

Baselining Analysis

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Baselining

Baseline (noun) is a self-consistent set of measurements and performance metrics that can be used as a reference for the evaluation of future observed and anticipated conditions

Baselining (verb) is comparing the data characterizing some condition of interest with an appropriately chosen of baseline measurements. Baselining involves two processes (a) getting and archiving the baseline and (b) using the baseline

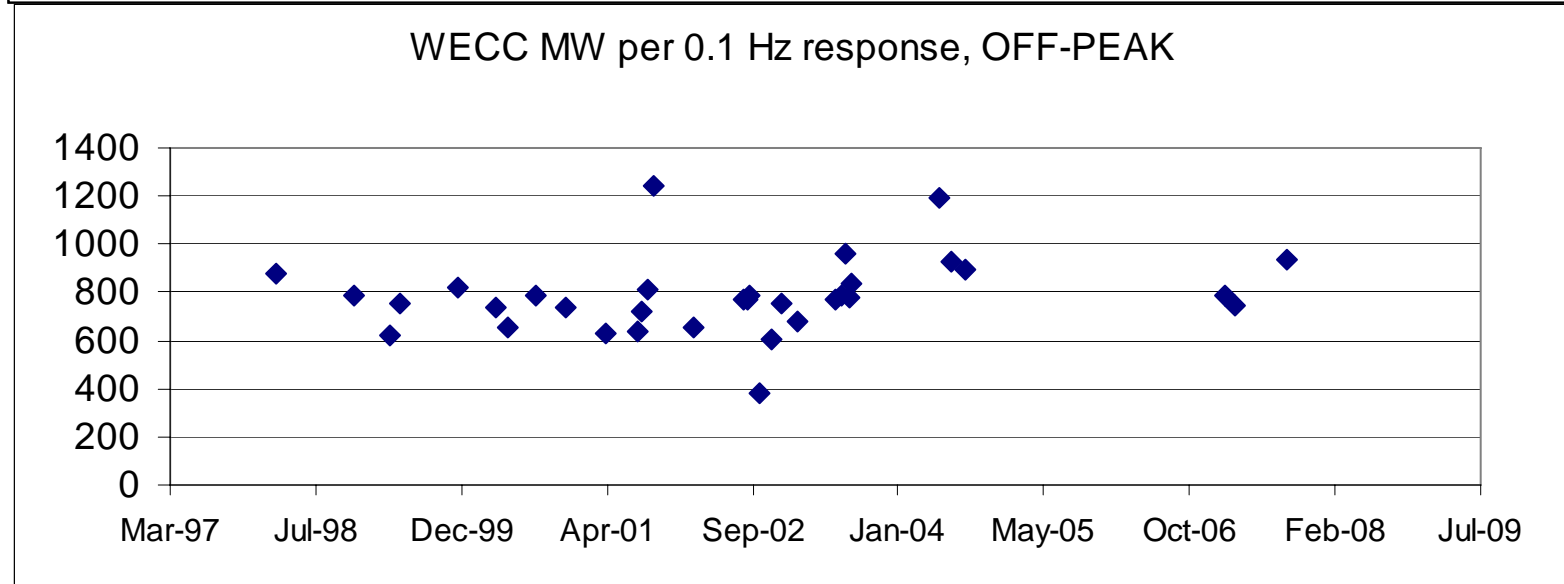
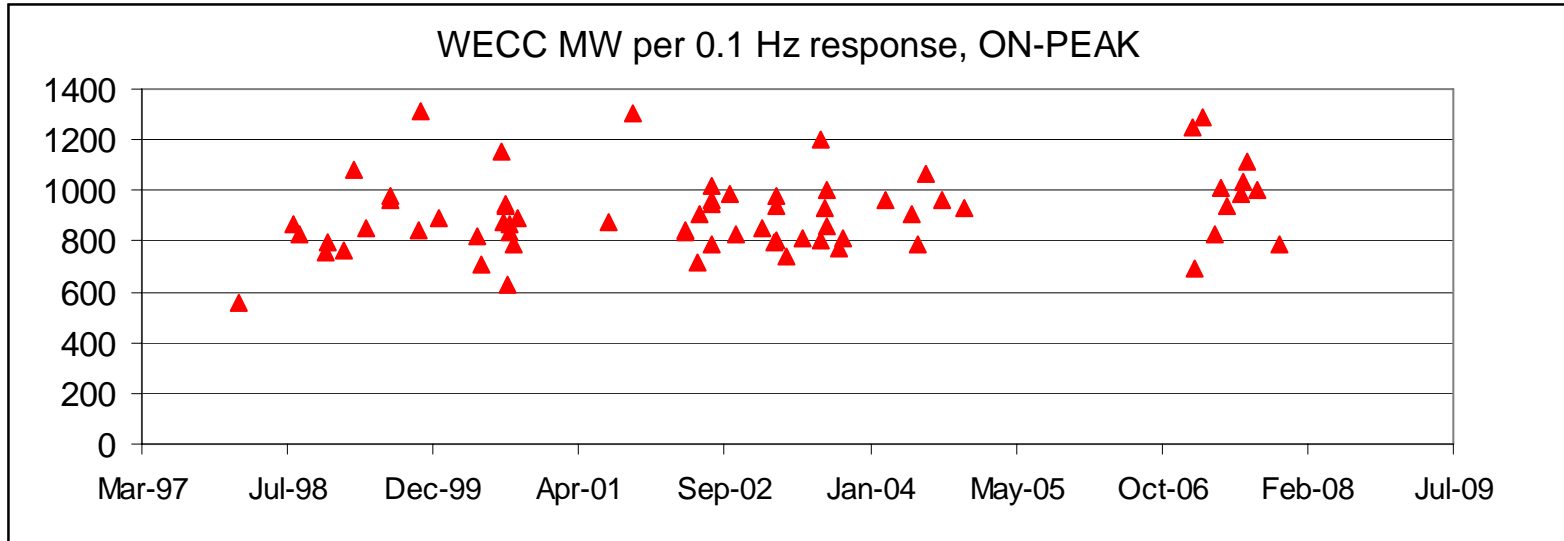
Baselining Activities

