

# Phasor Technology Research Roadmap for the Grid of the Future



Briefing for  
**Secretary of Energy Samuel W. Bodman and  
OEDER Director Kevin Kolevar**  
May 15, 2006

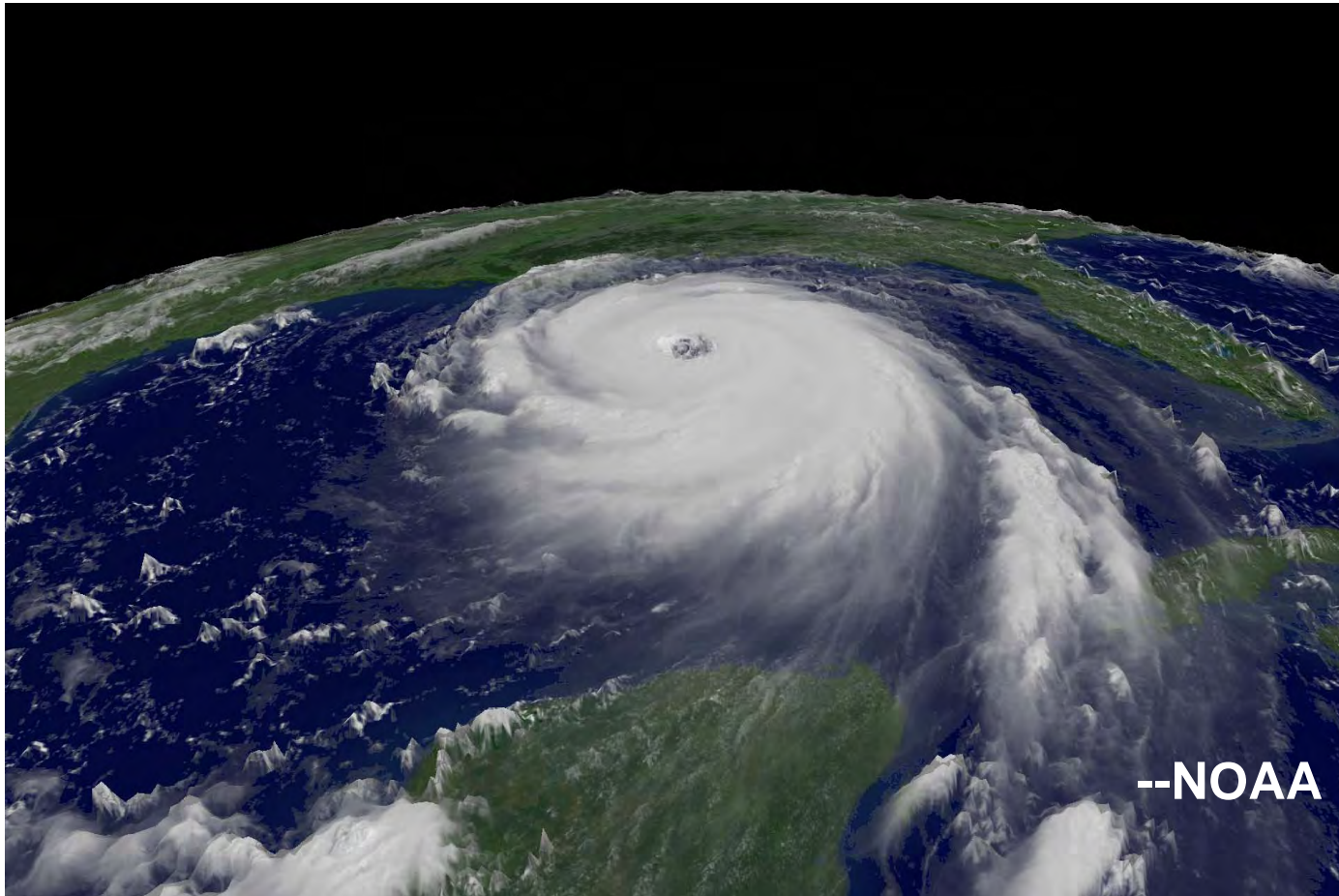
# Briefing Summary

---

- EIPP started in 2002 to address reliability challenges
- August 2003 blackout underscored need & value of EIPP
- DOE provided initial leadership – followed by investments by utilities, NERC, ISOs, vendors & researchers
- EIPP data network started operating in 2005
- Focus shifts to research in utilization of data for situational awareness, wide area monitoring, visualization, modeling to improve reliability & market efficiency
- EIPP Executive Steering Group approved research roadmap in Feb. '06
- Research roadmap calls for continued DOE leadership & funding public interest, long-term research with industry investing in hardware & infrastructure
- Today's Briefing
  - ✓ Reliability Needs & Challenges
  - ✓ Phasor Technology Benefits
  - ✓ Research Needs
  - ✓ Recommendations

