ORNL's Support of NASPI

Presented at:

DOE OE Transmission Reliability Program Review

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U.S. DEPARTMENT OF ENERGY

OAK RIDGE NATIONAL LABORATORY

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Project Objective(s)

NASPI Goal: To improve the reliable operation of the North American power system by successfully transitioning synchrophasor technologies from research to industry adoption.

ORNL's activities in support of NASPI include:

- Participate in NASPI Leadership Team
- Support Operations Implementation Task Team
- Participate in Performance and Standards Task Team
- Develop needed metrology capabilities in partnership with NIST.

Major FY12 Accomplishments and Deliverables/Schedule for FY12

- Participate in NASPI Leadership Team
  - Participated in leadership team meetings and telecons - ongoing
  - Supported NERC Project Manager in drafting NASPI Annual Report - Feb 2012
- Support Operations Implementation Task Team (OITT)
  - Participated in OITT meetings and telecons - ongoing
  - Supported OITT Task Team Leaders in identifying goals, creating agendas and preparing meeting minutes for telecons and F2F meetings – ongoing
- Participate in Performance and Standards Task Team (PSTT)
  - Participated in PSTT meetings and telecons - ongoing
  - Presented preliminary results “Accuracy of Line Parameters Calculations from Synchrophasor Data” – Feb 2012

Major FY12 Accomplishments and Deliverables/Schedule for FY12 (cont.)

- Develop needed metrology in partnership with NIST
  - In discussions with Gerry FitzPatrick, Jerry Steinbakken and Yi-hua Tang of NIST– ongoing
    - Identified three metrology gap areas (field installation, latency and environmental impacts)
    - Conducted simulation to assess impact of latency on applications
  - NIST PMU testing round-robin – agreement reached for ORNL participation
    - Measurement parameters (IEEE C37.118.1)
      - ❑ Interoperability
      - ❑ Steady state test
      - ❑ Dynamic test
      - ❑ Performance classes: P class and M class
      - ❑ Temperature impact to PMU
      - ❑ Latency test
      - ❑ Full test or partial test?

Risk Factors

- Data
  - Lack of real operating data hinders technology development.
  - Lack of power system network and communications network data hinders analysis of specific system characteristics and thus impact on synchrophasor measurements.
- Use of mixed hardware using different algorithms for synchrophasor measurements
  - Varying impacts on measurements and applications
- Multi-vendor integration into a consolidated database

Thoughts for FY13

- **PMU and PDC Latency**
  - Characterize range of PMU/PDC configurations and operating conditions
  - Characterize latencies of these devices
  - Identify practical effects on wide-area measurements and applications
  - Develop methods for mitigating deficiency or compensating for them
- **Installation Burdens**
  - Characterize the range of actual installations of CTs, PTs, and wiring leads across operating systems and conditions
  - Characterize burdens (constant, time-varying) of installations
  - Identify practical effects on wide-area measurements and applications
  - Develop methods for mitigating deficiencies or compensating for them

Thoughts for FY13 (cont.)

- **Environmental Impacts (primarily weather, temperature, and aging)**
  - Characterize the range of installation configurations across operating systems and conditions
  - Characterize effects of varying weather/temperature/humidity/aging conditions on measurements provided by PMUs/PDCs
  - Identify practical effects on wide-area measurements provided by these devices and applications that use these measurements
  - Develop methods for mitigating deficiencies or compensating for them
- **GPS Timing**
  - Characterize the range of installation configurations for precise time signals
  - Characterize effects of errors in time signals on measurements
  - Identify practical effects of erros on wide-area measurements and applications
  - Develop methods for mitigating GPS timing issues or for compensating for them

