Department of Energy

Bonneville Power Administration
P.O. Box 3621
Portland, Oregon 97208-3621

PUBLIC AFFAIRS

October 16, 2012

In reply refer to: DK-7

Dan Seligman
Columbia Research Corporation
PO Box 99249
Seattle, WA 97208

FOIA #BPA-2012-01928-F

Dear Mr. Seligman:

This is a final response to your request for information that you made to the Bonneville Power Administration (BPA) under the Freedom of Information Act (FOIA), 5 USC § 552.

You have requested the following:
Copies of all documents on any subject given to FERC Chairman Jon Wellinghoff from January 2012 to present.

Response:
The documents responsive to your request are provided in their entirety.

Pursuant to 10 CFR 1004.8, if you are dissatisfied with this determination, or the adequacy of the search, you may appeal this FOIA response in writing within 30 calendar days of receipt of a final response letter. The appeal should be made to the Director, Office of Hearings and Appeals, HG-1, Department of Energy, 1000 Independence Avenue, SW, Washington, DC 20585-1615.
The written appeal, including the envelope, must clearly indicate that a FOIA Appeal is being made.

There are no fees associated with this request.

I appreciate the opportunity to assist you. Please contact Kim Winn, Communications Specialist, at 503-230-5273 with any questions about this letter.

Sincerely,

For /s/Kim Winn
Christina J. Munro
Freedom of Information Act/Privacy Act Officer

Enclosure: Responsive documents

Synchro-phasors

Briefing for

Jon Wellinghoff, Chairman, FERC

Bonneville Power Administration

July 2012

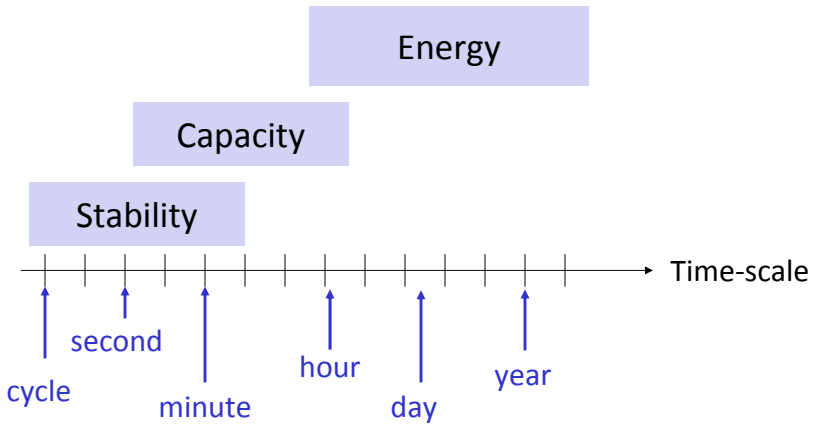
BONNEVILLE POWER ADMINISTRATION

Presentation Outline

- Synchro-phasor Technology Overview
- Investment
- Today's Success Stories: Diagnosing Outages and System Performance via Engineering Analysis
- Tomorrow's Success Stories: Preventing Blackouts via Real-time Control Room Applications
- Value

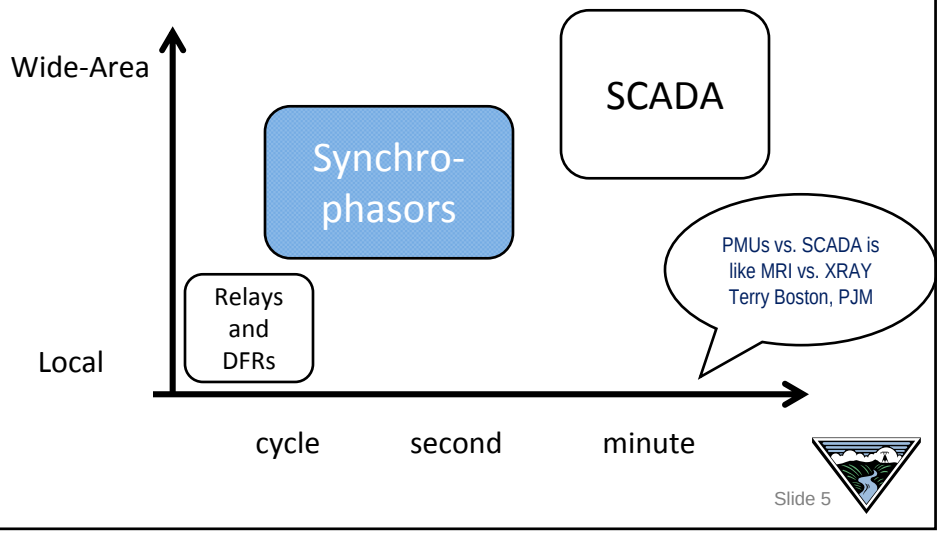
Technology

Timeframes



Primary focus is on “stability” – system ability to withstand disturbances and “capacity”

