

Balancing Authority ACE Limit Proof-of-Concept Field Trial

Update Discussion
January 25, 2010

Doug Hils – Duke Energy

Reliability-Based Control Standard Drafting Team

Balancing Authority ACE Limit Proof-of-Concept Field Trial

December 2009 Eastern Interconnection Field Trial Participation

Participation reflects approximately 67% of the projected 2009 peak load for the Eastern Interconnection

Balancing Authority Participants	2009 Frequency Bias	Region	Reliability Coordinator	Start Date
American Electric Power (CSW)	-102.3	SPP	SPP	September 1, 2005
Duke Energy Carolinas (DUK)	-201.0	SERC	VACS	April 1, 2009
East Kentucky Power Cooperative (EKPC)	-37.9	SERC	TVA	July 6, 2005
Entergy (EES)	-223.3	SERC	ICTE	July 6, 2005
EON-US (LGEE)	-72.0	SERC	TVA	April 1, 2008
Independent Electricity System Operator (IESO)	-285.0	NPCC	IESO	March 1, 2008
Manitoba Hydro (MHEB)	-44.9	MRO	MISO	July 6, 2005
Midwest Independent Transmission System Operator (MISO)	-1106.0	MRO, RFC, SERC	MISO	January 6, 2009
PJM Interconnection (PJM)	-1344.0	RFC	PJM	August 1, 2005
Santee Cooper (SC)	-79.6	SERC	VACS	March 1, 2006
Southern Company (SOCO)	-465.0	SERC	SOCO	October 15, 2005
Tennessee Valley Authority (TVA)	-319.2	SERC	TVA	October 1, 2005

* Upon entry of the Midwest ISO into the Field Trial on January 6, 2009, the ALTE, ALTW, CIN, MECS, NIPS and WEC Balancing Authorities ceased operating under the Field Trial as their areas are now included within the MISO Balancing Authority Area. The six Balancing Authorities started operating under in the Field Trial between July and September of 2005.

Balancing Authority ACE Limit Proof-of-Concept Field Trial

The Balancing Authority ACE Limit (BAAL) shall not be exceeded for more than 30 consecutive clock-minutes*

	Longest exceedance of the Balancing Authority ACE Limit since starting operation under the Field Trial		December 2009 Performance under BAL-007	
	Max MinCtLow	Max MinCtHigh	Max MinCtLow	Max MinCtHigh
BA01	26	16	5	4
BA02	12	17	9	11
BA03	19	18	14	9
BA04	10	20	5	7
BA05	16	22	8	9
BA06	15	23	5	5
BA07	20	24	12	7
BA08	28	26	13	14
BA09	17	26	12	10
BA10	14	32	8	4
BA11	27	40	19	12
BA12	28	43	8	10

MinCtLow = Count of consecutive clock-minutes BAAL_Low was exceeded

MinCtHigh = Count of consecutive clock-minutes BAAL_High was exceeded

*BAAL being exceeded for more than 30 consecutive clock-minutes would be a violation under the proposed BAL-007 standard.

Clock-Minutes of Actual Frequency <= FTL_Low (59.95 Hz)												
Year	Month	>=1 Min	>=2 Min	>=3 Min	>=4 Min	>=5 Min	>=6 Min	>=7 Min	>=8 Min	>=9 Min	>=10 Min	Max_Duration
2005	7	32	14	7	3	2						5
2005	8	56	36	20	12	8	2	1	1	1	1	10
2005	9	33	20	9	4	2	1	1	1			8
2005	10	43	21	12	5	2	2	1	1	1	1	11
2005	11	58	26	14	5	4	1					6
2005	12	41	18	5	4	2	2	1				7
2006	1	43	20	7	2	2	1					6
2006	2	39	17	4	2	1	1					6
2006	3	50	23	4	2							4
2006	4	58	30	10	5	2						5
2006	5	54	30	15	10	4	4	1	1			8
2006	6	41	22	11	4	1						5
2006	7	34	18	9	4	2	1	1	1	1		9
2006	8	49	26	15	8	3						5
2006	9	39	21	11	4	3	1					6
2006	10	51	29	9	9	2	1					6
2006	11	47	22	10	8	4						5
2006	12	34	14	3	1							4
2007	1	44	21	10	7	3	2	1				7
2007	2	33	13	2								3
2007	3	76	39	18	10	3	2	2	1	1	1	15*
2007	4	45	18	7	4	3						5
2007	5	64	32	10	7	3						5
2007	6	47	24	12	6	2	1					6
2007	7	33	19	8	4	2	1					6
2007	8	31	16	9	3	2	1					6
2007	9	41	27	12	6	4	2	2	1			8
2007	10	73	25	15	8	1						5
2007	11	60	23	10	2							4
2007	12	38	13	4	2	1	1					6
2008	1	34	21	11	4	2	1	1	1			8
2008	2	46	27	8	4	1	1	1	1			8
2008	3	55	27	10	7	2	1					6
2008	4	60	28	11	4	3						5
2008	5	63	31	9	3							4
2008	6	34	16	6	4	1						5
2008	7	29	17	9	1	1	1	1				7
2008	8	35	18	5	1	1						5
2008	9	39	20	9	1							4
2008	10	38	18	8	3	1						5
2008	11	13	5	2	1	1						5
2008	12	35	11	3	1							4
2009	1	16	7	3	2							4
2009	2	18	10	5	1							4
2009	3	23	10	4	2	2						5
2009	4	37	14	5	2	1						5
2009	5	31	9	2	1							4
2009	6	28	19	8	2	1						5
2009	7	22	12	2								3
2009	8	20	6									2
2009	9	21	10	2								3
2009	10	44	24	12	5	2	2					6
2009	11	33	12	4								3
2009	12	20	9	3	1	1						5
SUM		2181	1055	433	198	88	33	14	9	4	3	

This chart lists the number of times that the duration of the FTL_{Low} exceedance was greater than or equal to 1 minute, 2 minutes, 3 minutes and so on, with the maximum duration for the month noted in the right column. *The 15-minute duration in March 2007 was for the Monday morning after the change to the new Daylight Saving Time.

Clock-Minutes of Actual Frequency <= FTL_Low (59.95 Hz) and 60 Hz Scheduled Frequency

Year	Month	>=1 Min	>=2 Min	>=3 Min	>=4 Min	>=5 Min	>=6 Min	>=7 Min	>=8 Min	>=9 Min	>=10 Min	Max_Duration
2005	7	16	8	4	1	1						5
2005	8	39	23	13	9	6	1					6
2005	9	16	9	6	3	2	1	1	1			8
2005	10	22	10	5	2	2	2	1	1	1	1	11
2005	11	26	10	4	1	1	1					6
2005	12	23	8	2	1	1	1					6
2006	1	21	7	2	1	1	1					6
2006	2	39	17	4	2	1	1					6
2006	3	33	15	2	1							4
2006	4	46	25	9	4	2						5
2006	5	33	19	8	5	1	1					6
2006	6	19	9	5	1							4
2006	7	22	11	6	1							4
2006	8	38	22	14	8	3						5
2006	9	30	17	8	2	2	1					6
2006	10	24	14	2	2							4
2006	11	19	8	4	3	1						5
2006	12	10	5	2	1							4
2007	1	14	7	3	2	1	1	1				7
2007	2	22	8	1								3
2007	3	41	17	7	6	2	1	1	1	1	1	15*
2007	4	21	10	4	3	3						5
2007	5	26	10	4	4	2						5
2007	6	18	10	2								3
2007	7	12	5	2	1							4
2007	8	9	6	5	2	2	1					6
2007	9	28	22	10	6	4	2	2	1			8
2007	10	33	14	11	6	1						5
2007	11	14	5	2								3
2007	12	14	5	1	1	1	1					6
2008	1	34	21	11	4	2	1	1	1			8
2008	2	39	21	5	2	1	1	1	1			8
2008	3	38	19	4	3	1						5
2008	4	38	16	6	3	2						5
2008	5	23	12	3	1							4
2008	6	13	6	1	1							4
2008	7	10	5	2								3
2008	8	13	5	1								3
2008	9	25	11	7	1							4
2008	10	19	9	3	2							4
2008	11	6	2	1								3
2008	12	23	7	3	1							4
2009	1	15	6	3	2							4
2009	2	18	10	5	1							4
2009	3	23	10	4	2	2						5
2009	4	37	14	5	2	1						5
2009	5	25	7	2	1							4
2009	6	17	8	3								3
2009	7	14	7	1								3
2009	8	8	2									2
2009	9	13	8	1								3
2009	10	22	12	6	3	1	1					6
2009	11	14	4	1								3
2009	12	12	6	3	1	1						5
SUM		1227	584	233	109	51	19	8	6	2	2	

This chart lists the number of times that the duration of the FTL_{Low} exceedance was greater than or equal to 1 minute, 2 minutes, 3 minutes and so on, when Scheduled Frequency = 60 Hz, with the maximum duration for the month noted in the right column. *The 15-minute duration in March 2007 was for the Monday morning after the change to the new Daylight Saving Time.