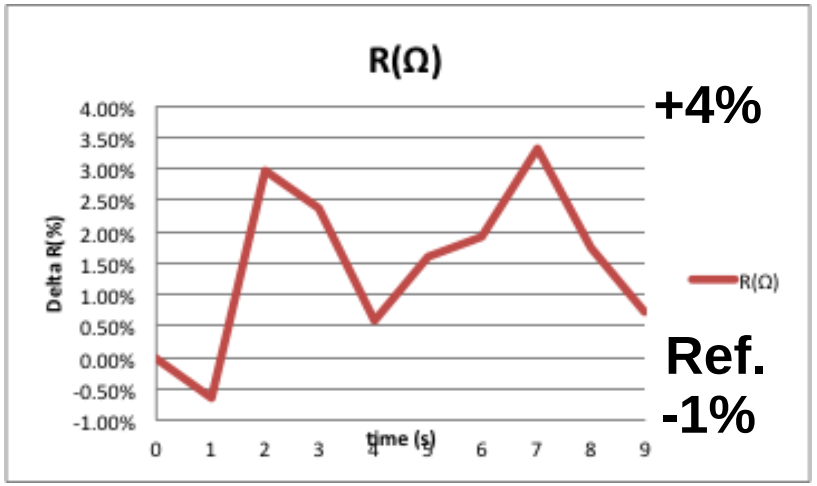
ORNL impact of phasor measurement errors on line parameter calculations

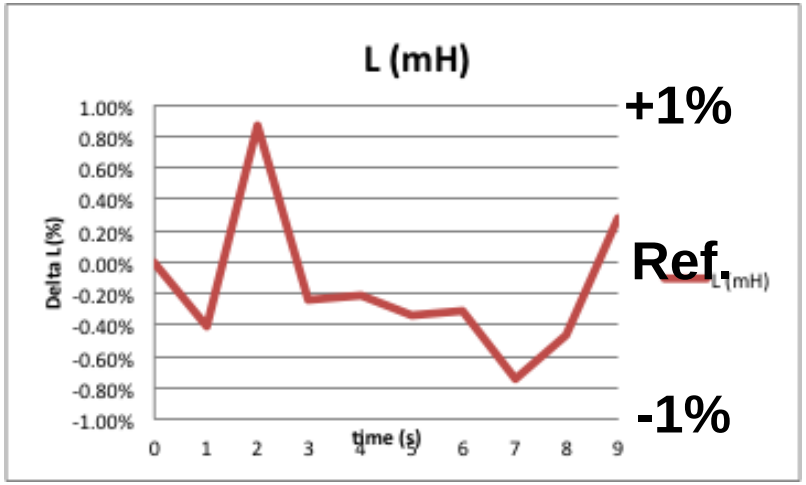
Voltage measurement uncertainty	Rerror	Lerror	Cerror
Amplitude between -1% to 1%	70%	2%	0.5%
Angle between -2 to +2 deg	40%	50%	0.3%

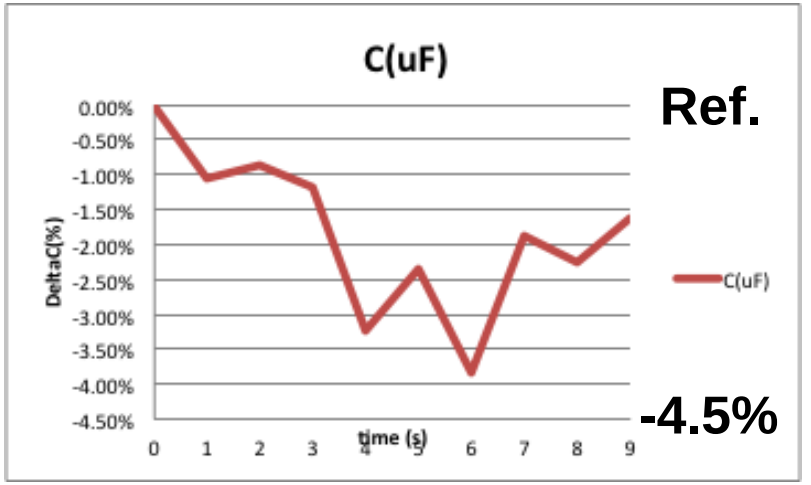
Current measurement uncertainty	Rerror	Lerror	Cerror
Amplitude between -1 and 1%	0.5	0.5%	4%
Angle between -2 and 2 deg	10%	0.4%	120%

ORNL line parameter calculations -- -- Variation over time

time (s)	R(Ω)	L (mH)	C(uF)
0	0.244	3.221	4.032
1	0.2424	3.208	3.99
2	0.2512	3.249	3.997
3	0.2498	3.213	3.984
4	0.2454	3.214	3.902
5	0.2479	3.21	3.937
6	0.2487	3.211	3.877
7	0.2521	3.197	3.956
8	0.2482	3.206	3.941
9	0.2458	3.23	3.967







1 second data.