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NORTH AMERICAN ELECTRIC
RELIABILITY CORPORATION

Frequency Response Technical Conference

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BAL-003-1 Overview

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- BAL-003-1 goals
- Bias vs. Beta
- Overview of BAL-003-1
- Changes since last posting
- Differences between version 0 and version 1
- Bias setting process
- Frequency Response Obligation allocation
- Example annual cycle

- Original SAR
 - Objectively benchmark and track BA and Interconnection performance
 - Establish a better process for developing Bias Settings
 - Enable technically sound decisions on setting any future performance obligations
- FERC Order No. 693 directed additional work
 - Determine the appropriate periodicity of frequency response surveys
 - Define necessary amount of Frequency Response for reliable operations with methods of obtaining response and measuring that the frequency response is achieved

- Frequency Bias Setting (B) is not the same as Frequency Response (β)
 - Frequency Response is actual MW contribution to stabilize frequency
 - Bias is an approximation of β used in the ACE equation (prevents AGC withdrawal of β)
- Both are negative numbers by convention* (as frequency drops, MW output increases and vice versa)
- Both are measured in MW/0.1Hz
- Bias _(absolute value) must be $\geq \beta$ _(absolute value) (stated another way, Bias should be equal to, or more negative than, β)
- In the East, B _(absolute value) is about twice as large as β _(absolute value)
- Bias _(absolute value) under the present standard must be at least 1% of Balancing Authority peak load
- If there is to be a difference between B and β , it is preferable to be over-biased

Note: Some EMS' use a reverse sign convention for ACE and therefore Bias

- Proposed Standard nearly identical to the “Version 0” BAL-003 (only one Requirement is a material change)
 - Frequency Response performance obligation
 - Frequency Bias Setting Implementation
 - Appropriate Frequency Bias Setting for those providing Overlap Regulation Service,
 - Minimum Frequency Bias Setting
- More detail in the following slides

- Minimum Bias Setting modified (covered later)
- Clarified the event selection process
- BA responsibility for Frequency Response Obligation (FRO) allocation now based on historic peak data
- Defined Frequency Response Sharing Groups
- Defined upper bound for Frequency Response Obligation

- BA to provide an average (median) amount of Frequency Response for defined set of events
- Frequency Response Obligation (FRO) is defined for upcoming year (based on BA size)
- BA reports performance at the end of the year for frequency excursions during the year
- With attention, all BAs should be able to meet their FRO
 - Generally sufficient Frequency Response in each Interconnection
 - Standard provides mechanisms to obtain response
 - Field trial data showed good results

2. Implement Frequency Bias Setting on date specified by NERC
3. Defines how Overlap Regulation providers implement Bias Setting
4. Identifies minimum Bias Setting
 - Drafting team proposes 0.9% of peak/0.1Hz
 - See *“Procedure for ERO Support of Frequency Response and Frequency Bias Setting Standard”* (formerly Attachment B) for process to manage changes to the Bias Setting floor

- The Bias Setting process will be very similar to what is done today
- Form 1 will automatically calculate a proposed Bias Setting for the upcoming year
 - The data submitted by the BA will be validated
 - CPS Limits, Bias Settings and FRO for upcoming year will be posted on NERC website
- BAs will be given an implementation date for the new Bias Setting (e.g. March 1 or April 1)

- *“Procedure for ERO Support of Frequency Response and Frequency Bias Setting Standard”* defines the process NERC will follow to elect events for analysis
- *“Attachment A”* outlines the allocation of the Interconnection’s Frequency Response Obligation to BAs
- NERC now publishes lists of events during the year so BAs will have “heads up” on events that will be used
- BAs encouraged to develop local tools to scan for events and capture data for ongoing analysis

- Determine FRO based on the historic annual average monthly peak load and generation (FERC Form 714)

- Formula:

$$FRO_{BA} = FRO_{Int} \times \frac{\text{Peak Gen}_{BA} + \text{Peak Load}_{BA}}{\text{Peak Gen}_{Int} + \text{Peak Load}_{Int}}$$