Clock-Minutes of Actual Frequency >= FTL_High (60.05 Hz)												
Year	Month	>=1 Min	>=2 Min	>=3 Min	>=4 Min	>=5 Min	>=6 Min	>=7 Min	>=8 Min	>=9 Min	>=10 Min	Max_Duration
2005	7	11	4	1								3
2005	8	21	7	4	2	1						5
2005	9	21	9	3	2	2	1	1				7
2005	10	23	6	2	1	1						5
2005	11	22	7	4	1	1	1	1				7
2005	12	19	6	2								3
2006	1	27	15	11	6	2						5
2006	2	24	10	7	5							4
2006	3	33	12	4	2	1	1	1	1			8
2006	4	46	22	3	1	1	1	1	1			8
2006	5	39	20	9	4	1						5
2006	6	24	10	7	4	4	3	3	2	1	1	10
2006	7	29	11	8	2							4
2006	8	26	13	10	5	1	1	1	1			8
2006	9	33	14	4	2							4
2006	10	28	14	4	3	2	1	1	1			8
2006	11	22	11	4								3
2006	12	29	12	7	3	2	1					6
2007	1	31	14	5	2	1	1	1				7
2007	2	21	13	4	1							4
2007	3	38	21	10	4	2	1	1	1			8
2007	4	31	15	8	4							4
2007	5	49	20	11	7	4	4	1				7
2007	6	25	14	7	2	1	1	1				7
2007	7	20	12	8	2							4
2007	8	32	14	7	3	2						5
2007	9	16	6	4	2	1						5
2007	10	36	16	4	1	1						5
2007	11	24	7	5	2	1						5
2007	12	38	16	7	2							4
2008	1	24	16	8	1							4
2008	2	24	11	6	3	3	2	1	1			8
2008	3	34	6									2
2008	4	33	12	8	3	3	1					6
2008	5	20	10	6	4	1						5
2008	6	19	10	3	2	1						5
2008	7	12	4	1								3
2008	8	17	6	3	1	1	1					6
2008	9	21	11	6	5	3	3	3	3	2	1	11
2008	10	19	7	1								3
2008	11	9	2	1	1							4
2008	12	8	2	1								3
2009	1	9	6	4								3
2009	2	11	3	1	1	1	1					6
2009	3	11	4	3	2	1	1	1	1	1		9
2009	4	20	6	1								3
2009	5	15	4	2	2	1	1	1	1			8
2009	6	16	8	1								3
2009	7	16	7	2	1	1	1					6
2009	8	10	3									2
2009	9	14	4	1	1							4
2009	10	10	5	3								3
2009	11	21	8	4	1							4
2009	12	15	5	2								3
SUM		1246	531	242	103	48	28	19	13	4	2	

This chart lists the number of times that the duration of the FTL_{HIGH} exceedance was greater than or equal to 1 minute, 2 minutes, 3 minutes and so on, with the maximum duration for the month noted in the right column.

