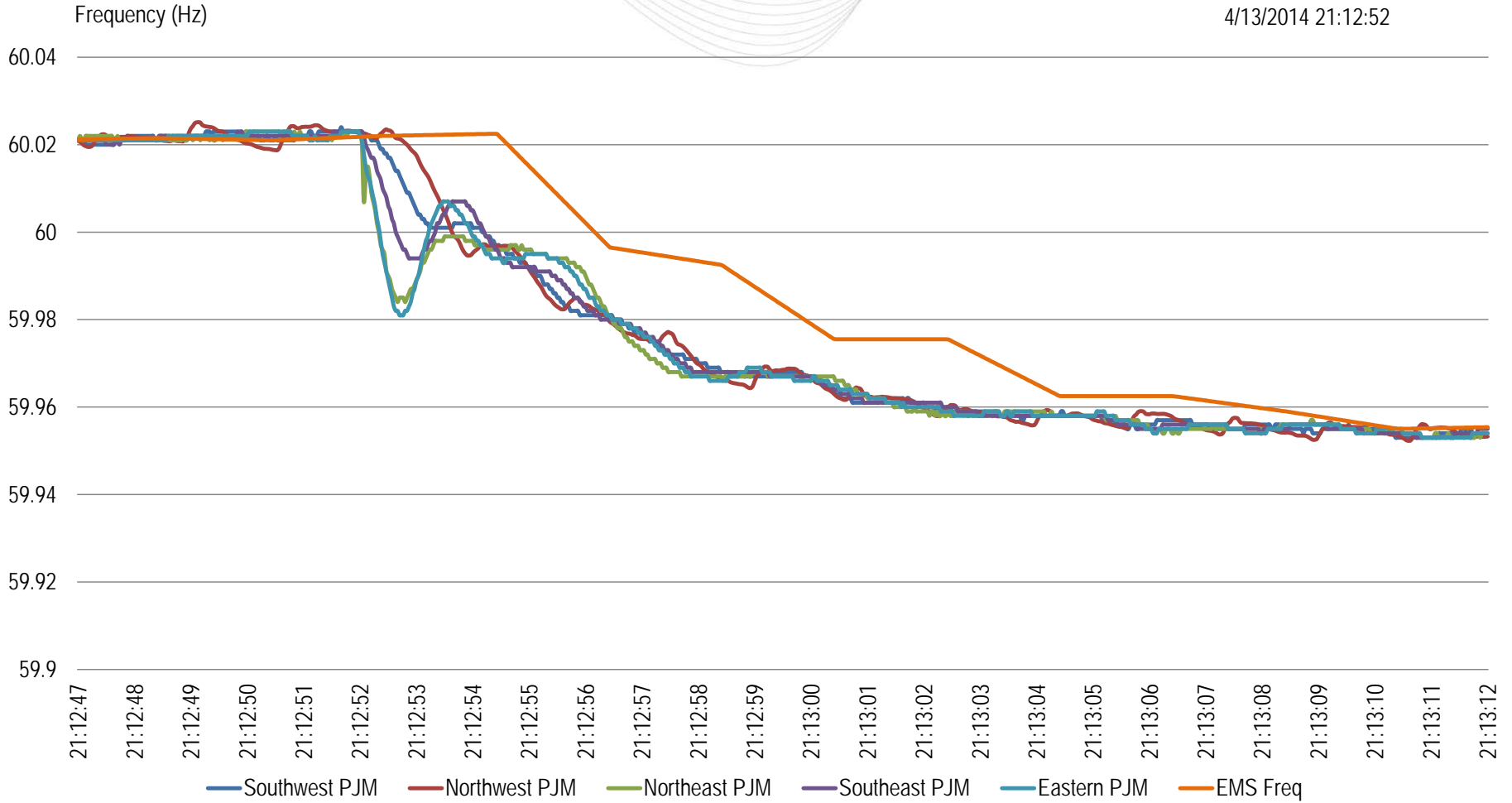
Large Unit Trips

No	Event Start	Facility	Gen MW
1	13APR14:21:13:25	Anonymous Nuclear Unit in Eastern PJM	1238

[Return to Previous Report](#)

