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NORTH AMERICAN ELECTRIC
RELIABILITY CORPORATION

Project 2007-18 Reliability-Based Control

Discussion of Questions Presented to
the NERC Stakeholders

September 15, 2008

Doug Hils — Duke Energy

to ensure
the reliability of the
bulk power system

Discussion Items

- 1) Standard Drafting Team members
- 2) Overview of the project purpose statements
- 3) Discussion of the each purpose statement, current status, and related questions
- 4) Meeting dates
- 5) Documents on the NERC Website
- 6) Next Steps

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Project 2007-18 Reliability-Based Control

Overview of the Project Purpose
Statements

to ensure
the reliability of the
bulk power system

Project 2007-18

Reliability-Based Control

- The Reliability-Based Control SAR includes the purpose statements:
- A) To maintain Interconnection frequency within predefined frequency limits under all conditions (i.e., normal and abnormal), to manage frequency-related issues such as frequency oscillations, instability, and unplanned tripping of load, generation or transmission, that adversely impact the reliability of the Interconnection. (Work brought into this SAR from draft BAL-007 through BAL-011).
 - B) To support corrective action by the BA when its excessive Area Control Error, as determined by this standard, may be contributing to or causing action to be taken to correct an SOL or IROL problem.

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Reliability-Based Control

- The Reliability-Based Control SAR includes the purpose statements:
- C) To prevent Interconnection frequency excursions of short-duration attributed to the ramping of Interchange Transactions.
 - D) To support timely congestion relief by requiring the Balancing Authority to employ corrective load/generation management within a defined timeframe when participating in transmission loading relief procedures.
 - E) To address the directives of FERC Order 693:
 1. Add data retention requirements to all standards.
 2. Require a continent-wide contingency reserve policy.
 3. Modify BAL-003 – Frequency Response and Bias.
 4. Require minimum Regulating Reserves for a Balancing Authority.

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Project 2007-18 Reliability-Based Control

Discussion of Each Purpose Statement,
Current Status of Each, and Related
Questions

to ensure
the reliability of the
bulk power system

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Reliability-Based Control

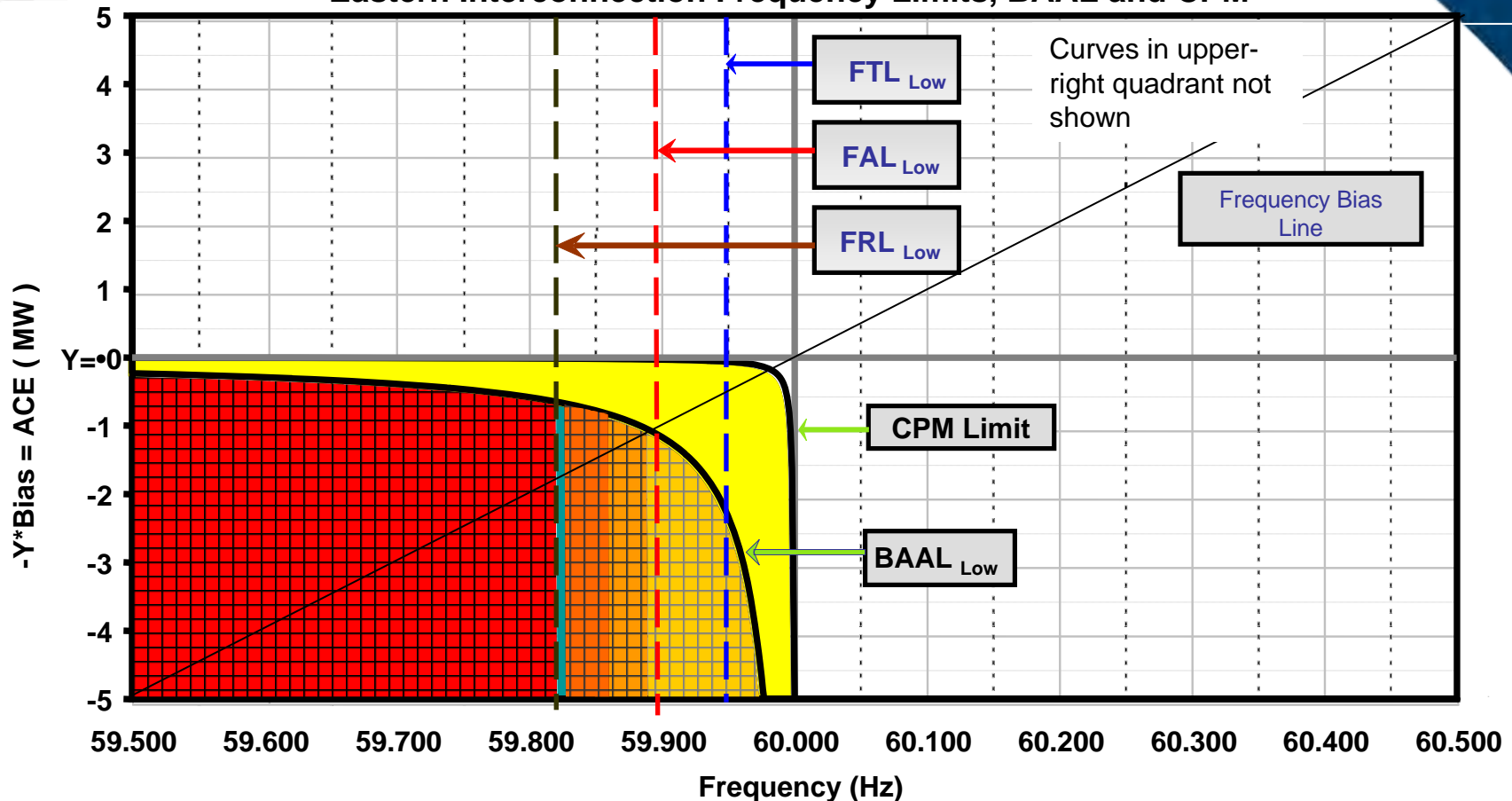
- Purpose Statement A: Work brought into this SAR from draft BAL-007 through BAL-011.
- Prior work on BAL-007 through BAL-011 defined a method of developing frequency and ACE limits, based on outage statistics and relay settings, and intended to limit the rate of activation of frequency sensitive relays to a targeted bound. Under the proposed standard, RCs may incur violations when the frequency of their Interconnection continuously exceeds any of these frequency limits for longer than the associated time limits specified by the proposed standard. BAs may incur violations when their ACE exceeds a variable frequency-based ACE limit continuously for longer than T_v , a time limit specified by the standard. 30 consecutive clock-minutes is the criteria being used in the Field Trial in the Eastern Interconnection.