# Wide Area View

*What if no one could see it coming?*



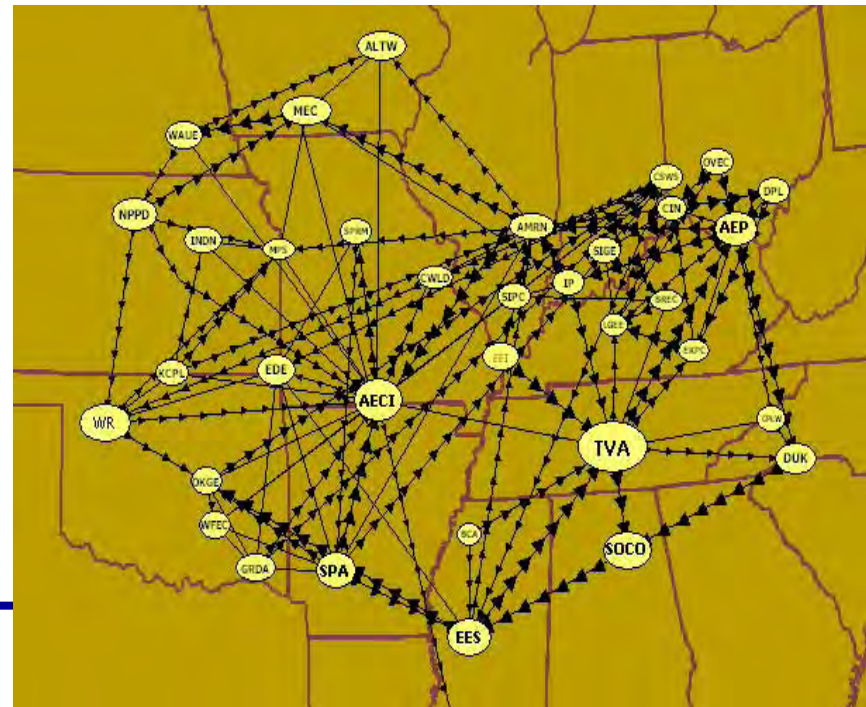
# August 2003 Blackout Underscored Need & Value of Phasor Technology

## August 2003 Blackout

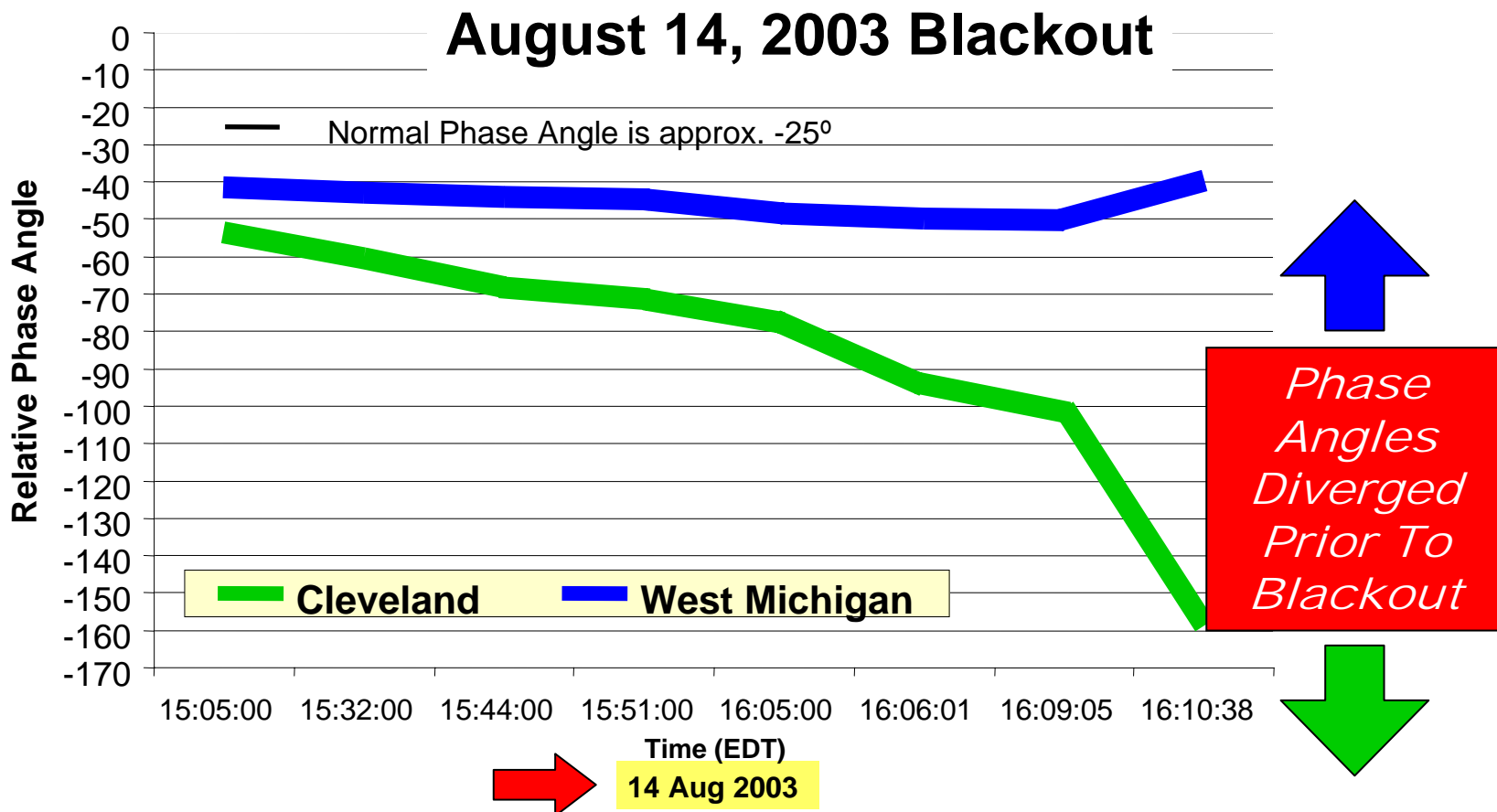
- 50 million people impacted
- Economic losses exceeded \$4.5 billion
- 60,000 MW of power lost