- January 10, 2013: BAs submit FRS Forms 1 and 2
- January-February 2013: NERC and RS validate data, NERC posts CPS, Bias Setting, FRO
- April 1, 2013: Implement 2013 Bias Settings
- March-November 2013: NERC periodically posts and updates list of candidate events likely to be used for current year's FRM and next year's Bias Setting
- December 7, 2013: NERC posts:
 - Official list of events for Bias Setting and FRM (Forms 1 and 2)
 - BAs notified

- Present minimum Bias Setting is 1% of peak/0.1Hz
- For most BAs, Frequency Response is < this 1% value
- Control theory says Bias and Frequency Response should closely match
- Proposed field test in 2013 to adjust minimum Bias Settings
 - 0.9% of peak
 - If no issues observed, NERC's procedure will be used to consider further reduction in future years



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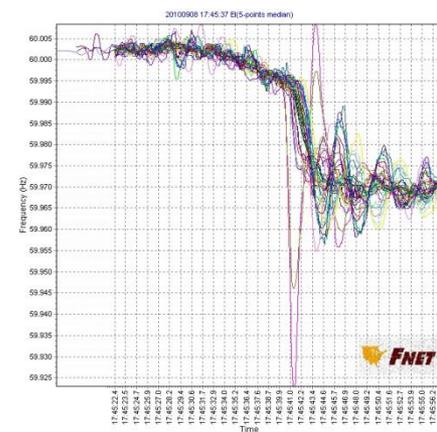
Measurement of Frequency Response

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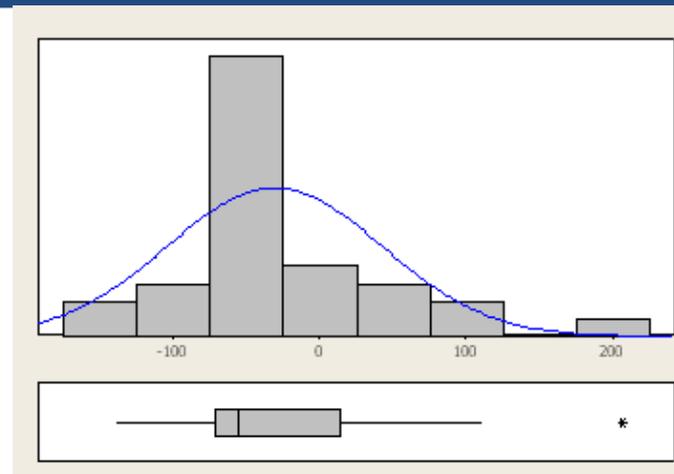
- Use of “B value” as the metric
- Median as the measure of annual performance
- Measurement error and data variability
- Proposed Interconnection target obligations
- Estimating your BA’s obligation
- Supplemental discussion (answers to other recently asked questions)
 - Comparison of US-Europe frequency performance
 - Comparison of Interconnections
 - FRS measurement window

- Much like dropping a stone in a pond, point C is different throughout an Interconnection for the same event and occurs at different times
- The B value is nearly identical among all BAs for the same event
- The ratio of C-B is generally consistent among events within an Interconnection
- Given this, we can use the B value as a metric and apply a correction ratio to measure encroachment on UFLS

