

# **Balancing Authority ACE Limit Proof-of-Concept Field Trial Project 2010-14**

Eastern Interconnection Update Discussion

November 1, 2010

Starting at 2:30 PM EDT

Doug Hils – Duke Energy

Balancing Authority Reliability-based Control Standard Drafting Team  
(BARCSDT)

# Balancing Authority ACE Limit Proof-of-Concept Field Trial

## Eastern Interconnection Field Trial Participation

Participation reflects approximately 67% of the projected 2010 peak load for the Eastern Interconnection

Eastern Interconnection Balancing Authority Participants	2010 Frequency Bias	Region	Reliability Coordinator	Start Date
American Electric Power (CSWS)	-103.4	SPP	SPP	September 1, 2005
Associated Electric Cooperative, Inc. (AECI)	-45	SERC	TVA	April 1, 2010
Duke Energy Carolinas (DUK)	-196	SERC	VACS	April 1, 2009
East Kentucky Power Cooperative (EKPC)	-42.73	SERC	TVA	July 6, 2005
Entergy (EES)	-227.1	SERC	ICTE	July 6, 2005
EON-US (LGEE)	-74	SERC	TVA	April 1, 2008
Independent Electricity System Operator (IESO)	-245.8	NPCC	IESO	March 1, 2008
Manitoba Hydro (MHEB)	-43.3	MRO	MISO	July 6, 2005
Midwest Independent Transmission System Operator (MISO)	-1038.6	MRO, RFC, SERC	MISO	January 6, 2009
PJM Interconnection (PJM)	-1358	RFC	PJM	August 1, 2005
Santee Cooper (SC)	-61.52	SERC	VACS	March 1, 2006
Southern Company (SOCO)	-445	SERC	SOCO	October 15, 2005
Tennessee Valley Authority (TVA)	-317.6	SERC	TVA	October 1, 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		September 2010 Performance under BAL-007	
	Max MinCtLow	Max MinCtHigh	Max MinCtLow	Max MinCtHigh
BA01	26	16	11	6
BA02	17	17	7	14
BA03	19	19	7	7
BA04	10	20	6	6
BA05	16	22	9	20
BA06	28	22	18	22
BA07	15	23	6	6
BA08	20	24	6	14
BA09	28	26	14	14
BA10	21	31	13	11
BA11	14	32	5	4
BA12	29	40	15	14
BA13	28	43	5	12

MinCtLow = Count of consecutive clock-minutes BAAL<sub>Low</sub> was exceeded

MinCtHigh = Count of consecutive clock-minutes BAAL<sub>High</sub> was exceeded

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

# 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
2010	1	36	26	62	58.06%	35	6	0	16	16	0.00%	9	3	42	78
2010	2	23	16	39	58.97%	24	3	0	26	26	0.00%	16	2	42	65
2010	3	38	71	109	34.86%	65	6	0	40	40	0.00%	22	6	111	149
2010	4	63	38	101	62.38%	65	5	0	54	54	0.00%	34	6	92	155
2010	5	72	30	102	70.59%	60	6	0	40	40	0.00%	29	4	70	142
2010	6	10	28	38	26.32%	27	2	0	10	10	0.00%	9	2	38	48
2010	7	8	19	27	29.63%	17	4	0	30	30	0.00%	13	5	49	57
2010	8	16	29	45	35.56%	24	4	0	17	17	0.00%	11	3	46	62
2010	9	0	56	56	0.00%	31	4	0	22	22	0.00%	11	4	78	78

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.