Project 2007-18 Reliability-Based Control Field Trial Participants

Balancing Authority Participants - Eastern Interconnection	2008 Bias (MW/0.1Hz)	Region	Reliability Coordinator	Start Date
Alliant Energy (ALTE)	-42	MRO	MISO	July 6, 2005
Alliant Energy (ALTW)	-57	MRO	MISO	July 6, 2005
American Electric Power (CSW)	-101.9	SPP	SPP	September 1, 2005
Duke Energy (CIN)	-136	RFC	MISO	July 6, 2005
East Kentucky Power Cooperative (EKPC)	-37.9	SERC	TVA	July 6, 2005
Entergy (EES)	-222.4	SERC	ICTE	July 6, 2005
E.ON U.S. (LGEE)	-92	SERC	TVA	April 1, 2008
Independent Electricity System Operator (IESO)	-303	NPCC	IESO	March 1, 2008
Manitoba Hydro (MHEB)	-43.9	MRO	MISO	July 6, 2005
Michigan Electric Coordinated Systems (MECS)	-233	RFC	MISO	September 1, 2005
Northern Indiana Public Service (NIPS)	-59	RFC	MISO	July 6, 2005
PJM Interconnection (PJM)	-1418	RFC	PJM	August 1, 2005
Santee Cooper (SC)	-88.3	SERC	VACS	March 1, 2006
Southern Company (SOCO)	-463	SERC	SOCO	October 15, 2005
Tennessee Valley Authority (TVA)	-328.32	SERC	TVA	October 1, 2005
We Energies (WEC)	-73	RFC	MISO	September 1, 2005

Reliability-Based Control Standard Proof-of-Concept Field Trial

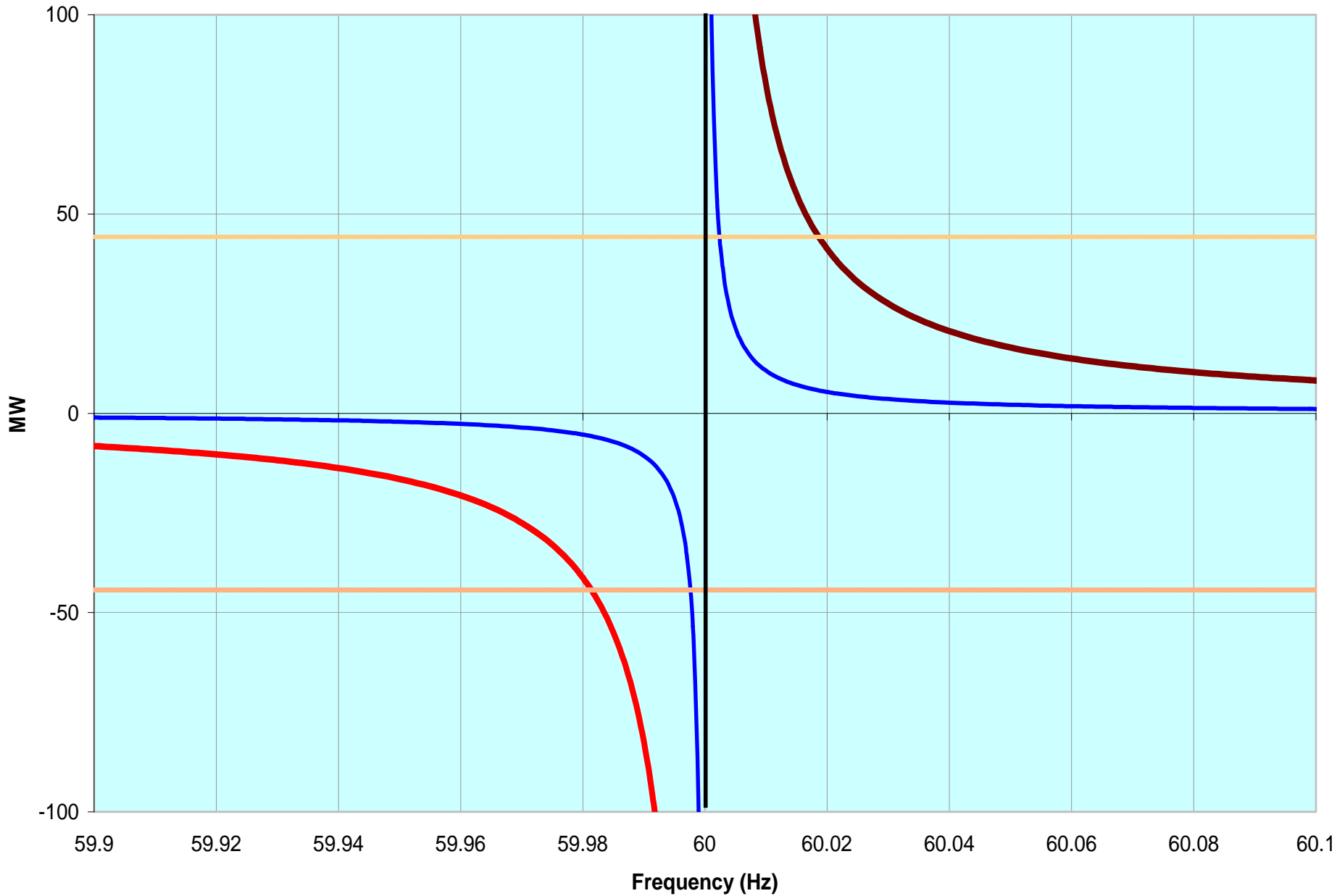
Eastern Interconnection Frequency Limits, BAAL and CPM



- Frequency Relay Limit (FRL)** - if exceeded, will result in tripping of frequency-related relays
- Frequency Abnormal Limit (FAL)** - cannot be exceeded w/out exposing interconnection to unacceptable level of risk (greater than a one in ten-year probability of unwarranted load shed relay activity)
- Frequency Trigger Limit (FTL)** – can operate for **limited** time before risk to interconnection is unacceptable.

BA97 -33 MW/0.1 Hz
Frequency Bias

CPS1 and BAAL



Prior CPS2 L10
Limits 44.26 MW

BAAL_High BAAL_Low CPS1 Bound at 60 Hz SF L10

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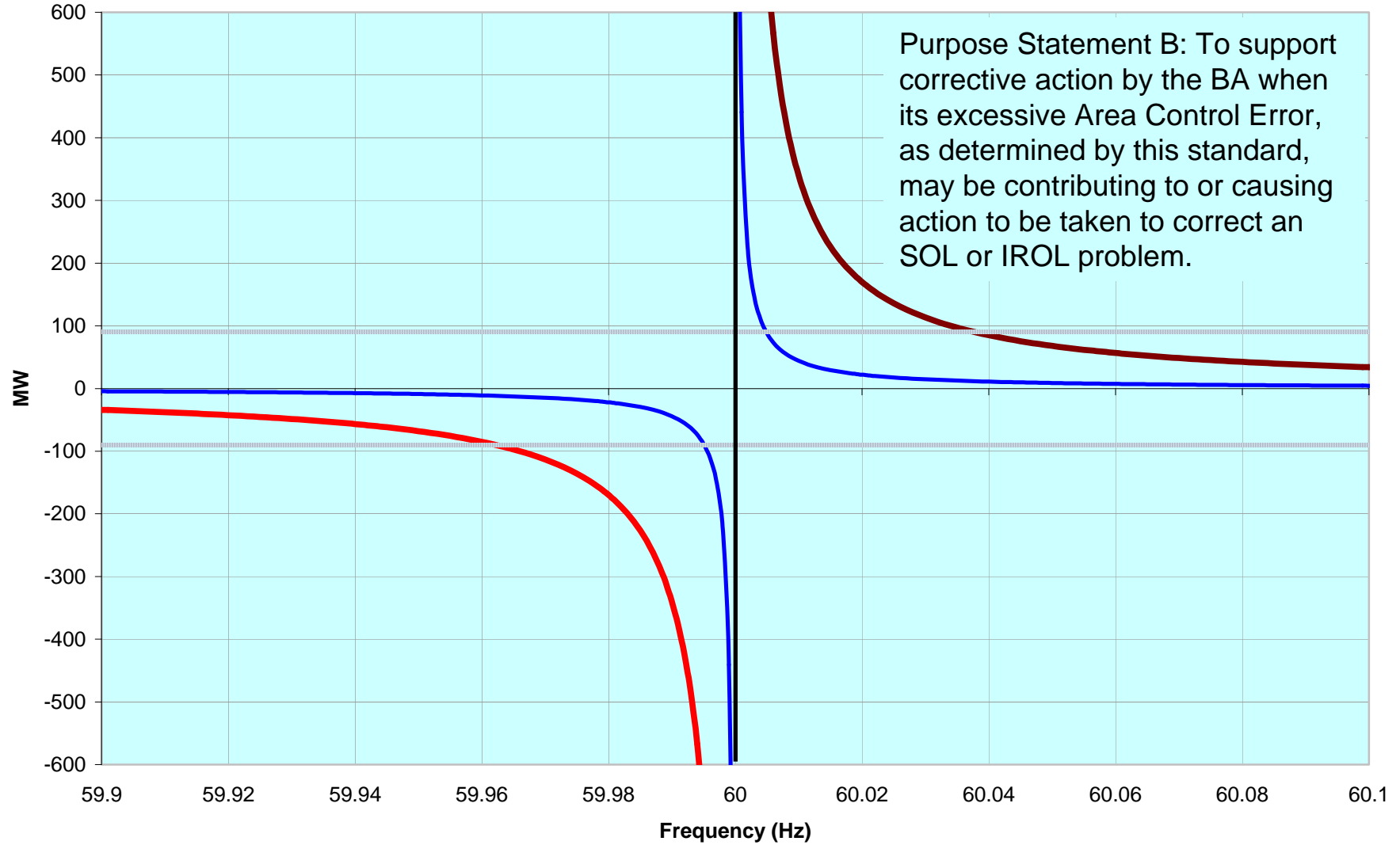
Reliability-Based Control