Synchro-Phasor Technology



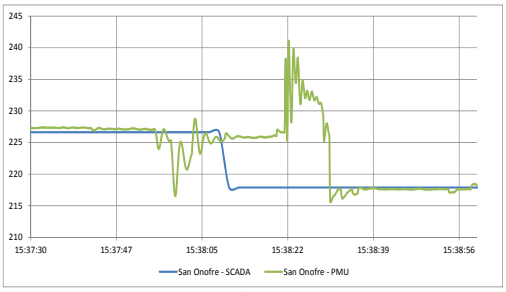
PMU versus SCADA

- Supervisory Control And Data Acquisition (SCADA)
  - 2-second, or often 4-second scan rate
  - Data are not time synchronized; they are time stamped when received at the control center
  - SCADA is OK for steady-state applications, but is not adequate for observing system dynamics

- Phasor Measurement Units (PMUs)
  - Very high time resolution: 30 to 60 samples per second
  - Data are time synchronized at the source
  - Provide an unprecedented view of the dynamic state of the power system

September 8, 2011 Pacific Southwest Outage

- PMU data were critical in developing the sequence of events – because of the high resolution and time synchronization of the data
- SCADA data were misleading; time tags were contradictory, and data resolution was too low



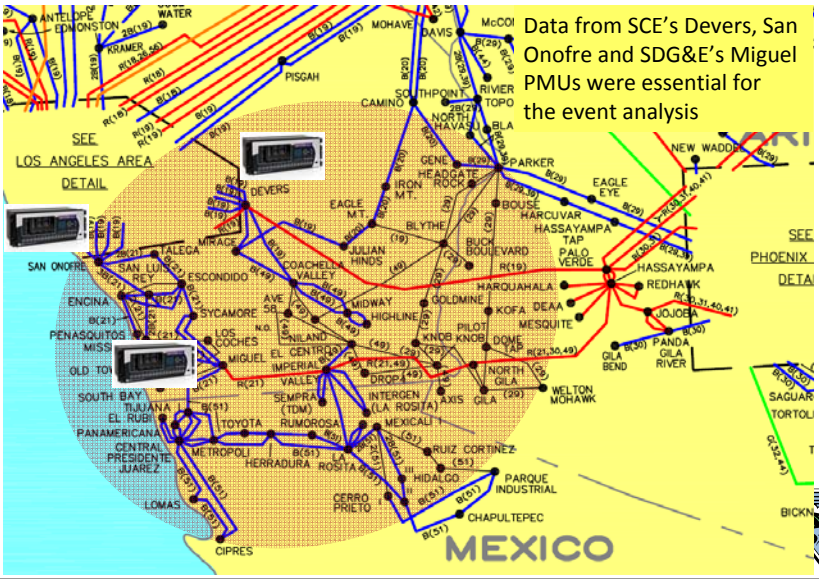
1 minute

South of SONGs Separation

PMU data SCADA data

B O N N E V I L L E P O W E R A D M I N I S T R A T I O N

September 8, 2011 Pacific Southwest Outage



Data from SCE's Devers, San Onofre and SDG&E's Miguel PMUs were essential for the event analysis

Changing Nature of Electrical Loads

Resistive Cooking
Resistive Heating

Incandescent Lighting

Power Electronics

Distributed Generation

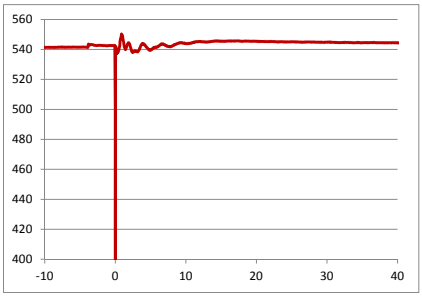
Data Centers

AC and Heat Pumps

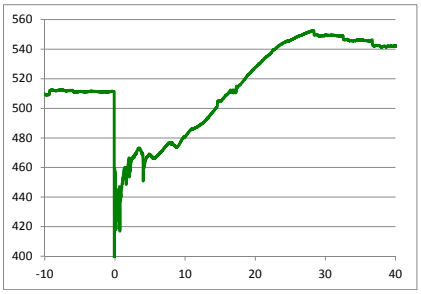
Share of total system load

Changing Nature of Electrical Loads

Synchro-phasor data help transmission planners better understand the implications of changing electrical loads, so that they can make timely and appropriate capital investments