# Frequency Statistics

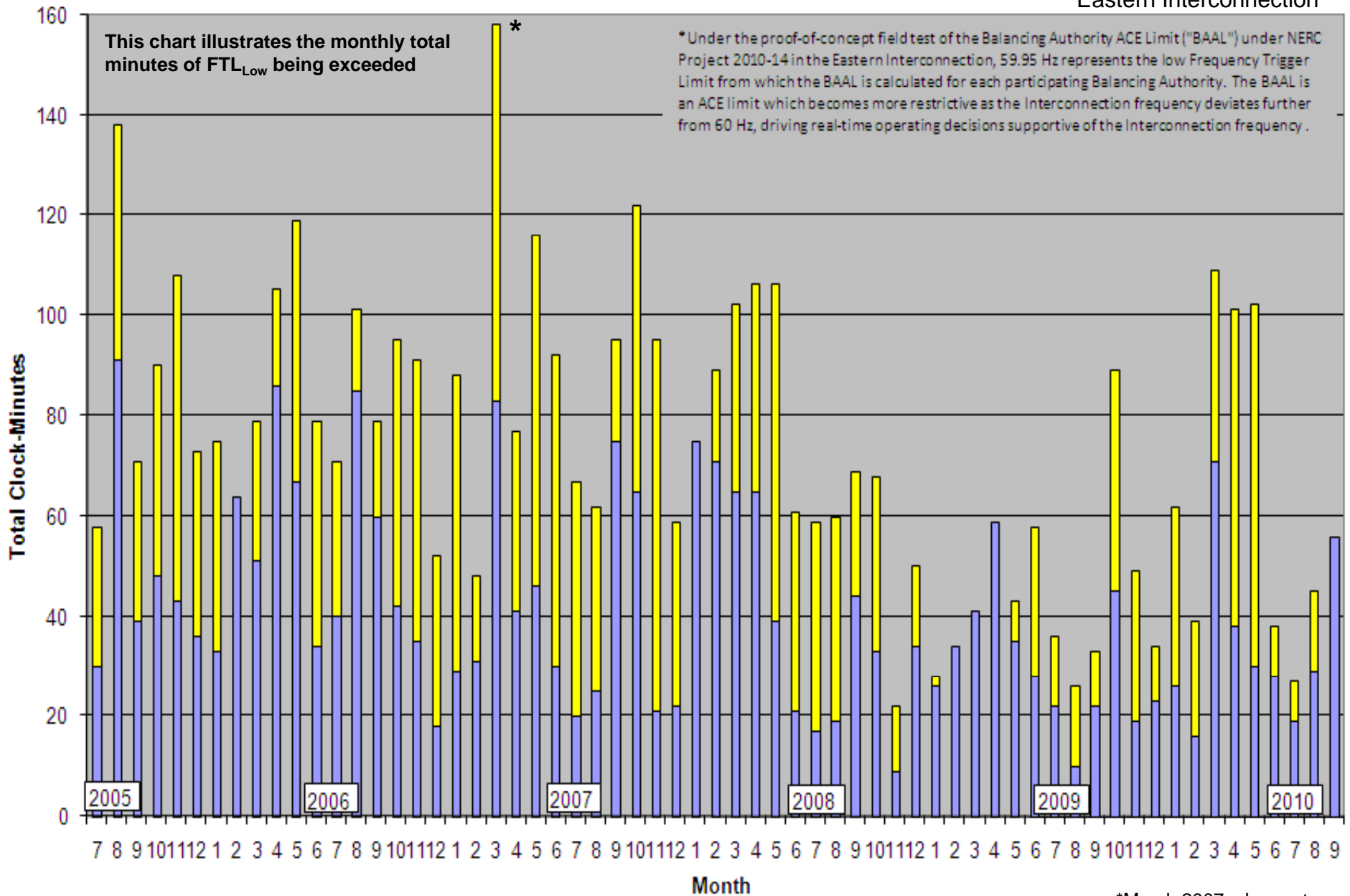
# Eastern Interconnection

Year	Month	Total Minutes FTL_Low at 60 Hz SF	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	FTL_Low FTL_High at 60 Hz SF	Total FTL_Low and FTL_High Minutes
2007	10		1	56	57	1.75%	36	5	121	179		74
2007	11		0	34	34	0.00%	24	5	55	129		172
2007	12		0	61	61	0.00%	38	4	83	120		110
2008	1		0	48	48	0.00%	24	4	123	123		123
2008	2		0	51	51	0.00%	24	8	122	140		136
2008	3		0	40	40	0.00%	34	2	105	142		138
2008	4		0	59	59	0.00%	33	6	124	165		141
2008	5		0	40	40	0.00%	20	5	79	146		142
2008	6		0	35	35	0.00%	19	5	56	96		108
2008	7		0	17	17	0.00%	12	3	34	76		108
2008	8		0	29	29	0.00%	17	6	48	89		138
2008	9		0	55	55	0.00%	21	11	99	124		141
2008	10		0	27	27	0.00%	19	3	60	95		108
2008	11		0	13	13	0.00%	9	4	22	35		118
2008	12		0	11	11	0.00%	8	3	45	61		108
2009	1		0	19	19	0.00%	9	3	45	47		108
2009	2		0	18	18	0.00%	11	6	52	52		108
2009	3		0	25	25	0.00%	11	9	66	66		108
2009	4		0	27	27	0.00%	20	3	86	86		108
2009	5		0	27	27	0.00%	15	8	62	70		108
2009	6		0	25	25	0.00%	16	3	53	83		108
2009	7		0	28	28	0.00%	16	6	50	64		108
2009	8		0	13	13	0.00%	10	2	23	39		108
2009	9		0	20	20	0.00%	14	4	42	53		108
2009	10		0	18	18	0.00%	10	3	63	107		108
2009	11		0	34	34	0.00%	21	4	53	83		108
2009	12		0	22	22	0.00%	15	3	45	56		108
2010	1		0	16	16	0.00%	9	3	42	78		108
2010	2		0	26	26	0.00%	16	2	42	65		108
2010	3		0	40	40	0.00%	22	6	111	149		108
2010	4		0	54	54	0.00%	34	6	92	155		108
2010	5		0	40	40	0.00%	29	4	70	142		108
2010	6		0	10	10	0.00%	9	2	38	48		108
2010	7		0	30	30	0.00%	13	5	49	57		108
2010	8		0	17	17	0.00%	11	3	46	62		108
2010	9		0	22	22	0.00%	11	4	78	78		108

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 Clock-Minutes of Frequency below 59.95 Hz\*