- During the SAR drafting phase, some comments were received indicating that the current method of developing frequency and ACE limits may not fully address significant dependent events such as credible major transmission events, and coincident operation such as pumped-storage utilization and market behavior.
- Questions for stakeholders:
 - 1. Do you support the RBCSDT researching further the concept of using dependent events as described above as the basis for supplementing or replacing the frequency trigger limits determined from the targeted research?
 - 2. The RBCSDT has discussed having each Interconnection define a specific reliability target and compare actual performance against the target on a periodic basis. Do you agree with this concept?
 - 3. The RBCSDT has discussed gathering data to analyze the performance of each Interconnection and using this data to evaluate and revise the frequency limits. Do you agree with this concept?

Purpose Statement B

BA -136 MW/0.1 Hz
Frequency Bias

CPS1 and BAAL



Purpose Statement B: To support corrective action by the BA when its excessive Area Control Error, as determined by this standard, may be contributing to or causing action to be taken to correct an SOL or IROL problem.

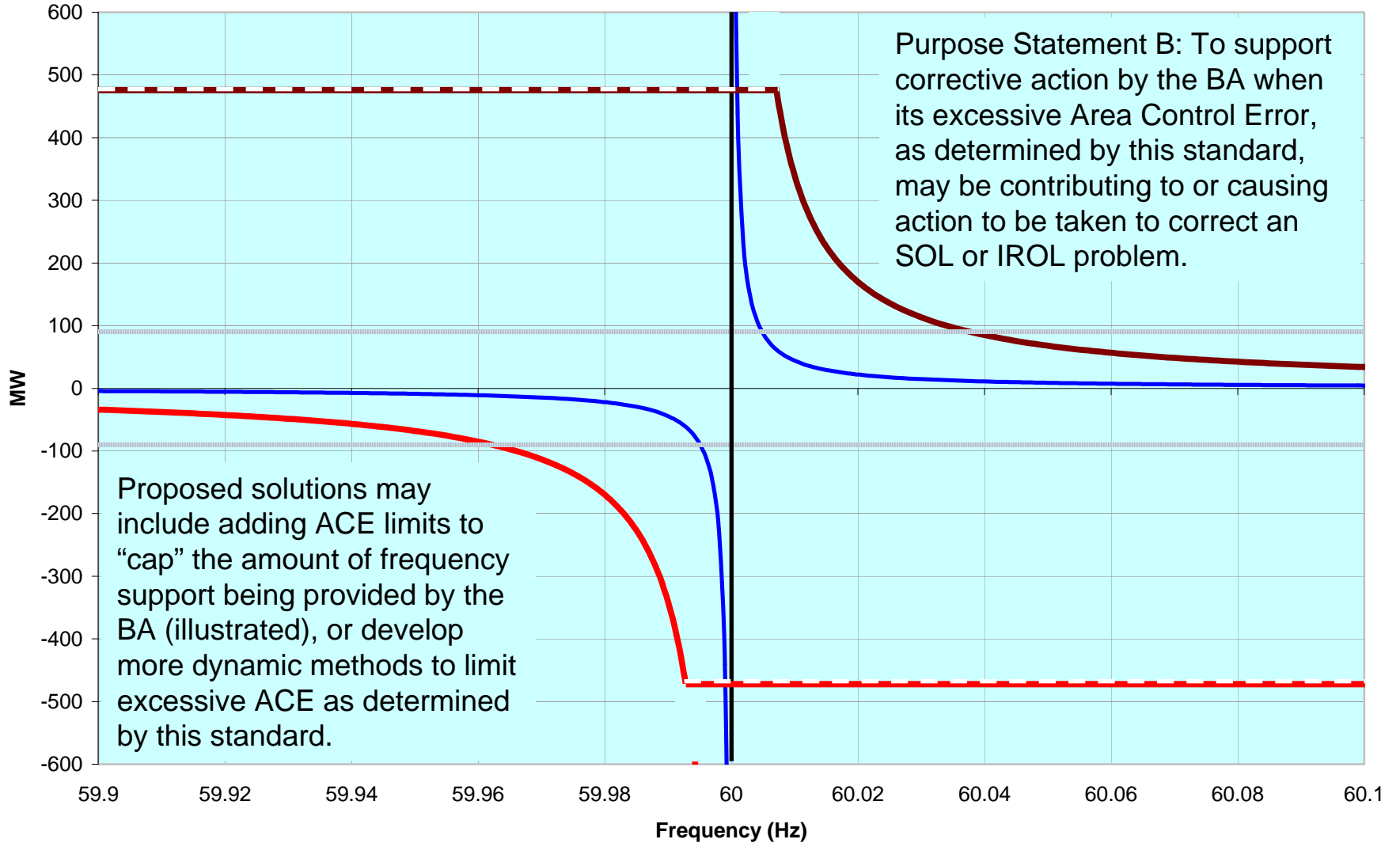
CPS2 L10 Limits
90.30 MW

BAAL_High BAAL_Low CPS1 Bound at 60 Hz SF L10

BA -136

MW/0.1 Hz
Frequency Bias

CPS1 and BAAL



CPS2 L10 Limits

90.30 MW



Project 2007-18

Reliability-Based Control

- Purpose Statement B: To support corrective action by the BA when its excessive Area Control Error, as determined by this standard, may be contributing to or causing action to be taken to correct an SOL or IROL problem.
- Proposed: Determination of a bound to “cap” ACE even when in support of Interconnection frequency.
- Metric Option 1 is a dynamic ACE limit (for both over-generation and under-generation) calculated in real time based on transmission sensitivity analysis.
- Metric Option 2 is a static ACE limit (for both over-generation and under-generation) based on prior transmission sensitivity analysis.
- (Please see background document for more information on the proposed metrics)

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Reliability-Based Control

Purpose Statement B: To support corrective action by the BA when its excessive Area Control Error, as determined by this standard, may be contributing to or causing action to be taken to correct an SOL or IROL problem.

Questions for stakeholders:

- Do you agree with the technical concepts of prospective metric 1? If not, please provide specific comments defining your objections and your proposed alternative.
- Do you agree with the technical concepts of prospective metric 2? If not, please provide specific comments defining your objections and your proposed alternative.

