Project Plan and Status Update

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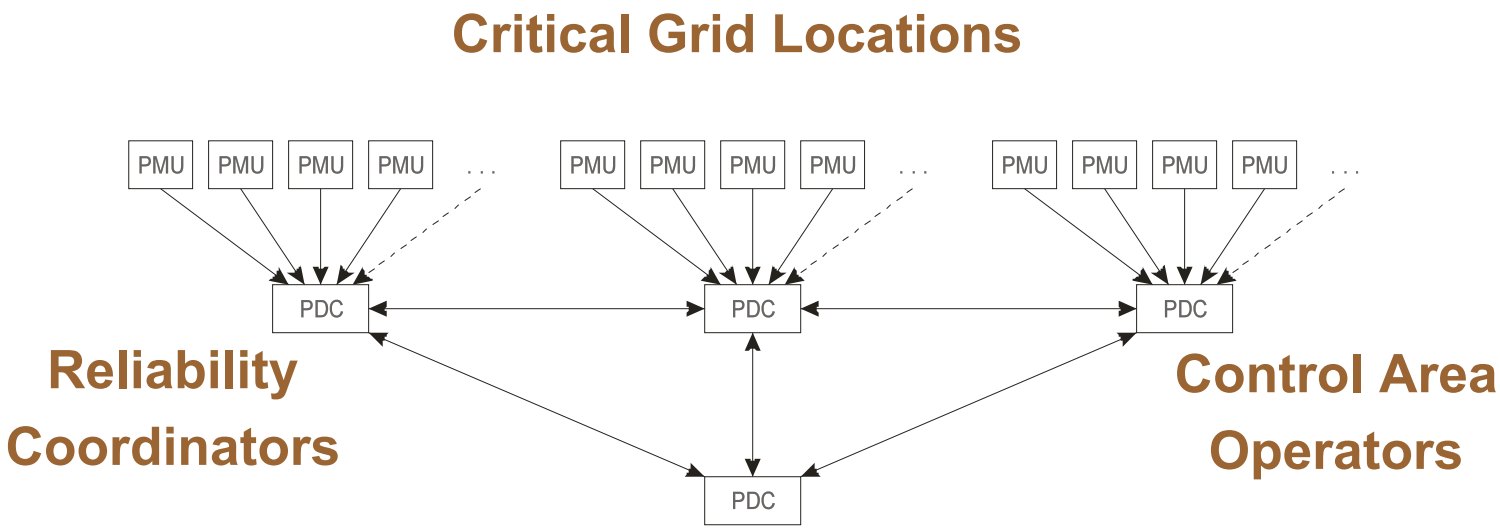
Phasor Measurement Systems



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Main Benefits of WAMS

1. More comprehensive wide-area view of system
2. Rapid assessment of system conditions
3. Improved system models for steady-state and dynamic analysis
4. Enhanced post-disturbance analysis
   - *sequence of events*
   - *what happened first*
5. Power swing detection by on-line angle difference monitoring
6. Increased power system performance
7. Higher utilization of existing investments
8. Reduced outage costs

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Project Participants

Department of Energy

Transmission Reliability Program

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(through funding from the DOE TRP)

Facilitate/Coordinate

Reliability Councils

Standards Organizations

Enable/Supervise

Eastern Interconnection

System Operators

Implement/Benefit

Transmission Owners

Manufacturers

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PMU Placement

- **The overall wide-area system must provide a comprehensive report of line flows, bus conditions, and control actions for**
  - major and/or critical interchanges and load areas
  - major control systems, especially those for HVDC and FACTS
  - major and/or critical generation projects

- **Over 280 possible locations identified through interviews with participants last year. Ninety of these sites identified as key.**