Eastern Interconnection

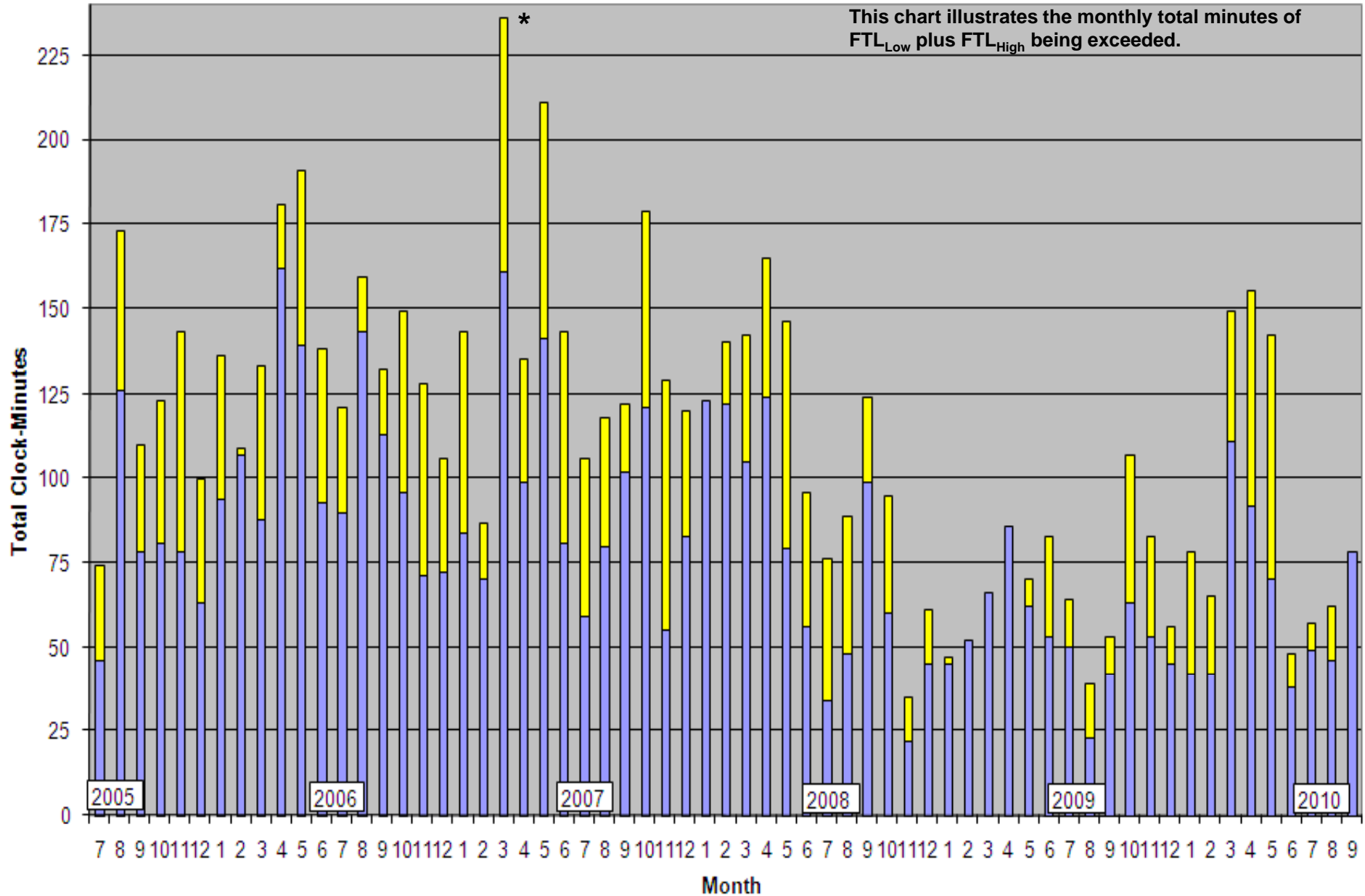


■ Total Minutes at 60 Hz   ■ Addition Minutes During Time-Error Corrections

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

# Total Clock-Minutes less than 59.95 Hz or greater than 60.05 Hz

Eastern Interconnection



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

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

DateTime_EDT	ActualFreq	SchedFreq	MinCtLow	MinCtHigh	DateTimeGMT_shift
9/6/10 7:24	60.037	60	0	16	9/6/10 11:24
9/6/10 7:25	60.03	60	0	17	9/6/10 11:25
9/6/10 7:26	60.029	60	0	18	9/6/10 11:26
9/6/10 7:27	60.04	60	0	19	9/6/10 11:27
9/6/10 7:28	60.035	60	0	20	9/6/10 11:28
9/3/10 0:52	60.0185	60	0	16	9/3/10 4:52
9/6/10 2:54	60.0228	60	0	16	9/6/10 6:54
9/6/10 2:55	60.0123	60	0	17	9/6/10 6:55
9/6/10 7:19	60.0428	60	0	16	9/6/10 11:19
9/6/10 7:20	60.0425	60	0	17	9/6/10 11:20
9/6/10 7:21	60.0444	60	0	18	9/6/10 11:21
9/6/10 7:22	60.0446	60	0	19	9/6/10 11:22
9/6/10 7:23	60.0355	60	0	20	9/6/10 11:23
9/6/10 7:24	60.0367	60	0	21	9/6/10 11:24
9/6/10 7:25	60.0307	60	0	22	9/6/10 11:25
9/6/10 17:21	59.9801	60	16	0	9/6/10 21:21
9/11/10 10:18	59.9718	60	16	0	9/11/10 14:18
9/11/10 10:19	59.9626	60	17	0	9/11/10 14:19
9/11/10 10:20	59.9722	60	18	0	9/11/10 14:20
9/13/10 22:47	60.0232	60	0	16	9/14/10 2:47

All minutes of the BAAL being exceeded for more than 15 consecutive clock-minutes noted on left.

