NERC
NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

Handling the Data Flood

8th Annual CMU Conference On The Electricity Industry

March 13, 2012

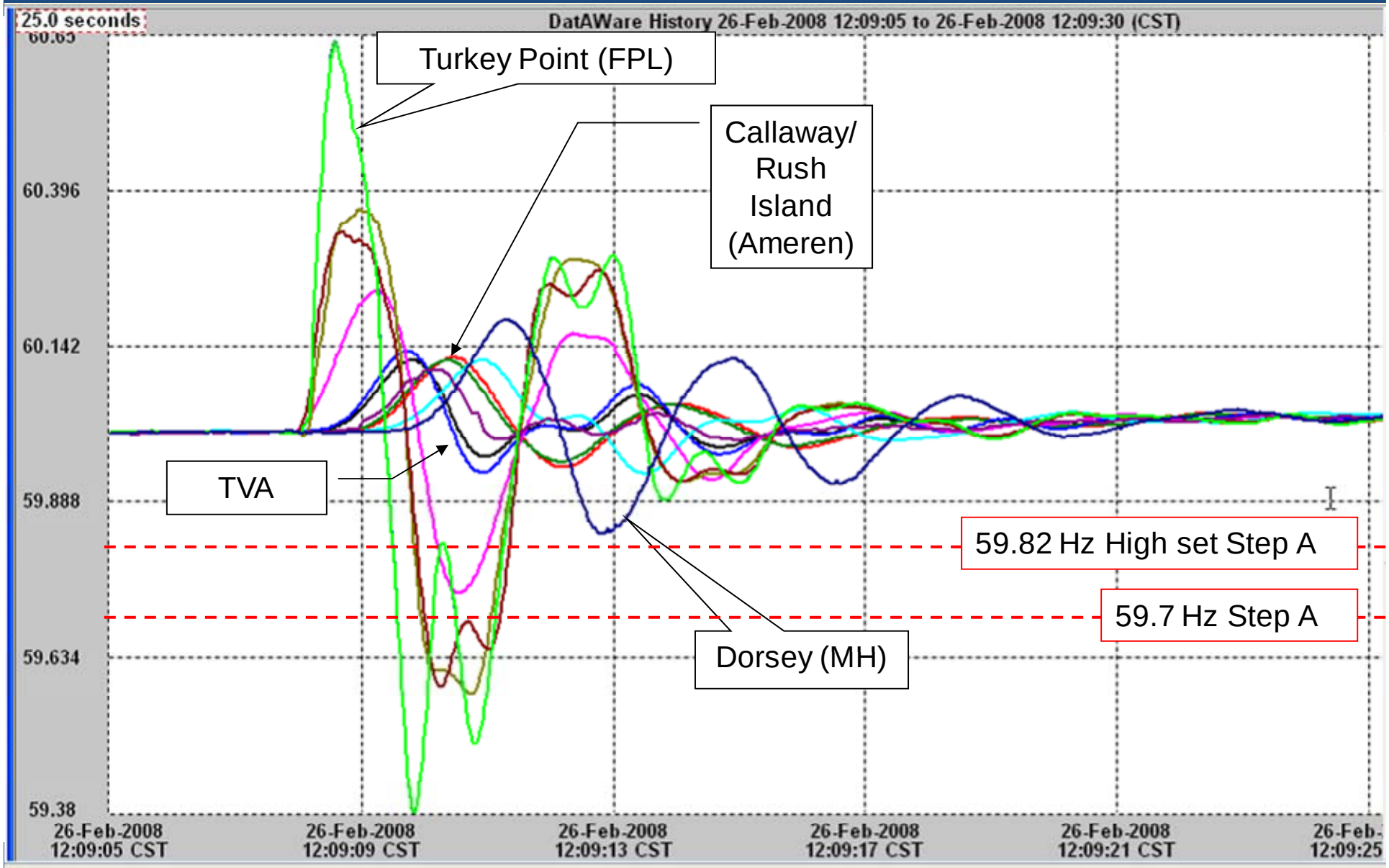
RELIABILITY | ACCOUNTABILITY



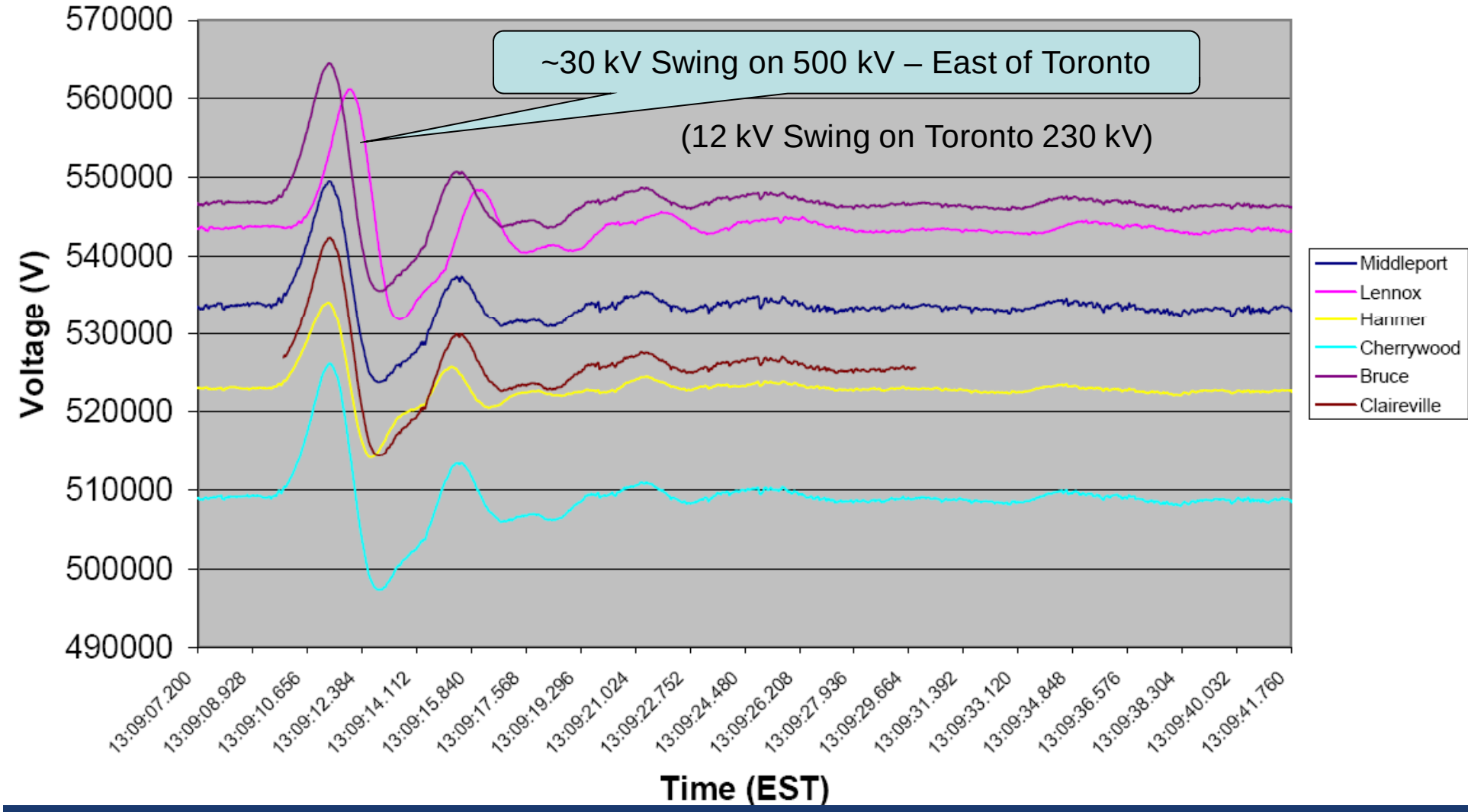

Day of the Phasor

- Industry facing watershed of new data
  - ARRA monies funding
- Applications abound
  - Visualization
  - Oscillation detection
    - Mode meters
  - State Estimator enhancement
    - Move to State Measurement
  - Predictive tools
    - Instability prediction – angular and voltage
- Forensic Analysis