Frequency Statistics

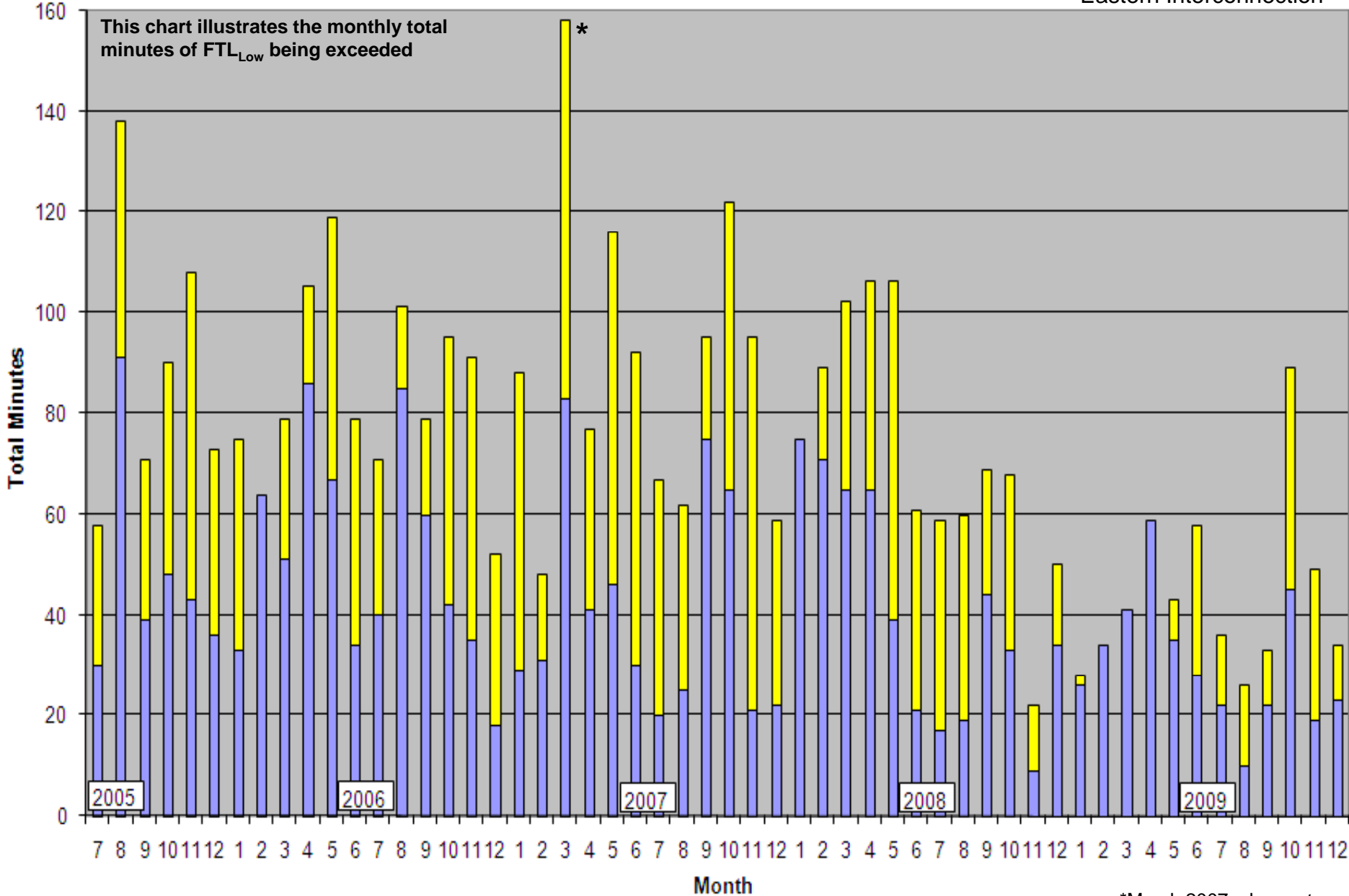
Eastern Interconnection

Year	Month	Total Minutes FTL_Low at 59.98 Hz SF	Total Minutes FTL_Low at 60 Hz SF	Total FTL_Low Minutes	Percentage Low During TEC	FTL_Low Events	FTL_Low Max Duration	Total Minutes FTL_High at 60.02 Hz SF	Total Minutes FTL_High at 60 Hz SF	Total FTL_High Minutes	Percentage High During TEC	FTL_High Events	FTL_High Max Duration	Total FTL_Low and FTL_High Minutes at 60 Hz SF	Total FTL_Low and FTL_High Minutes
2005	7	28	30	58	48.28%	32	5	0	16	16	0.00%	11	3	46	74
2005	8	47	91	138	34.06%	56	10	0	35	35	0.00%	21	5	126	173
2005	9	32	39	71	45.07%	33	8	0	39	39	0.00%	21	7	78	110
2005	10	42	48	90	46.67%	43	11	0	33	33	0.00%	23	5	81	123
2005	11	65	43	108	60.19%	58	6	0	35	35	0.00%	22	7	78	143
2005	12	37	36	73	50.68%	41	7	0	27	27	0.00%	19	3	63	100
2006	1	42	33	75	56.00%	43	6	0	61	61	0.00%	27	5	94	136
2006	2	0	64	64	0.00%	39	6	2	43	45	4.44%	24	4	107	109
2006	3	28	51	79	35.44%	50	4	17	37	54	31.48%	33	8	88	133
2006	4	19	86	105	18.10%	58	5	0	76	76	0.00%	46	8	162	181
2006	5	52	67	119	43.70%	54	8	0	72	72	0.00%	39	5	139	191
2006	6	45	34	79	56.96%	41	5	0	59	59	0.00%	24	10	93	138
2006	7	31	40	71	43.66%	34	9	0	50	50	0.00%	29	4	90	121
2006	8	16	85	101	15.84%	49	5	0	58	58	0.00%	26	8	143	159
2006	9	19	60	79	24.05%	39	6	0	53	53	0.00%	33	4	113	132
2006	10	53	42	95	55.79%	51	6	0	54	54	0.00%	28	8	96	149
2006	11	56	35	91	61.54%	47	5	1	36	37	2.70%	22	3	71	128
2006	12	34	18	52	65.38%	34	4	0	54	54	0.00%	29	6	72	106
2007	1	59	29	88	67.05%	44	7	0	55	55	0.00%	31	7	84	143
2007	2	17	31	48	35.42%	33	3	0	39	39	0.00%	21	4	70	87
2007	3	75	83	158	47.47%	76	15	0	78	78	0.00%	38	8	161	236
2007	4	36	41	77	46.75%	45	5	0	58	58	0.00%	31	4	99	135
2007	5	70	46	116	60.34%	64	5	0	95	95	0.00%	49	7	141	211
2007	6	62	30	92	67.39%	47	6	0	51	51	0.00%	25	7	81	143
2007	7	47	20	67	70.15%	33	6	0	39	39	0.00%	20	4	59	106
2007	8	37	25	62	59.68%	31	6	1	55	56	1.79%	32	5	80	118
2007	9	20	75	95	21.05%	41	8	0	27	27	0.00%	16	5	102	122
2007	10	57	65	122	46.72%	73	5	1	56	57	1.75%	36	5	121	179
2007	11	74	21	95	77.89%	60	4	0	34	34	0.00%	24	5	55	129
2007	12	37	22	59	62.71%	38	6	0	61	61	0.00%	38	4	83	120
2008	1	0	75	75	0.00%	34	8	0	48	48	0.00%	24	4	123	123
2008	2	18	71	89	20.22%	46	8	0	51	51	0.00%	24	8	122	140
2008	3	37	65	102	36.27%	55	6	0	40	40	0.00%	34	2	105	142
2008	4	41	65	106	38.68%	60	5	0	59	59	0.00%	33	6	124	165
2008	5	67	39	106	63.21%	63	4	0	40	40	0.00%	20	5	79	146
2008	6	40	21	61	65.57%	34	5	0	35	35	0.00%	19	5	56	96
2008	7	42	17	59	71.19%	29	7	0	17	17	0.00%	12	3	34	76
2008	8	41	19	60	68.33%	35	5	0	29	29	0.00%	17	6	48	89
2008	9	25	44	69	36.23%	39	4	0	55	55	0.00%	21	11	99	124
2008	10	35	33	68	51.47%	38	5	0	27	27	0.00%	19	3	60	95
2008	11	13	9	22	59.09%	13	5	0	13	13	0.00%	9	4	22	35
2008	12	16	34	50	32.00%	35	4	0	11	11	0.00%	8	3	45	61
2009	1	2	26	28	7.14%	16	4	0	19	19	0.00%	9	3	45	47
2009	2	0	34	34	0.00%	18	4	0	18	18	0.00%	11	6	52	52
2009	3	0	41	41	0.00%	23	5	0	25	25	0.00%	11	9	66	66
2009	4	0	59	59	0.00%	37	5	0	27	27	0.00%	20	3	86	86
2009	5	8	35	43	18.60%	31	4	0	27	27	0.00%	15	8	62	70
2009	6	30	28	58	51.72%	28	5	0	25	25	0.00%	16	3	53	83
2009	7	14	22	36	38.89%	22	3	0	28	28	0.00%	16	6	50	64
2009	8	16	10	26	61.54%	20	2	0	13	13	0.00%	10	2	23	39
2009	9	11	22	33	33.33%	21	3	0	20	20	0.00%	14	4	42	53
2009	10	44	45	89	49.44%	44	6	0	18	18	0.00%	10	3	63	107
2009	11	30	19	49	61.22%	33	3	0	34	34	0.00%	21	4	53	83
2009	12	11	23	34	32.35%	20	5	0	22	22	0.00%	15	3	45	56

This chart is a summary of frequency-related statistics gathered since the start of the Field Trial. Of particular interest is the drop in operation outside of the FTL bounds, trending lower in the latter part of 2008 with November 2008 having the least number of clock-minutes of operation outside the FTL bounds, followed by August 2009, over the dataset.

Total Minutes Exceeding FTL_low

Eastern Interconnection

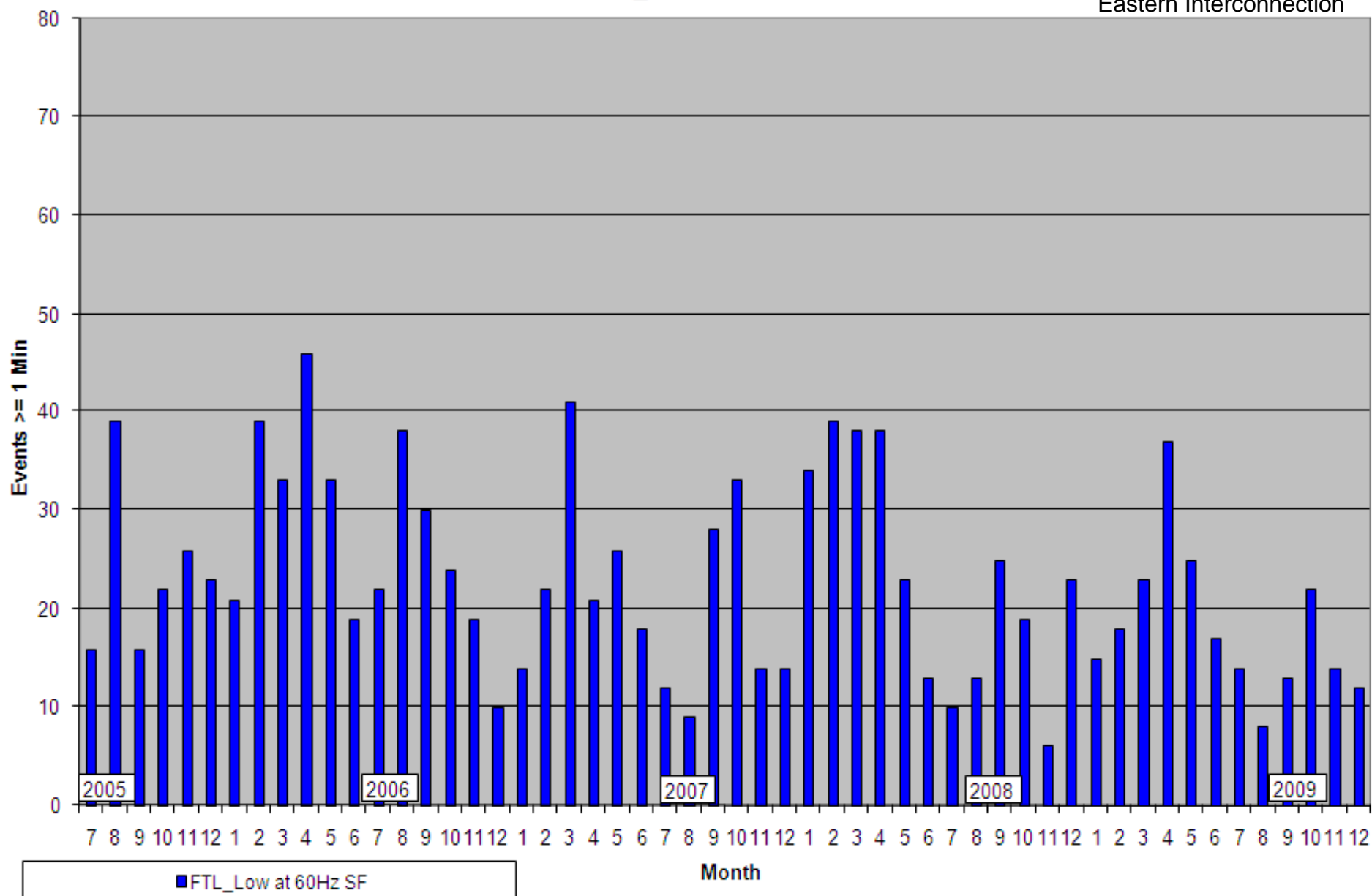


■ Total Minutes at 60 Hz
 ■ Addition Minutes During Time-Error Corrections

*March 2007- change to the new Daylight Saving Time.