Same event above 60 Hz

Periods of the FTL being exceeded for this presentation:

PrevailingTime	PTimeZone	FreqError	ActualFreq	SchedFreq	MinuteCount
9/2/10 22:32	EDT	0.0547	60.0547	60	1
9/2/10 22:33	EDT	0.0614	60.0614	60	2
9/2/10 22:34	EDT	0.0647	60.0647	60	3
9/2/10 22:35	EDT	0.0616	60.0616	60	4
9/15/10 6:01	EDT	-0.0587	59.9413	60	1
9/15/10 6:02	EDT	-0.0698	59.9302	60	2
9/15/10 6:03	EDT	-0.0646	59.9354	60	3
9/15/10 6:04	EDT	-0.0547	59.9453	60	4

DateTime_EDT	ActualFreq	SchedFreq	MinCtLow	MinCtHigh	DateTimeGMT_shift	
9/6/10 7:24	60.037	60	0	16	9/6/10 11:24	All minutes of the BAAL being exceeded

Dates in this presentation:

Clock-minute Frequency greater than the  $FTL_{High}$  on September 2, 2010, ending 22:35 EDT: 4 consecutive clock-minutes

Clock-minute ACE greater than the  $BAAL_{High}$  on September 6, 2010, ending 7:24 EDT: 22 consecutive clock-minutes

Clock-minute ACE less than the  $BAAL_{Low}$  on September 11, 2010, ending 10:19 EDT: 18 consecutive clock-minutes

Clock-minute Frequency less than the  $FTL_{Low}$  on September 15, 2010, ending 6:04 EDT: 4 consecutive clock-minutes

Periods  
this pres

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.

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

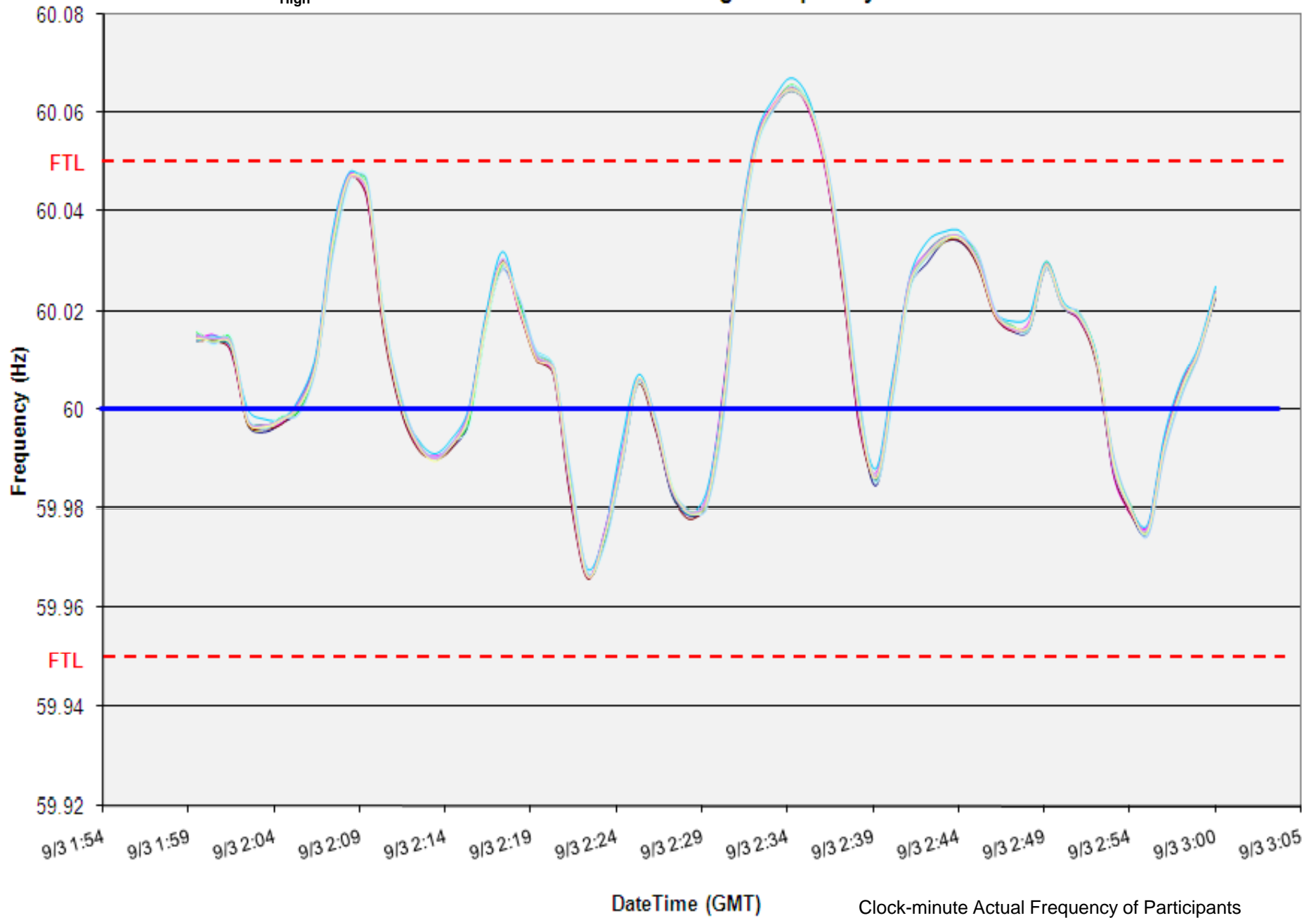
req	MinuteCount
60	1
60	2
60	3
60	4
60	1
60	2
60	3
60	4

