April 15, 2020
Webinar Questions and Answers

Use of SynchroPhasor Technology in Control Rooms: Opportunities and Challenges

Moderator: Sarma NDR Nuthalapati, Co-Chair, NASPI Control Room Solutions Task Team
Description: There are significant efforts taking place in using SynchroPhasor Technology in control room operations. This panel will discuss some of the opportunities and challenges in taking technology to the control room.
Panelists:

- Dr. Aftab Alam, CAISO
- Dr. Hongming Zhang, Joint Synchronized Information Subcommittee (JSIS), WECC
- Jim Kleitsch, American Transmission Co (ATC)

Question: Could the panelists comment on measuring and collecting three phase voltage and current quantities in PMUs versus positive sequence quantities, which choice they are using now and the rationale behind it?

Answer:

Jim K – ATC elected to bring back and store phase measurements from each of our PMUs. We wanted to be able to use the data to be able to analyze fault events and determine fault types (phase to ground, phase to phase, 3 phase, etc..). We also wanted to have the ability to identify and understand any phase imbalances on our system associated with things like open phases, un-transposed lines, etc. We felt the tradeoff between more detailed information and increased storage requirements was justified.

Question: How do you distinguish between natural and forced oscillations?

Answer (from Hongming)

Hereafter, there are a few rules for ones to distinguish a forced oscillation from a natural oscillation

- Sustained oscillations until source mechanism mitigated
- Near zero damping ratio
- Mostly fixed oscillation frequency
- High oscillation energy on some measurements
- High estimation confidence if applicable

BPA used the MAS/ODM software developed by MontanaTech to detect forced oscillations for years. Peak RC worked with Dr. Mani's group of Washington State University to apply those rules in the Forced Oscillation Detection and Source Locating (FODSL) tools for real-time detection of forced oscillation events in 2017-2019. Both the ODM and FODSL approaches were proven effectively for the most time.

Question: Do you use any wide area damping control in control center to damp the oscillation?

Answer (from Aftab): There is no wide area damping controller. There may be local. Eg. controllers installed on DC lines to reduce impact of DC

Question: Are CAISO and/or SPP also monitoring oscillations in real time within the footprints of BCHA and AESO?

Answer (from Aftab): SPP and CAISO do get PMU data from BCHA and monitor it but I don't think either company gets data from AESO. CAISO is working on getting data from AESO

Question: Is CAISO using GE Phasor point?

Answer (from Aftab): CAISO uses EPG's RTDMS

Question: Do CAISO/SPP/ATC has phasor angle based instructions given to operators or phasor data are used only for monitoring, mitigation actions are based on operator experience or model based or SCADA information based ?

Answer (from Aftab): Phase angles have found use beyond oscillation monitoring. We at CAISO, validate our SE calculated phase angles against PMUs in our RTCA we actually monitor pre and post contingency angle differences for lines that we know have angle diff thresholds on the synch check relays that gives awareness to operators on whether they can reclose a line or redispatch needs to occur to reduce angle difference similarly post contingency angle difference monitoring allows operators know whether post contingency redispatch would be needed following the contingency in order to be able to reclose the line. There is a NERC SMS report on Phase Angle monitoring (https://www.nerc.com/comm/PC/Synchronized%20Measurement%20Subcommittee/Phase%20Angle%20Monitoring%20Technical%20Reference%20Document%20-%20FINAL.pdf).

Response from NDR: There is also a report on 'Using SynchroPhasor Data for Phase Angle alarming' at NASPI CRSTT website (https://www.naspi.org/node/351)

Jim K – we do not have instructions based on phasor angle information at this time and no immediate plans to mover that direction. Our primary use of the data is all post event.

Question: Are the PMU data collected from the wind plants used for the plant model validation? What applications are being fed these data into?

Answer (from Aftab): PMU data for Power Plant Model validation is a well-established practice for any kind of generator, not just Wind.

Jim K – we are capturing the data to better understand the dynamic performance of all interconnected generation on our system but have not validated/modified dynamic unit models to date.

Question: Could the panelists comment on their experience with the use of measurements from PMUs compatible with IEEE C37.118 2005 version versus 2011/2014 version of this standard?

Answer:

Jim K – All of our PMUs, including relays and digital fault recorders, utilize the 2005 version of the standard.

Aftab – I believe CAISO uses the latest version of the standard. Can confirm if needed.

Question: Are you aware of tools to estimate inertia (momentum) in ambient conditions, i.e. not driven by events?

It may be noted that, Inertia is not actually a quantity and therefore cannot be measured. Momentum is the quantity that can be measured.

Answer (from Hongming): Peak RC worked with the vendors to implement the custom feature in GE/EMS and PowerTech online TSAT software to calculate the inertia values for WECC system level or BA level on every minute and 15 minutes, respectively. The calculated WECC system inertia values were provided to WECC and NERC for system dynamic response performance evaluations.

Jim K – NERC held a webinar 4/16/2020 to review a new white paper "Fast Frequency Response Concepts and Bulk Power System Reliability Needs". They included the following slide with a rated unit MVA based calculation for all online units using SCADA/real time model information. We're considering implementing that to track inertia similar to what ERCOT has reported they are doing. Since we (ATC) are a very small portion of the eastern interconnection I'm not sure how much value that will provide other than the ability to gauge our real time inertia/system momentum versus where we have been operating in the past.

NERC
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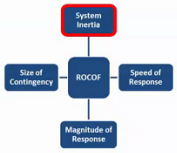
System Inertia

- Power system synchronous inertia:

  "the ability of a power system to oppose changes in system frequency due to resistance provided by rotating masses"



- Summation of kinetic energy stored in rotating masses of synchronously connected machines
  - Synchronous generators, synchronous condensers, synchronous motor loads

$$KE_{sys} = \sum_{i \in I} H_i * MVA_i$$

- When a sudden change in gen or load occurs, synchronous machines and the electric system inherently exchange kinetic energy → machines change speed (i.e., "inertial response")

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