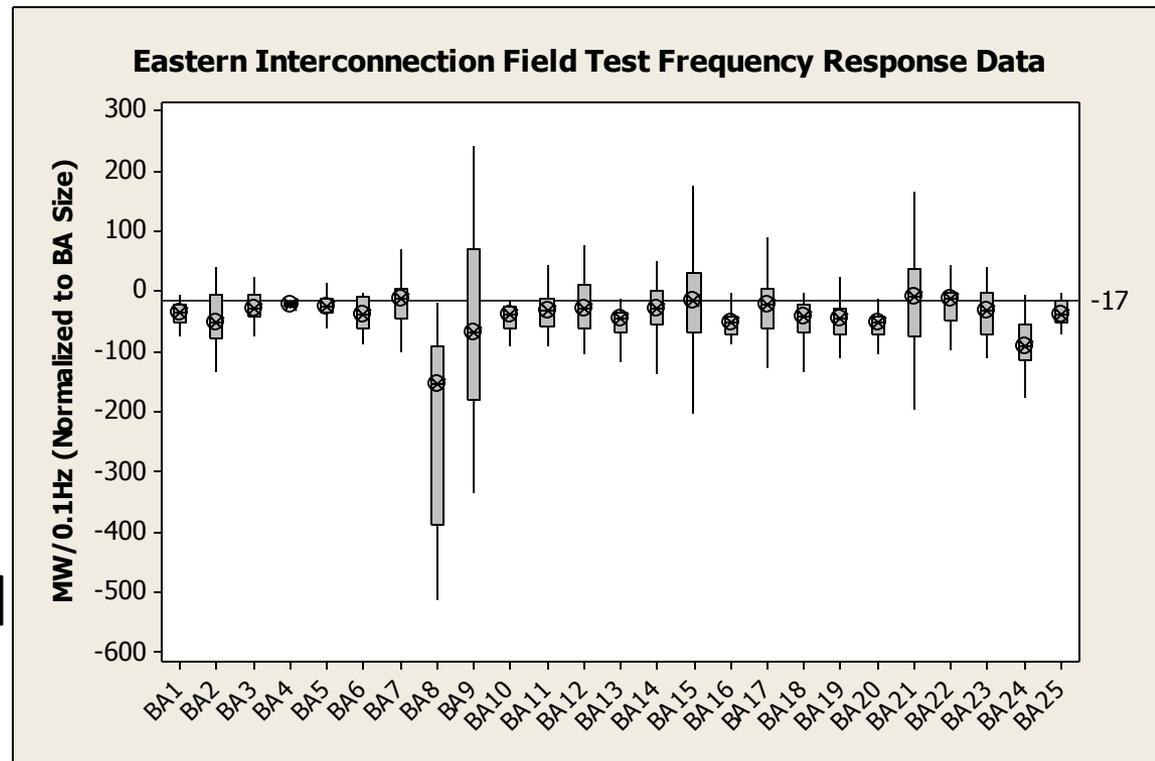


- The standard uses the median response of about 25 events annually as the measure of a BA's performance
- The frequency response calculation has a very low signal to noise ratio, particularly in a multi-BA Interconnection
 - Governor response is easily masked by minute to minute changes in load
 - Noise causes outliers that corrupt the estimate of frequency response
 - The outliers are not symmetrical and will inflate or underestimate beta
- The median is the preferred measure of central tendency in a population with outliers

- This graph is typical calculated performance for an Eastern Interconnection BA
- Notice that some values are actually positive
- For the 27 BAs that submitted field trial data, for about 35% of the individual observations, the calculated response is corrupted by the noise to the point of showing low BA frequency response even though Interconnection performed adequately