## U.S. Canada Power System Outage Task Force Report Addressed Need For:

- Improved situational awareness
- Wide area monitoring
- New technologies & tools
- Time-synchronized data
- Improved Modeling



# Lack of Visibility and Situational Awareness Led to Aug. '03 Blackout

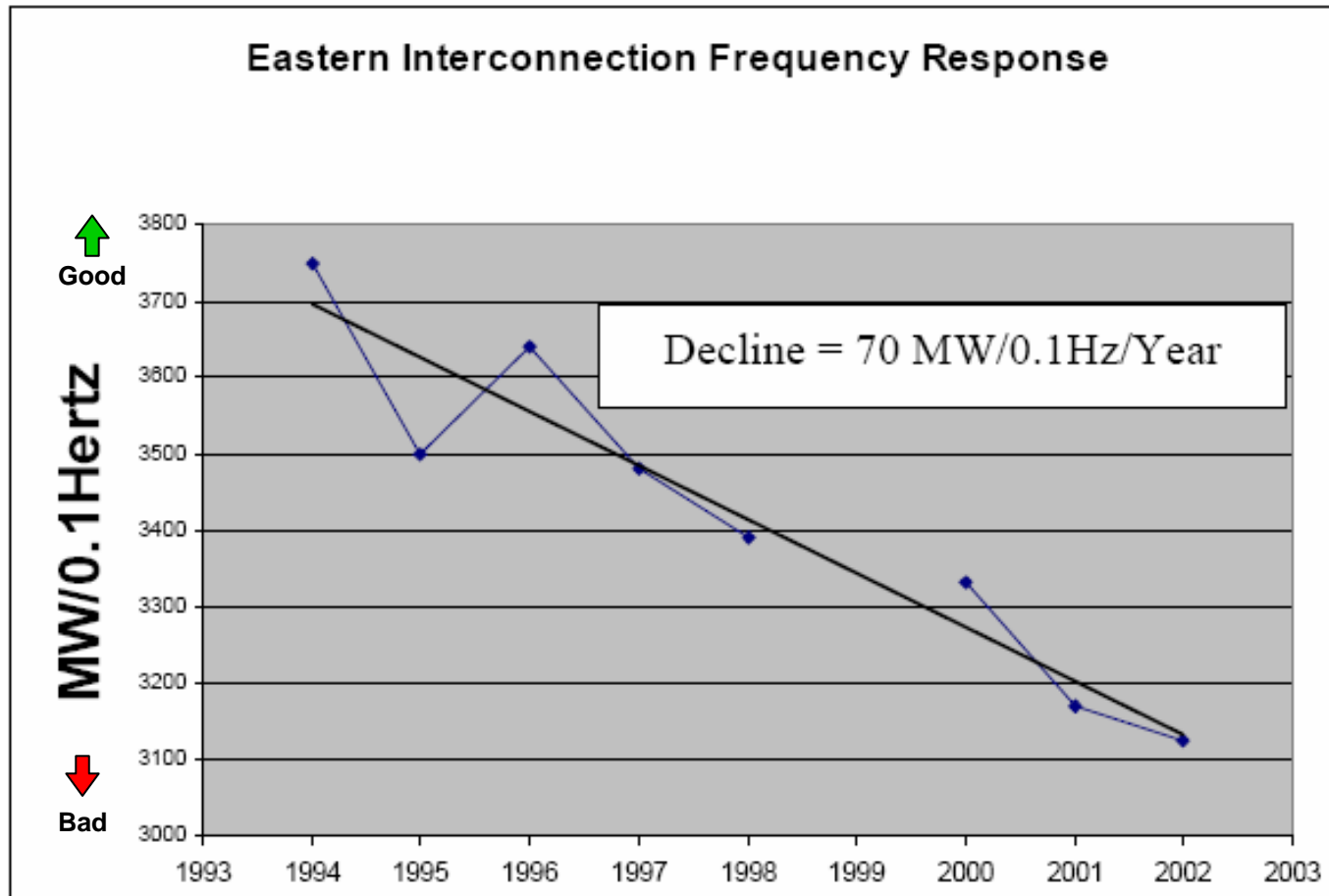


### Notes:

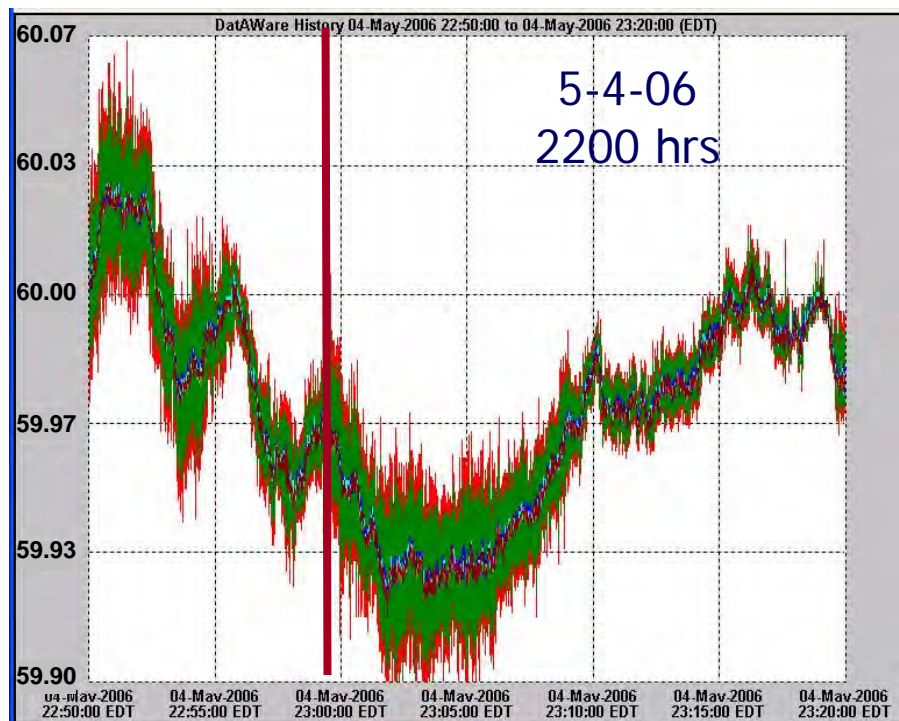
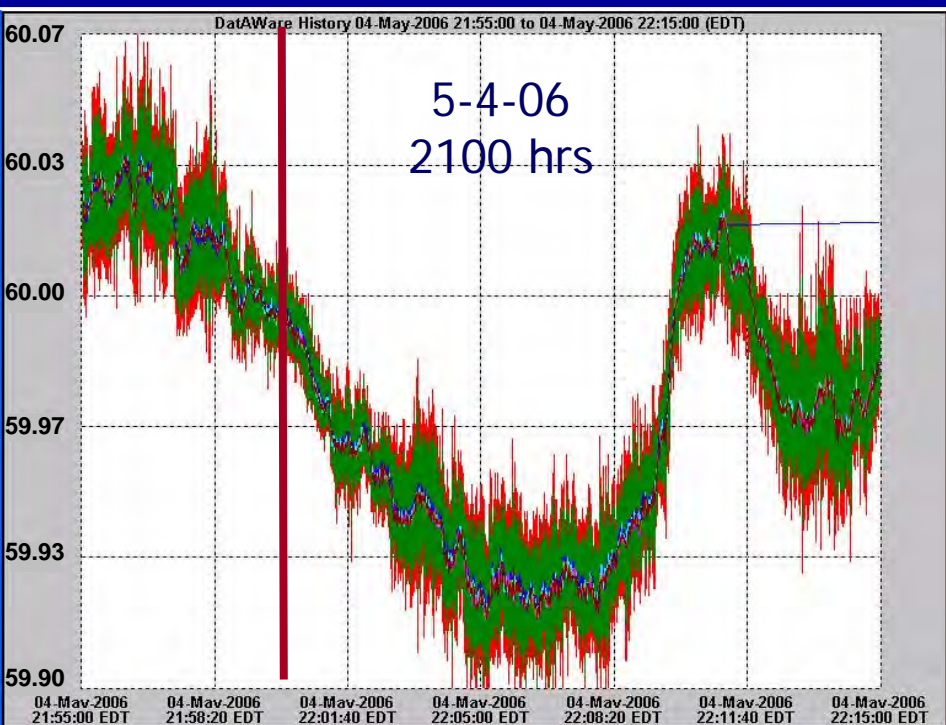
Angles are based on data from blackout investigation.  
Angles are calculated from a Powerflow Simulation.  
Angle reference is Browns Ferry.