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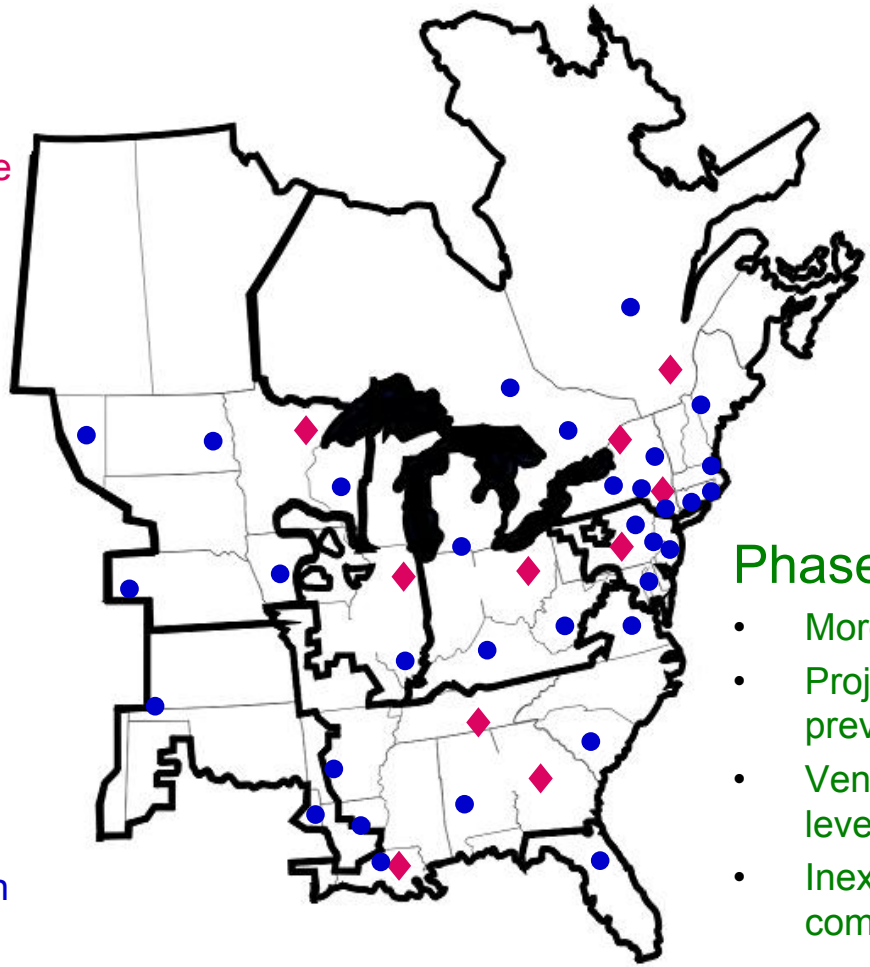
Proposed Plan

Phase I

- 10-12 Instruments, most are already installed but not connected
- Work out communications issues
- Transfer software tools to users
- Establish relationships

Phase II

- ~50 Instruments
- Immediate benefits from previous slide realized
- All major corridors covered
- Data available to research community to begin work on projected benefits



Phase III

- More than 350 Instruments
- Projected benefits from previous slide realized
- Vendors participating at all levels
- Inexpensive instruments and communications available

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Proposed PDC Locations (Phase 1)

- TVA Installation
  - October 2003
- NYISO Installation
  - Winter 2003-2004
- Both installations coordinated with reliability councils and ISOs to serve broad regional needs

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The Role of CERTS & DOE

- PHASE I
  - CERTS acts as facilitator among stakeholders
  - Provide software tools and training for both operations environment (voltage & frequency profiles, security coordinator tools, etc.) and off-line environment (planning, post-disturbance analysis, model validation, etc.)
  - Provide a "data concentrator" to integrate data and disseminate to participants
- PHASE II
  - CERTS engages vendors to incorporate software tools into EMS systems and planning/control environments
  - Continued assistance to stakeholders to resolve hardware or software issues
  - Development of "projected" benefits such as new state estimator
- PHASE III
  - CERTS supports technical issues as they arise

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Status Update

- One-on-one meetings with major system operators
  - Jan 2003 through May 2003
- Development of the project plan
  - April 2003 through June 2003
- Analysis of sources of August 14 data
- Procure/program/deploy 1st Phasor Data Concentrator at TVA
  - June 2003 through October 2003
- Procure/program/deploy 2nd PDC at NYISO
  - October 2003 through January 2004