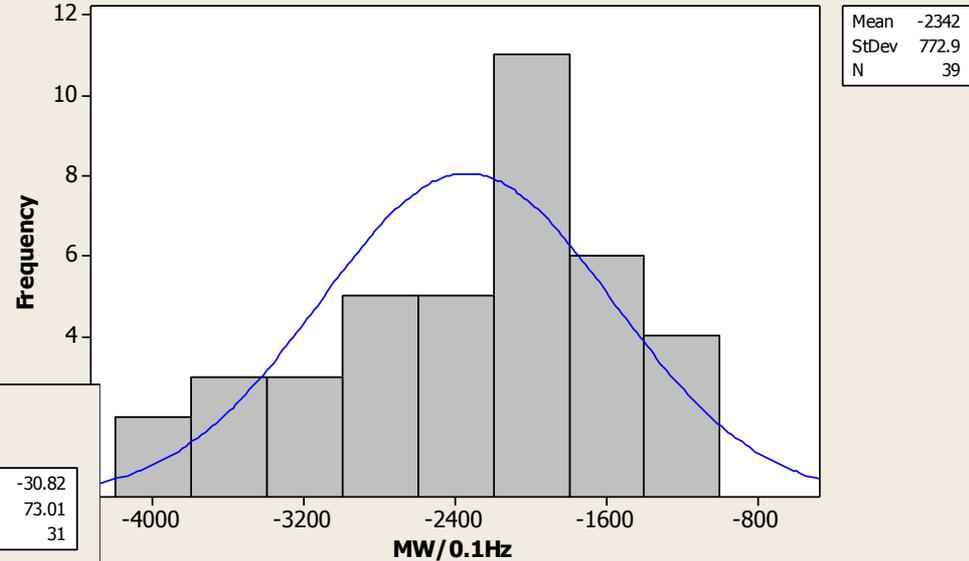


- The graph below shows actual (normalized) data provided by BAs for the field trial
- Note that median performance is OK across the board
- Refer to the previous slide that showed Interconnection performance was acceptable as well for the same period

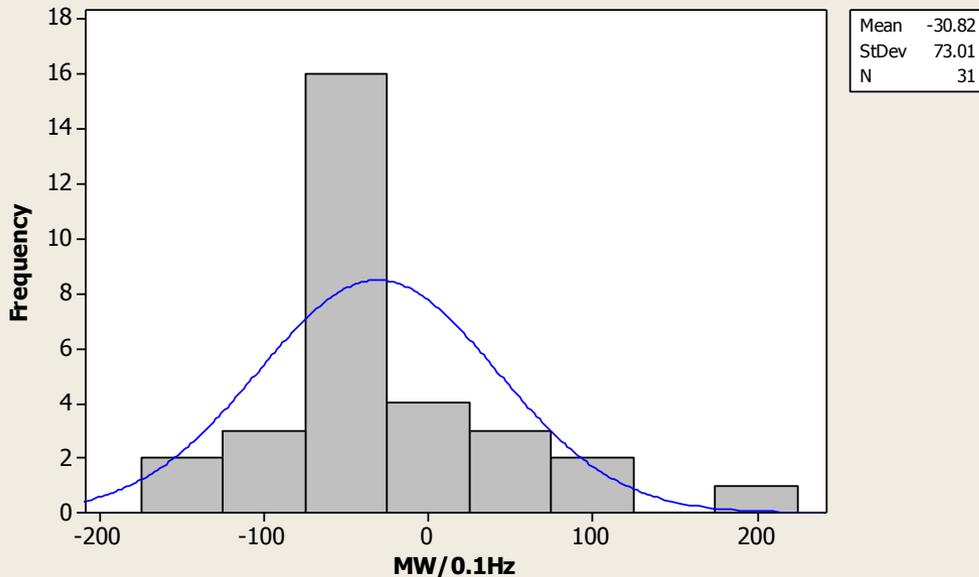


Measurement quality increases when performance is aggregated to the Interconnection level

2011 Eastern Interconnection Performance



Typical Eastern Interconnection BA Calculated Performance



NERC and the Resources Subcommittee will monitor Interconnection performance for trends

- The drafting team was asked for further technical justification of the Interconnection target obligations
- The table below outlines the new targets

Interconnection	East	West	Texas	HQ	
Target Protection Criteria	4500	2740	2750	1700	MW
Credit for Load Response		-400	-1400		MW
Prevailing UFLS First Step	59.5	59.5	59.3	58.5	Hz
Frequency Margin (tenths)	5	5	7	15	0.1Hz
Typical C-B Ratio	1.08	1.37	1.24	2.15	
Necessary Frequency Response	-972	-641	-239	-244	MW/0.1Hz
FRO with Reliability Margin (25%)	-1215	-801	-299	-305	MW/0.1Hz

1. Use the proposed FRO for your Interconnection (previous slide)

2. Multiply this value by:

$$\frac{\text{Your BA's Bias Setting}}{\text{Your Interconnection's Total Bias}}$$

You can find Bias Setting values at:

[www.nerc.com/docs/oc/rs/2012%20CPS2%20Bounds%20Report%20Final\(Update20120419\).pdf](http://www.nerc.com/docs/oc/rs/2012%20CPS2%20Bounds%20Report%20Final(Update20120419).pdf)

