NASPI Control Room Solutions Task Team Monthly Meeting

Presenters: Mike Cassiadoro & Jim Kleitsch

November 16, 2016

NASPI North American SynchroPhasor Initiative

Agenda

I. Introductions

II. Provide Highlights of NASPI Oct. 2016 WG Mtg. CRSTT Breakout Session

III. Review Status of CRSTT Work Products

IV. Provide Update on CRSTT Industry Outreach Efforts

V. Discuss Proposed Training-Related Survey

VI. Discuss How CRSTT and the Distribution Task Team (DisTT) Can Coordinate Work Efforts.

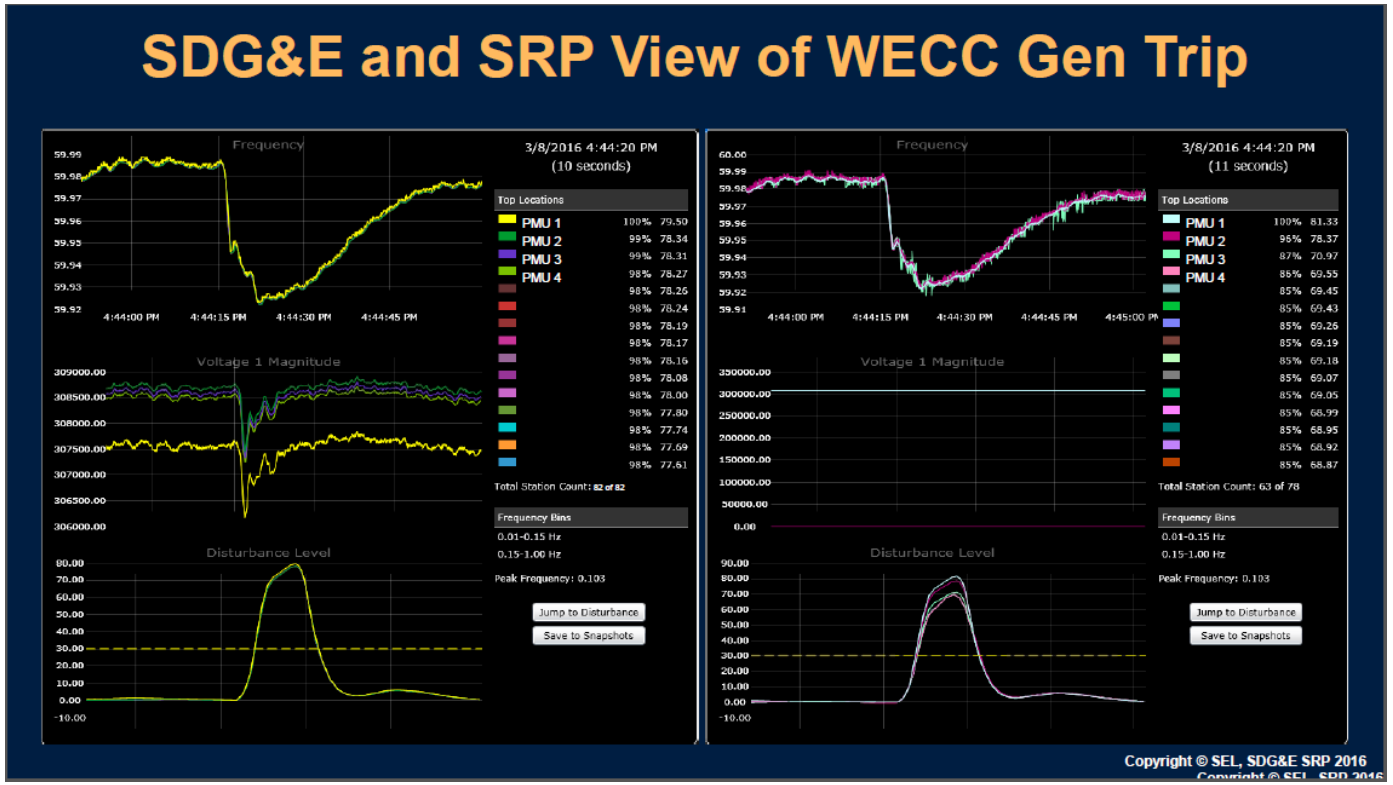
VII. Consider Changes to CRSTT Vision, Mission, Priorities and Goals for 2017

VIII. Adjourn

CRSTT Breakout Session Highlights

Jared Bestebreur (SEL) reviewed Automatic Disturbance and Oscillation Detection work performed at SDG&E and SRP