# Declining Reliability Performance – Cause for Concern

## Declining Reliability Performance Trend



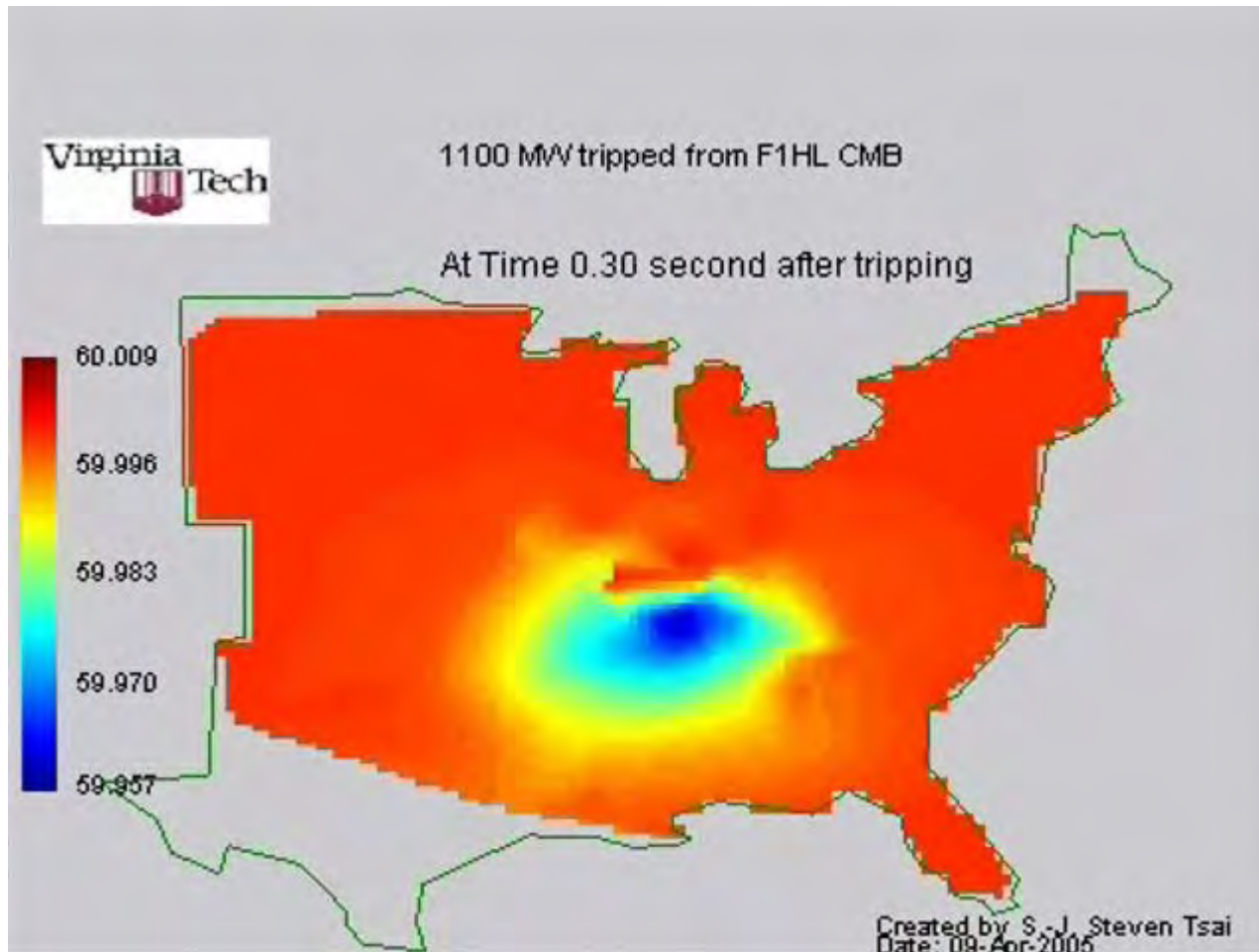
# Recent Large Frequency Excursions With Changes Over 3,000 MW