You can find candidate frequency events at:

www.nerc.com/filez/rs.html



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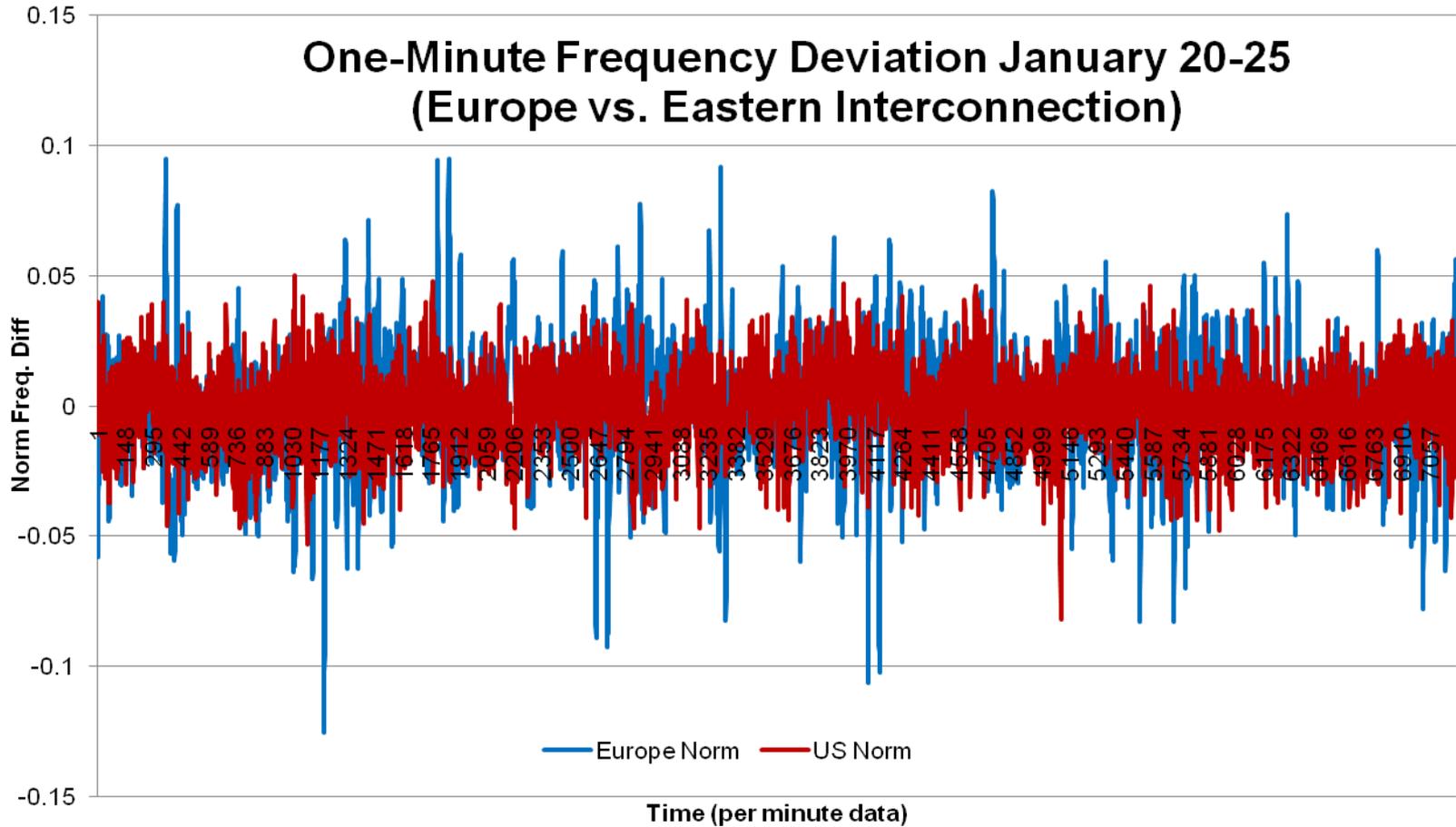
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Other recently asked questions

