

NERC

NORTH AMERICAN ELECTRIC
RELIABILITY CORPORATION

Synchronized Measurement Subcommittee Update

Ryan D. Quint, NERC
NERC SMS Coordinator

Jim Kleitsch, ATC
NERC SMS Chair

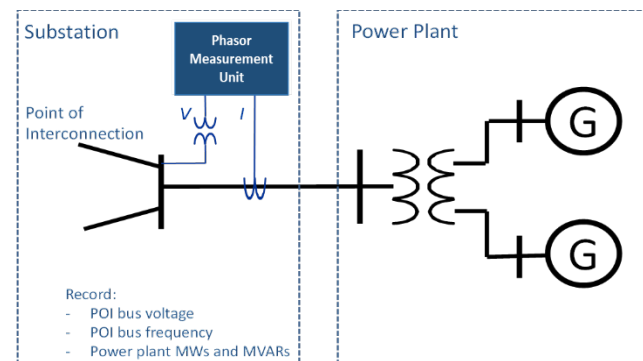
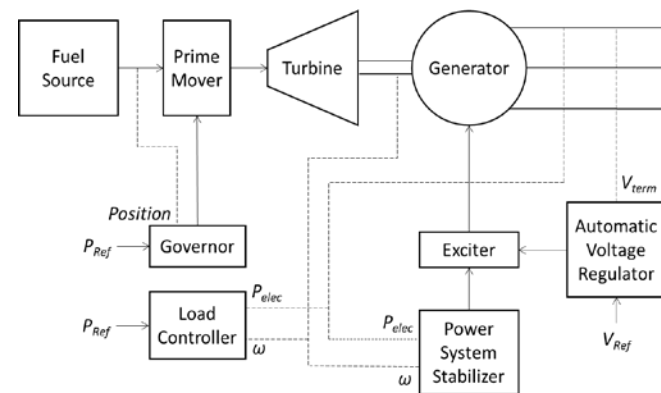
NASPI Work Group Meeting
October 2016

RELIABILITY | ACCOUNTABILITY



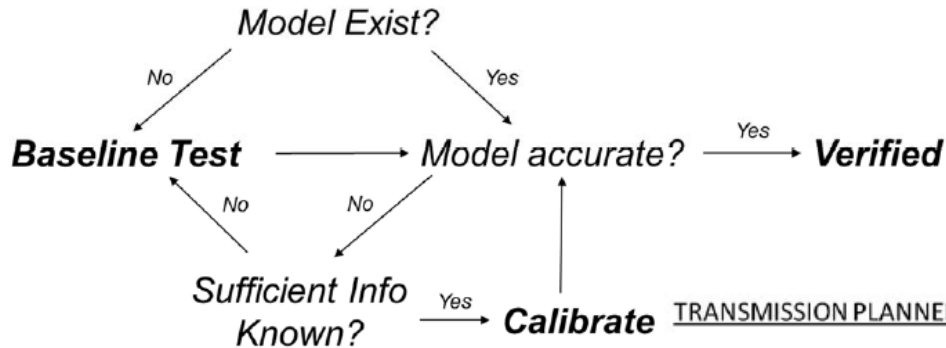
- Document Covers:

- Fundamental need for representative models
- Power Plant Model Verification (PPMV)
- Offline Baseline Testing for *pro forma* Model
- Online Performance Monitoring
- Process for Model Validation
- Value Proposition for Disturbance-Based Verification
- Related NERC Reliability Standards
- Performing PMU-Based Model Verification
 - Procedure Overview
 - Measurement & Modeling Considerations
 - Event Selection
- Disturbance-Based Verification Examples Library
- Appendix – Software Tools Guidelines