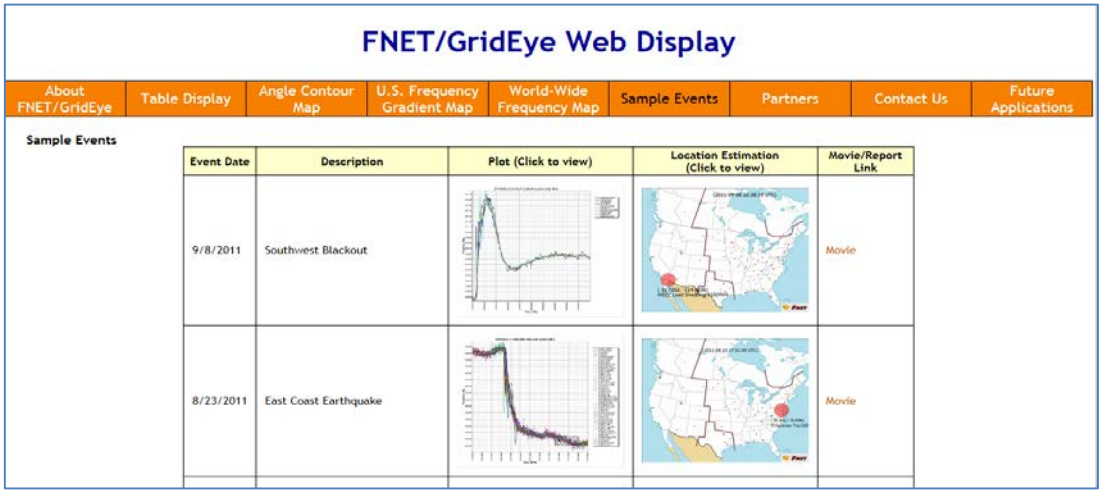
- Identify most impacted PMUs
- Frequency ranges for identified oscillatory modes



CRSTT Breakout Session Highlights (Cont.)

Dr. Yilu Liu (UT Knoxville) presented on Data Analytics Study of FNET/GridEye Measurements

- Developed multitude of reports using 16 years of data collected from single low voltage (120/230 V) PMUs
  - Oscillation event reports and replay
  - Generator trip event reports and replay
  - New line trip detection app
  - New low inertia tool
  - FIDVR alert



CRSTT Breakout Session Highlights (Cont.)

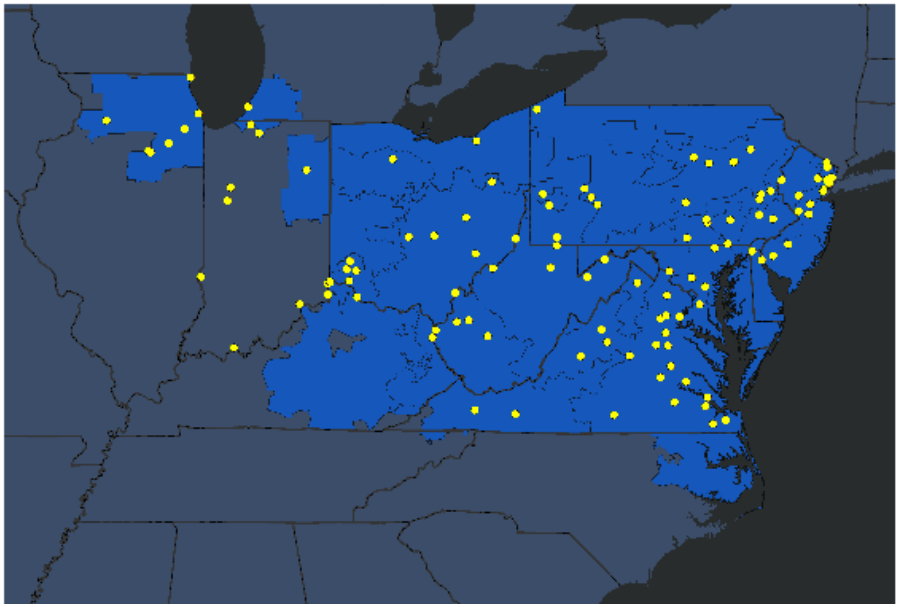
Emanuel Bernabeu (PJM) provided update on OTS project

- Developed tools to feed simulated synchrophasor data into training tools (no SCADA)
- Receiving data from the ~1000 signals they have installed
- Operators train with the tools they will ultimately use in production

How do you introduce synchrophasors to the control room?

Easy – provide enhanced training.