9/15/10 6:01	EDT	-0.0587	59.9413	60	1
9/15/10 6:02	EDT	-0.0698	59.9302	60	2
9/15/10 6:03	EDT	-0.0646	59.9354	60	3
9/15/10 6:04	EDT	-0.0547	59.9453	60	4

9/2/2010 ending 22:35 EDT

4-minute duration above  $FTL_{High}$

### EI Clock-Minute Average Frequency

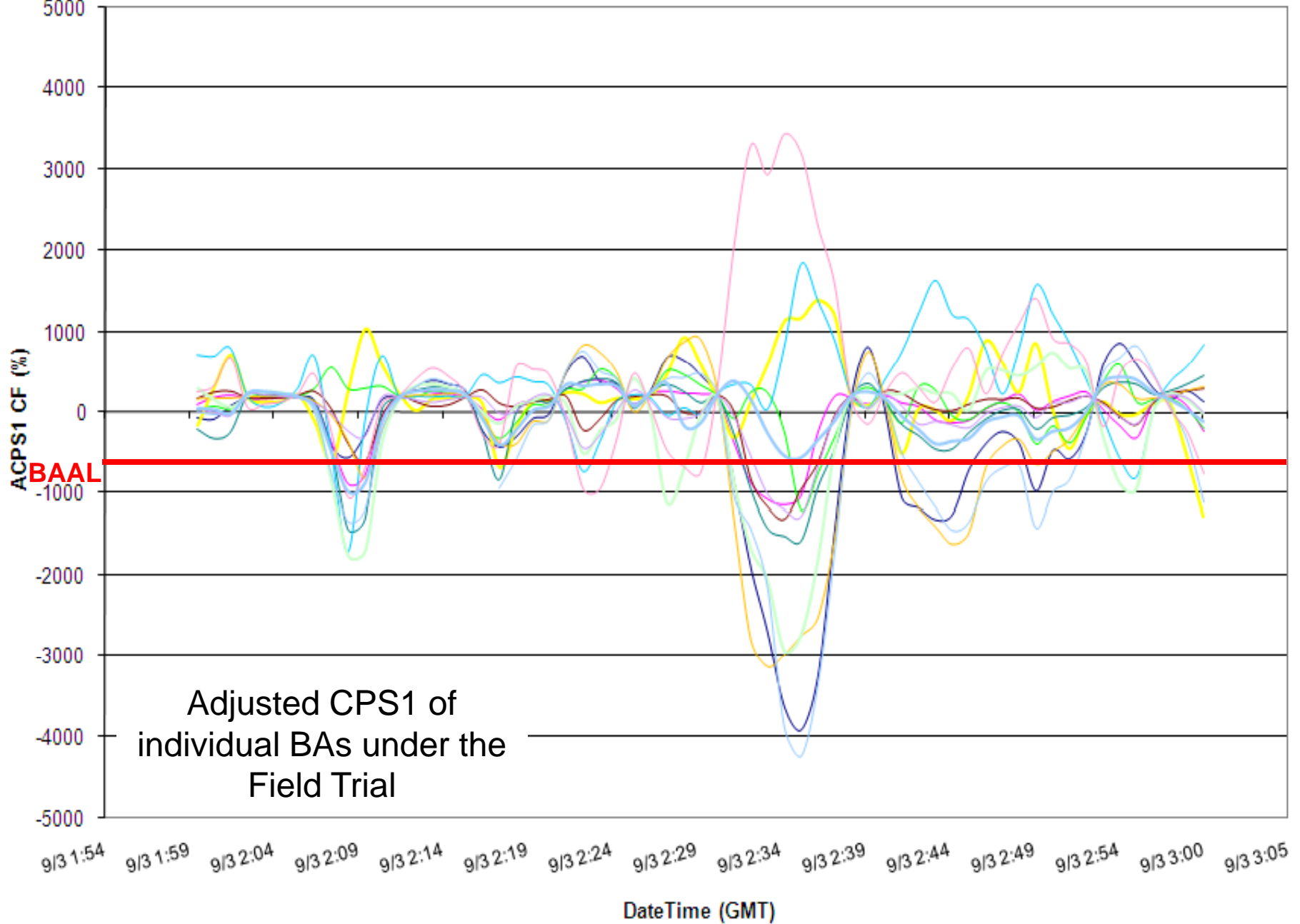