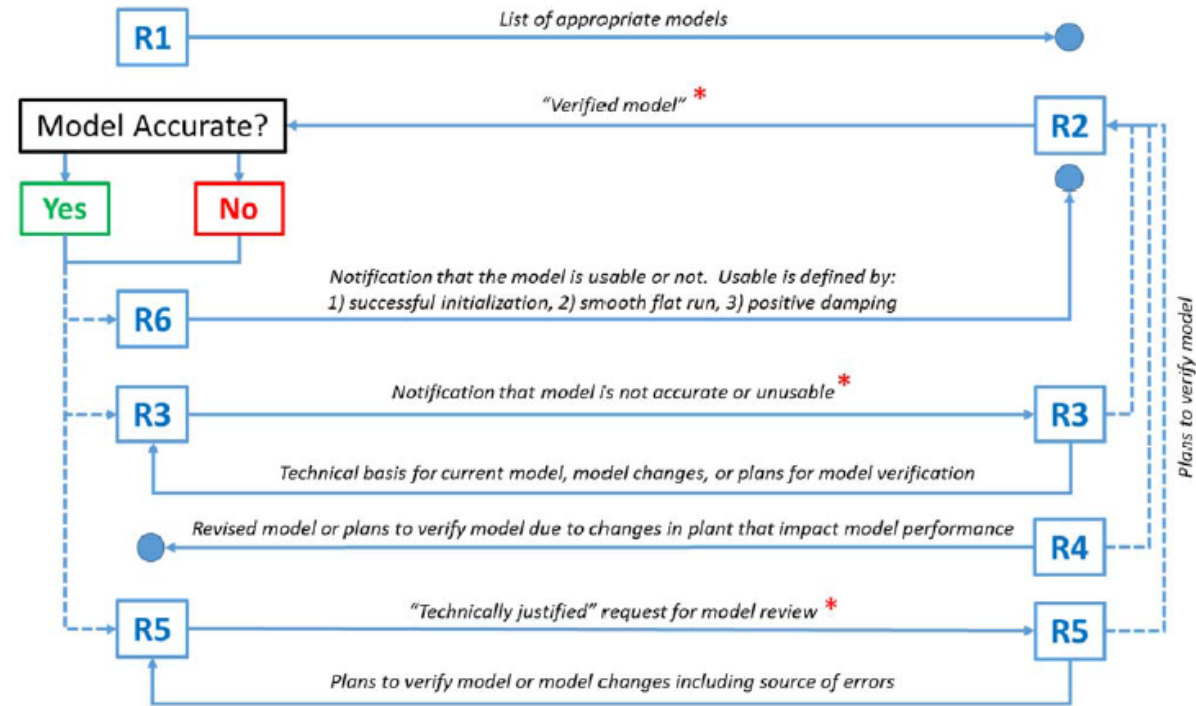
Reliability Guideline: Power Plant Model Verification using PMUs

Model Validation



TRANSMISSION PLANNER

GENERATOR OWNER



- PMU Installation
 - Equipment considerations
 - Digital relays and stand-alone devices
 - Communications and IT
 - Data quality
- Data storage and retrieval