- Recoding system measurements that best indicative of system stress:
 - Total generation in an interconnection
 - Phase angles
 - Generation clusters
 - Power flows on key flowgates
 - Reactive power reserves, etc
- Calculating system performance indicators:
 - Frequency response performance (pre-disturbance, dip and settling frequency, time of minimum dip, size of generation event, etc)
 - Oscillation performance (frequency, damping, energy, mode shapes)
 - Voltage stability and power-angle indicators
- Correlating system performance indicators with measurements

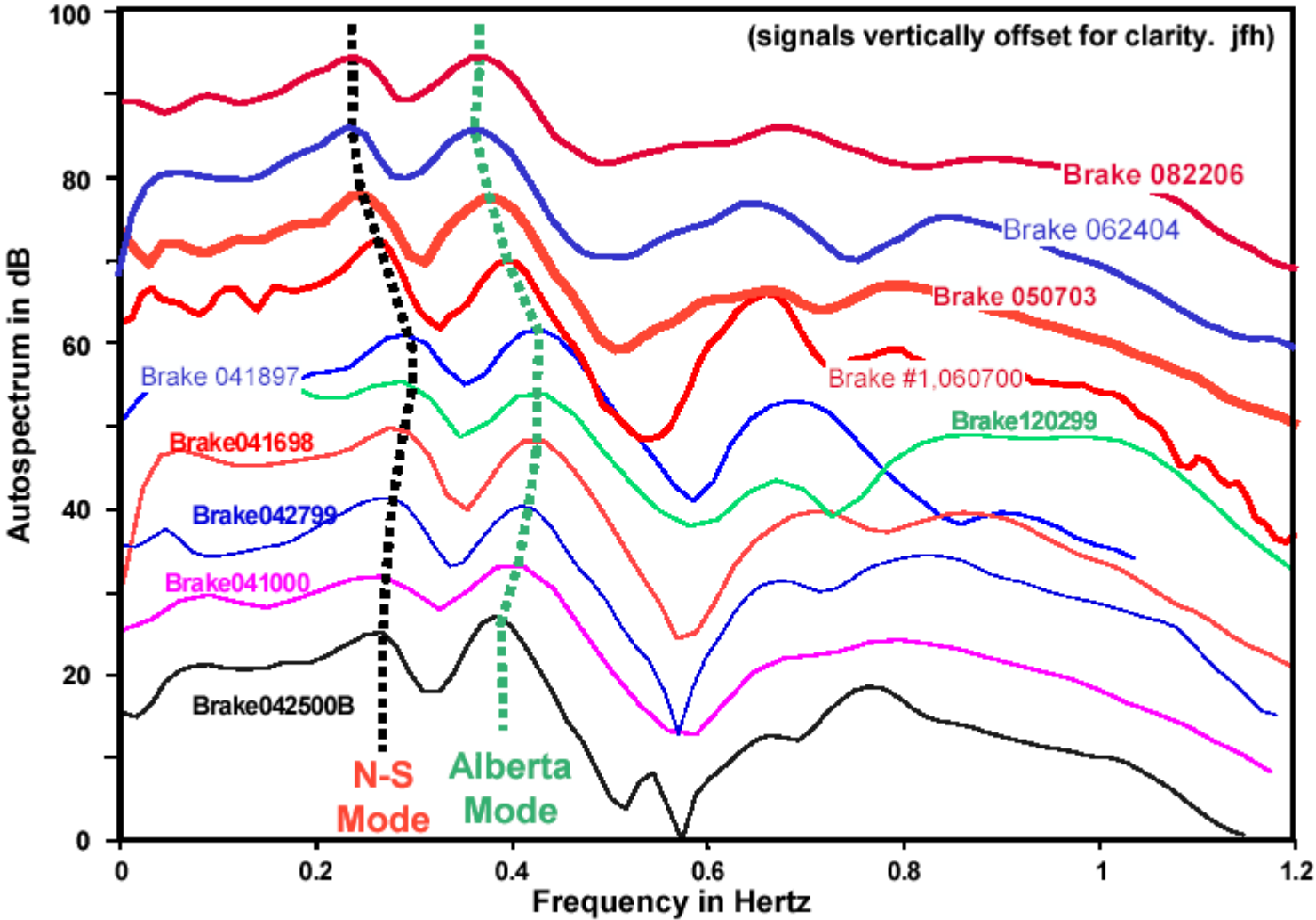
Current Status in the West

- Baselineing is not new in the West, WECC has been baselineing a variety of system performance indicators for several decades
- Statistical analysis
 - Phase angle information is integrated into EMS systems - cannot look at phase angle information in isolation from breaker status, generation, etc
 - EPG performed statistical analysis of phase angles for 2008 season
- System Performance Analysis
 - WECC has a 10+ year trend of frequency response
 - WECC has a great track record of oscillation damping performance during disturbances and system tests (John Hauer, Jeff Dagle, Dan Trudnowski)
 - Dan Trudnowski and PNNL performed oscillation baseline of ambient conditions
 - For voltage stability, reactive reserve monitors are used since 1996, work is under way to develop additional voltage stability indicators
- Correlation analysis
 - Tom Ferryman (PNNL) is looking at sophisticated data mining, including signatures and correlation between measurement sets and dynamic performance
- NASPI project provides a kick start to the baselineing efforts, and WECC needs to integrate them into existing processes

Is there a deterioration of frequency response in the West ?