Phasor Measurement Units (PMU) Locations

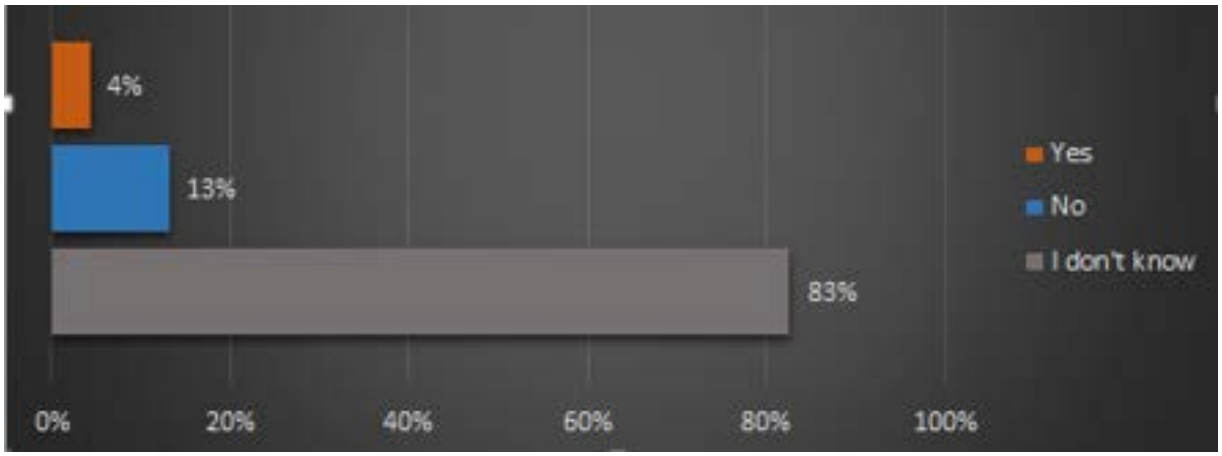


CRSTT Breakout Session Highlights (Cont.)

Bill Blevins (ERCOT) reviewed status of the NASPI CRSTT Oscillation Detection focus area doc.

- NDR has sent out requests for info, good reply rate so far
- Hope to have document wrapped up before the March meeting

Marianna Vaiman (V&R Energy) reviewed preliminary results from Enhanced State Estimator Survey and it's apparent that more work must be done to integrate the technology.



Focus Area Documents

1. **System Islanding Detection and Blackstart Restoration – Posted in June 2015**
   - (Kleitsch – ATC, Cassiadoro – TRS)
2. **Using Synchrophasor Data for Voltage Stability Assessment – Posted in Nov. 2015**
   - (Farantatos – EPRI, Vaiman – V&R Energy)
3. **Using Synchrophasor Data for Phase Angle Monitoring – Posted in May 2016**
   - (Cassiadoro – TRS, Nuthalapati - ERCOT)
4. **Enhanced State Estimation Survey – Preliminary responses received, more analysis needed.**
   - (Vaiman – V&R Energy, Kleitsch – ATC)
5. **Oscillation Detection**
   - (Dyer – EPG, Blevins and Rjagopalan – ERCOT, Patel - EPRI)
6. **Determining Disturbance Locations**
   - (Dyer – EPG, Zweigle – SEL Inc., Cassiadoro – TRS)
7. **Using Synchrophasor Data to Monitor Reactive Power Balancing**
   - (Cassiadoro - TRS, SCE –A.J, Peak RC – Zhang)

Collecting Data for Video Event Files

- Objective: build a video library of events to demonstrate the value of synchrophasor data when analyzing disturbances

CRSTT Discussion: What other types of events should we pursue?

Video
PMU versus SCADA Video Events Summary. Please refer to EPG's template and the Synchrophasor Data File Format .CSV when creating a video event.
Video 1 - Current and voltage oscillations observed on the 138 kV system during testing of new generator controls (65 MW gas turbine). RTDMS PMU vs. SCADA Video 1
Video 2 - Voltage oscillations observed on the 230 kV system when a water pump was taken offline. RTDMS PMU vs. SCADA Video 2
Video 3 - Voltage oscillations observed following the loss of a 345 kV line during a period of high wind generation. RTDMS PMU vs. SCADA Video 3
Video 4 - Real and Reactive Power oscillations observed on the 69 kV system during a period of high wind generation with the plant radially connected (i.e. one of two normal source lines out of service). RTDMS PMU vs. SCADA Video 4
Video 5 - Real and Reactive Power oscillations observed during a period of high wind generation. RTDMS PMU vs. SCADA Video 5
Video 6 - Real Power and voltage oscillations observed following the loss of a large generator. RTDMS PMU vs. SCADA Video 6
Video 7 - Wind farm Oscillation Detection and Mitigation using Synchrophasor Technology Wind Farm Oscillation Detection and Mitigation
Video 8 - A 230kV fault followed by a loss of a large generation plant caused system frequency to drop approximately 72mHz momentarily, while having an impact on nearby system voltages and online generators (Clip 1, Clip 2 , Clip 3)
Video 9 - Please be patient with the download, the video is very large. This video captures the actual synchronization of a large generator to the electric grid. The windows in the visualization tool capture frequency, output power, voltage angle, and voltage magnitude of the generator and at a reference point on the electric grid.