FTL_{Low} Events

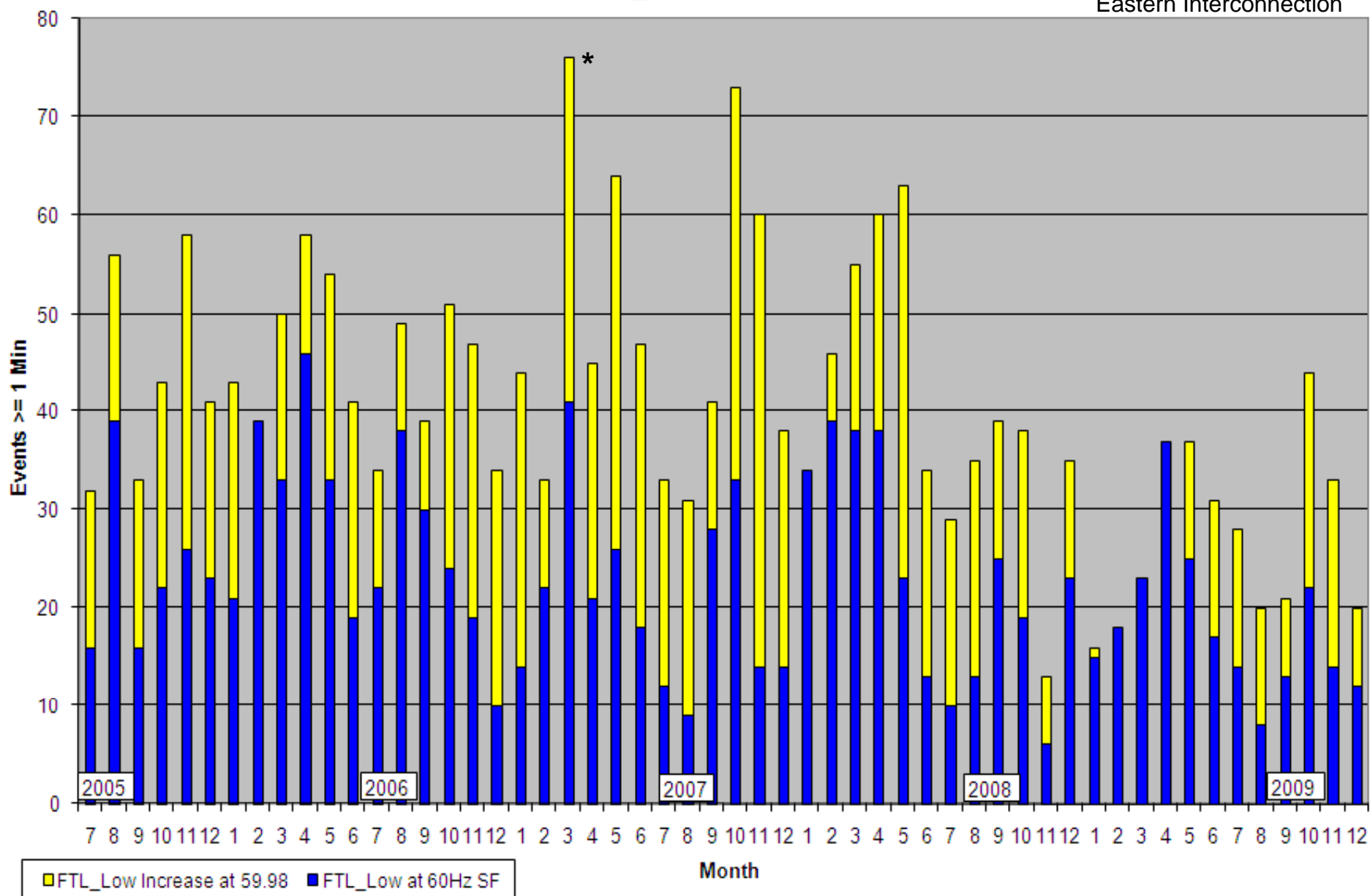
Eastern Interconnection



This chart illustrates the monthly number of FTL_{Low} events greater than or equal to 1 minute at 60 Hz Scheduled Frequency.

FTL_{Low} Events

Eastern Interconnection



This chart illustrates the monthly number of FTL_{Low} events greater than or equal to 1 minute

*March 2007 had an event of FTL_{Low} being exceeded for 15-minutes the Monday morning after the change to the new Daylight Saving Time.

Balancing Authority ACE Limit Proof-of-Concept Field Trial

Project 2007-18 Reliability-Based Control

Dates in this presentation:

Frequency Trigger Limit Low (FTL_{Low}) exceedance on Dec. 9, 2009,
ending 7:05 EST: 5 consecutive clock-minutes.¹

Balancing Authority ACE Limit Low ($BAAL_{Low}$) exceedance on Dec. 1, 2009,
ending 7:14 EST: 14 consecutive clock-minutes²

Balancing Authority ACE Limit High ($BAAL_{High}$) exceedance on Dec. 26, 2009,
ending 13:59 EST: 14 consecutive clock-minutes

Balancing Authority ACE Limit Low ($BAAL_{Low}$) exceedance on Dec. 26, 2009,
ending 17:54 EST: 19 consecutive clock-minutes

¹ Under draft BAL-008, a proposed FTL_{Low} violation would occur when the actual frequency is lower than FTL_{Low} for more than 30 consecutive clock-minutes and a proposed FTL_{High} violation would occur when the actual frequency is greater than FTL_{High} for more than 30 consecutive clock-minutes.

² Under draft BAL-007, a proposed $BAAL_{Low}$ violation would occur when the ACE is lower than $BAAL_{Low}$ for more than 30 consecutive clock-minutes and a proposed $BAAL_{High}$ violation would occur when the ACE is greater than $BAAL_{High}$ for more than 30 consecutive clock-minutes.