# Ripple effects of an 1,100 MW generator tripping off line

Good

Bad





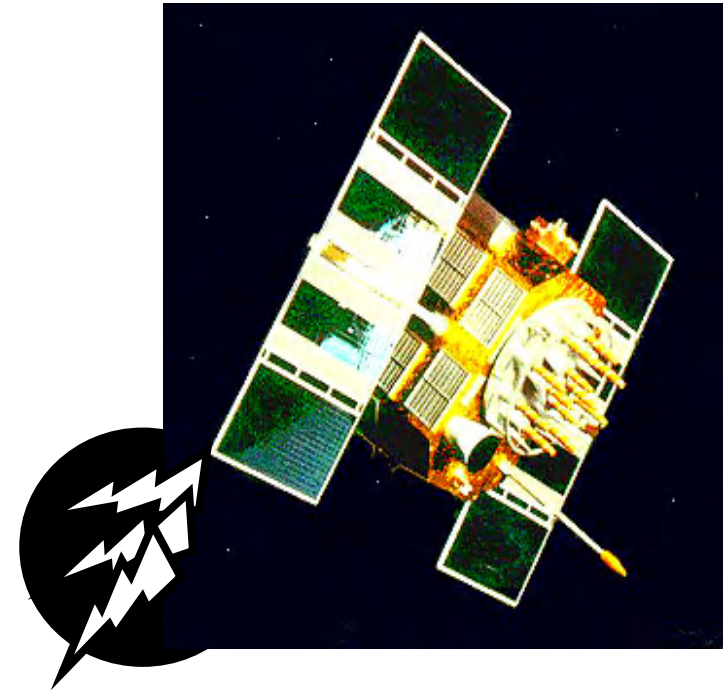
# PMUs Offer Wide-Area Visibility



- Phasor Measurement Units will extend visibility across Eastern Interconnection
- Ability to triangulate the location of disturbances
- Completed installations
  - TVA
  - NYISO
  - AEP
  - Ameren
  - Entergy
  - Hydro One
- All were coordinated with reliability councils & ISOs

# *Phasor Technology – Key for the Grid of The Future*

- Phasor Measurement Units --  
New Advanced Technology
- Provides MRI of Power System  
Compared to X-ray Quality  
Visibility From Traditional SCADA
- Addresses Current Industry  
Problems