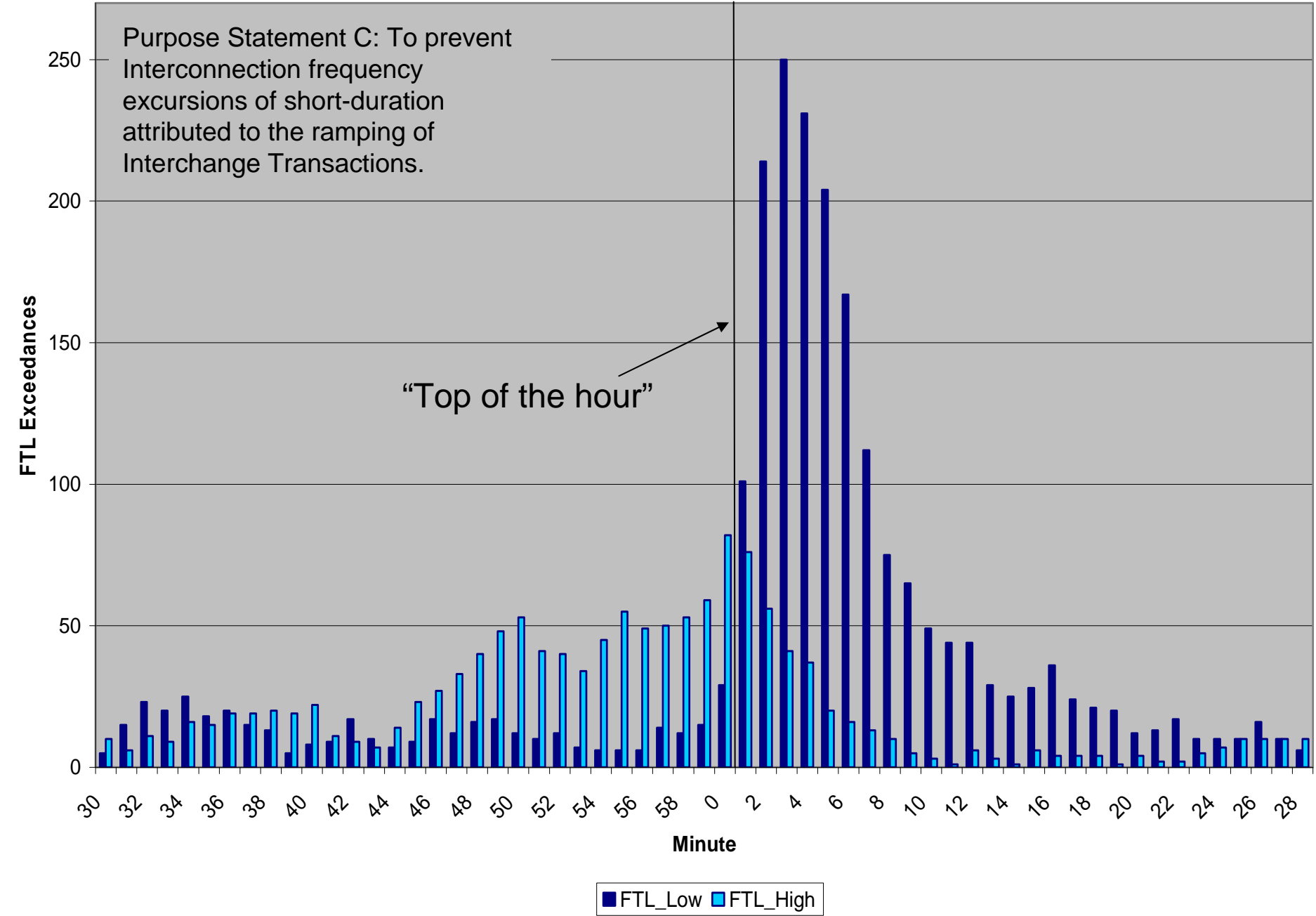
Project 2007-18

Reliability-Based Control

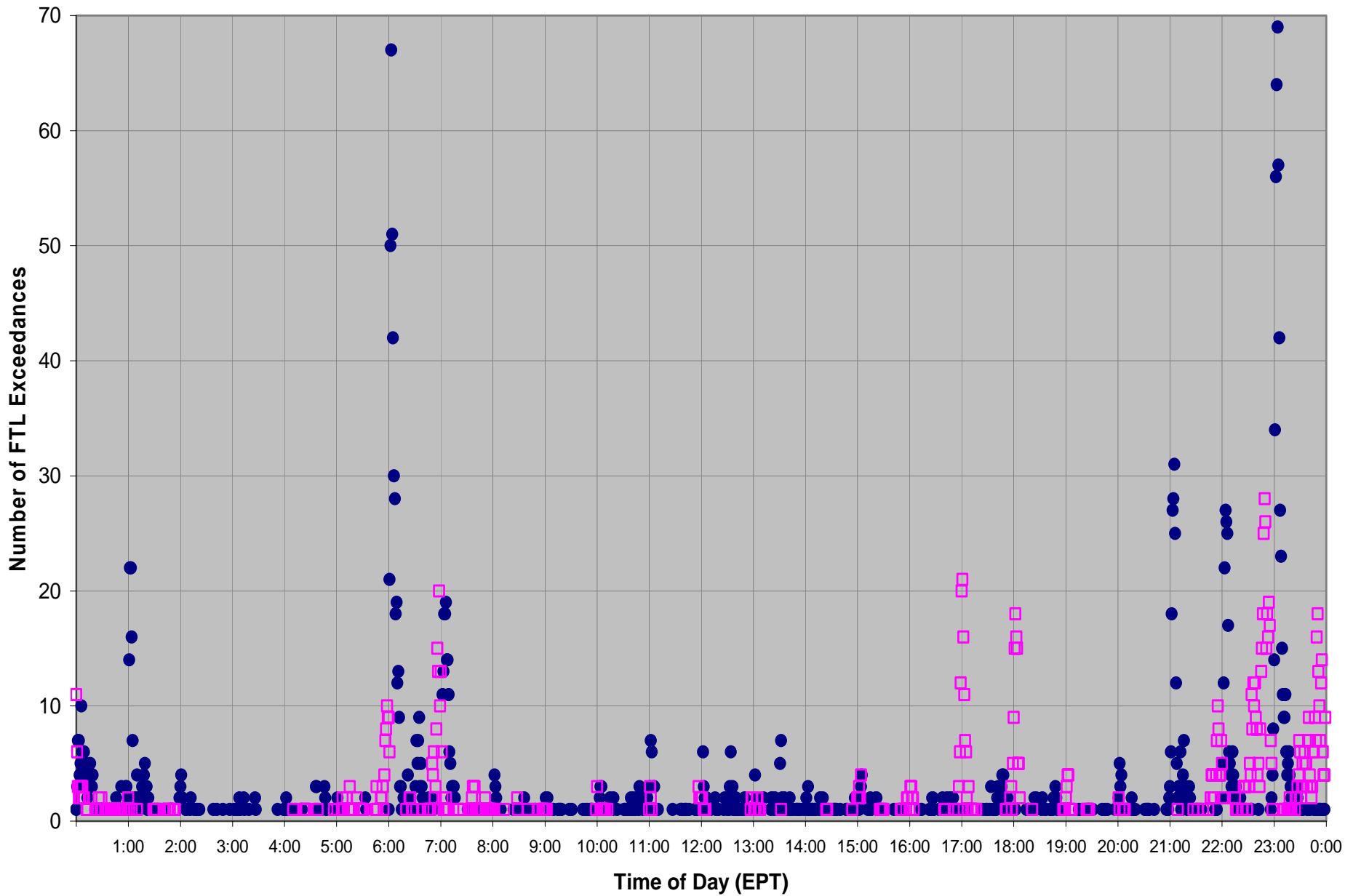
- Purpose Statement C: To prevent Interconnection frequency excursions of short-duration attributed to the ramping of Interchange Transactions.
- Over the course of reviewing frequency data from the Field Trial, the RBCSDT found that the predominant source of frequency excursions exceeding the Frequency Trigger Limit (FTL) of 59.95 Hz in the Eastern Interconnection was attributed to the inability of resources to adequately ramp to match the implementation of Interchange Transactions or coincident actions within the Interconnection.
- Such coincident actions would include implementation of pumped storage, on/off peak transition, load changes, intermittent resources and generation status changes.
- Imbalance across such short-duration excursions is not adequately addressed in the current CPS2 or the BAAL implemented under the Field Trial.