12/09/2009 7:01-7:05 EST

5 minute duration below FTL_{Low}

Clock-Minute Average Frequency

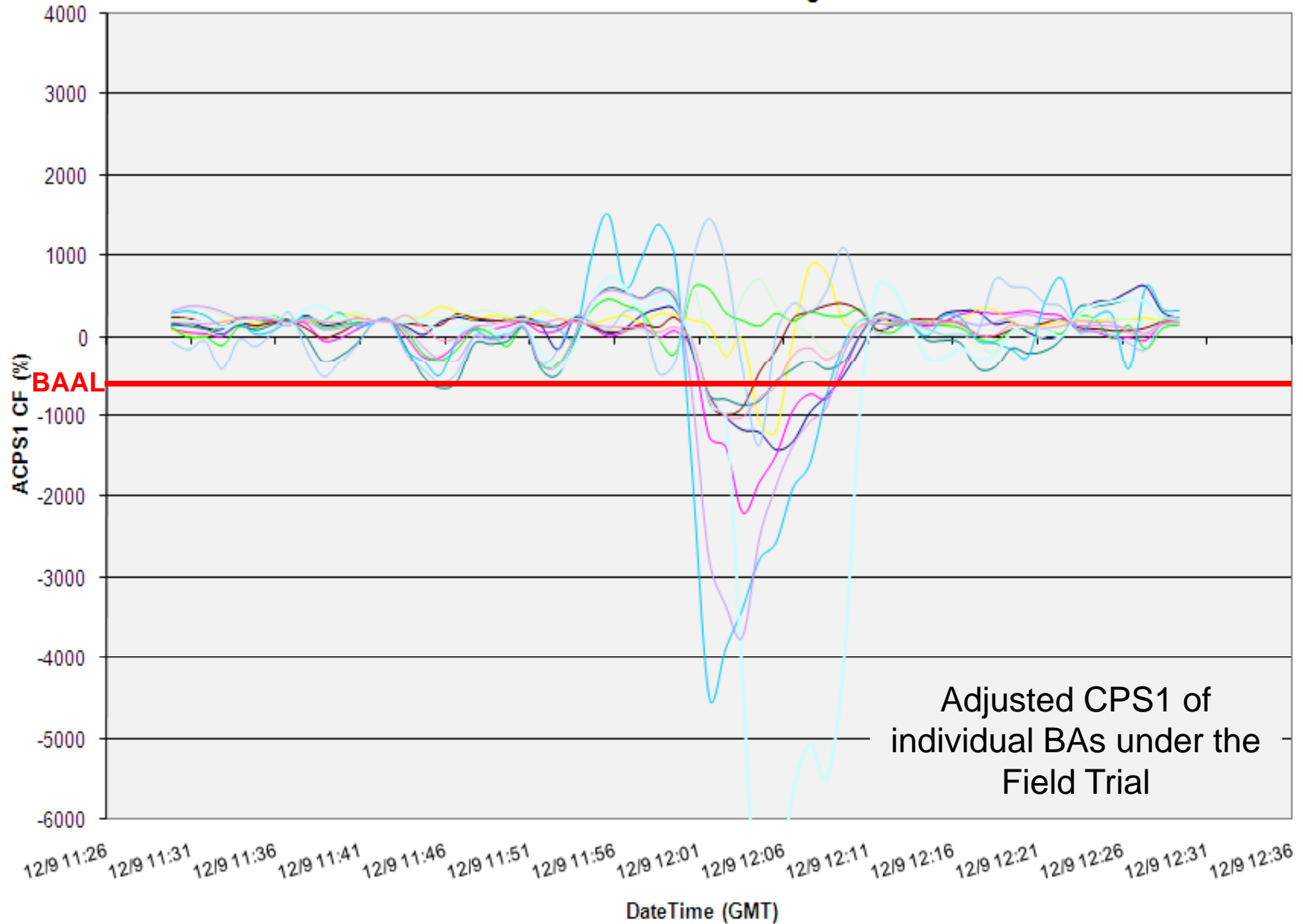


Clock-minute Actual Frequency of Participants

12/09/2009 7:01-7:05 EST

5 minute duration below FTL_{Low}

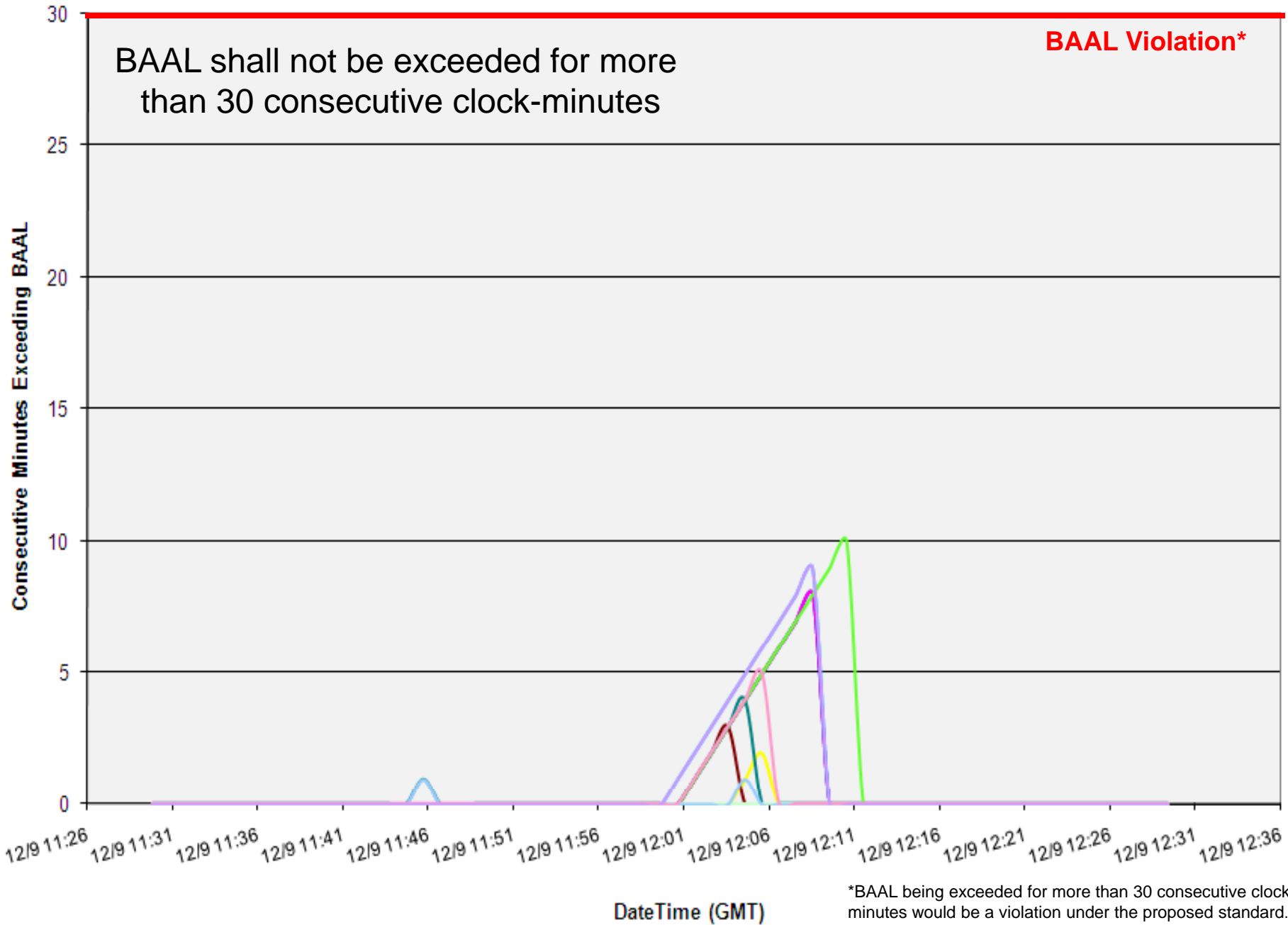
ACPS1 Clock-Minute Averages



12/09/2009 7:01-7:05 EST

5 minute duration below FTL_{Low}

Consecutive Minutes Exceeding BAAL



12/01/2009 7:01-7:14 EST

14-minute duration below BAAL_{Low}