Clock-minute Actual Frequency of Participants

9/2/2010 ending 22:35 EDT

4-minute duration above  $FTL_{High}$

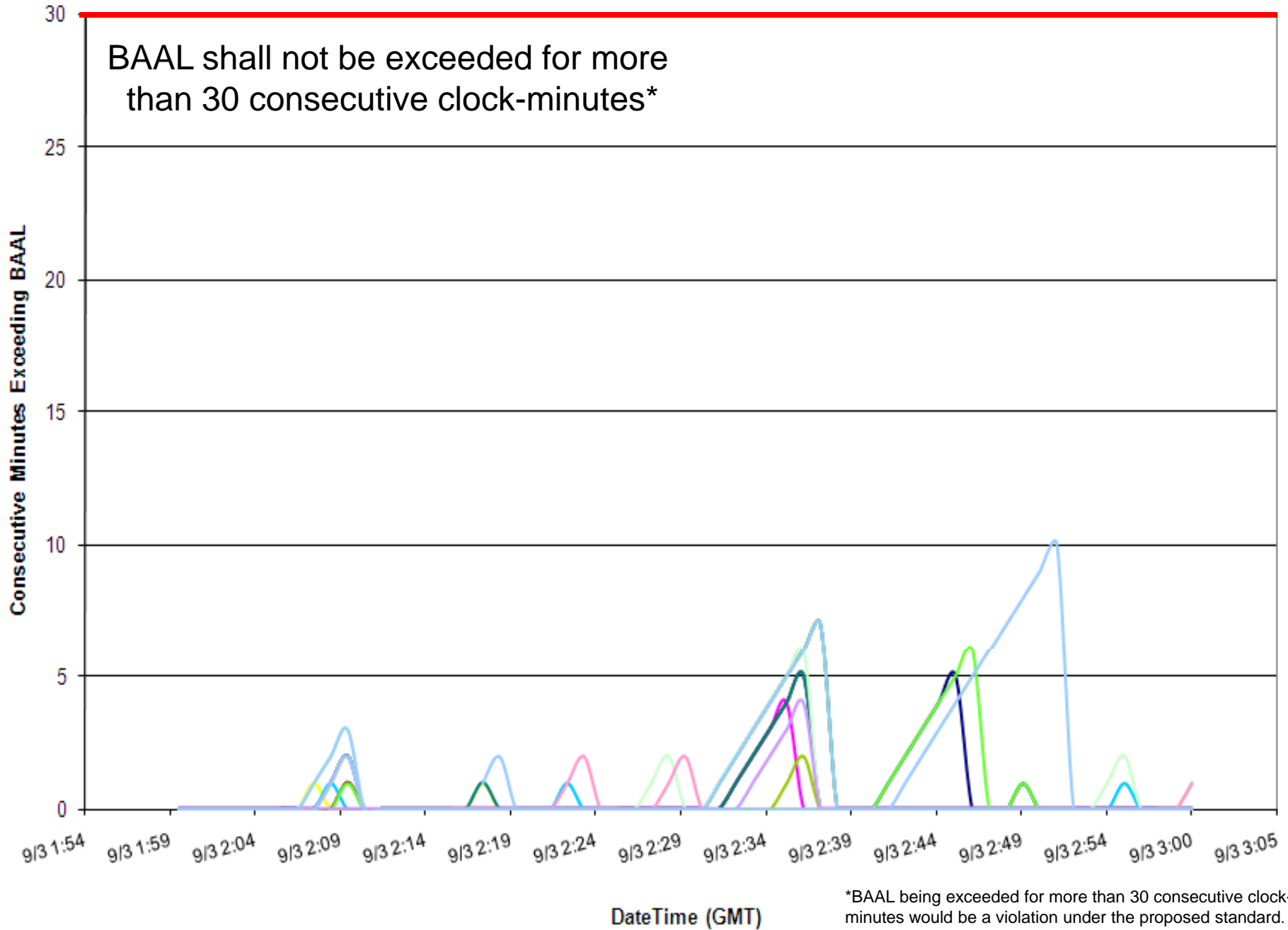
### ACPS1 Clock-Minute Averages



9/2/2010 ending 22:35 EDT  
4-minute duration above  $FTL_{High}$

### Consecutive Minutes Exceeding BAAL

**BAAL Violation\***



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