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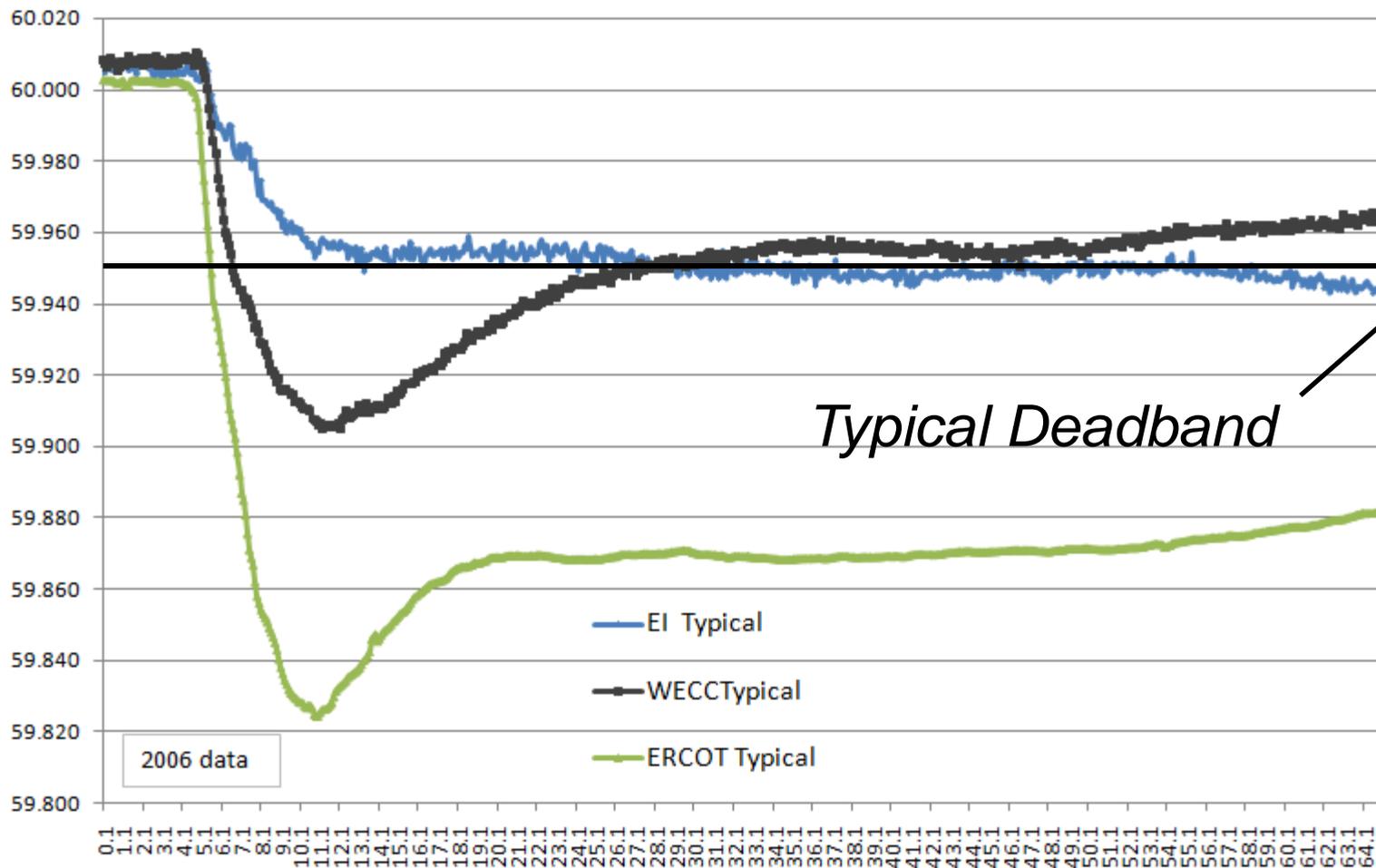