Clock-Minute Average Frequency

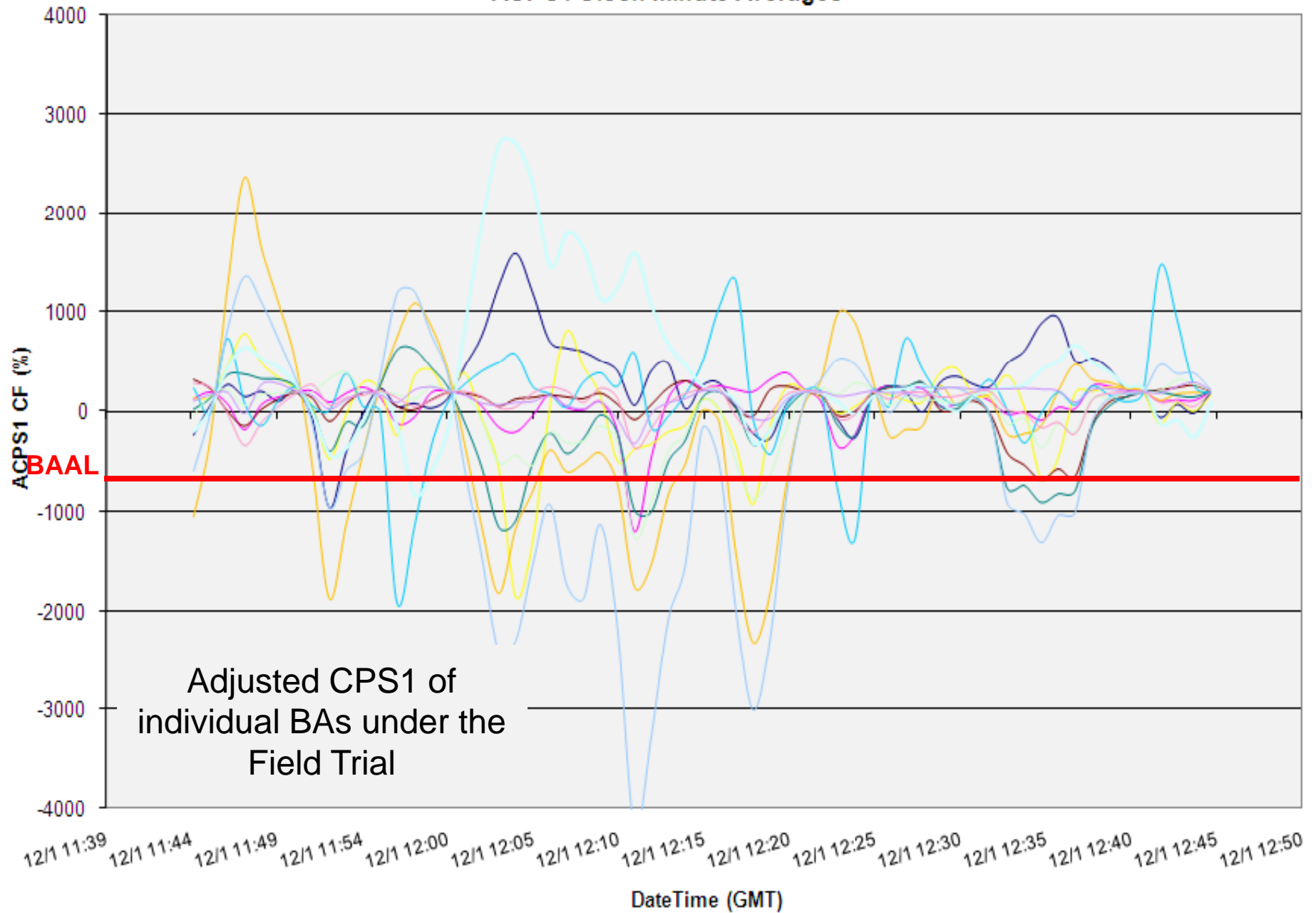


Clock-minute Actual Frequency of Participants

12/01/2009 7:01-7:14 EST

14-minute duration below BAAL_{Low}

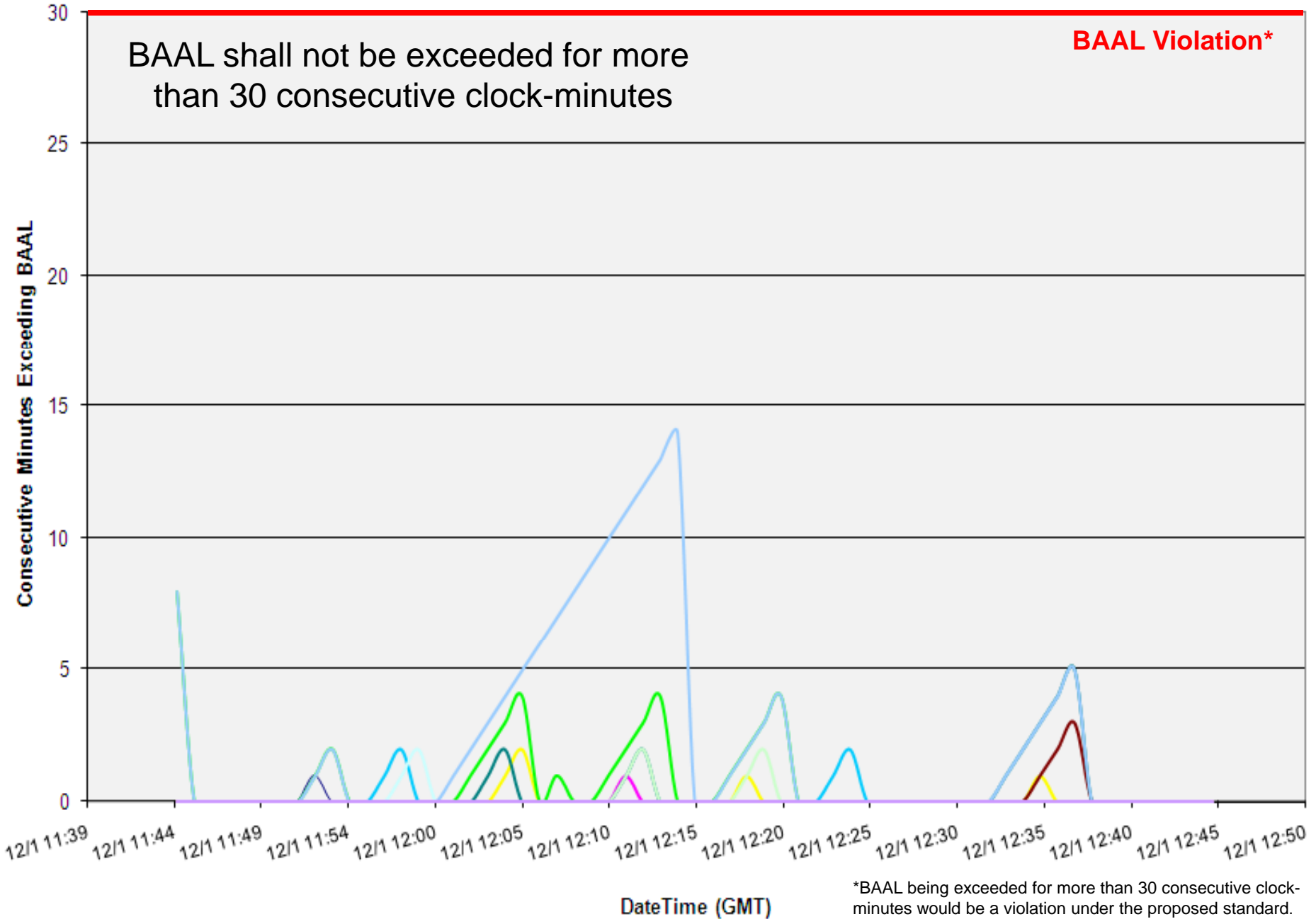
ACPS1 Clock-Minute Averages



12/01/2009 7:01-7:14 EST

14-minute duration below BAAL_{Low}

Consecutive Minutes Exceeding BAAL



12/26/2009 13:45-13:59 EST

14-minute duration above BAAL_{High}

Frequency

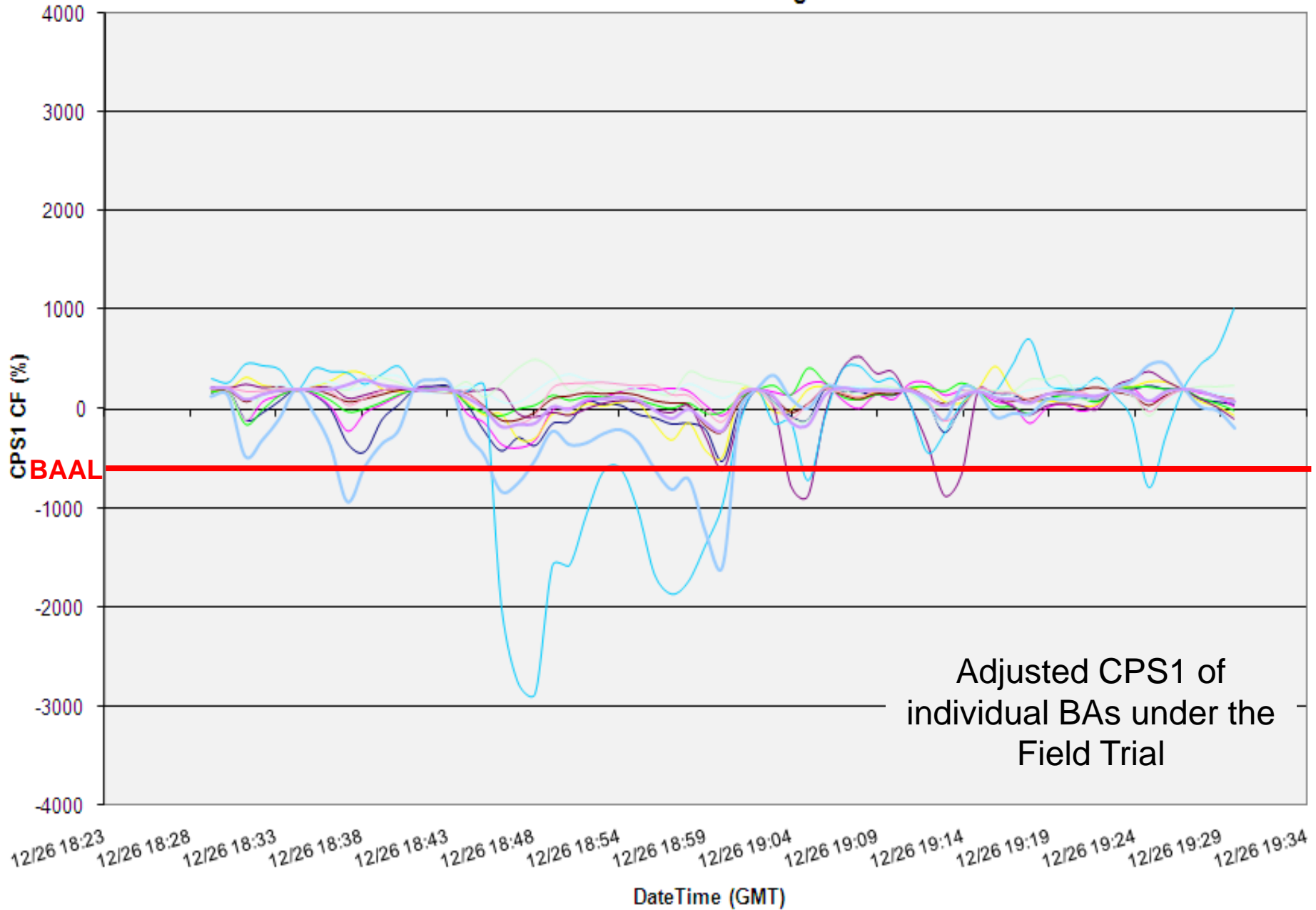