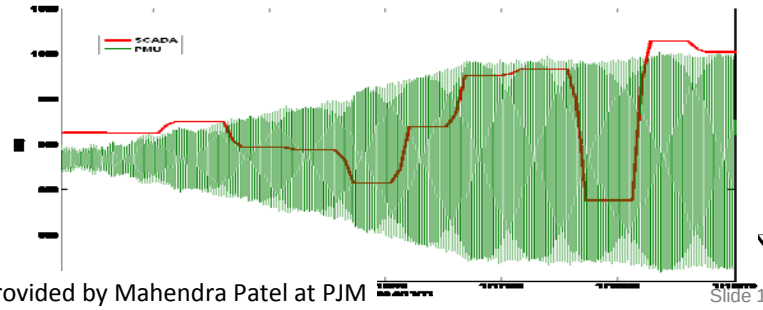
Transmission voltage during a fault in an area with mainly resistive loads



Transmission voltage during a fault in an area with high amount of residential air-conditioning load

Power Oscillations

- Power system oscillates
- SCADA measurements cannot see most oscillations; worse – they can misrepresent what's actually happening on the grid
- Synchro-phasors are required to observe and understand the oscillations because the PMUs have faster data sampling rates, higher data resolution, and time synchronization



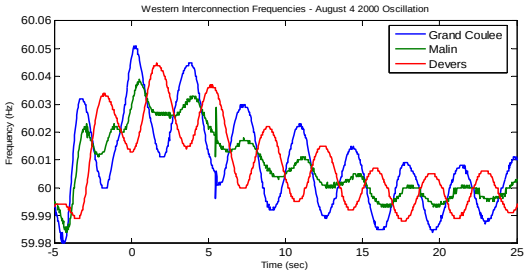
Provided by Mahendra Patel at PJM

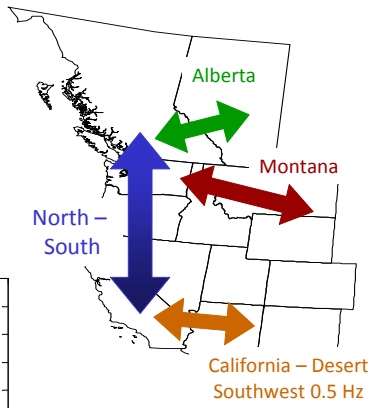
Inter-area Power Oscillations

Generators in two regions oscillating against each other

PMUs provide wide-area synchronized view necessary to understand the interactions

Whom am I oscillating with ?





Investment

Synchro-phasors at BPA

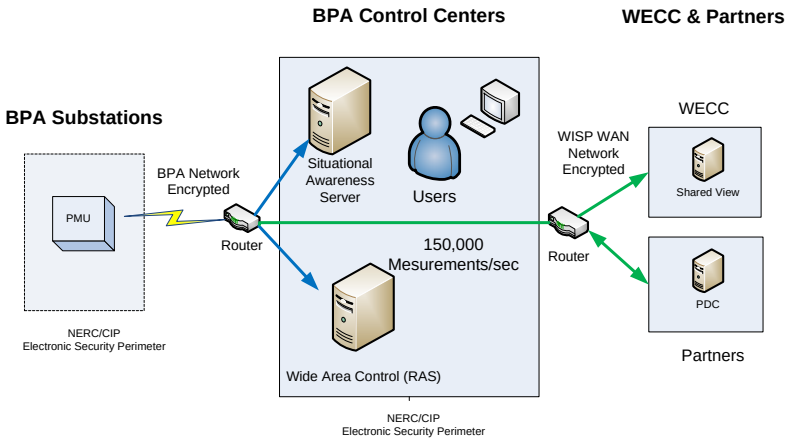
- 1990's – BPA was one of the early technology adapters
- 1996 outages – increases PMU coverage, networked PMUs to stream real-time data to BPA control center
- 1999 – real-time data exchange with SCE
- 2000's – development of engineering applications, research of real-time applications
- 2009 – moving from a research prototype system to a **production grade system**

BPA Synchrophasor Project Overview

- 5-year, $35m project began in 2010
- State-of the art measurement equipment for the transmission grid
- Key partner in $108m WECC WISP Program
- PMU Installation
  - 50 key substations and wind sites
  - 120 PMUs installed
- DOE Smart Grid Program
- Control center upgrades for system operators
  - PDCs, Applications, Archives
- Wide Area Controls (RAS)