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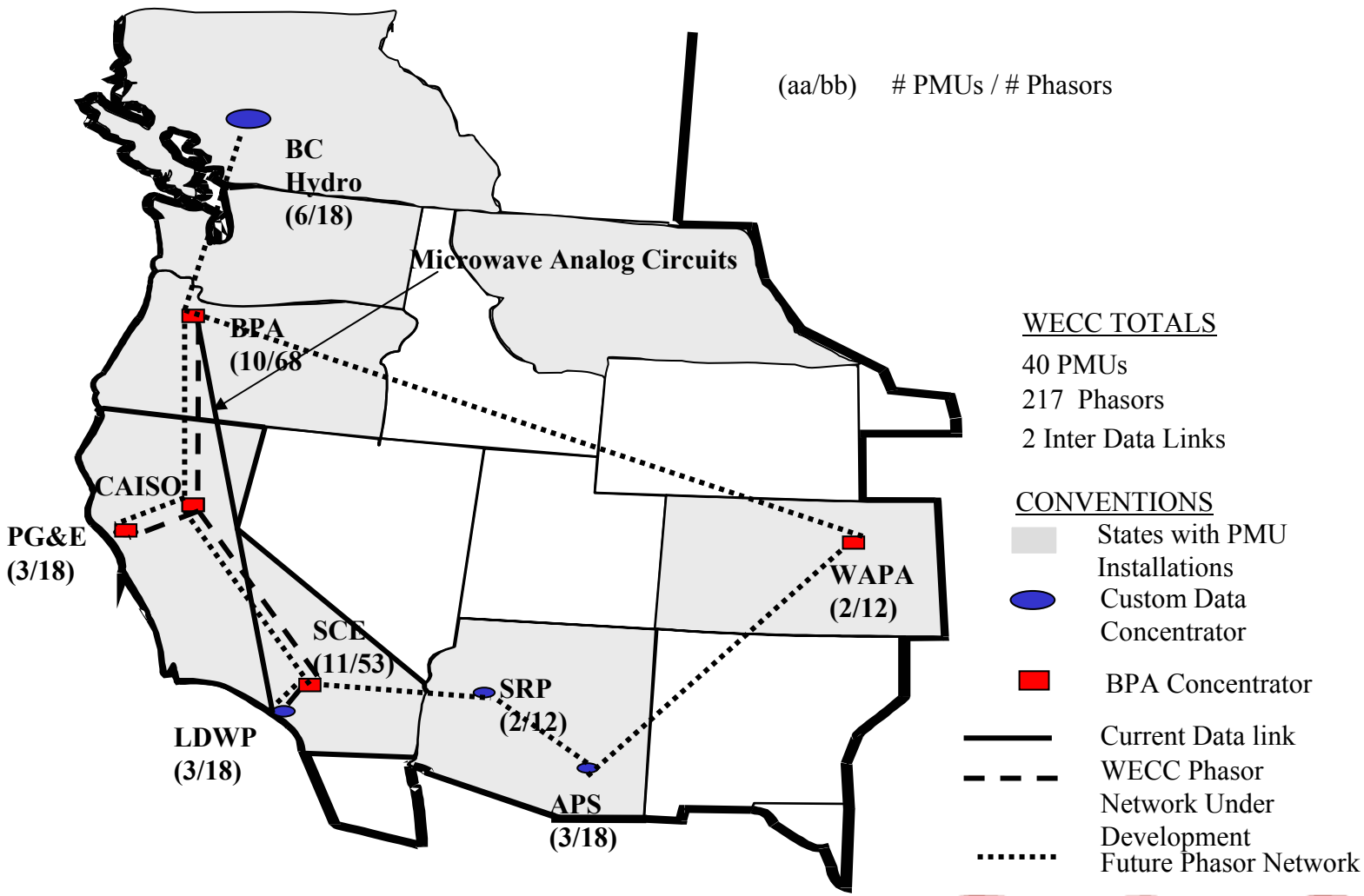
Synchronized Phasor Network In WECC



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BPA StreamReader Display
Oscillations following Alberta separation on August 4, 2000

