



Use of Time-Synchronized Measurements in the Operations Horizon – Train-the-Trainer Session

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Training Course Description



TRS and PNNL collaborated to develop a *Use of Time-Synchronized Measurements in the Real-time Ops Horizon* training course (8 CEH).

Course Summary: Provides an introduction to synchrophasor technology, describes the value it can provide in the Real-time Ops Horizon, and demonstrates how synchrophasor-based apps can be used to improve wide-area situational awareness and grid reliability.

Intended Audience: RC, BA and TOP System Operators and Ops Support staff tasked with monitoring and controlling the BES.

Training Course Description (Cont.)



Training Location: Train-the-Trainer sessions and operator training classes held at offsite locations in Summer/Fall 2019.

Training Cost: No registration fee (entities responsible for travel costs only).



Overreaching Training Goals



- Increase knowledge and advance use of synchrophasor technology by creating training materials that grid operators and electric utilities can integrate into their respective training programs.
- Provide train-the-trainer workshops to help electric industry trainers meet the underlying knowledge requirements before delivering company-specific training on the topic.



Approach to Course Development



The general approach that PNNL and TRS applied to create electric industry training is as follows:

1. Analyze industry training needs.
2. Design the training course.
3. Develop the training materials.
4. Implement the training.
5. Evaluate the training.

Analyzing Training Needs



Current State of Synchrophasor-Based Applications:

- Widely deployed for use in the Operations Planning and Operations Assessment Horizons.
- Limited integration into the control room environment for use in the Same-day and Real-time Operations Horizon.

Solution: Develop training for System Operators and Operations Support staff to demonstrate how synchrophasor measurements can be used to support the performance of reliability-related tasks.

Designing the Training Course



- Lesson 1: Intro to Synchrophasor Technology
- Lesson 2: NERC Functional Roles & Responsibilities
- Lesson 3: Recognizing Power System Oscillations
- Lesson 4: Monitoring Frequency, Voltage & Real/Reactive Power
- Lesson 5: Monitoring Phase Angle Differences

Developing Training Materials – Lessons Learned



- **Demonstrate Value in the Control Room** – Developed content that will help entities build business cases.
- **Strong Operational Use Cases** – Defined specific uses of time-synchronized measurements to perform operational tasks.
- **Flexible Assessment Methods** – Designed a training course that allows for different assessment methods.
- **Advanced Training Options** – Will Consider additional training classes to address more advanced uses of the technology (enhanced state estimation, system islanding/blackstart restoration)

Implementing Training



- Limited number of operator training courses and “train-the-trainer” sessions were provided as part of this project.
- Grid Operators and Electric Utilities that request access to the training materials may customize and deliver the course at their respective facilities.

Evaluating Training



- “Train-the-Trainer” sessions held to receive feedback from industry training experts prior to course delivery.
- Course evaluation forms distributed at operator training classes to gather feedback and identify potential improvements to course materials and delivery methods.
- Industry partners may be surveyed to gather additional feedback after-the-fact.

Review the following *Use of Time-Synched Measurements in Real-Time Ops Horizon* training documents:

- Training Plan
- NERC ILA
- Training Presentation
- Instructor's Guide
- Training Assessment
- Training Evaluation
- Supplemental Information Sheet
- Time-Synched Measures Reference Document

Technical Training Delivery



TRS instructor to deliver the following course lessons to “train-the-trainer” session attendees to ensure underlying knowledge requirements are met:

- Introduction to Synchrophasor Technology
- Power System Oscillations

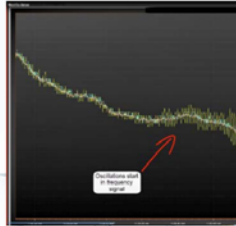
Operational Scenario Review



TRS instructor to review each operational scenario with the “train-the-trainer” session attendees and discuss how each can be modified to meet their respective needs.

Operational Scenario No.1

Event Description: A double circuit outage resulted in the eastern Upper Peninsula being isolated from the rest of the ATC footprint. Significant frequency oscillations were observed on the system servicing the area of

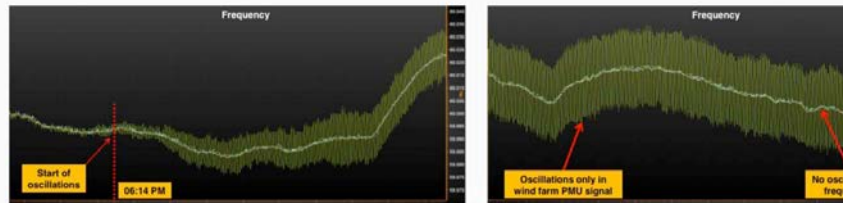


Source: Screenshots captured from



Operational Scenario No.2

Event Description: ERCOT System Operators observed frequency oscillations at a wind plant resulting from a control system malfunction