Purpose Statement C

Count of FTL Exceedances by Minute (Weekdays)



Count of Frequency Trigger Limit (FTL) Exceedances (Weekdays)



● FTL_Low □ FTL_High

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Reliability-Based Control

- Purpose Statement C: To prevent Interconnection frequency excursions of short-duration attributed to the ramping of Interchange Transactions.
- The RBCSDT has discussed alternate concepts for this metric and whether it should be based upon a fixed MW amount or based on a variable MW amount that is frequency dependent similar to CPS1. As this metric is to address performance over a short duration, the RBCSDT has some reservations using the CPS1 One Minute Averages as there are other factors to consider such as:
 - Differences between expected and actual frequency bias response
 - Duration may be too short for normal CPS1 control to be practical and effective

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Reliability-Based Control

- Purpose Statement C: To prevent Interconnection frequency excursions of short-duration attributed to the ramping of Interchange Transactions.
- Questions for stakeholders:
 - Would you agree that Purpose Statement C should be modified to reflect all contributing factors to short-duration frequency excursions including coincident actions rather than just ramping of Interchange Transactions only?
 - The proposed metric for Purpose Statement C would only apply during the time period where the clock minutes within the day chronically exhibit poor frequency performance. Do you agree that the proposed metric should only apply during the time period where the clock minutes within the day chronically exhibit poor frequency performance? If not, please provide specific comments on why you do not agree and an alternate basis for the metric.

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Reliability-Based Control

- Questions for stakeholders (cont):
 - The RBCSDT has discussed possible concepts for this metric and whether it should be based upon a fixed MW amount or based on a variable MW amount that is frequency dependent similar to CPS1. Do you agree that the RBCSDT should consider the development of a fixed MW bound and recognize the differences between expected and actual frequency response in the bounds determined? If not, please provide specific comments on why you do not agree and an alternative basis for the metric.
 - The RBCSDT has discussed whether the proposed metric should apply only to BA's. The questions arose on performance with respect to Interchange Transactions and associated coincident behavior and whether GOP's should have a metric to measure their performance against Interchange ramping. Do you agree that the Generator Operator should have a requirement applicable to meeting the ramping of Interchange Transactions? If not, please provide specific comments on why you do not agree and an alternative if applicable.

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- Purpose Statement D: To support timely congestion relief by requiring the Balancing Authority to employ corrective load/generation management within a defined timeframe when participating in transmission loading relief procedures.
- In the issuance of curtailments, a BA could be in an imbalance situation where no transmission relief is realized unless the BA takes action as source or sink. There is not a current standard that requires the BA to balance resources and demand after a transmission loading relief procedure has been implemented. Considerations in the proposed solutions would be the severity of the transmission issue, the firmness of the transactions, the magnitude of the imbalance, etc.

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- Purpose Statement D (cont.)
- For those entities in the Eastern Interconnection or Western Interconnection, the RBCSDT discussed using a metric similar to a DCS event for a transmission loading relief procedure implementation above a defined MW threshold with time for recovery based on the severity level and directives of the RC.
- The RBCSDT also discussed that, if the metrics proposed for Purpose Statement B are effective in addressing more localized constraint relief, the need for a separate metric to address transmission loading relief specifically may not be necessary.

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Reliability-Based Control

- Purpose Statement D (cont.)
- Question for stakeholders:
 - Do you support the RBCSDT deferring metric work for Purpose Statement D until work has been completed on the metric for Purpose Statement B? If not, please provide specific input on a possible metric to address Purpose Statement D?

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Reliability-Based Control

Meeting Dates:

Chicago

- Monday, October 6th — 1 to 5 p.m.,
- Tuesday, October 7th — 8 a.m. to 5 p.m.,
- Wednesday, October 8th — 8 a.m. to 5 p.m., and
- Thursday, October 9th — 8 a.m. to noon

San Antonio

- Monday, October 27th — noon to 5 p.m.,
- Tuesday, October 28th — 8 a.m. to 5 p.m., and
- Wednesday, October 29th — meet with Resources Subcommittee

Next Steps:

The RBCSDT is gathering information to draft the first set of proposals in NERC Standard format and post them for comment. The responses to the current posting will help guide the team on the content of the first drafts that could be posted as early as November 2008.

Reliability-based Control (Project 2007-18) - Microsoft Internet Explorer provided by Duke Energy

Address: http://www.nerc.com/filez/standards/Reliability-Based_Control_Project_2007-18.html

- To prevent Interconnection frequency excursions of short duration attributed to the ramping of on and off-peak Interchange Transactions
- To support timely transmission congestion relief by requiring corrective load/generation management by the Balancing Authority(ies) within a defined timeframe when participating in transmission loading relief procedures.
- To address the directives of FERC Order 693,
- To ensure that when finalized the standards associated with this project conform to the latest versions of NERC's Reliability Standards Development Procedure, the Sanction Guidelines of the North American Electric Reliability Corporation, and the ERO Rules of Procedure.

Additionally, the frequency model used to establish the frequency-based limits will be reviewed to see if additional enhancements are necessary.

Proposed Standard	Supporting Materials	Comment Period	Comments Received	Response to Comments
Announcement Reliability-based Control Proposed Metrics Posted for 30-day Comment Period	Frequency Response Reference Document Field Test Results Metrics Background	08/29/08 - 09/29/08 Electronic Comment Form Comment Form in Word Format		
Announcement Nominations Requested for Reliability-based Control Standard Drafting Team		11/09/07 - 11/28/07 (closed) Nomination		
Draft 3 SAR for Reliability-based Control Draft SAR Version 3 Clean Redline	Project 2007-18 — Reliability-Based Control Issues Raised by Industry to be Considered by the Standard Drafting Team			
Announcement				

http://www.nerc.com/filez/standards/Reliability-Based_Control_Project_2007-18.html

This page is accessed by going to the NERC Website and selecting:

- Standards, then
- Standards Under Development, then
- Project 2007-18 Reliability-based Control

http://www.nerc.com/docs/standards/sar/Background_for_RBC_Metrics_Comment_Form.pdf - Microsoft Internet Explorer provided by Du

Address http://www.nerc.com/docs/standards/sar/Background_for_RBC_Metrics_Comment_Form.pdf

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Reliability-based Control Standard Drafting Team's Proposed Metrics

The Reliability-based Control Standard Drafting Team is developing proposed metrics and standards based on the purpose statements contained in the SAR for Project 2007-18. The team is using a comment form to gather feedback regarding the proposed metrics or solutions for the purpose statements A, B, C, and D contained within the SAR. Please review the information that follows and answer the related questions on the posted comment form.