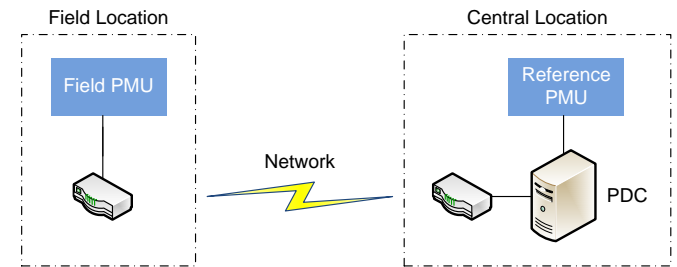
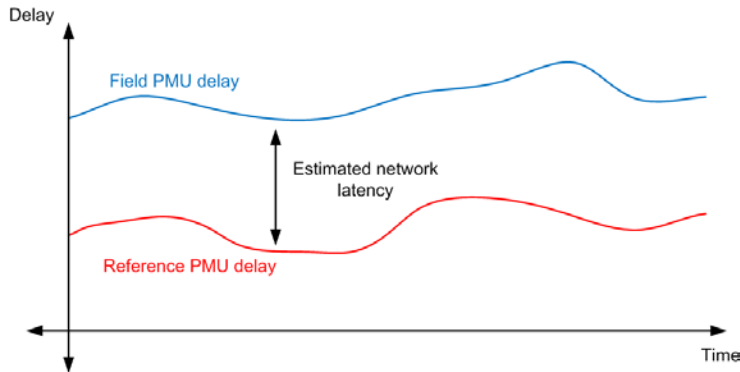
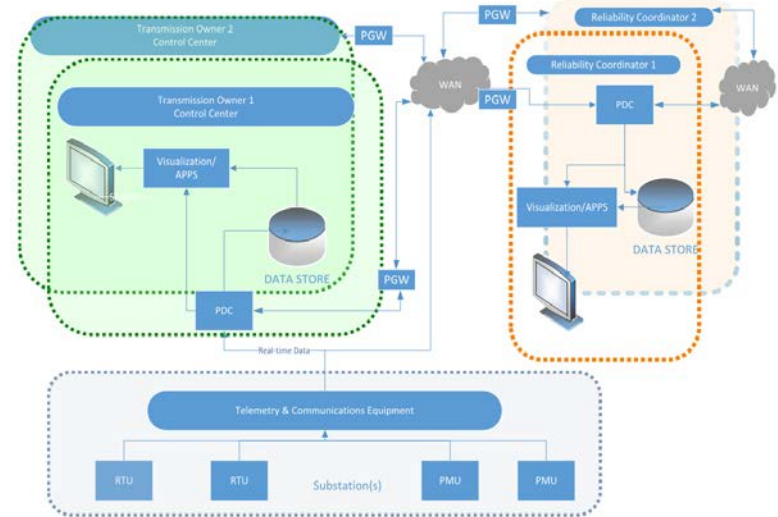
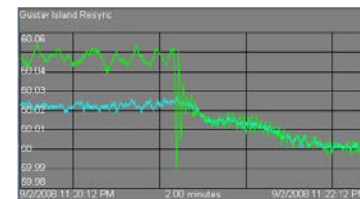
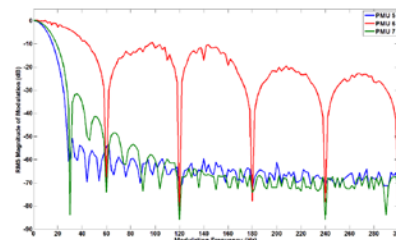
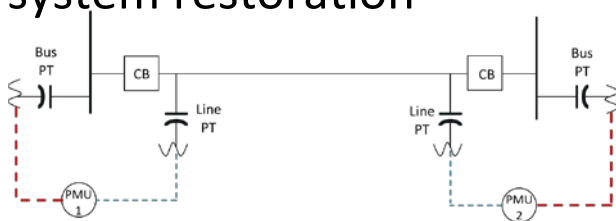
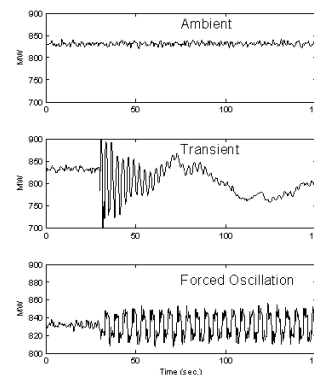
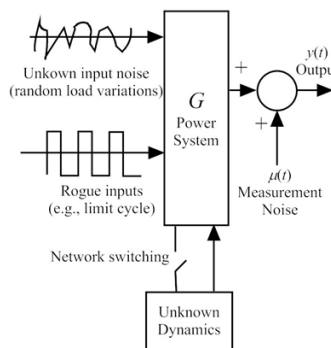
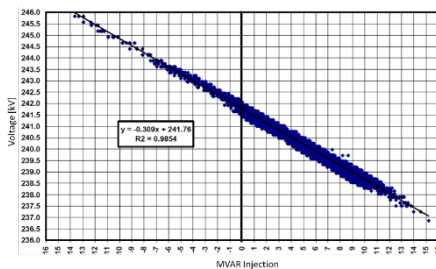
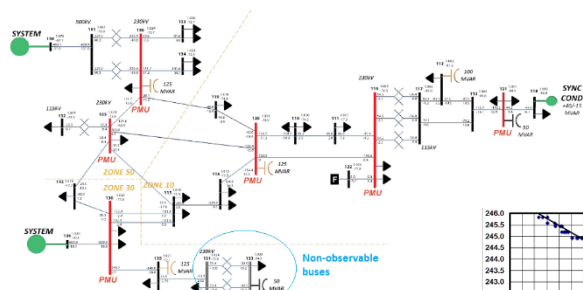