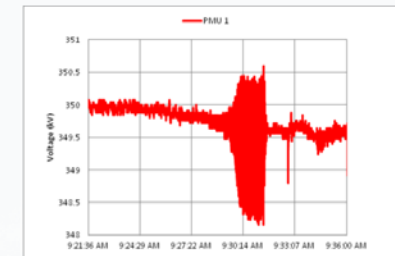


Source: NASPI Technical Report titled “Diagnosing Equipment Health and Mis-operations with PMU Data” dated May 20



Operational Scenario No.3

Event Description: NYISO System Operators observed transient voltage oscillations that lasted for three minutes and appeared on many of the western New York 345 kV busses.



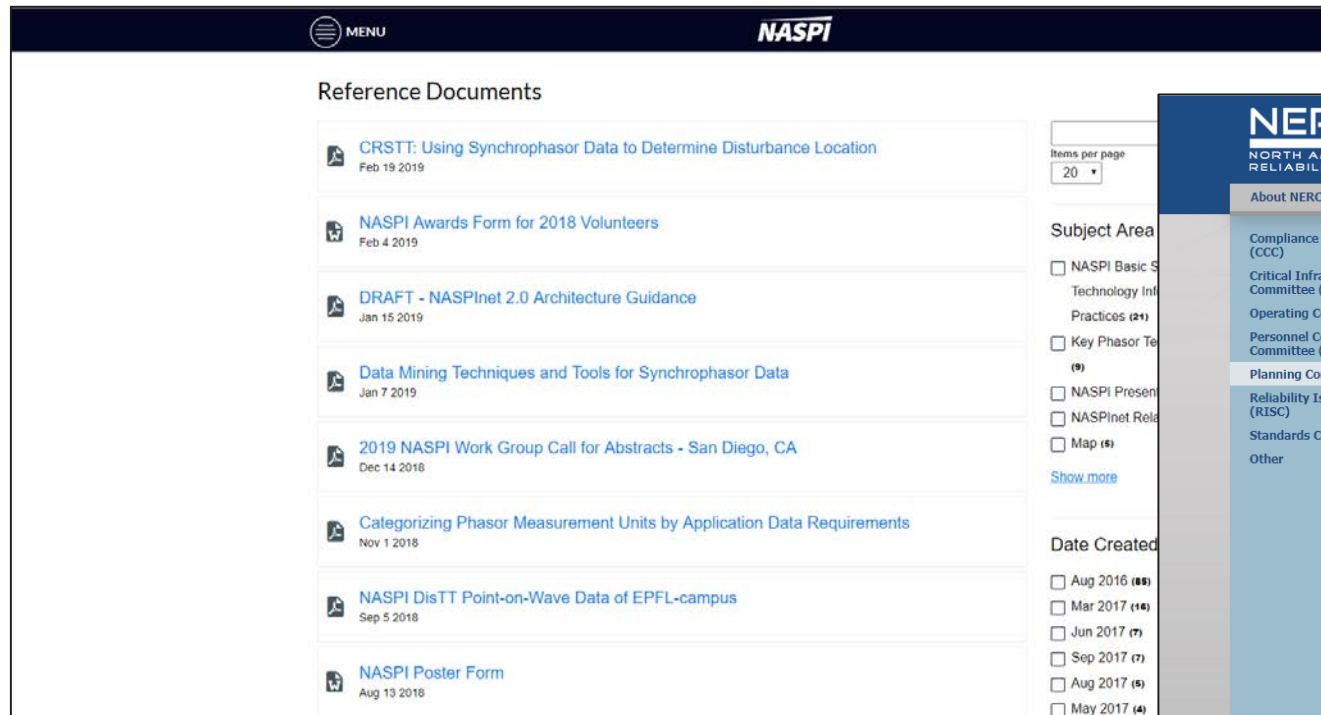
Source: NASPI CRSTT Operational Use Case GEN-003 – AVR Malfunction.