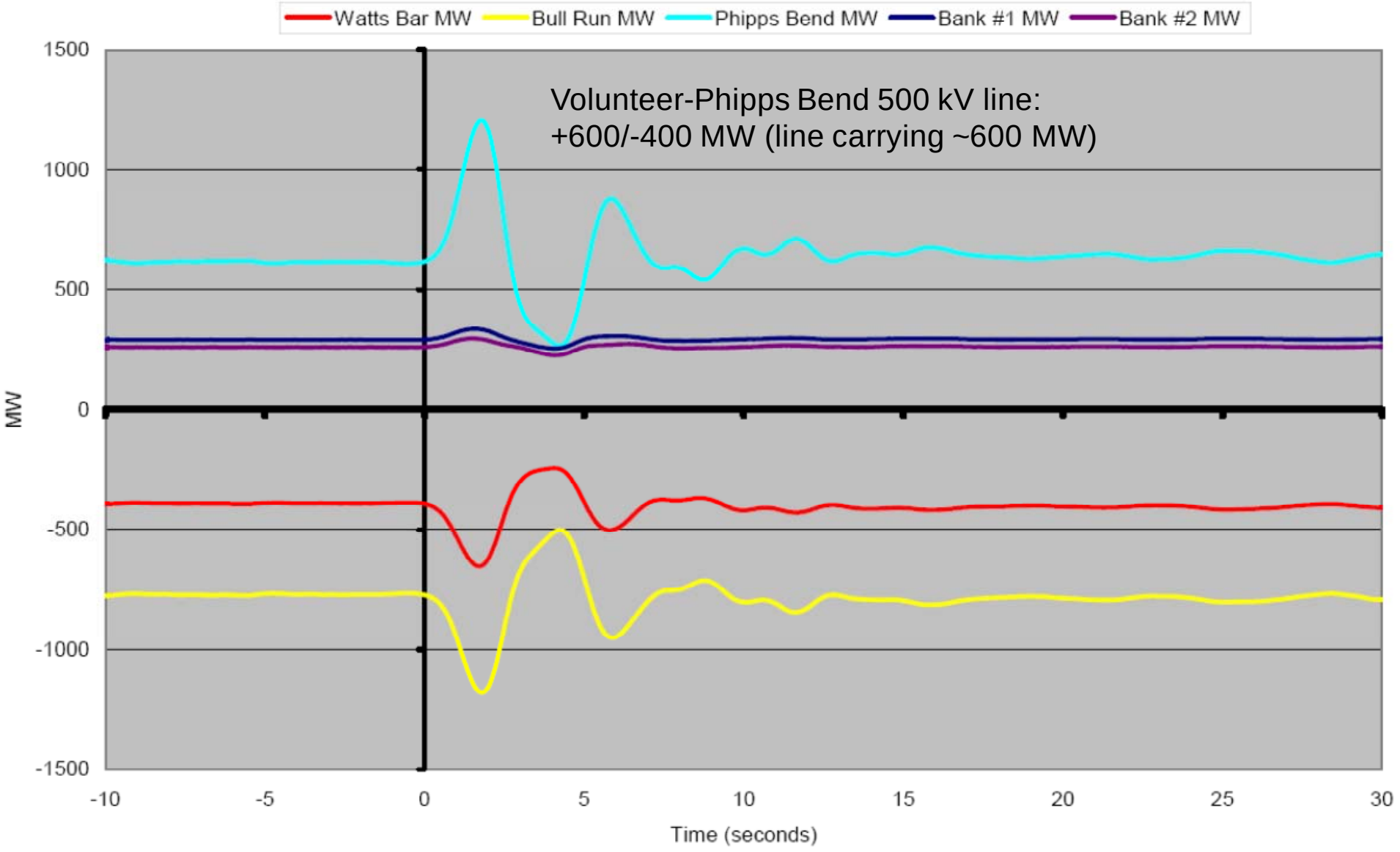
Florida Event – Non-Local Impacts



Ontario 500 kV Voltage Excursion



TVA Volunteer 500 kV Flows



Oscillation Analysis

Florida Disturbance

- 0.05 Hz Damping = ~52% (really good damping)
- 0.25 Hz Damping = ~17% (good damping)
- 0.51 Hz Damping = ~4.5% (not too good!)