Table 1: Example Comparison of Utility Data Historians

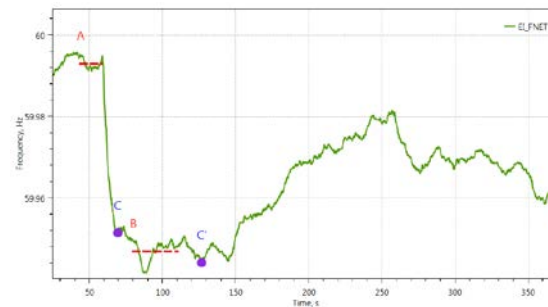
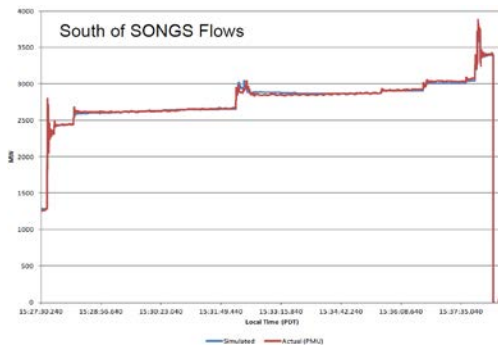
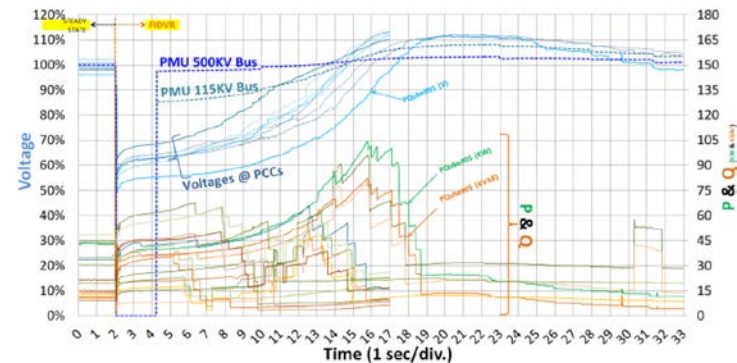
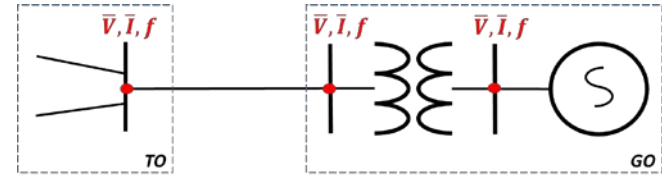
SCADA Historian System			PMU Historian System		
Number Tags	File Size	Archive Frequency	Number Tags	File Size	Archive Frequency
100,000	8 GB	8 – 10 days	1,500	8 GB	6 – 8 hours