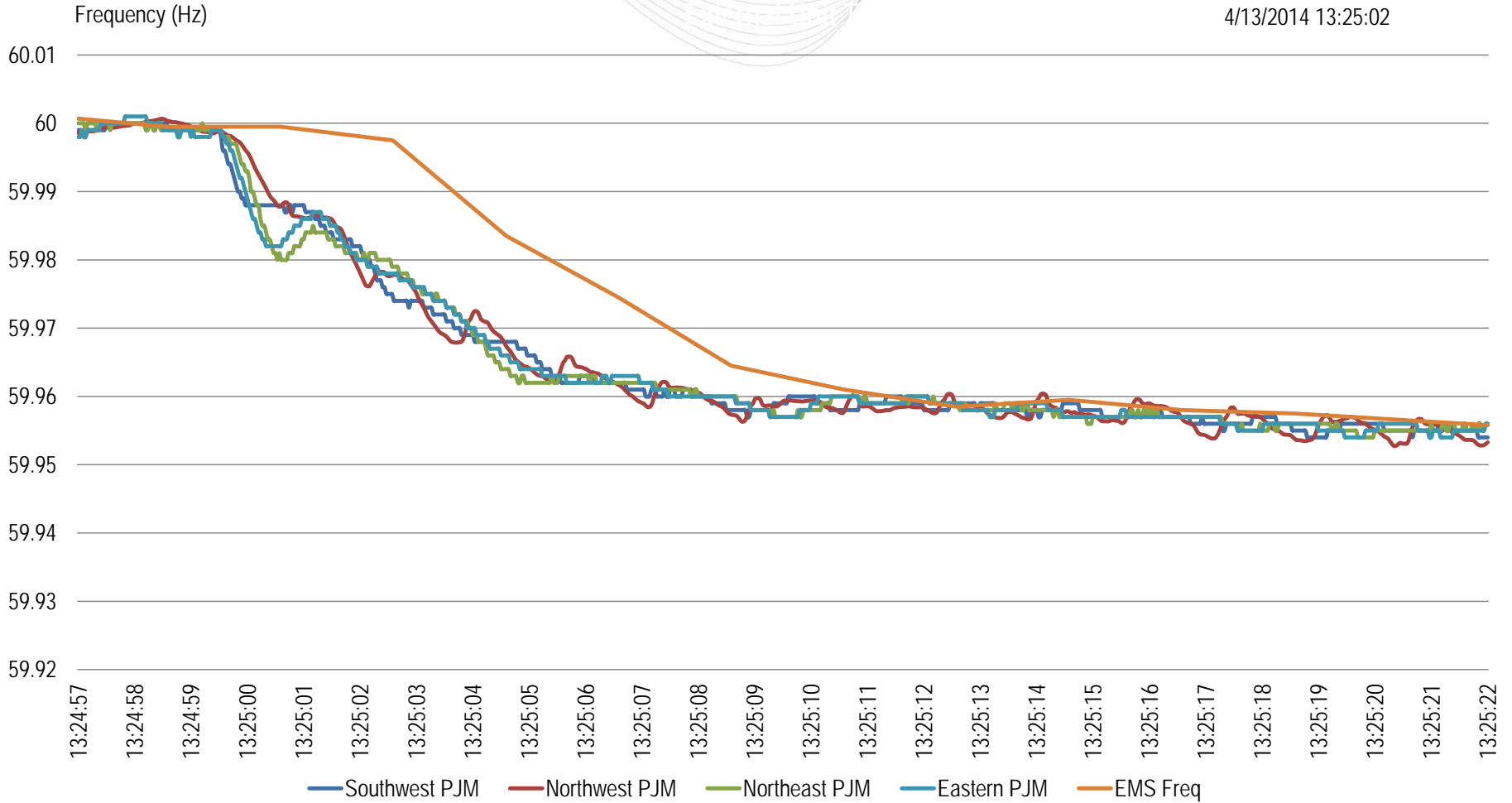


Event #2 - Nuclear Unit In Eastern PJM on April 13th, 2014