Broad River Disturbance

- 0.52 Hz Damping = ~4.2% (not too good!)

MRO Disturbance

- 0.5 Hz family Multiple times with variable damping

Advances Since 2003

2003 Blackout

- Stair-step plot of key line loadings based on powerflow simulations
- Took 3.5 months to develop

2011 Pacific Southwest Disturbance

- Stair-step plot based on PMU data
- To 2.5 hours to create (once data in hand)

Day of the Phasor

- Planning applications
  - Dynamic model validation
  - Planning a sustainable, stable system
    - Changing load and resource characteristics
      - Electronically coupled resources
      - Electronically coupled loads
    - **Compounding interaction of multiple control systems**
- Research possibilities
  - Exploratory analysis
    - Let the data talk to us

Too Many Data!!

Challenges

Challenges to IT & telecom

- Telecommunications management
- Data handling – sheer amount
- Data storage – what to keep & how long
- Processing – real-time processing
- Multiple program interfaces – differing data stream needs

Legal Challenges

- Agreements on data sharing & disclosure

PMU Penetration

Early 2011

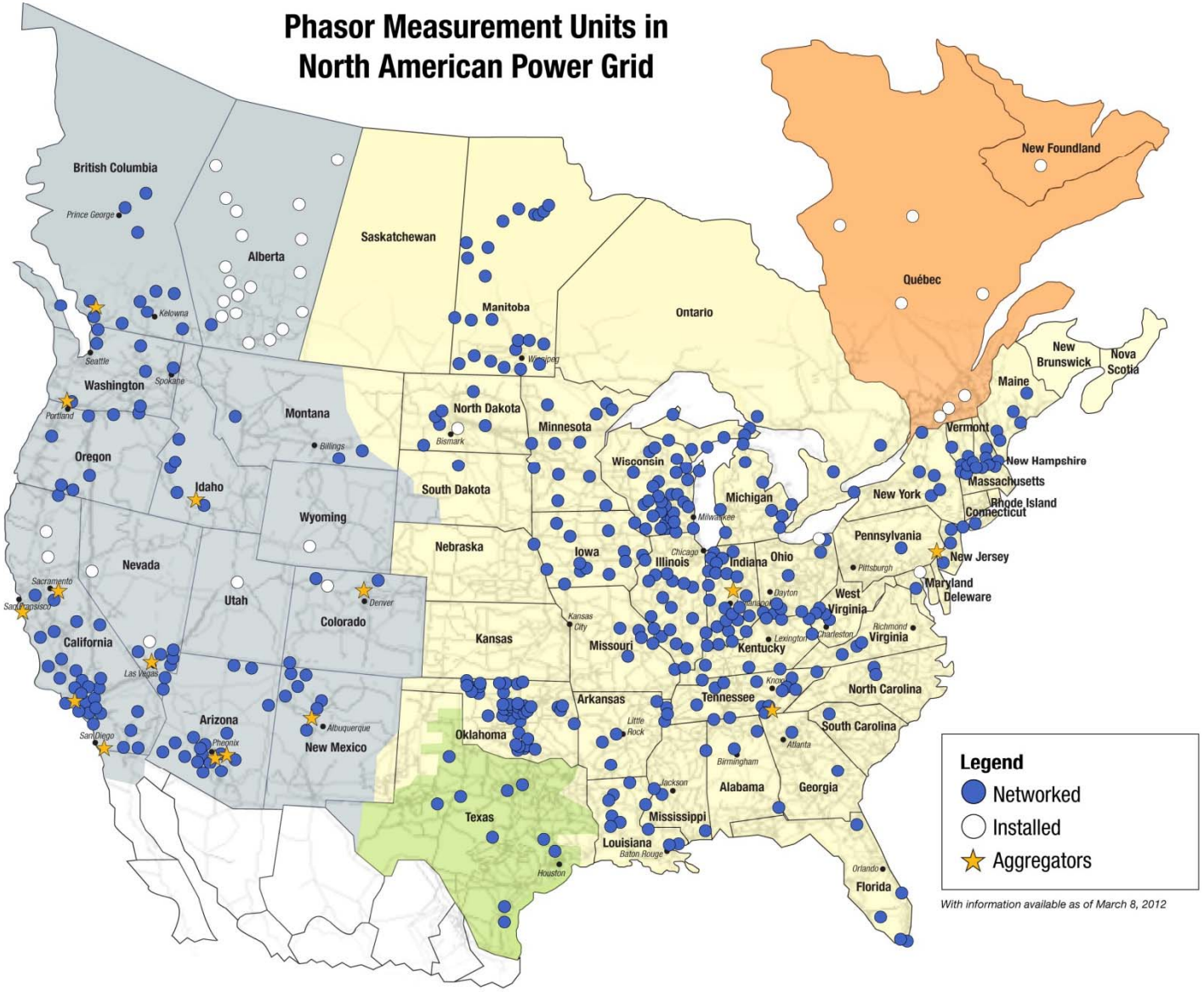
- about 250 PMUs

End of 2013

- over 1,000 PMUs – 10 SGIG projects

2015

- 1,300 – then growing again



Introduction to PMUs – NERC Reliability Coordinator Working Group - November 2004

First Reaction:

"*Nice pictures, but what do I do when I see that??*"

North American Synchrophasor Initiative (NASPI)

NASPI Background

- Collaboration between NERC, electric industry and DOE to advance adoption and use of phasor technology for grid reliability & economics
- Collaborative community – Industry, vendors, consultants, national lab staff, academics, students
- Task Teams
  - Data & Network Management
  - Operations, Performance Standards
  - Planning Initiatives
  - Research
- Three Work Group meetings a year

Major NASPI Accomplishments

- NASPInet communications architecture framework for phasor data
- Existence of NASPI convinced DOE to dedicate SGIG funds for phasor technology, and NASPI work helped frame project priorities and research tasks
- Help SGIG award recipients identify project solutions
- Help vendors identify awardees' needs and drive PMU and PDC product maturity