9/6/2010 ending 7:24 EDT

22-minute duration above BAAL<sub>High</sub>

### EI Clock-Minute Average Frequency

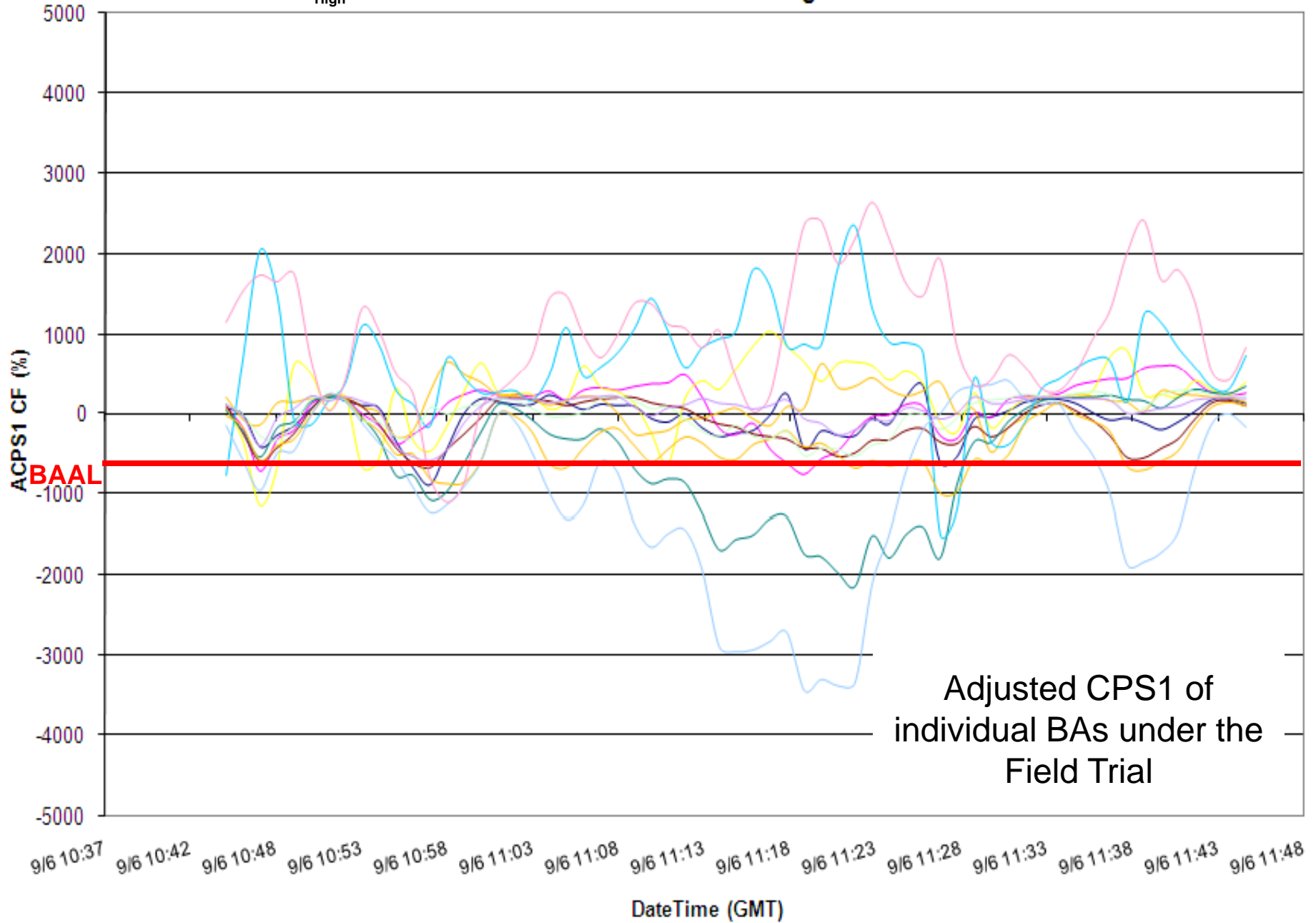


Clock-minute Actual Frequency of Participants

9/6/2010 ending 7:24 EDT

22-minute duration above BAAL<sub>High</sub>