- Real-Time Tools Considerations

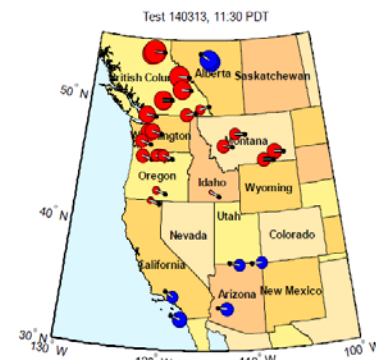
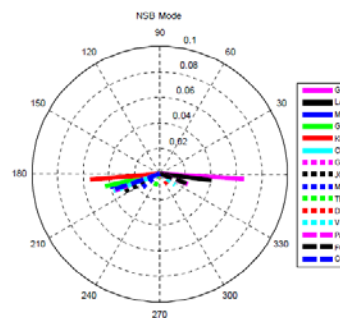
- State estimation
- Oscillation monitoring and analysis
- Subsynchronous resonance & control interaction
- Angle difference monitoring
- Voltage stability
- Transmission interfaces
- Remedial action schemes
- Wide-area visualization & alarming
- Variable energy resource integration
- Islanding detection and monitoring
- Blackstart & system restoration



- Offline Analysis Considerations
 - Power plant model validation
 - System model validation
 - Load model validation
 - Disturbance monitoring
 - Event analysis
 - Frequency response analysis
- Prioritization Based on Application
- Interconnection Requirements References

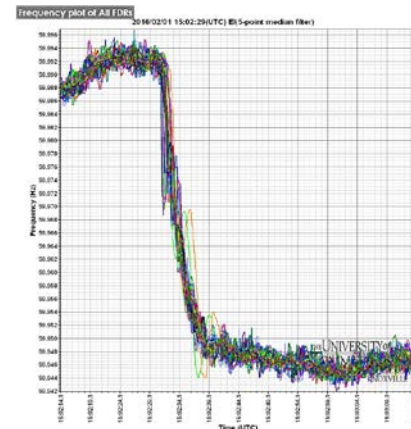
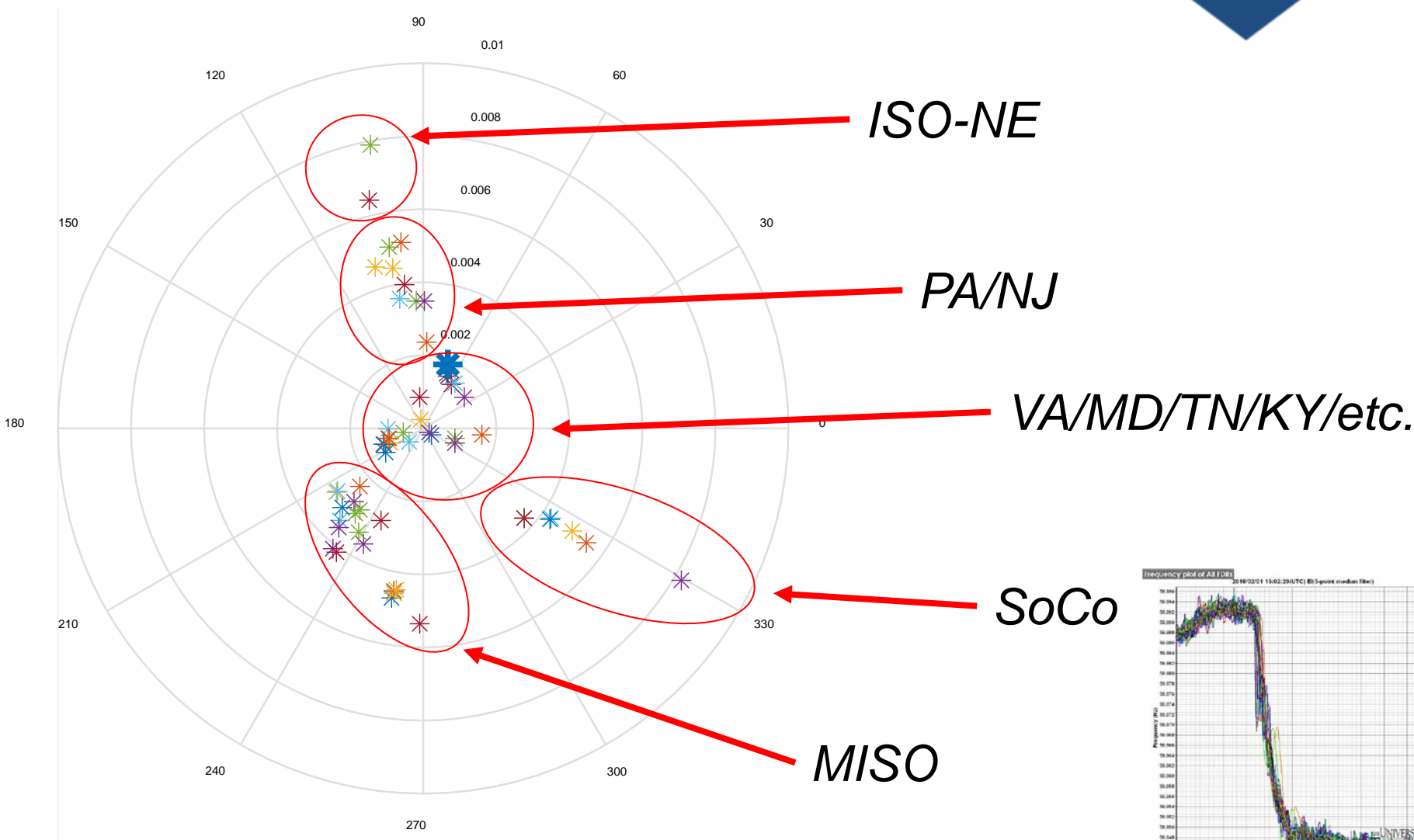