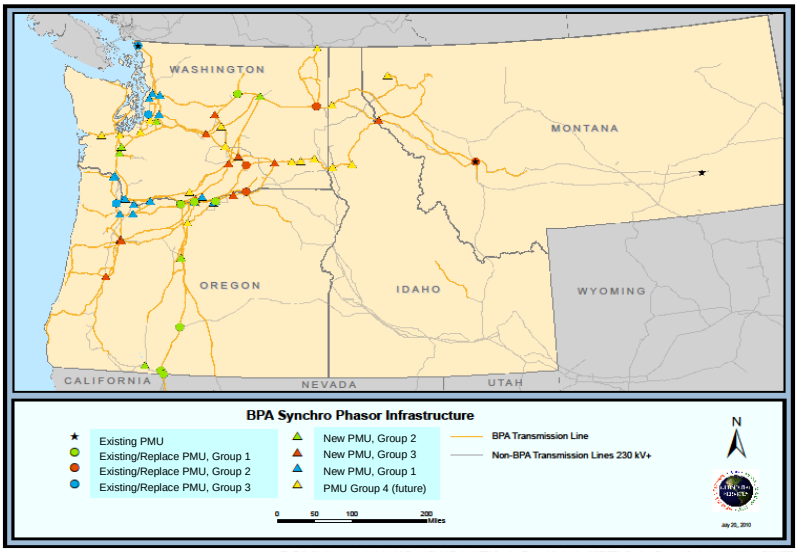
Rack with PMUs in a BPA substation

High-Level Architecture



All Field and Control Center installations will be fully NERC/CIP compliant, and will be considered Critical Cyber Assets (CCAs)

BPA PMU Deployment



B O N N E V I L L E P O W E R A D M I N I S T R A T I O N

Benchmarking On-Going Synchrophasor Projects

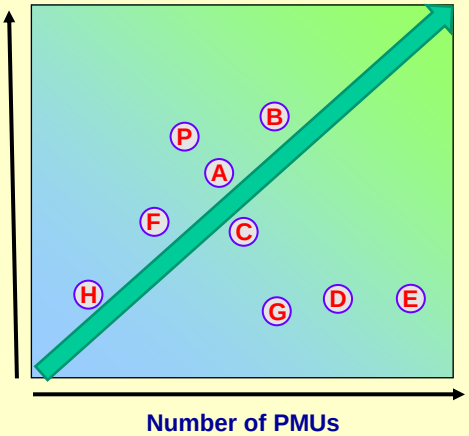
Application Maturity

Real-time closed loop control, protection, operation & other applications

Control room functions; alarming and situational awareness

Data visualization and operation analysis in control room

Monitoring; visualization & engineering analysis outside of control room



3-YEAR DEPLOYMENT

Number of PMUs

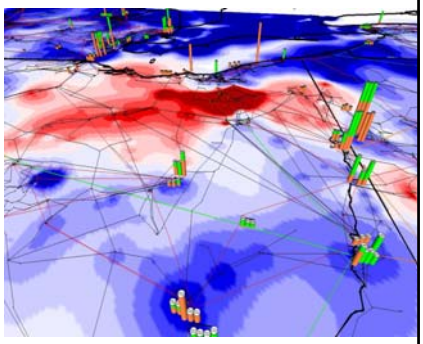
Bonneville Power Administration

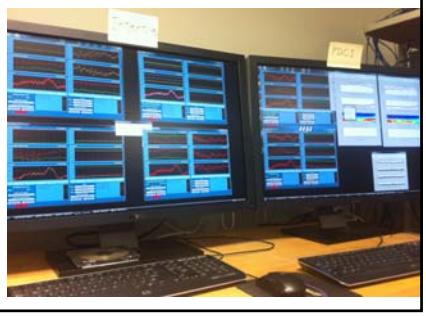
Provided by Damir Novosel, President of Quanta Technology

Applications

The value of the investment will be realized through the deployment of applications

- **Engineering Applications**
  - Understand system performance issues, make better capital investments, set safer operating limits
- **Real-Time Wide-Area Situational Awareness**
  - Give grid operators better visibility of the system state
- **Wide Area Controls**
  - Increase stability limits





BONNEVILLE POWER ADMINISTRATION

Success Stories of Today:

System Performance Monitoring, Analysis and Modeling

System Test Monitoring

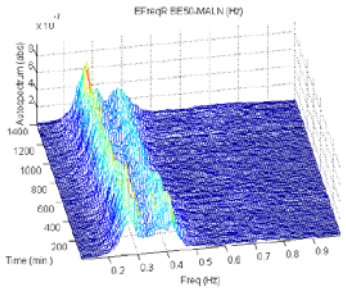
BPA has been conducting system tests to stimulate power oscillations under controlled conditions

PMU data are collected interconnection-wide for the analysis of generator interactions

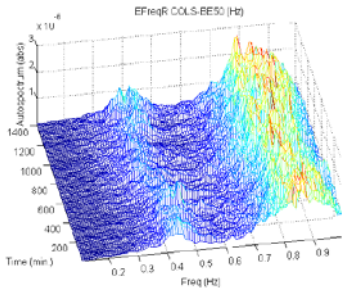
Our understanding of the oscillation risks have been greatly improved

An investment strategy has been developed to reduce these risks

California – Oregon Intertie



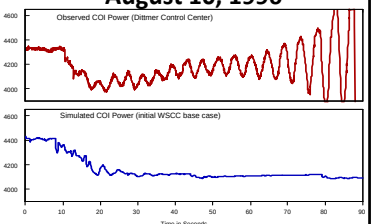
Montana - Northwest Intertie



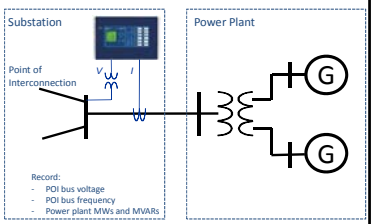
Using PMU Data for Model Validation

- Power system models are used to make decisions on capital investment and to set system operating limits
- 1996
  - Failure of models to predict or reproduce the 1996 disturbances
  - COI and PDCI were temporarily de-rated by 33%
  - Started installing PMUs at power plants
- Today:
  - WECC Policy on plant model validation, NERC is developing a Standard
  - PMU-recorded disturbances can be used for compliance
  - BPA has more than 17GW capacity monitored

August 10, 1996

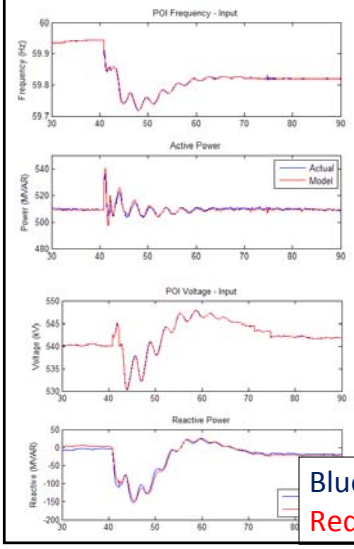


Red = actual,
blue = simulations

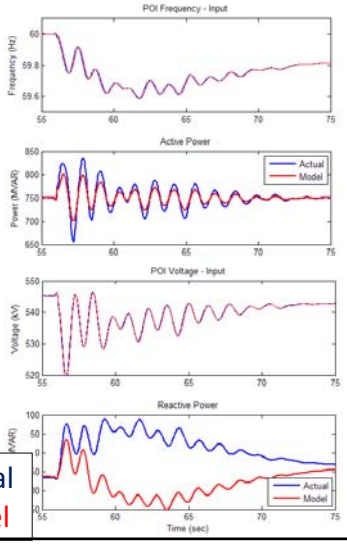


Using PMU Data for Model Validation

- Good Model:



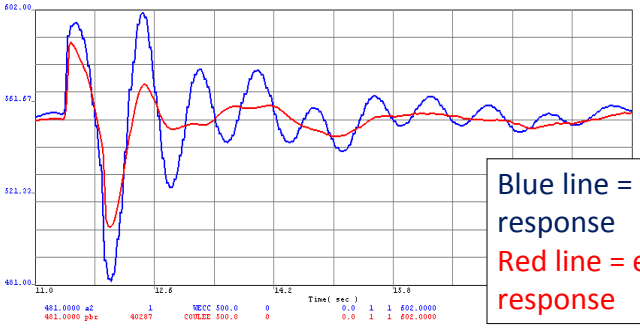
- Bad Model:



Blue = actual
Red = model

Using PMU Data for Detecting Generator Control Failures

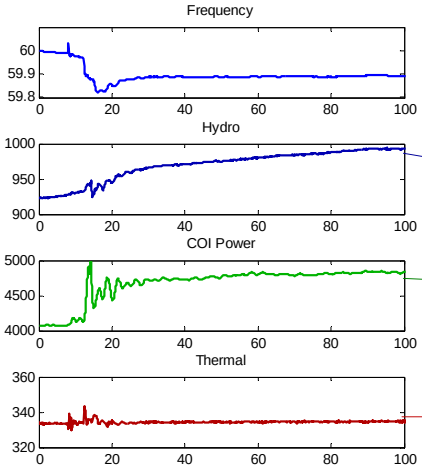
Controller status at the generator was indicating normal state
PMU disturbance data indicated actual response very different from what was expected (see figure below)
Power plant was contacted, controls inspected, found internal failure

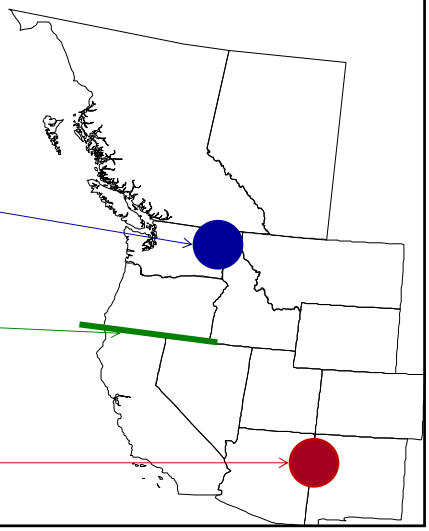


Blue line = actual response
Red line = expected response

Using PMUs for Frequency Response Analysis

- PMU data has been very valuable for understanding and modeling frequency response in the Western Interconnection, as well as informing policy and Standard development efforts





B O N N E V I L L E P O W E R A D M I N I S T R A T I O N

Success Stories of Tomorrow: Real-Time Applications

Moving Forward

2005

Vickie VanZandt:

It is time to move

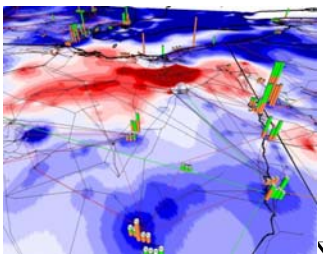
from *Wide-Area Monitoring*

to *Wide-Area Controls*

BONNEVILLE POWER ADMINISTRATION

Real-Time Wide Area Situational Awareness

- Control Room of the future
- Geographic display with multiple overlays – power system information, weather and lighting, fires, etc
- Trend displays
- Intelligent alarming and "heat" maps

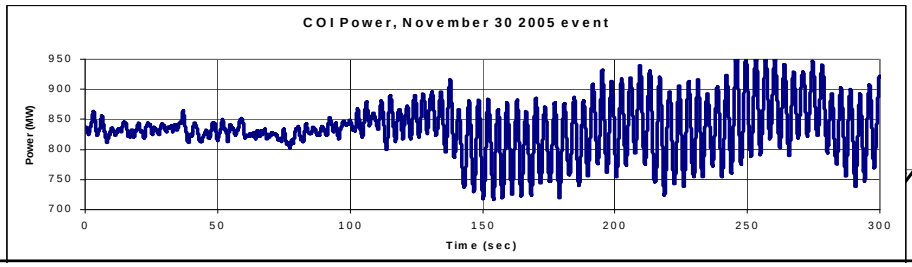


Oscillation Detection

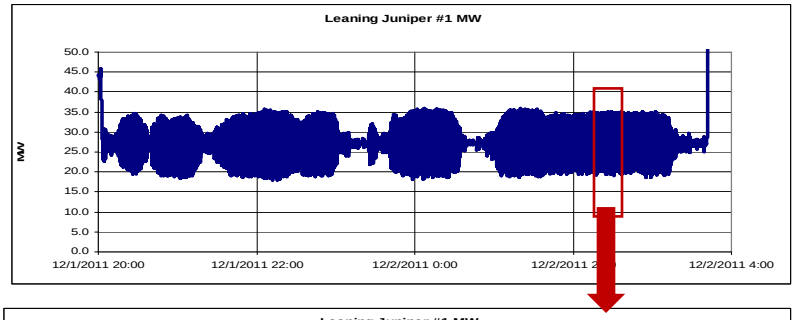
- Today with numeric SCADA displays today