Purpose Statement A of the approved SAR: To maintain Interconnection frequency within predefined frequency limits under all conditions (i.e., normal and abnormal), to manage frequency-related issues such as frequency oscillations, instability, and unplanned tripping of load, generation or transmission, that adversely impact the reliability of the Interconnection. (Work brought into this SAR from Draft BAL-007 though BAL-011)

Prior work on BAL-007 through BAL-011 defined a method of developing frequency and ACE limits, based on outage statistics and relay settings, and intended to limit the rate of activation of frequency sensitive relays to a targeted bound. Under the proposed standard, Reliability Coordinators (RCs) may incur violations when the frequency of their Interconnection continuously exceeds any of these frequency limits for longer than the associated time limits specified by the proposed standard. Balancing Authorities (BAs) may incur violations when their Area Control Error (ACE) exceeds a variable frequency-based ACE limit continuously for longer than T_v , a time limit specified by the standard. The [Field Trial of BAL-007](#) in the Eastern Interconnection is currently using a time limit of 30 consecutive clock-minutes.

During the SAR drafting phase, some comments were received indicating that the current method of developing frequency and ACE limits does not fully address significant dependent events such as credible

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Discussion

to ensure
the reliability of the
bulk power system

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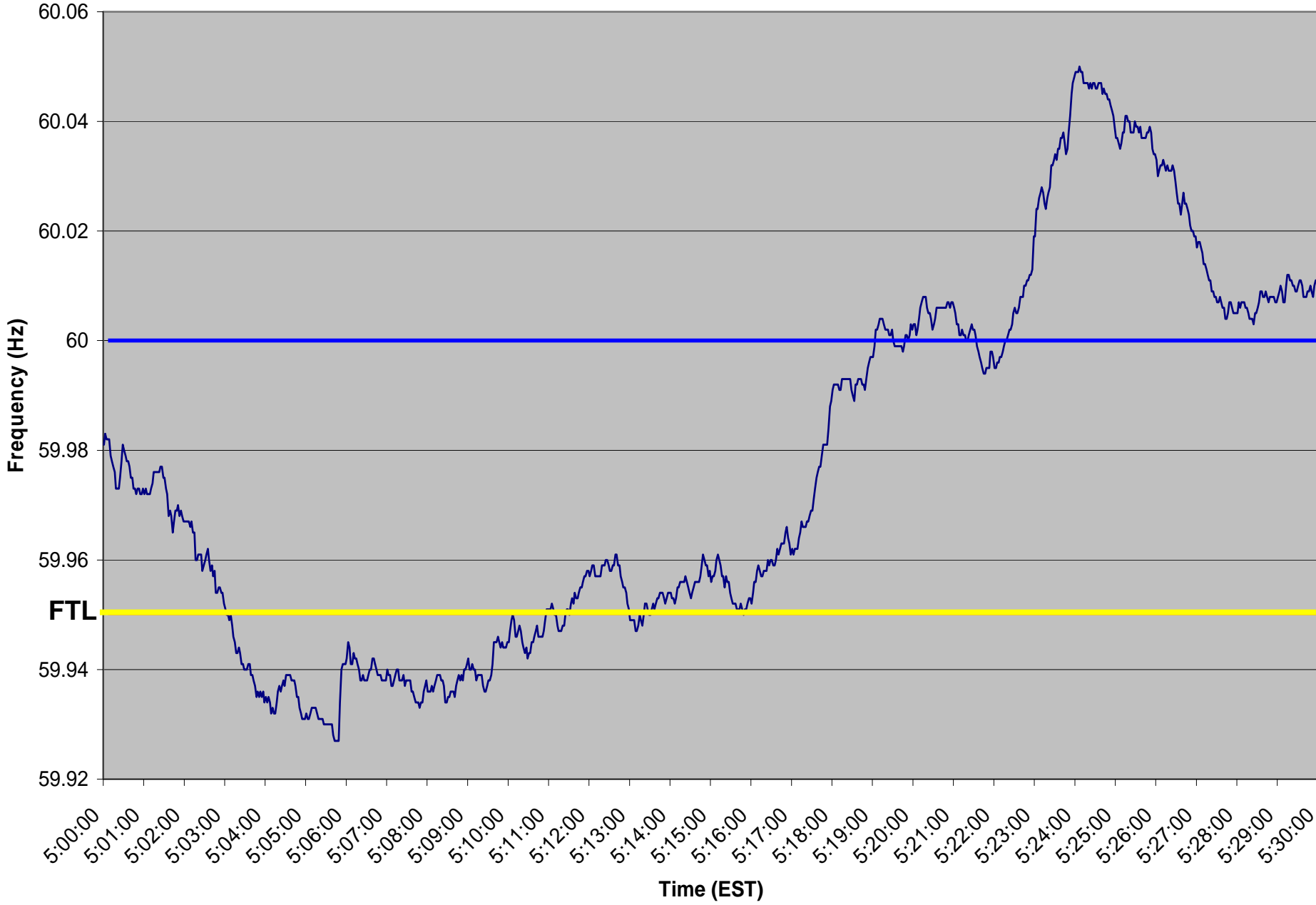
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Tools Development

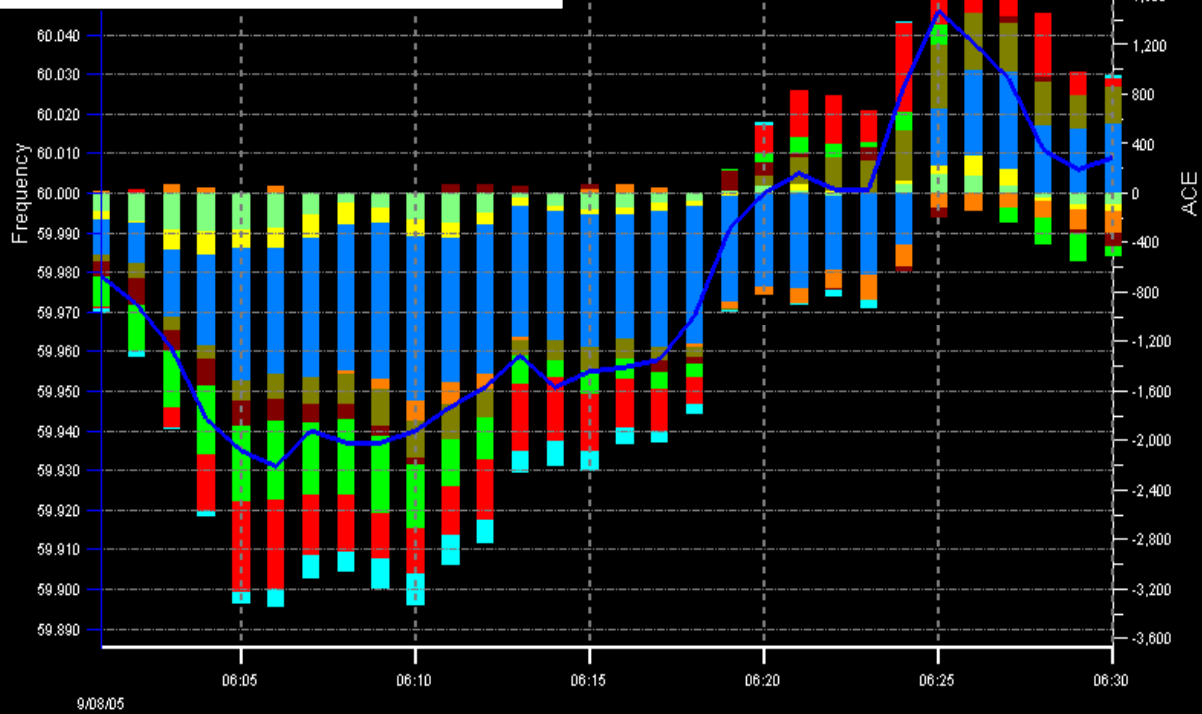
to ensure
the reliability of the
bulk power system