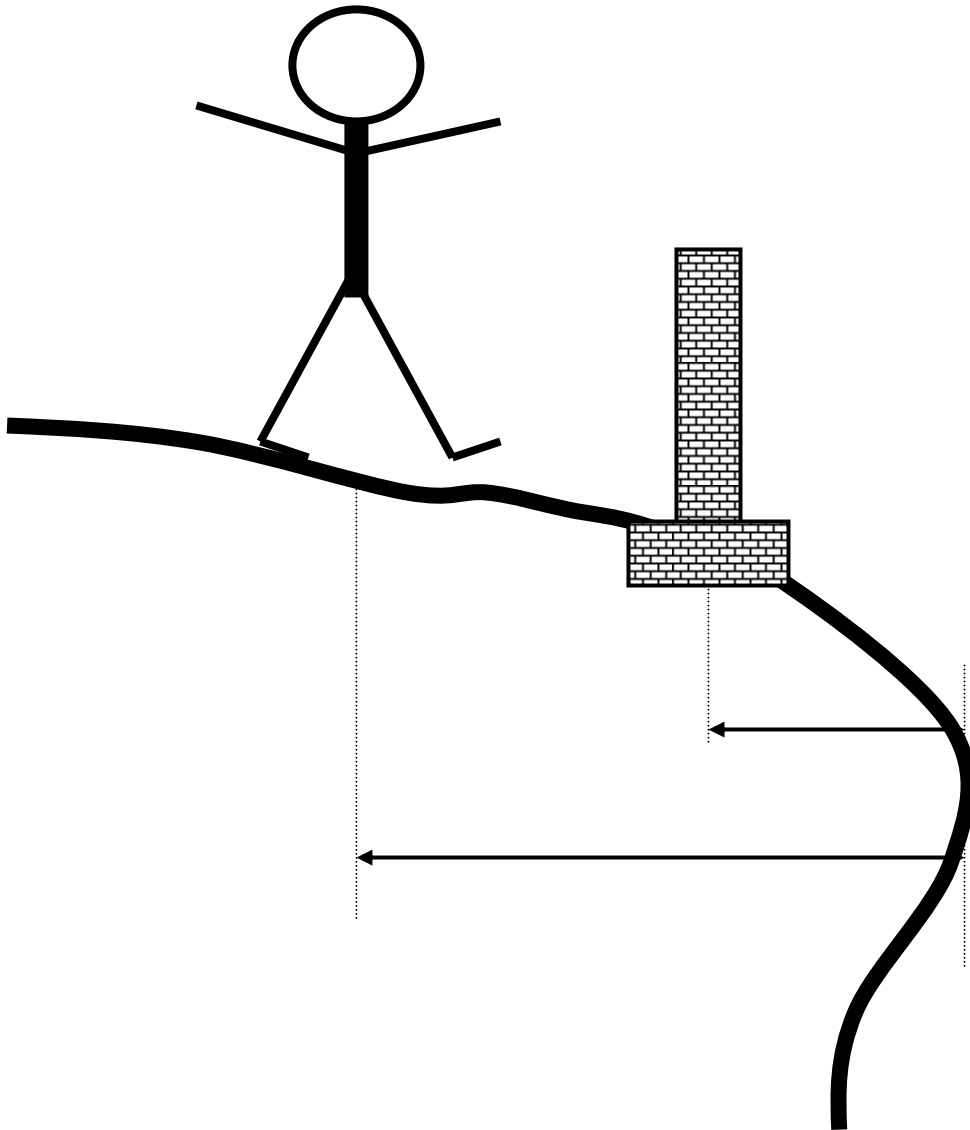
Power Oscillation Baseline for the Western Interconnection



Uses of Baseline Activities

- Baseline needs to be done at various levels:
 - * Interconnection
 - * Control area
 - * Power plants
- Baseline results will be used by various applications:
 - Tracking system performance over time
 - Detecting and action upon acute changes in the system performance
 - Validating power system models that are used in setting operational limits

Setting Operating Limits



- You want know where the edge is, and
- You know how far from the edge you are
- You may want to know how far from the edge you can be

Setting Operating Limits

- Measurements tell you where you are, measurements do not tell you where the edge is
 - a few notable exceptions – 8/14/03, 8/10/96, 7/2/96, ...
- Power System Models are needed to tell you where the edge is
 - Availability of validated models is essential :
 - Analyze the historic system performance (damping, sensitivities, etc) during past operating conditions and disturbance events
 - Validate dynamic models against these events and operating conditions

System Model Validation

- NERC Staff (Bob Cummings, Eric Allen) facilitated the development of System Model Validation White Paper – approved by NERC TIS
- System-Wide Model Validation Activities in the West
 - West-Wide System Model (WSM) is developed
 - Project to link WSM with dynamic database is planned
 - Tools for system performance analysis and model validation are being developed by WECC MVWG