- Fundamental understanding of inter-area modes
- Use of wide-area PMU data
- Explore oscillation analysis tools

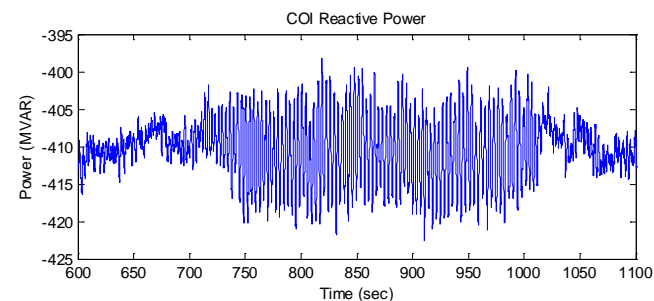
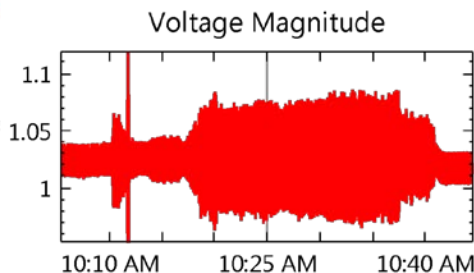
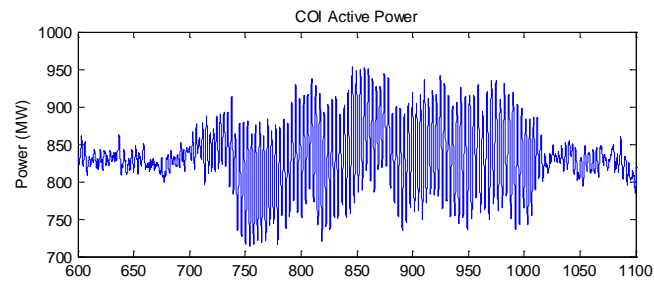
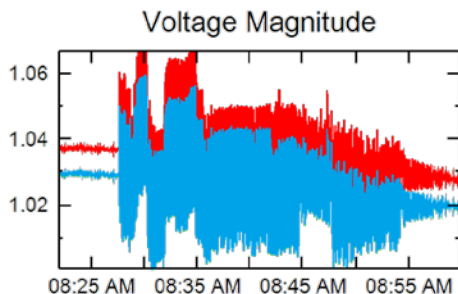
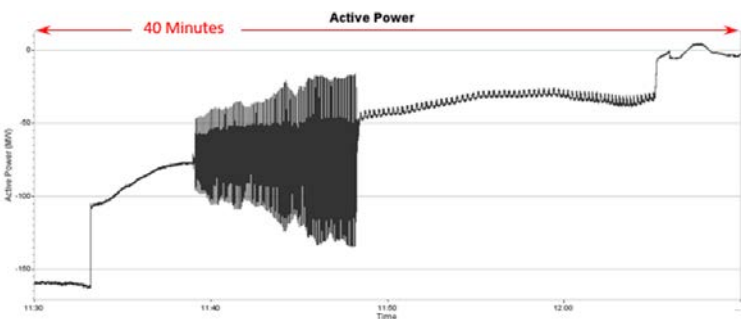
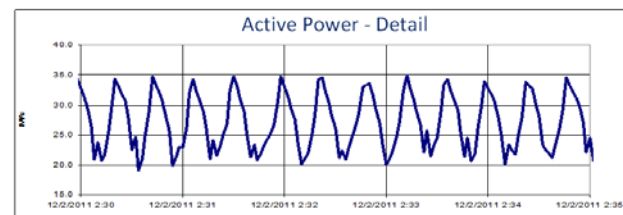
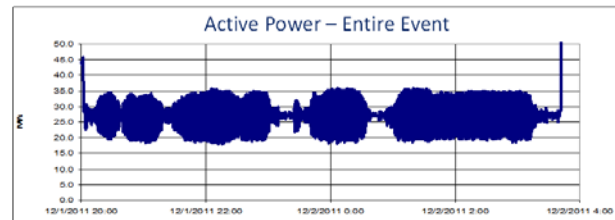