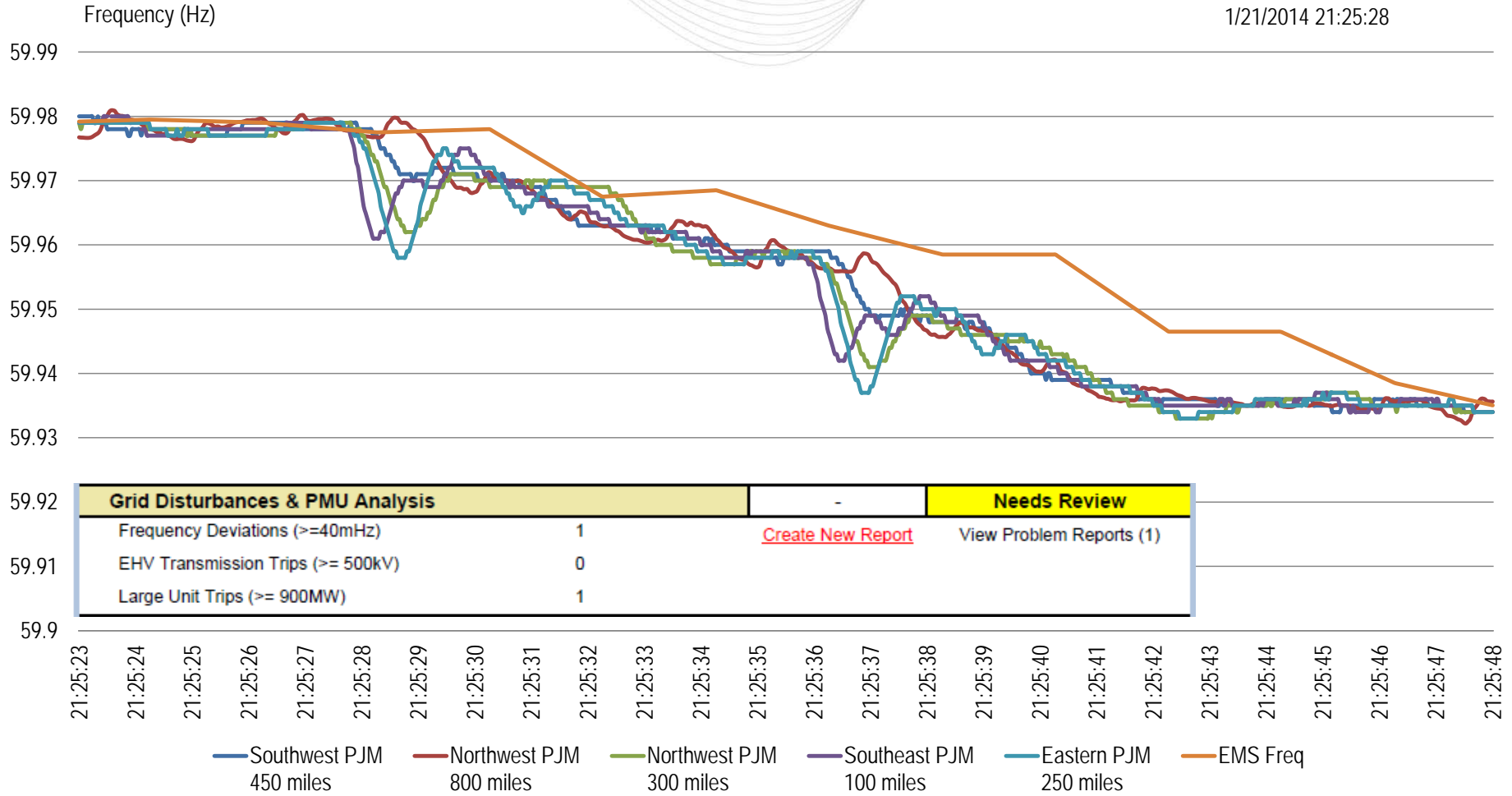
Event #1 - Unit In Southeast Region on April 13th, 2014