Frequency 9/8/05

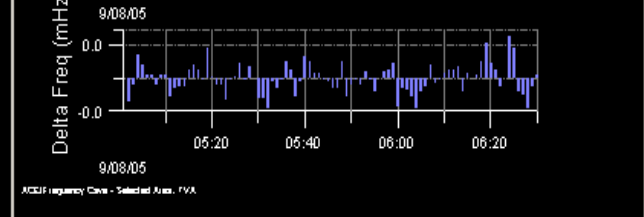
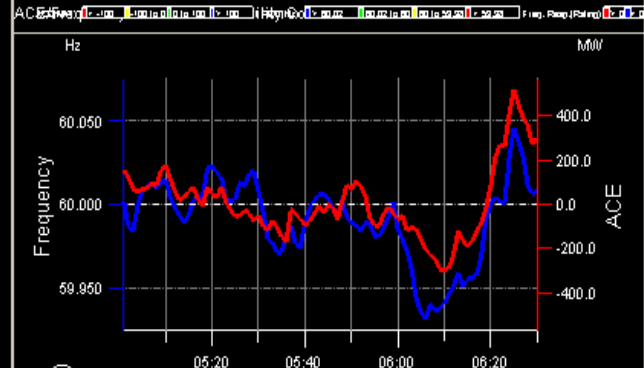
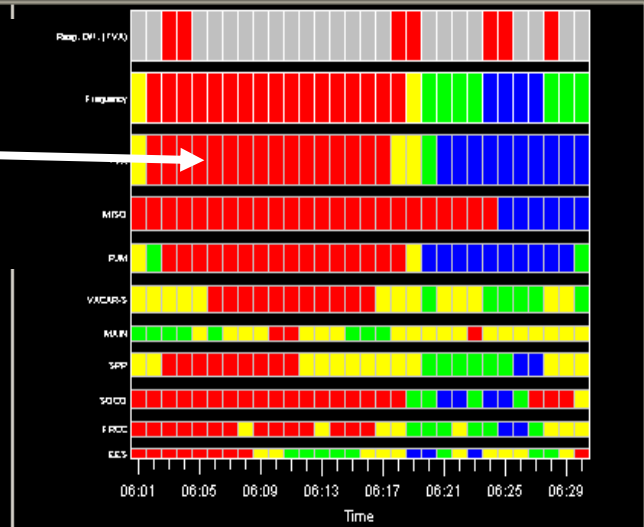


The ACE-Frequency Monitoring Tool used by the Reliability Coordinators has the capability to identify the RC regions impacting frequency and “drill down” to the performance of the BAs within the RC region.

This area indicates that the problem was spread across multiple RC regions



Frequency(Hz) vs. Net ACE(Mw)
 One-Minute Data Increments (0.1Hz/3200Mw) Selected Jurisdiction: FRCC, SPP, MISO, MAIN, TVA, EES, SOCO, PJM, VACAR-S



Date/Time 09/08/2005 6:30 AM
 Auto Refresh
 Jurisdiction ACE-Frequency 1/2
 Hour 1-Min ACE/Freq Bar-Chart
Interc. Missing ACE MW
E: 10 Q: -134 W: 37

Interconnection	Date_Time	Frequency	Freq_Delta	Expected_ACE	Actual_Net_ACE	Missing_ACE	Missing_ACE_Perc
E	09/08/2005 06:30	60.009	0.003	604.3	594.1	10.2	2
Q	09/08/2005 06:30	59.982	-0.018	-106.6	27.4	-134.1	126
W	09/08/2005 06:30	59.994	0	-120.2	-157	36.9	-31

Navigation icons: Home, Back, Forward, Stop, Refresh, Print, etc.

View Angle 55.

ACE-FREQ MONITORING
 © Electric Power Group, LLC 2005

Tools Development

Balancing Authority ACE Limit RADAR

CIN 3/10/08 14:04

60.00 Hz Scheduled Frequency

BIAS -136.00 MW / 0.1 Hz

Number of BAAL Exceedances in last 30 minutes = 0

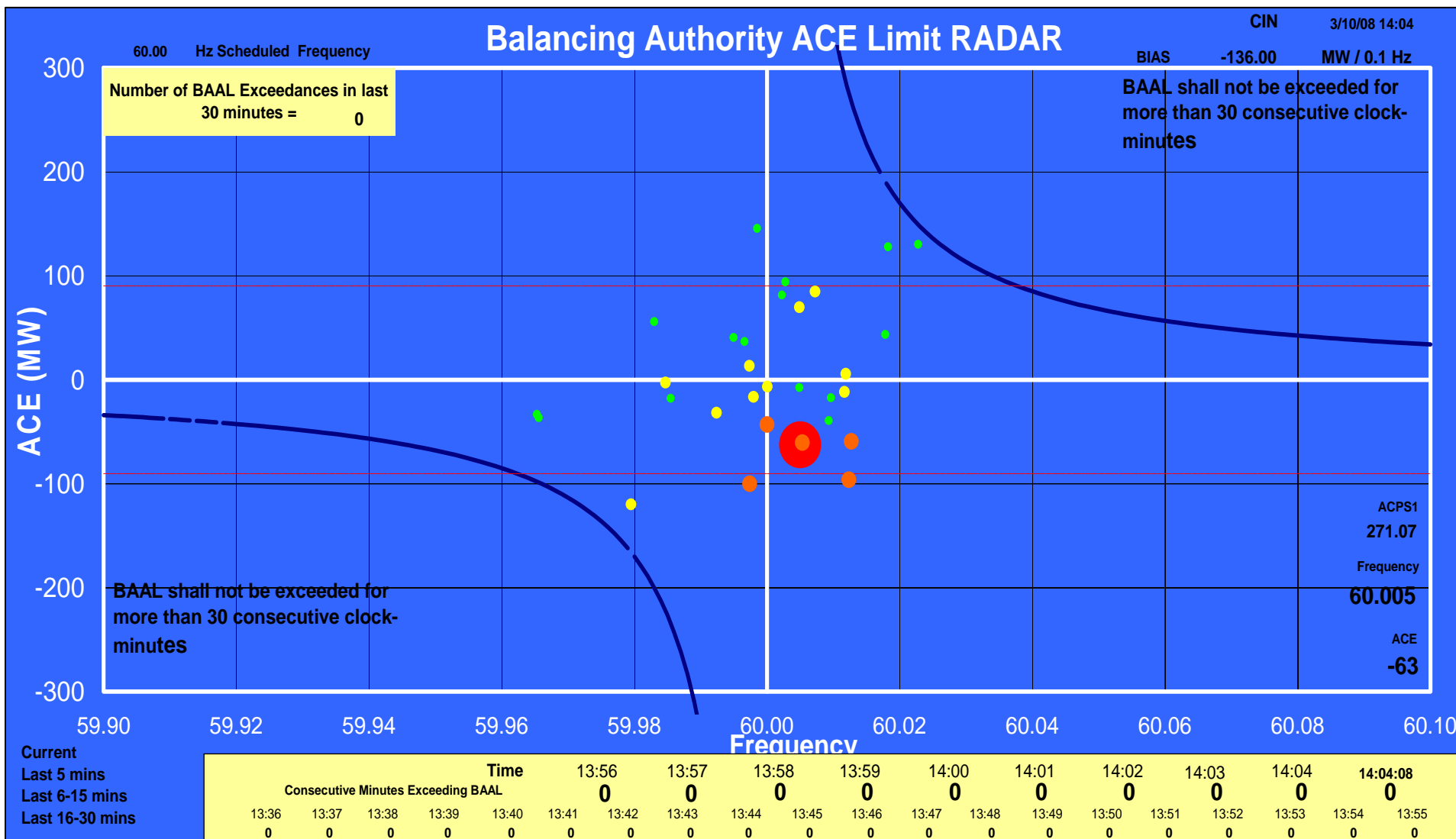
BAAL shall not be exceeded for more than 30 consecutive clock-minutes

BAAL shall not be exceeded for more than 30 consecutive clock-minutes

ACPS1
271.07

Frequency
60.005

ACE
-63



Balancing Authorities under the Field Trial have developed tools to monitor compliance to BAAL. This tool pulls in data from a "PI" data system and displays the BAAL boundaries along with clock-minute ACE plotted against clock-minute Actual Frequency, in addition to displaying the number of consecutive clock-minutes that ACE is outside the applicable BAAL bound.