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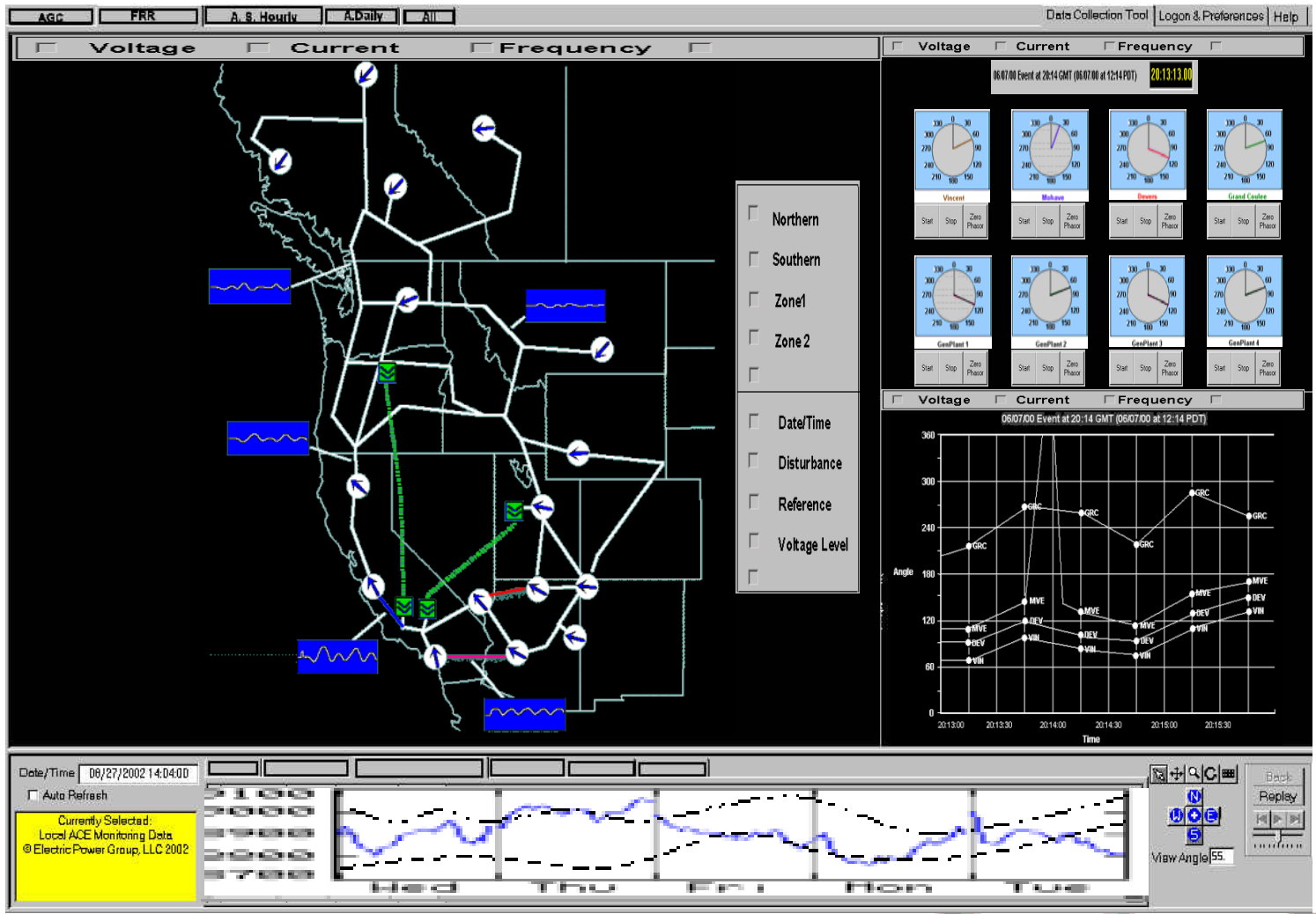
Synchronized Phasor Technology Applications

Real time Monitoring and Alarming of regional angle differences against predefined thresholds