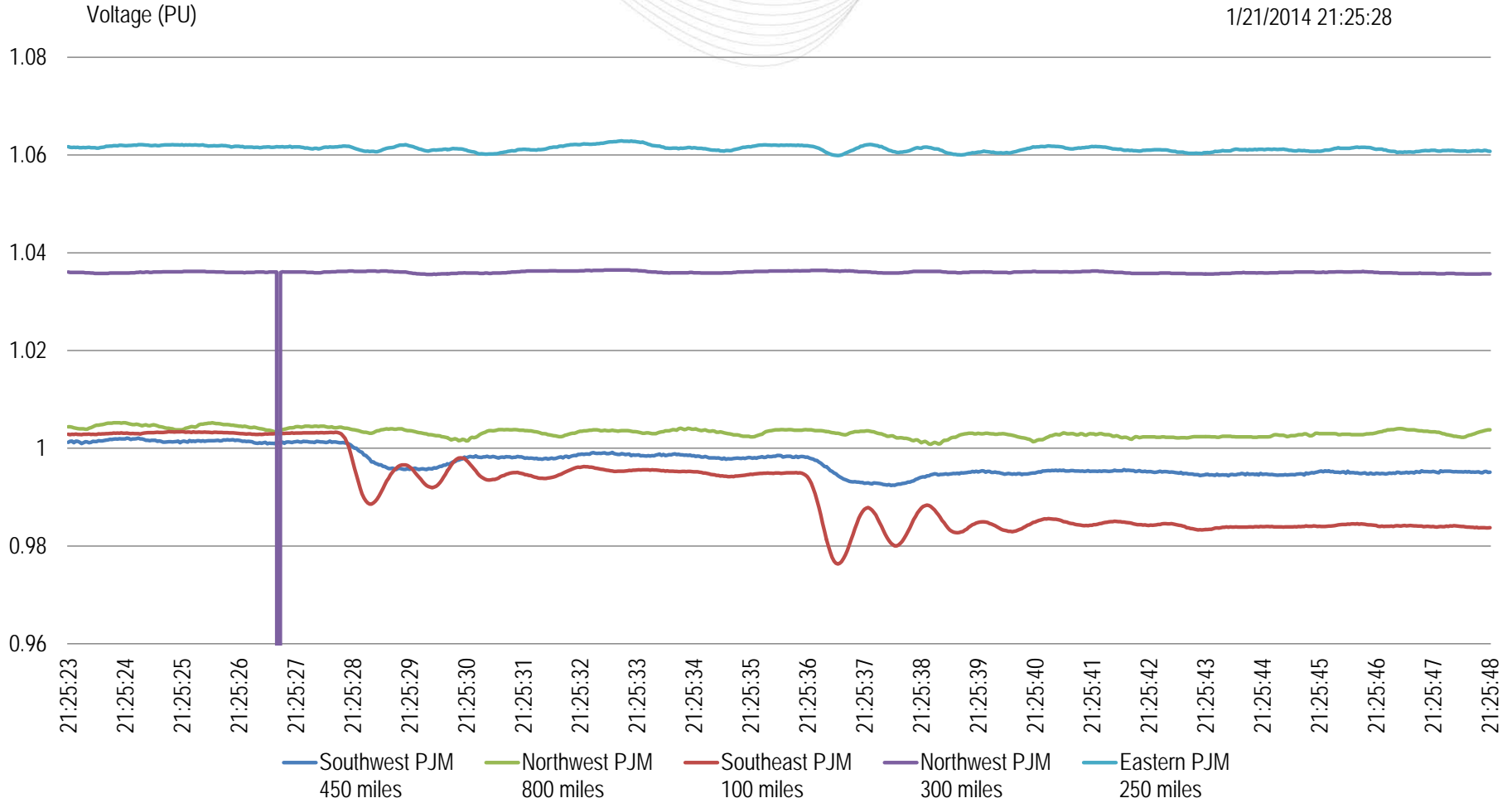
Loss of Two Nuclear Units on January 21st, 2014 (1864 MW)

1/21/2014 21:25:28





Loss of Two Nuclear Units on January 21st, 2014 (1864 MW)



- ✓ Oscillation & Rate of Change Detection
- ✓ Detection of Planning Criteria Violations
 - Oscillation Frequency & Damping Ratio
- ✓ Continue to Improve PMU Data Quality
 - PDQTF – Phasor Data Quality Task Force
- ✓ Enhancement of Analysis Tools & Training



Questions?