Tools Development

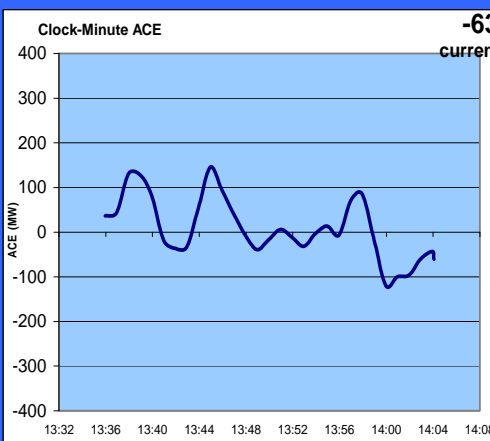
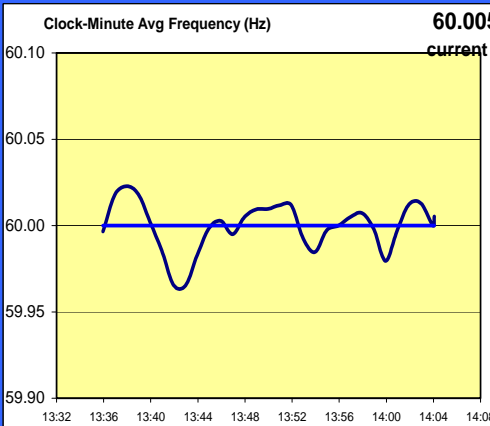
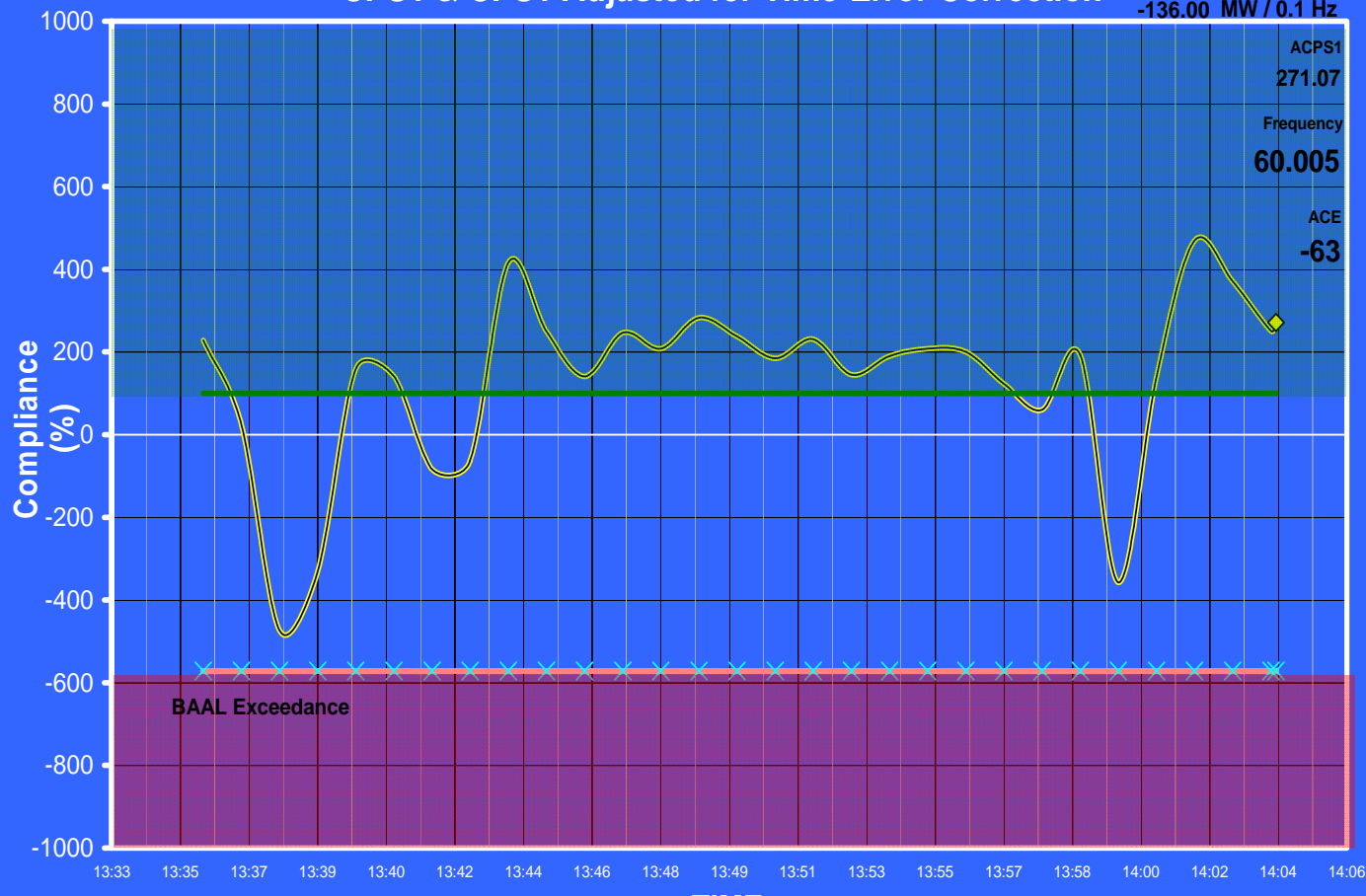
<http://www.midwestiso.org/page/LMP+Contour+Map+%26+Data>

CIN 3/10/08 14:04

-136.00 MW / 0.1 Hz

CPS1 & CPS1 Adjusted for Time-Error Correction

ACPS1
271.07
Frequency
60.005
ACE
-63



Note: During Time-Error Correction the compliance will be different than the CPS1 curve. BAAL is exceeded when the yellow curve drops below the BAAL line at -571.6% ACPS1

Time		13:56	13:57	13:58	13:59	14:00	14:01	14:02	14:03	14:04	14:04:08								
Consecutive Minutes Exceeding BAAL		0	0	0	0	0	0	0	0	0	0								
13:36	13:37	13:38	13:39	13:40	13:41	13:42	13:43	13:44	13:45	13:46	13:47	13:48	13:49	13:50	13:51	13:52	13:53	13:54	13:55
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

This tool pulls in data from a "PI" data system and displays CPS1 (dark line) and an adjusted CPS1 calculation for time-error corrections (yellow). When scheduled frequency equals 60 Hz, both curves are the same and exceeding the BAAL is equivalent to a CPS1 compliance of approximately -571.6%. The counter at the bottom displays the number of consecutive clock-minutes the adjusted CPS1 is worse than -571.6%. (Based upon FTL at 59.95 Hz and 60.05 Hz.)