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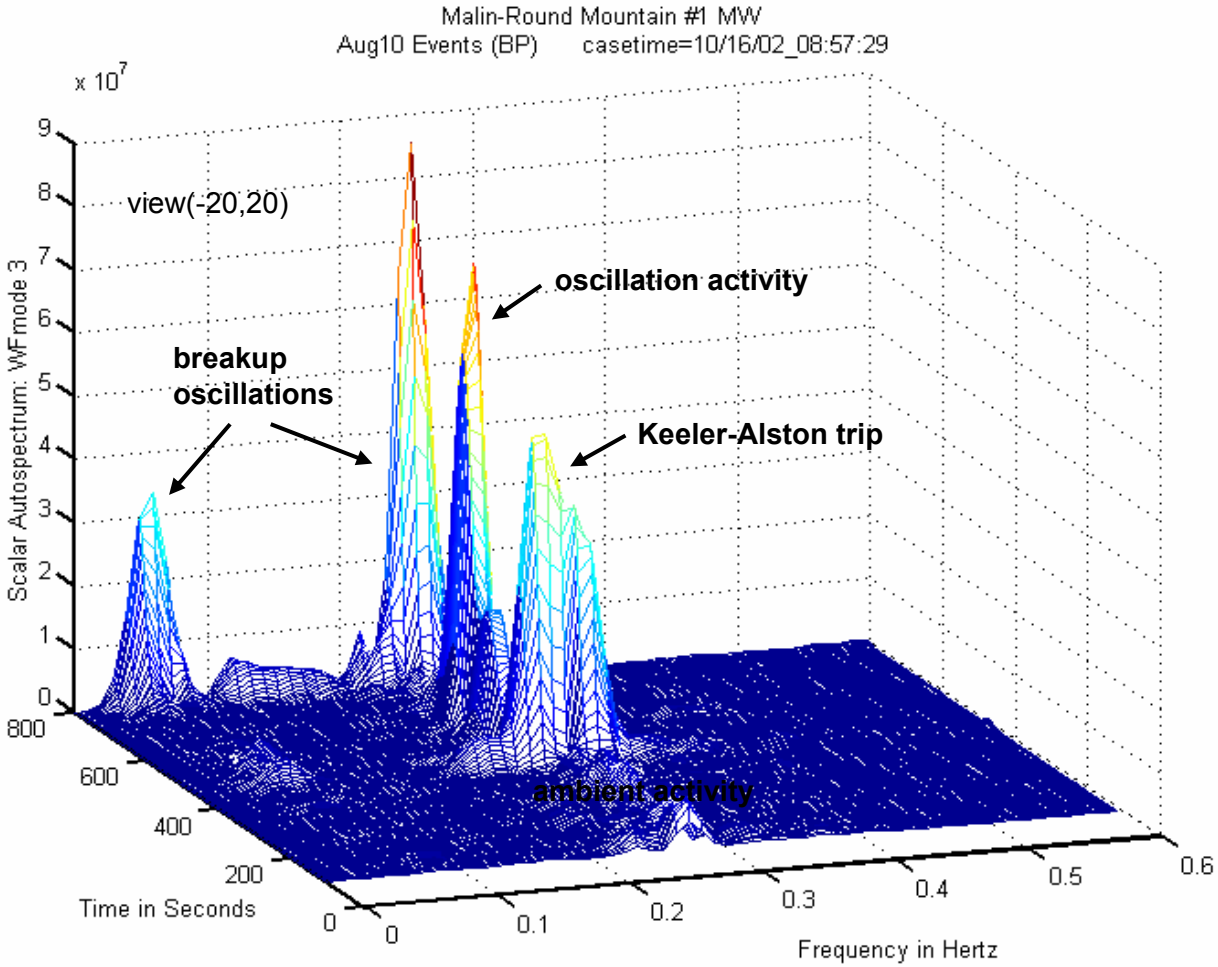
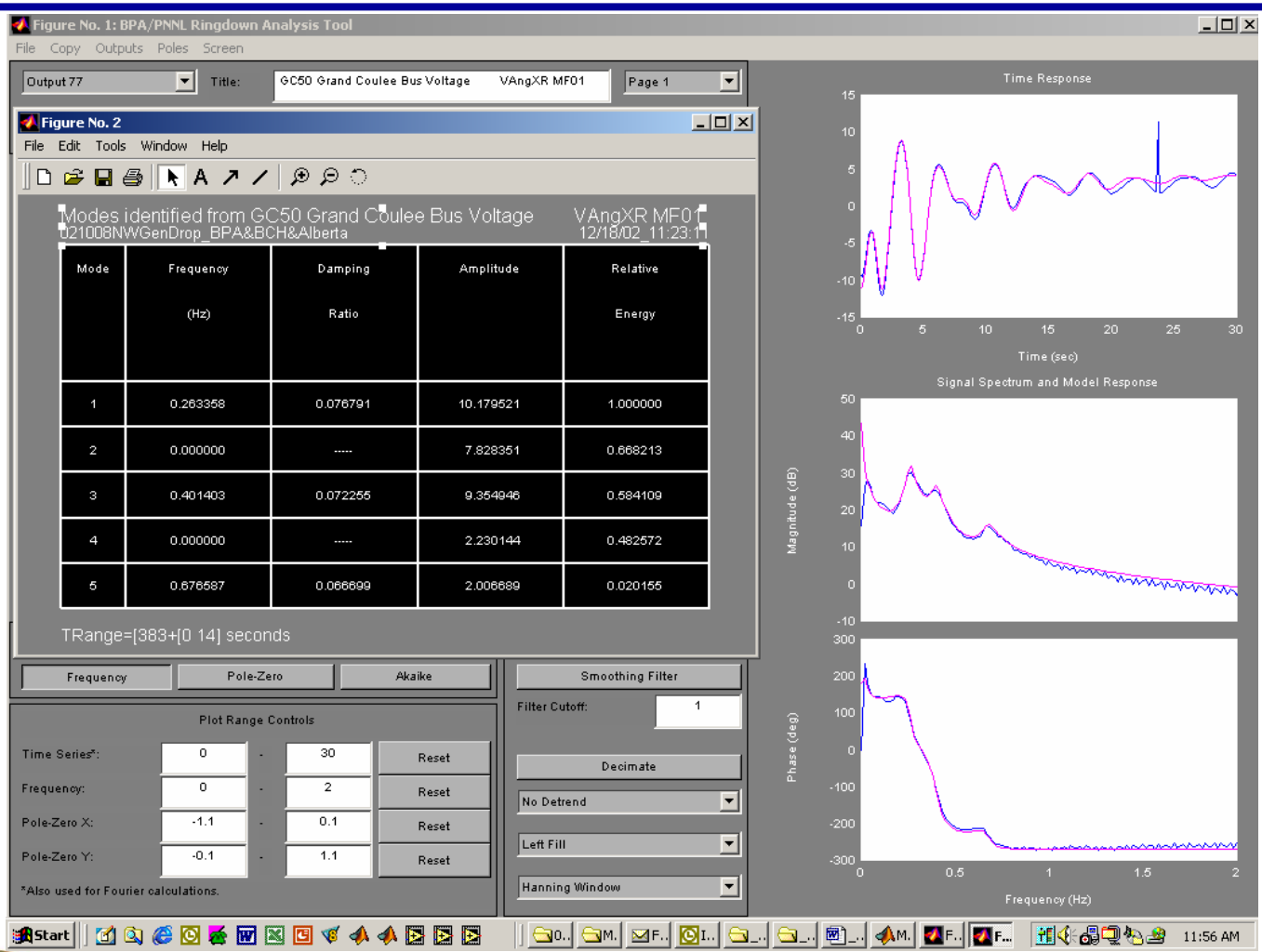
Scalar waterfall spectra just before WSCC breakup (bandpassed data, mesh display)



Event-Triggered Prony Analysis: NW Generation Trip Event on October 8, 2002



Mode	Frequency (Hz)	Damping Ratio	Amplitude	Relative Energy
1	0.263358	0.076791	10.179521	1.000000
2	0.000000	-----	7.828351	0.668213
3	0.401403	0.072255	9.354946	0.584109
4	0.000000	-----	2.230144	0.482572
5	0.676587	0.066699	2.006689	0.020155

Match to transient

Match to transient frequency content

Match to transient phase

Bus angles relative to SCE Devers

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