Clock-minute Actual Frequency of Participants

12/26/2009 13:45-13:59 EST

14-minute duration above BAAL_{High}

ACPS1 One-Minute Averages

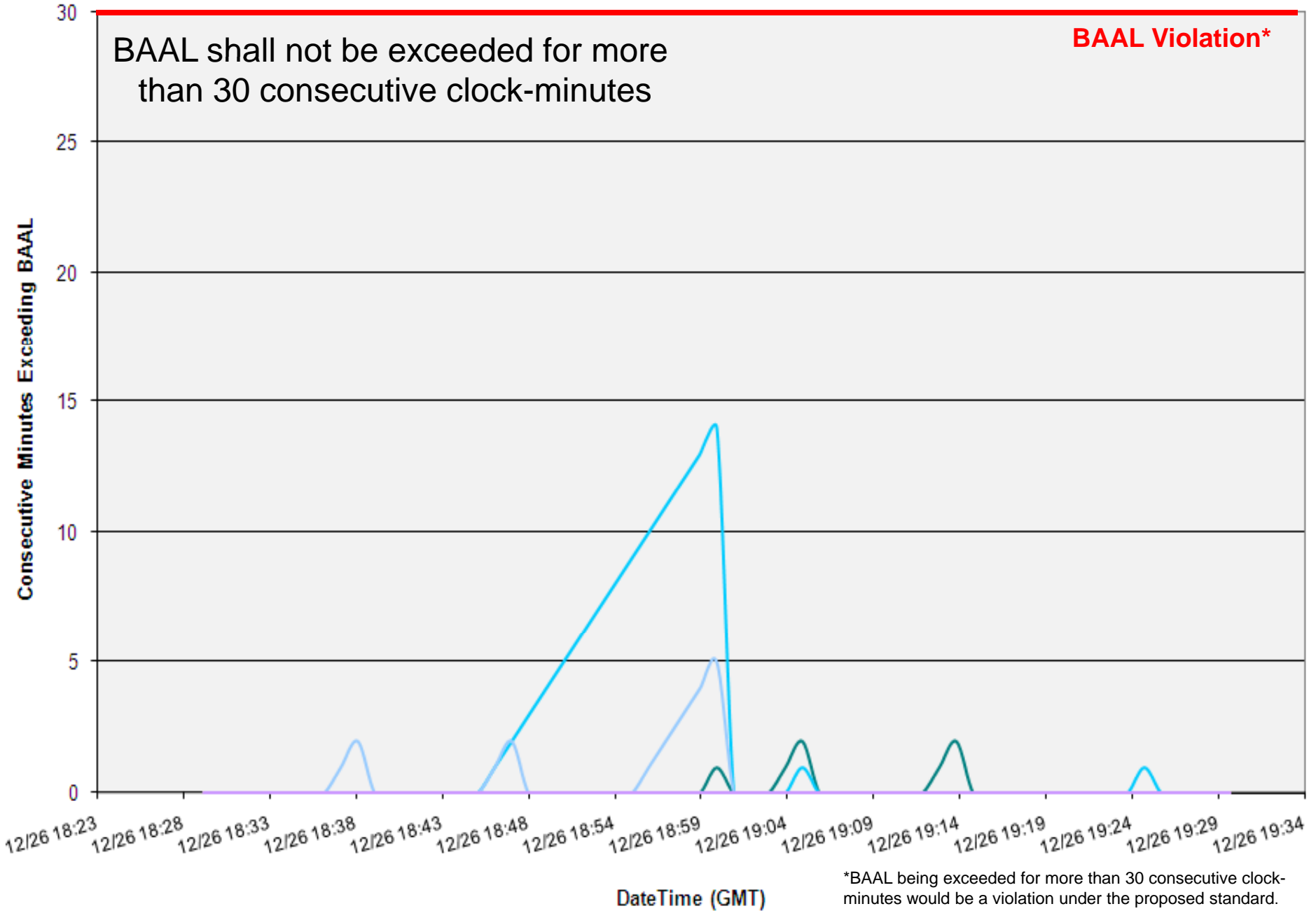


Adjusted CPS1 of individual BAs under the Field Trial

12/26/2009 13:45-13:59 EST

14-minute duration above BAAL_{High}

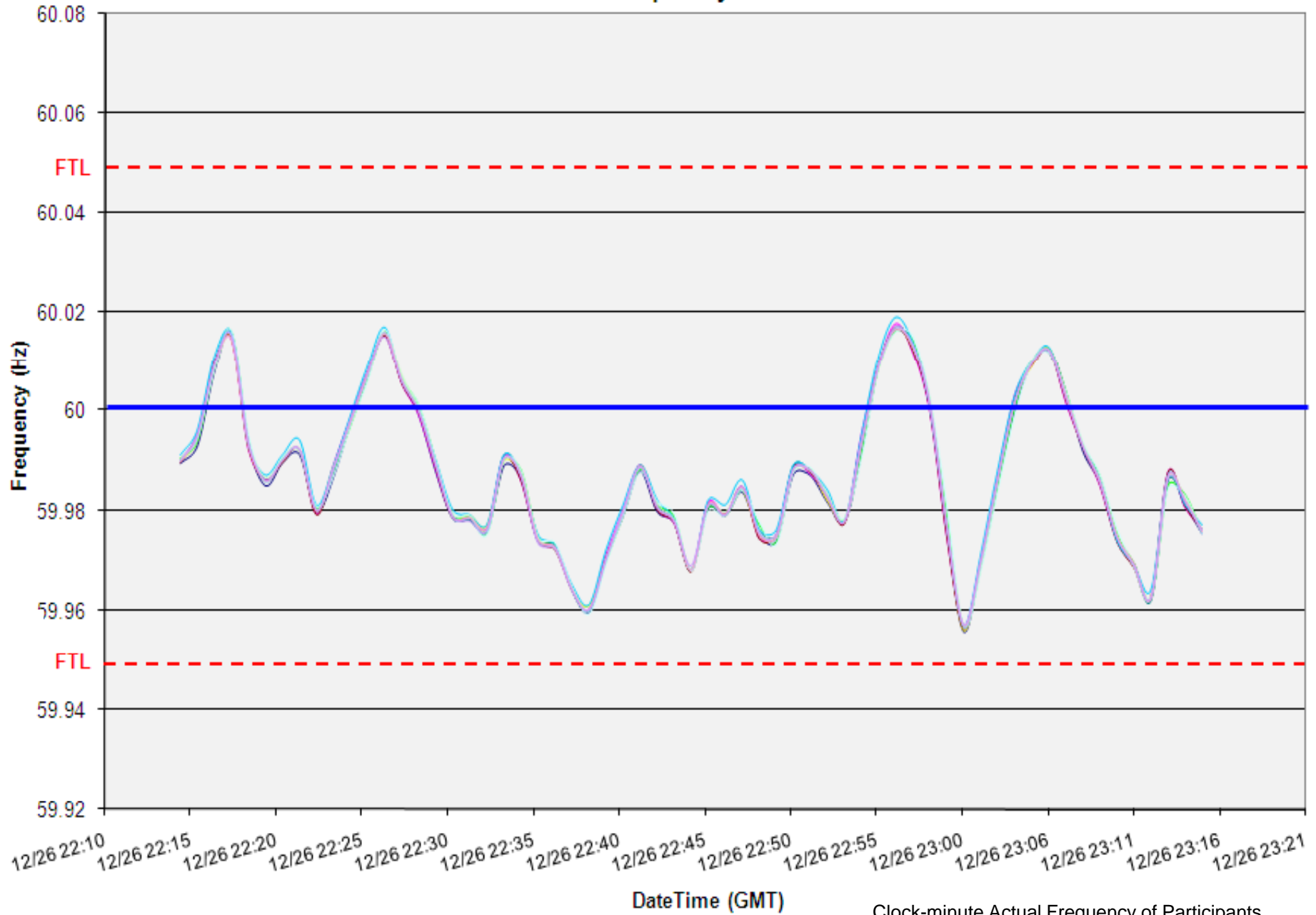
Consecutive Minutes Exceeding BAAL



12/26/2009 17:35-17:54 EST

19-minute duration below BAAL_{Low}

Frequency