- Vision and reference documents (phasor technology roadmap and strategic plan, applications review, NASPInet, fact sheets, RAPIR report, presentations for outreach)
- Major role in accelerated development of phasor technology interoperability standards, now working through IEEE and IEC adoption process
  - Phasor measurement
  - PMU communications
  - PMU calibration and testing guide
  - Timing standards
  - PDC guidelines
  - Data storage

NASPI Visualization Workshop

- Workshop Overview
  - 125 attendees
  - 20 operators (5 east, 15 west – RCs and BAs)
  - 4 visualization tool providers (Alstom Grid, Electric Power Group, OSIsoft, PowerWorld)
  - 3 human factors visualization experts (PNNL, ERCOT, NERC)

Visualization Workshop Purpose

Compare wide-area situational awareness tools using synchrophasor data to see whether they meet operators' needs

- Head-to-head comparison of several visualization tools for the same grid events
- Compare visual portrayal of information
- Direct operators' feedback
- Input from human factors visualization experts on how to make these better

What did we learn (or re-learn)?

- Operators could figure out every event from every tool
- Each visualization tool has strengths and weaknesses
- Operators preferences vary – numbers, graphs, & pictures
- Different operators' jobs require different screens and information at different times
  - no one screen or metric works all the time
  - sometimes there's too much information
- Synchrophasor data reveals conditions (esp. oscillations) that SCADA doesn't
- Don't need "common look and feel" w/in control rooms but do need common view and terms in emergencies

Workshop Results

- NASPI to issue workshop summary, share with attendees and NERC Operating Committee
- Share visualization principles from human factors experts with workshop participants
- Share workshop insights with NERC Human Factors conference – March 28-29, 2012 Atlanta
- NERC guidance – industry needs to move toward more common view of events to facilitate fast, effective interpretation and communication during grid emergencies

All summary materials and event clips will be posted on www.naspi.org

Questions?