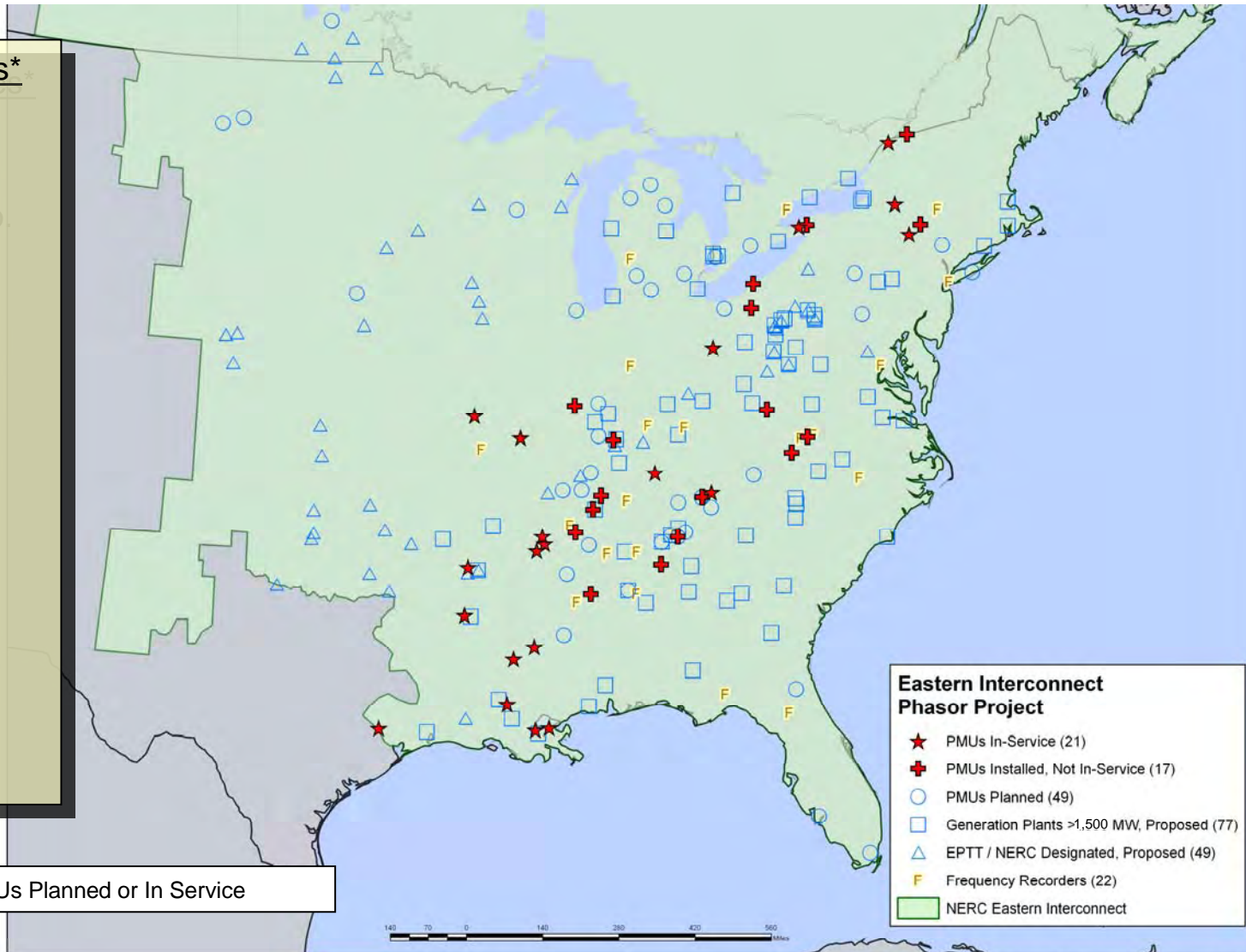


# DOE Leadership Was a Catalyst For EIPP Research

## EIPP PMU Companies\*

- Ameren
- AEP
- American Trans. Co.
- ConEdison
- Entergy
- Exelon/ComEd
- Exelon/PECO
- First Energy
- Hydro 1
- LIPA
- Manitoba Hydro
- METC
- Midwest ISO
- NY ISO / NYPA
- PPL Corp.
- Southern Company
- TVA

\* Companies with PMUs Planned or In Service



# ***DOE Leadership Needed to Address Long-Term R&D Challenges***

## **Analysis of Data**

- Baseline for normal
- Anomaly detection
- Anomaly magnitude characterization
- Anomaly Footprint
- Pattern Detection

## **New Applications**

- Wide area situational awareness
- System dynamics assessment
- Improved modeling
- State estimation/ measurement
- Grid of the Future – design, monitoring, control, protection, & automated network switching