Developing Uses Cases for NASPI Tech Paper

Event ID	Event	Event Category	Entities Involved	Event Description	Extended Description in Related NASPI Technical Paper	Safety Impact	Reliability Impact	Budgetary Impact
TE02	Failing potential transformer	Transmission Equipment	ATC	Abnormal voltage signature found while reviewing PMU data led to discovery of a failing potential transformer which was subsequently isolated and replaced.	p.38	The utility avoided safety risk to personnel that might have been in close proximity to the PT during its failure.		Utility avoided costs associated with customer minutes of interruption that would have resulted from the potential transformer's failure had the condition not been identified and a mobile transformer placed in service to facilitate the outages necessary for its replacement.
TE03	Loose connections in potential circuits	Transmission Equipment	OG&E	Fluctuations observed in positive sequence voltage data collected from PMUs led to discovery of a loose fuse connection in a CCVT safety switch. PMU data has been used in a similar fashion to reveal faulty terminations, animal-damaged conductor and contact corrosion.	p.40			Utility avoided costs associated with equipment damage and customer minutes of interruption that might have resulted had the issues not been addressed.
TE04	Failing voltage transformer	Transmission Equipment	Dominion	Sporadic voltage dips and fluctuations observed on a 500 kV line led to discovery of a failing CCVT which was subsequently isolated prior to its imminent failure.	p.42	The utility avoided safety risk to personnel that might have been in close proximity to the CCVT during its imminent failure.		Utility avoided costs associated with equipment damage that might have resulted from the CCVT's failure.
TE05	Identifying 69 kV arrester failure	Transmission Equipment	ATC	The details of a 69kV customer impact event were identified within two minutes by control room engineers reviewing PMU data. The fault could not be observed with SCADA data.	p.44		Utility able to identify and isolate the failed lightning arrestor shortly after relay operation occurred.	

Next Steps – Work to develop a single 1-2 pg. use case summary doc to help educate end users then expand effort to other use cases once format has been defined.

CRSTT Industry Outreach

- **WECC Joint Synchronized Info Subcommittee (JSIS) –** Several team members attended Sept. 2016 meeting and provided update on CRSTT work products.
- **NERC Synchronized Measurement Subcommittee (SMS) –** CRSTT co-leads joined Oct. 2016 meeting to discuss issues impeding integration of synchrophasor technology into control room environment.
- **NERC Operating Reliability Subcommittee (ORS) –** CRSTT co-leads to provide subcommittee with update on team work products during Nov. 2016 meeting.
- **IEEE PES CAMS Task Force on Understanding, Prediction, Mitigation and Restoration of Cascading Failures -** Marianna coordinating as team lead.

How Can CRSTT and DisTT Work Together?

DisTT Mission - To foster the use and capabilities of networked PMUs at the medium-voltage distribution level, beyond the substation. This group will share info in support of effective research, development and deployment of distribution PMUs and their apps. They aim to create a community to solve technical and other challenges specific to distribution PMU technology and context.

CRSTT Discussion – How can the CRSTT and DisTT coordinate work efforts for their mutual benefit?

Should CRSTT Conduct a Training Survey?

Proposal – Conduct survey of RCs, BAs and TOPs to gather info on the responsibilities they expect their operators to assume as synchrophasor apps become available in the control room and planned training activities.

CRSTT Discussion – Would this type of survey provide value and, if so, how and when should we go about conducting it?

CRSTT Vision & Mission (Review for 2017)

- **Vision –** to fully integrate real-time synchrophasor applications into daily control room operations with clearly defined operating limits, policies and procedures that provide wide-area situational awareness and enhanced grid reliability.
- **Mission –** to work collectively with other NASPI task teams to advance the use of real-time synchrophasor applications for the purpose of improving control room operations and grid reliability. This team will utilize its experience and regional diversity to provide advice, direction, support and guidance to NASPI stakeholders and other organizations involved in the development and implementation of real-time synchrophasor applications.

CRSTT Priorities (Review for 2017)

1. Increase awareness of advance synchrophasor apps and their use in the control room.
2. Provide guidance on best practices.
3. Identify issues that impede implementation.
4. Ensure training is available to end users and promote operational event analysis to demonstrate value.
5. Support the development of operating policies and procedures that relate to integration of synchrophasor data and information into the control room.
6. Encourage the integration of synchrophasor data with other control room data (e.g. SCADA) to enhance the info provide to real-time operations staff.

CRSTT Goals (Review for 2017)

1. Prioritize and complete remaining focus area documents.
2. Develop operational use case summary documents to support NASPI technical papers.
3. Create additional video event files for use cases and simulated events (includes data sharing).
4. Gather operator feedback on synchrophasor applications (best practices).
5. Identify available training materials.

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Next NASPI CRSTT Conference Call: December 21, 2016
Next NASPI WG Meeting: March, 2017 in Gaithersburg, MD