Committee on Electricity
Committee on Electricity and Task Force on Innovation

Innovation Spotlight: New Transmission Technologies
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**Moderator:** Hon. Brad Johnson, Montana

**Speakers:**
Alison Silverstein, North American Synchrophasor Initiative
Ken Blair, Ampjack Industries
David Rupert, Breakthrough Overhead Line Design (BOLD)
Todd Ryan, SmartWires
NARUC Summer Meeting 2017

SYNCHROPHASORS & THE GRID

Alison Silverstein, NASPI Project Manager

North American
SynchroPhasor Initiative
Synchrophasor technology improves grid reliability

• 30-60 samples/second – 100 times faster than SCADA – & time-synced, provides real-time situational awareness
• Highly granular, high volumes of data enable insight into grid conditions
  • Early warning of grid events & dynamic behavior
  • Fast identification of failing equipment and asset problems
  • Better models of equipment, generators and power system
• Redundant, secure operator tools and automated system protection
Grid visibility -- PMUs v. SCADA
Synchrophasor technology elements

1. Install PMUs at key substations & generators
2. Fast, secure, reliable communications networks
3. High-quality applications and analytical tools
4. Technical interoperability standards
5. Business practices that support reliable systems
2017 North America Synchrophasor networks

- Over 2,500 networked PMUS
- Most RCs are receiving and sharing PMU data for real-time wide-area situational awareness
Current uses for synchrophasor technology

Situational awareness
• Wide-area visualization
• Oscillation detection
• Angle monitoring
• Voltage stability monitoring
• Trending
• Event replay
• Alarms and alerts
• Linear state estimation
• Fault location

Off-line analysis
• NERC standard compliance
• Forensic event analysis
• Model validation (equipment, generation, power system)
• Identify equipment problems
• Equipment commissioning
A bad day in the Western Interconnection

Event Replay of 9/8/2011 Southwest Blackout

**Data Source:**
Power grid frequency data collected by FDRs (Frequency Disturbance Recorder)

**Event Description:**
On 9/8/2011, the Southwest Blackout occurred when a 500-kV line connecting Arizona with San Diego tripped following a capacitor switchout. This widespread power outage affected large areas of Southern California as well as western Arizona, northern Baja California, and Sonora. This event left nearly 7 million people without power.
BPA oscillation detection tool
Wind farm oscillations discovered with PMU data
Better data yields better generator models

**BPA generator model - before (2014) and after (2015) PMU data validation**

*Blue – actual event recording, red = model*
More synchrophasor uses

- Renewables integration – modeling, oscillation mitigation, transmission management
- Dynamic line loading for greater throughput w/o more capital investment
- Baselining – understanding “normal” and discovering new potential problems
- Electrical island detection and blackout restoration
- Automated system protection operations
What’s next for synchrophasor technology

- Advanced machine learning using PMU data to identify anomalous events and develop operator decision support tools
- Automated, autonomous system protection schemes, including wide-area damping
- Distribution-level uses for synchronized grid-level measurements (e.g., for two-way grid monitoring and analysis)
- Advance PMU deployment and applications use and data-sharing across TOs and RCs
Video credits

- PMUs v. SCADA – Electric Power Group
- Southwest blackout – FNET -- Dr. Yilu Liu, CURENT- University of Tennessee Knoxville
- Windfarm oscillations – Electric Power Group
- RTDMS

Other credits

- Map – North American Synchrophasor Initiative
- BPA application screen captures – BPA

More information – www.naspi.org
THANK YOU!

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https://www.youtube.com/user/TheAMPJACK
New Technology? Why Now?
Aging infrastructure
New technology offers:

- Higher capacity
- Greater efficiency
- Better use of existing rights-of-way
- Faster deployment
Compaction of entire three-phase circuit into delta arrangement
Optimization of individual conductors
BOLD can deliver 60% more power than conventional lines operating at the same voltage.
Line loss reduced by up to 33% over conventional lines
Better Use of ROW

**BOLD vs. Traditional 345 kV**
Better Use of ROW
Magnetic Field Profile

Conventional 345kV

BOLD 345kV
Community concerns over transmission lines include property value, health impacts, visual impacts:

- 79% value advanced technology
- 75% would pay more for advanced technology
- 70% preferred BOLD structures versus conventional double-circuit design
Faster Deployment

Community acceptance promotes faster project siting and completion
BOLD Projects

- Energized
- In planning or construction
Consider.

Learn more:
BOLDTtransmission.com/NARUC/
Magnetic Field Profile

Conventional 345kV

BOLD 345kV
https://www.youtube.com/channel/UCydroBm5gkMEJNpStRtHQ6g
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