Mode	Freq. (Hz)	Shape	Interaction Path(s)	Controllability	Comments
NSA	0.25	Alberta vs System. BC and PNW swing with Alberta	Alberta Interconnect. COI. Cust.	Alberta	An Alberta trip causes NSA and NSB to combine into one NS mode with reduced damping. Need to understand damping better.
NSB	0.38	Alberta vs (BC + N. US) vs (S. US).	Alberta Interconnect. COI. Cust. Boundary.	Wide-spread. PDCI	This is the most wide spread mode in the system. Need to understand damping better.
EWA	0.4	(Mid E. - CO) vs System	Unkown	Eastern CO?	Lots of eastern system data in 2014.
MT	0.55 to 0.8, 0.8 typical	MT vs system.	Garrison.	Colstrip	Sometimes MT swings against BC.
BC	0.6	BC (Kemano) vs system. Ripples to S. Cal.	Cust. ?	Kemano?	Strong interactions with PDCI and PNW.

Sources: Montana Tech



- Overview of Forced Oscillations
- Potential Mitigation Measures
- Online Tools across Industry
- Forced Oscillation Examples



#	Task	Status	Expected Completion
1	RG: PMU Placement and Installation	Draft	Q4 2016
2	TR: SW Outage Rec 27: Angular Separation	Complete	
3	TR: Utilizing PMUs for NERC Reliability Standards	Tabled	Q3 2017
4	RG: Model Verification Using PMUs	Complete	
5	Workshop: Power Plant Model Verification & Testing	Complete	
6	TR: PMUs for Cascading Outages	Starting	Q3 2017
7	Monitoring: IEEE C37.118 Certification Process	Closing Out	
8	Monitoring: Operator Training Practices	Ongoing	N/A
9	SRA: Inter-Area Oscillation Analysis	Draft	Q3 2017
10	GPS Availability Analysis – Ad-Hoc Analysis	Complete	
11	RG: Forced Oscillations	Draft	Q3 2017

Synchronized Measurement Subcommittee (SMS) Meeting

January 17, 2017 | 1:00 p.m. to 5:00 p.m. Central Time Zone

January 18, 2017 | 8:30 a.m. to 5:00 p.m. Central Time Zone

January 19, 2017 | 8:30 a.m. to 12:00 p.m. Central Time Zone

SPP Offices

Little Rock, AR 72223



Questions and Answers