Reference Materials



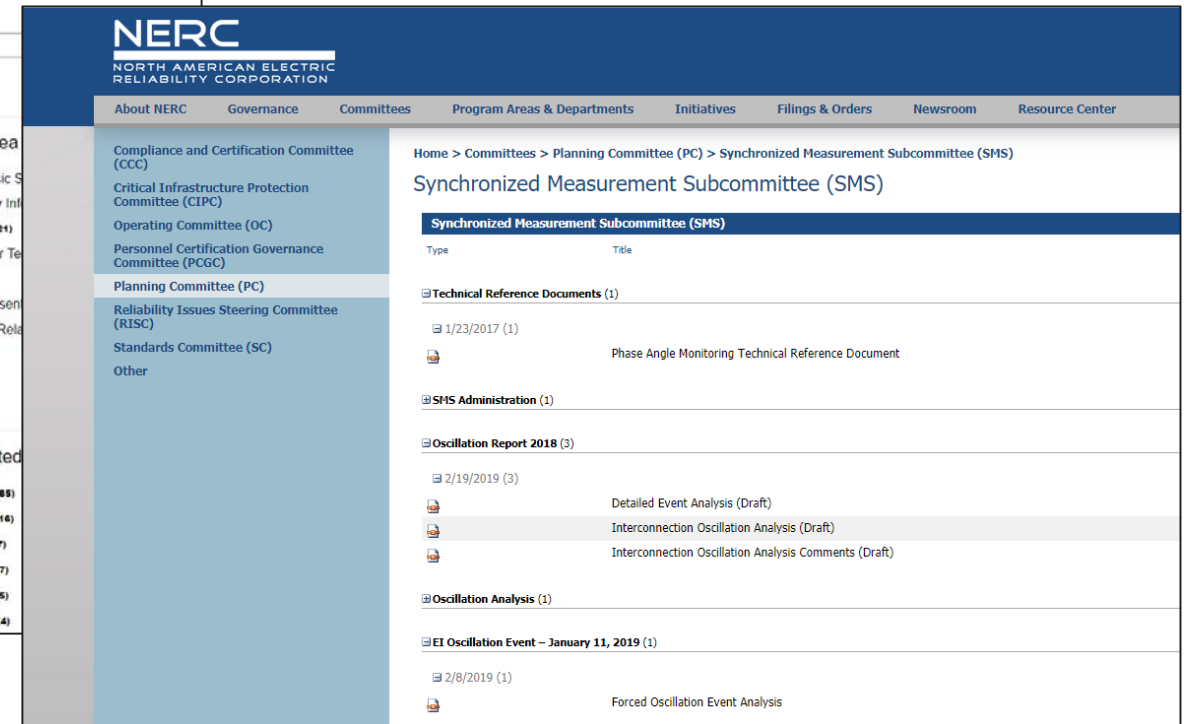
TRS Instructor to review reference materials and additional sources of information that attendees might find useful.



The screenshot shows the NASPI website's 'Reference Documents' page. The header includes a 'MENU' icon and the 'NASPI' logo. The main content area lists several documents with their titles and dates:

- CRSTT: Using Synchrophasor Data to Determine Disturbance Location (Feb 19 2019)
- NASPI Awards Form for 2018 Volunteers (Feb 4 2019)
- DRAFT - NASPInet 2.0 Architecture Guidance (Jan 15 2019)
- Data Mining Techniques and Tools for Synchrophasor Data (Jan 7 2019)
- 2019 NASPI Work Group Call for Abstracts - San Diego, CA (Dec 14 2018)
- Categorizing Phasor Measurement Units by Application Data Requirements (Nov 1 2018)
- NASPI DisTT Point-on-Wave Data of EPFL-campus (Sep 5 2018)
- NASPI Poster Form (Aug 13 2018)

On the right side, there are filters for 'Items per page' (set to 20), 'Subject Area' (with checkboxes for various categories), and 'Date Created' (with checkboxes for various months and years).



The screenshot shows the NERC website's 'Synchronized Measurement Subcommittee (SMS)' page. The header includes the 'NERC' logo and navigation links: 'About NERC', 'Governance', 'Committees', 'Program Areas & Departments', 'Initiatives', 'Filings & Orders', 'Newsroom', and 'Resource Center'. The main content area displays a list of documents under the heading 'Synchronized Measurement Subcommittee (SMS)'. The list is organized into sections:

- Technical Reference Documents (1)**
 - 1/23/2017 (1) Phase Angle Monitoring Technical Reference Document
- SMS Administration (1)**
- Oscillation Report 2018 (3)**
 - 2/19/2019 (3) Detailed Event Analysis (Draft)
 - Interconnection Oscillation Analysis (Draft)
 - Interconnection Oscillation Analysis Comments (Draft)
- Oscillation Analysis (1)**
- EI Oscillation Event – January 11, 2019 (1)**
 - 2/8/2019 (1) Forced Oscillation Event Analysis

Requests for Feedback



Roundtable discussion about the training to gather feedback:

Do you think this training will be of interest to your operators?

Do you think the training will provide value?

Do you have recommendations for how the training could be improved?

Contact Information



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