**Industry Focus:  
Infrastructure**

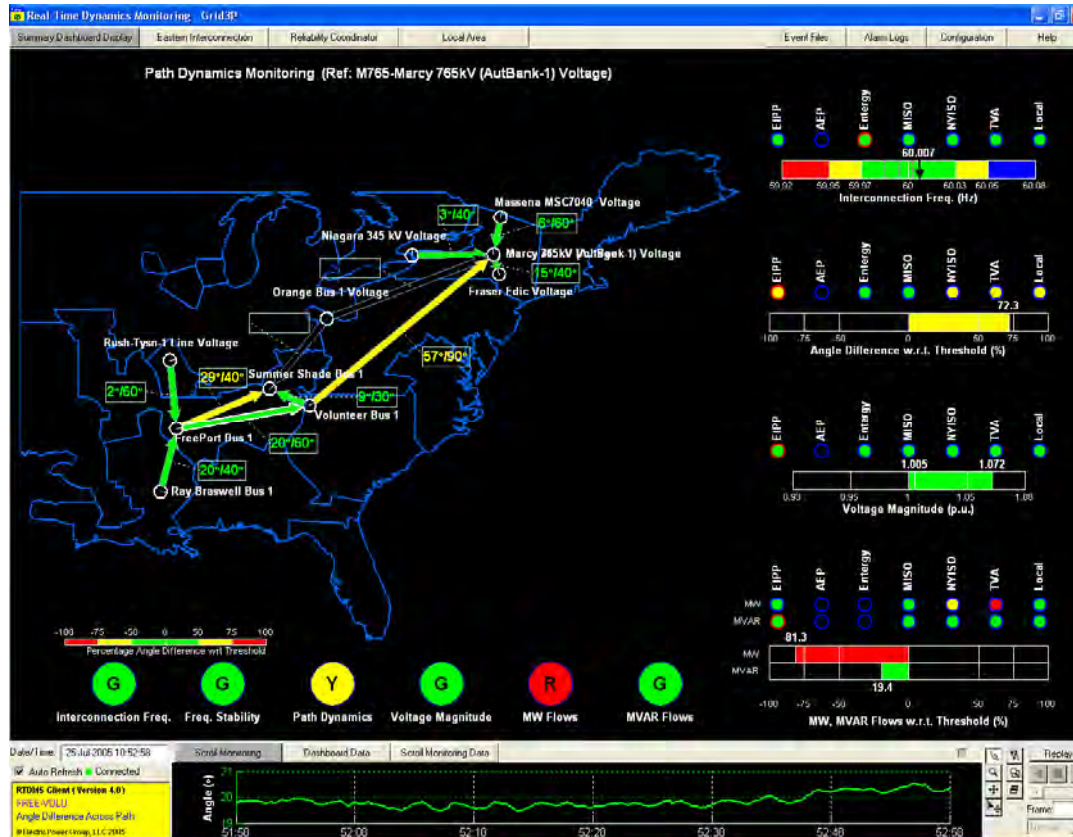
**DOE Focus:  
R&D**

# Wide Area Visualization & Monitoring with Phasors – Illustrative

Wide Area Visualization



Situational Awareness Dashboard



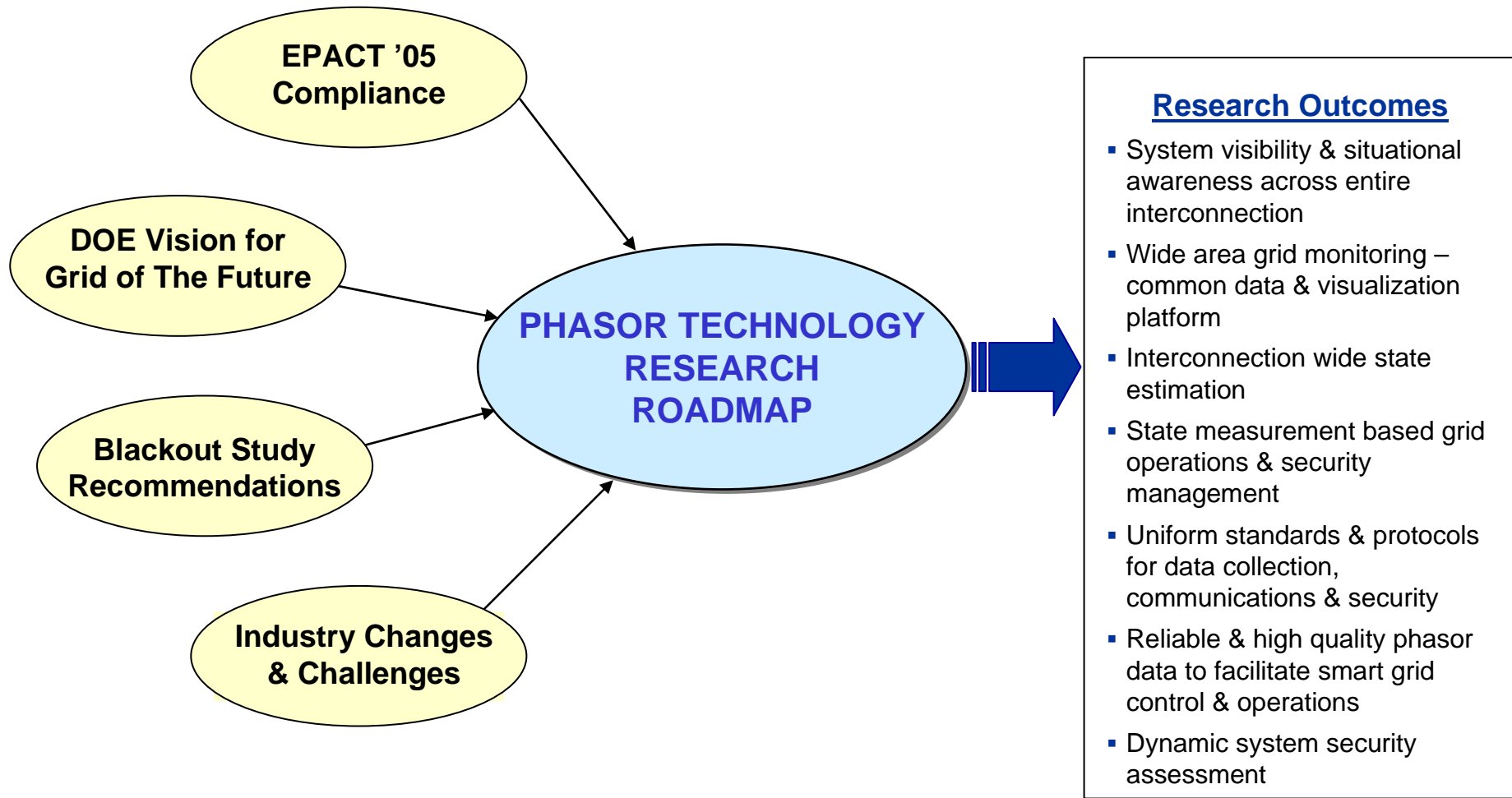
Interconnection Monitoring

Dynamics Monitoring

Reliability Metrics

Operating Margins

# Phasor Technology Vision & Roadmap -- Summary



# *Recommend Continued DOE Investment in Phasor Technology Program Research*

---

- DOE investment in EIPP: \$3M since 2002
- Industry investment in EIPP infrastructure & staff time at 5:1 ratio (industry to DOE).
- Research targeted at reliability, security & efficiency – benefits economy & the public – extends beyond footprint of individual companies
- DOE role will transition to long-term R&D to maximize economic & security benefit of the emerging new class of monitoring data
- Recommend DOE commit to \$5M/year for five years for core Phasor Technology R&D Program