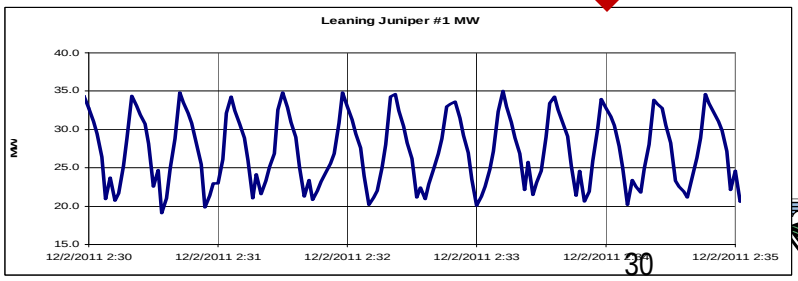
Rapidly changing digits on a numeric display

- With synchro-phasors
  - Automatic scanning 100+ signals for oscillations
  - High resolution trend displays
  - Dispatcher alarms and operating procedures



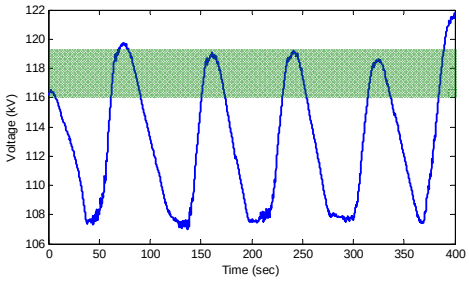
Wind Power Plant Control Oscillation





PMU Monitoring of Wind Generation

- More than 5,000 MW of wind generation in PNW with no validated models
- BPA is installing PMUs at wind power plant POIs
- BPA is partnering with DOE, NERL, UWIG and EPRI on wind power plant model validation

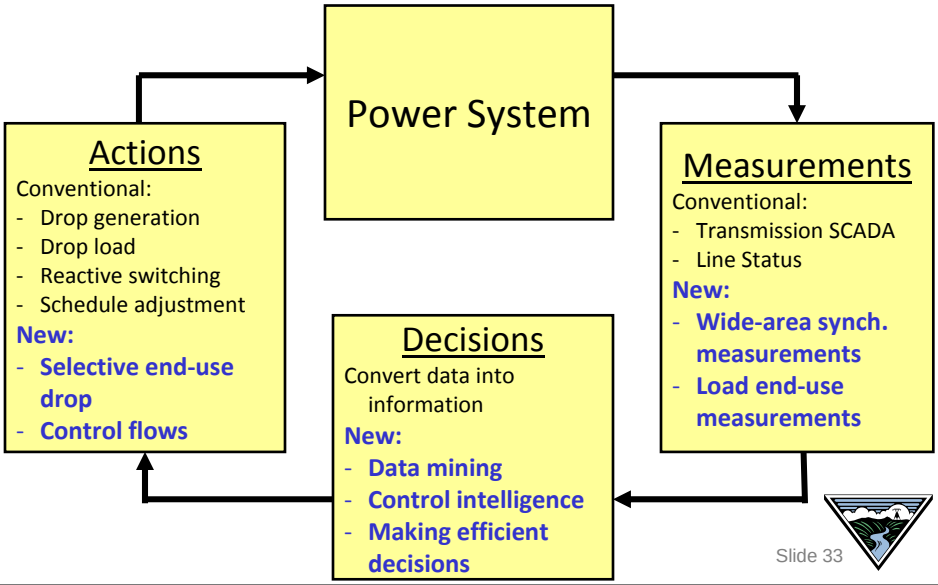


Voltage instability event observed at a wind power plant

Reliable Integration of Wind Generation

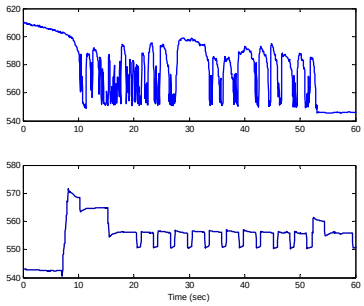
- BPA held a technical conference on wind generation voltage controls in August 2011
  - More than 100 participants – utilities, wind power plant operators, wind turbine generator manufacturers
  - Wind generation is a major player in PNW, affecting stability of the major interties in the interconnection
- Key takeaways and BPA experience:
  - Earlier technologies have issues with voltage controls
  - New generators are capable of voltage controls
  - BPA is working with the manufacturers and wind power plant operators on setting their voltage controls
  - BPA developed monitoring applications
  - BPA is installing PMUs at wind power plants

Wide Area Controls Vision



Wide Area Controls under Development

- BPA wide-area controls:
  - Start with low risk actions: shunt capacitor switching
  - Use wide-area synchronized measurements
  - Response-based controls, take actions within 1/2 second
  - Deliverable under WISP
  - Implement by March 2013, operational by September 2015
  - Challenge: control intelligence – how to recognize bad data from a system event



Which one event and which one is bad data ?