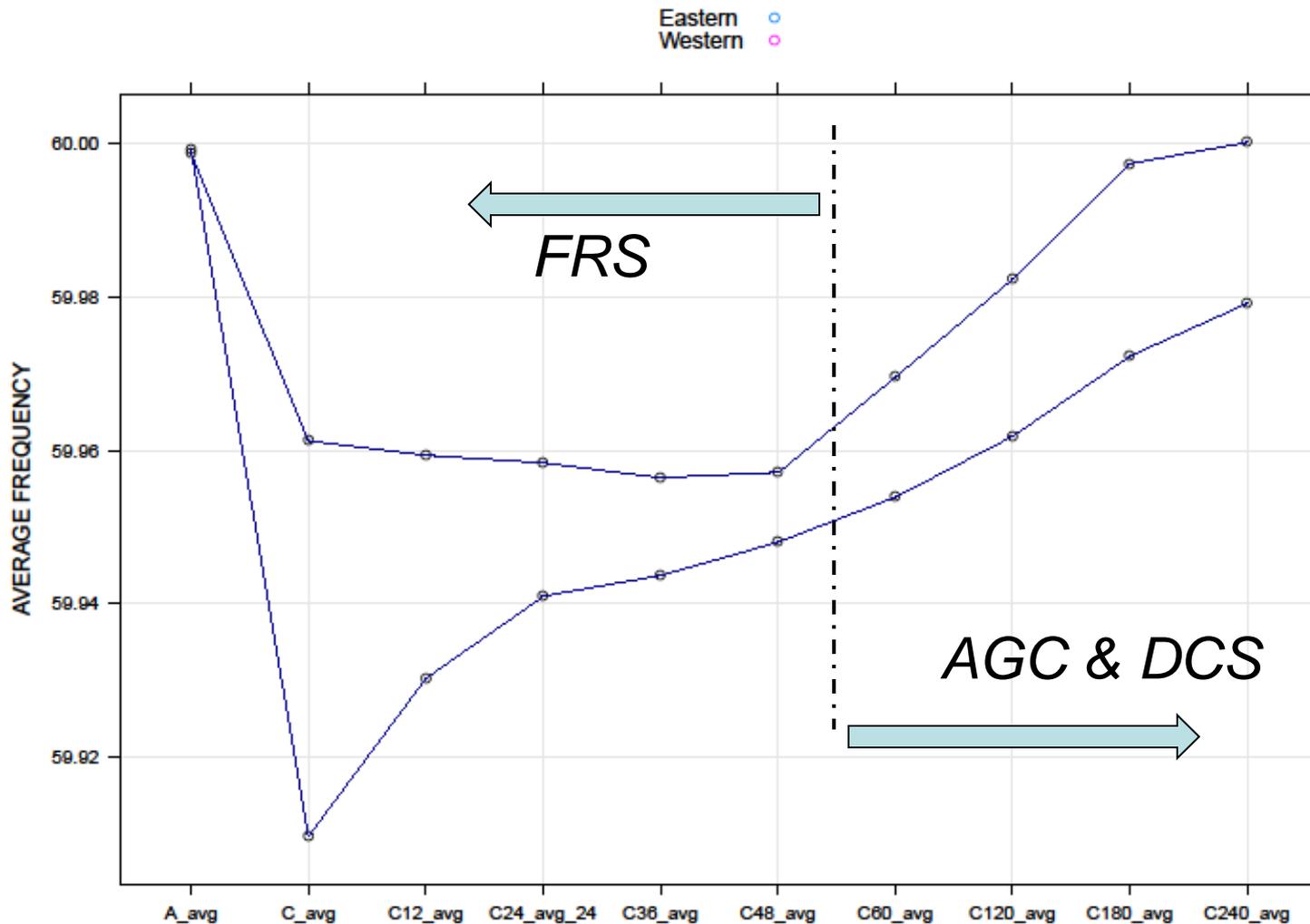
2010 comparison by the Resources Subcommittee

Interconnection Comparison

Typical Events (5 seconds before unit trip to 60 seconds thereafter)



EASTERN AND WESTERN RECOVERY AVERAGE FREQUENCIES FOR ALL 2011 FREQUENCY EVENTS



A, C AND RECOVERY AVERAGE FREQUENCIES FOR ALL 2011 EVENTS