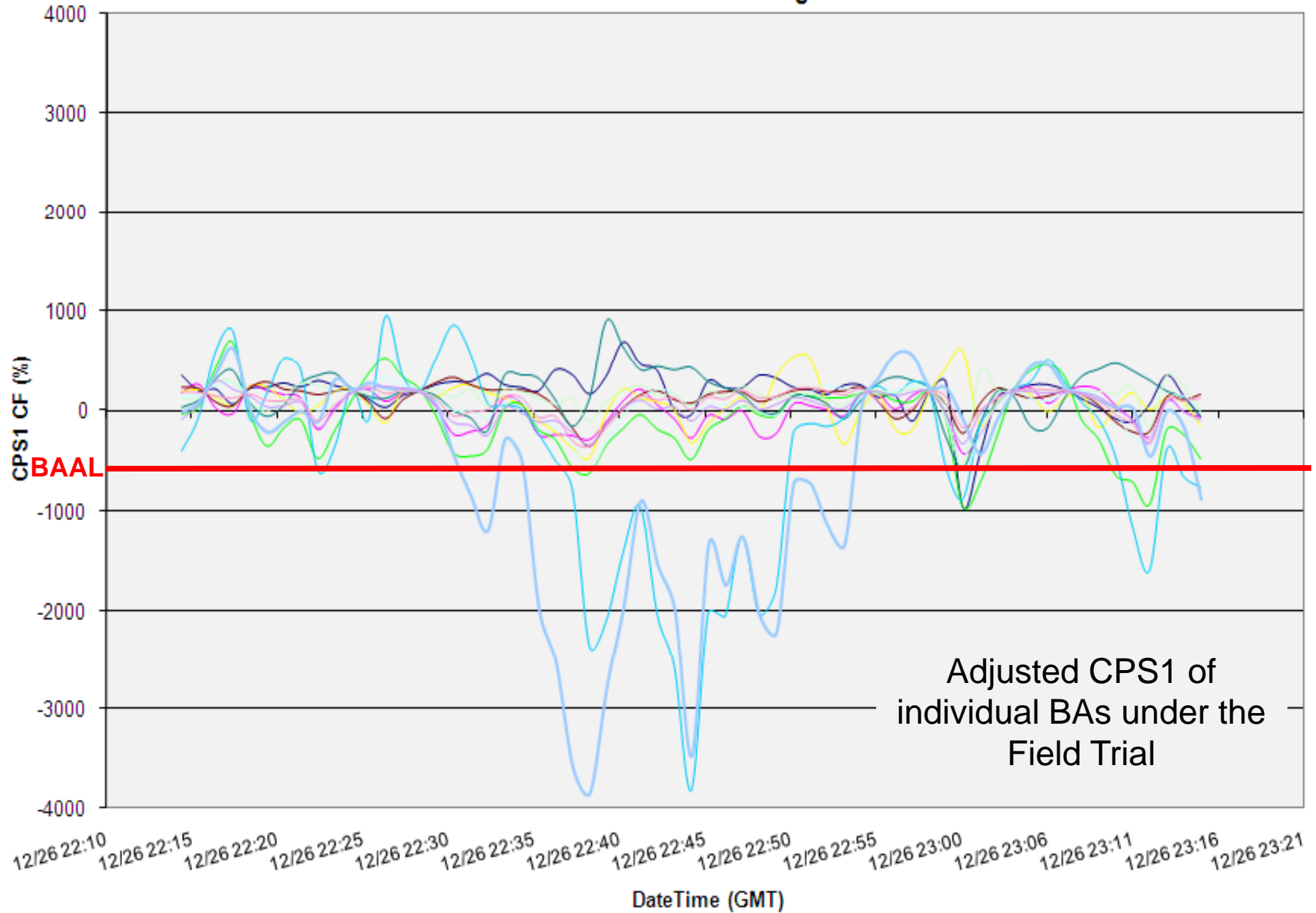


Clock-minute Actual Frequency of Participants

12/26/2009 17:35-17:54 EST

19-minute duration below BAAL_{Low}

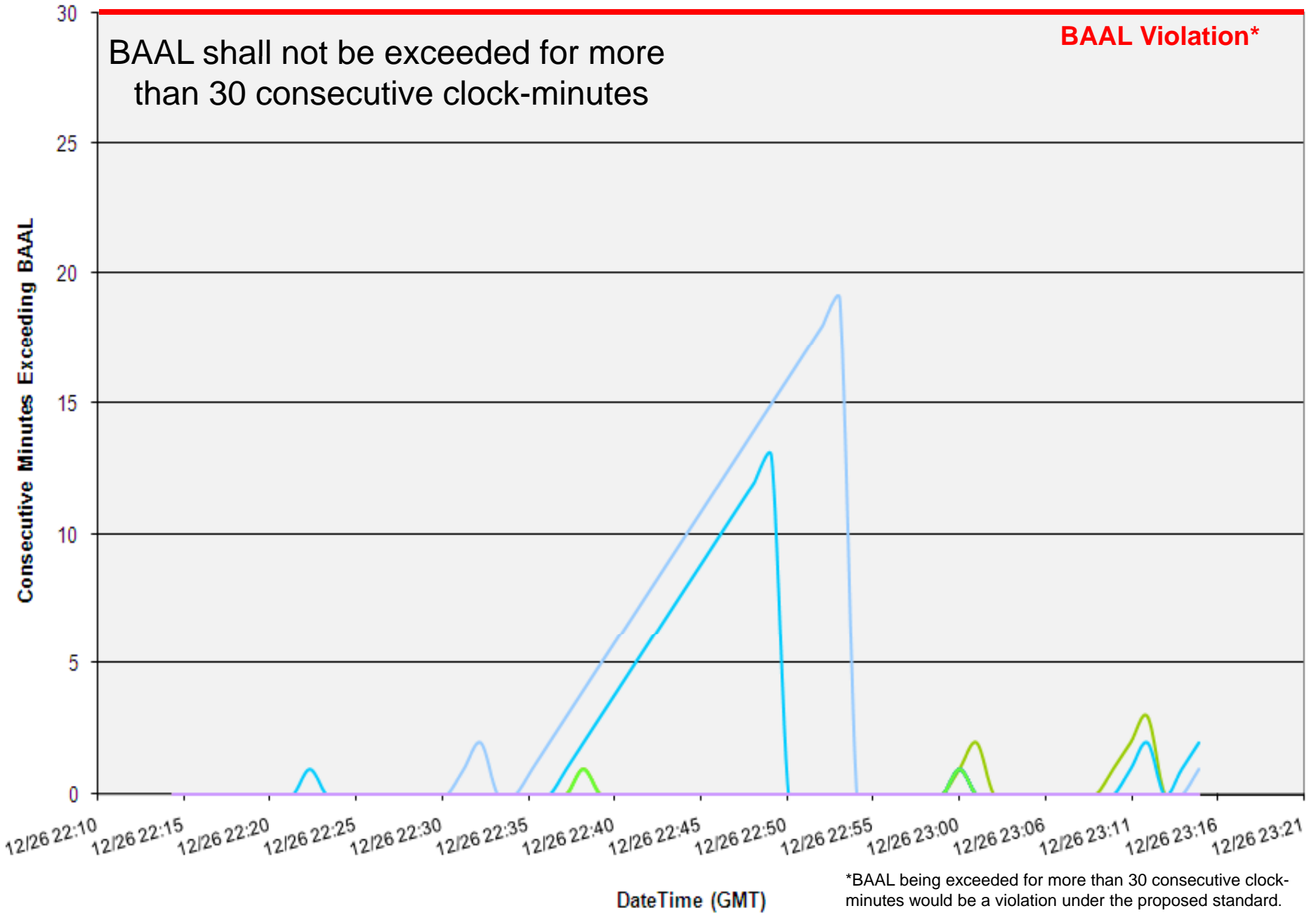
ACPS1 One-Minute Averages



12/26/2009 17:35-17:54 EST

19-minute duration below BAAL_{Low}

Consecutive Minutes Exceeding BAAL



Balancing Authority ACE Limit Proof-of-Concept Field Trial

Discussion

Doug Hils

Reliability-Based Control Standard Drafting Team

Doug.Hils@duke-energy.com