Future Breakthroughs

- Data mining
  - We will be getting 150,000 measurements / second
  - We are “data rich, information poor”
  - Data mining will inform the development of new applications
- Robust pipeline of new applications in research phase
  - Adaptive relaying (PG&E and SCE)
  - Island detection and Restoration (Entergy)
  - Advanced State Estimation/Measurement (Dominion)
  - Wide area controls (BPA, SCE, PG&E)
  - Powerflow and load controls (BPA)

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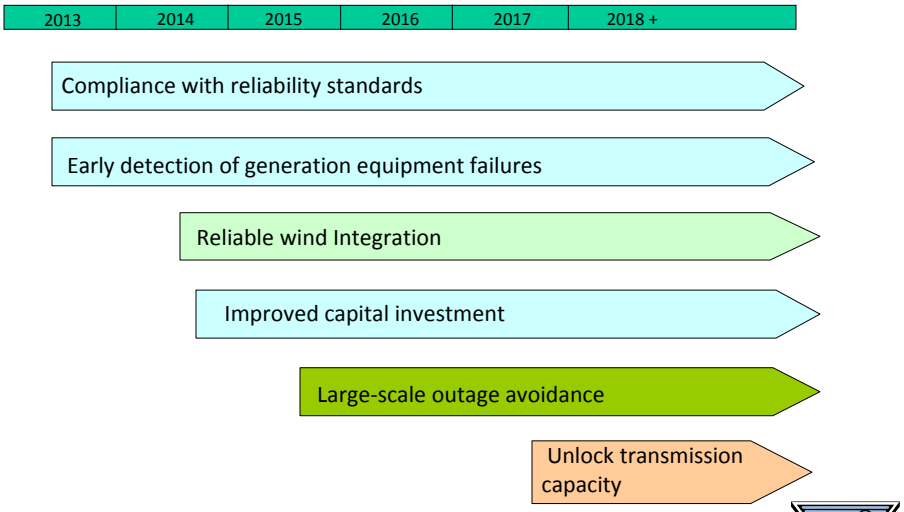
Value

Value Added by Synchrophasors at BPA



Who Benefits?

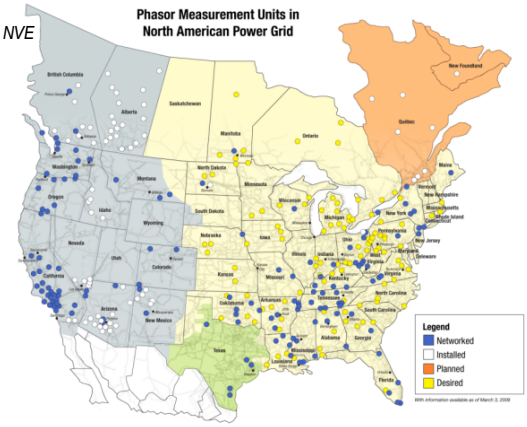
Organization	Benefits
Rate Payers	Improved reliability, outage avoidance, optimized BPA capital investments
BPA	Operational excellence, improved situational awareness, model validation, wide area controls, optimized capital investments
Partner Utilities / RCs	Wide area situational awareness
Wind Developers	More reliable integration
DOE	Smart Grid Investment Grant (SGIG)
Advanced Studies	Data Archive

Support at National Level

- US Department of Energy was the early supporter of the technology
  - 2009 ARRA Smart Grid Investment
- NERC North American Synchro-Phasor Initiative (NASPI)
  - Collaboration among utilities, grid operators, regulators, vendors and researchers
- WECC:
  - Joint Synchronized Information Subcommittee
  - Modeling and Validation Working Group

Transmission Smart Grid:
US DOE Stimulus for PMUs

- *WECC WISP*: 300+ PMUs *($108M)*:
  WECC RC, PG&E, BPA, SCE, CISO, PAC, SRP, IPC, NVE
- *PJM*: 90 PMUs *($28M)*
- *NY ISO*: 35 PMUs *($74M)*
- *MISO*: 150 PMUs *($35M)*
- *ATC*: 5 PMUs *($28M)*
- *Entergy:* 18 PMUs *($10M)*
- *ISO New England*: 30 PMUs *($9M)*
- *Duke Energy*: 45 PMUs *($8M)*
- *Midwest Energy:* 1 sub *($1.5M)*



Source: NASPI (www.naspi.org)
NASPI is a collaborative effort between the U.S. Department of Energy, the North American Electric Reliability Corporation (NERC), and North American electric utilities