### ACPS1 Clock-Minute Averages

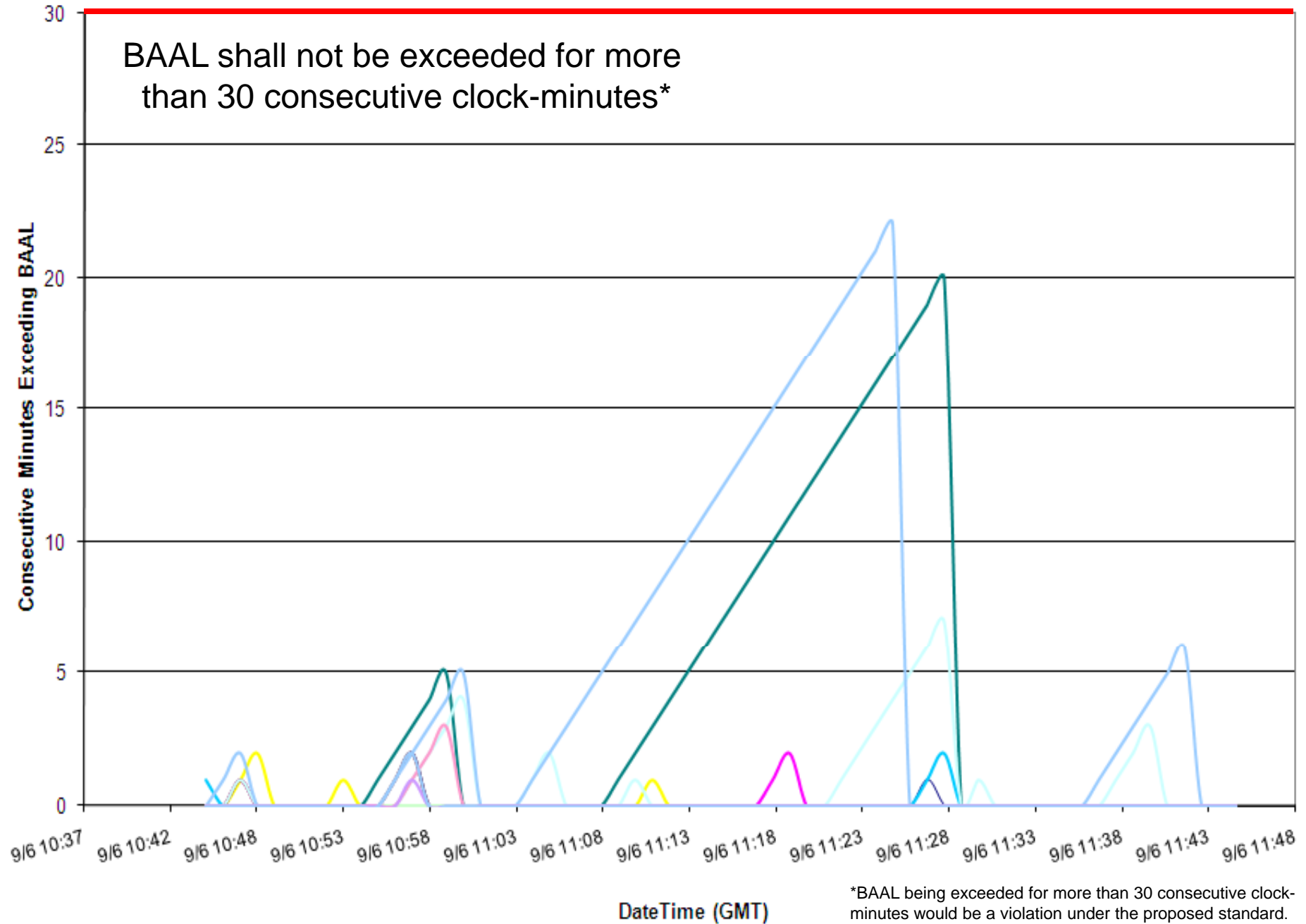


9/6/2010 ending 7:24 EDT

22-minute duration above BAAL<sub>High</sub>

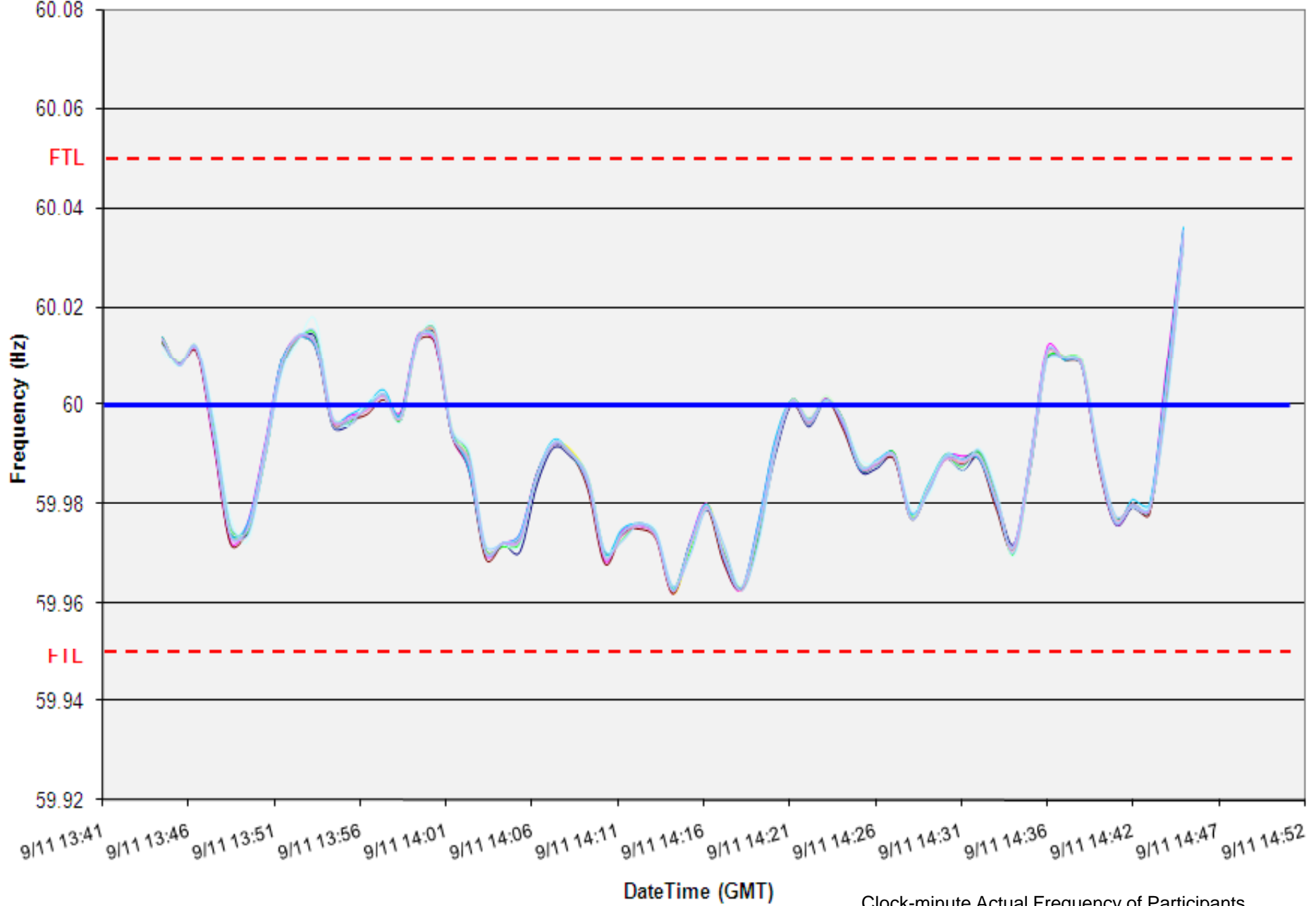
Consecutive Minutes Exceeding BAAL

BAAL Violation\*



9/11/2010 ending 10:19 EDT  
18-minute duration below BAAL<sub>Low</sub>

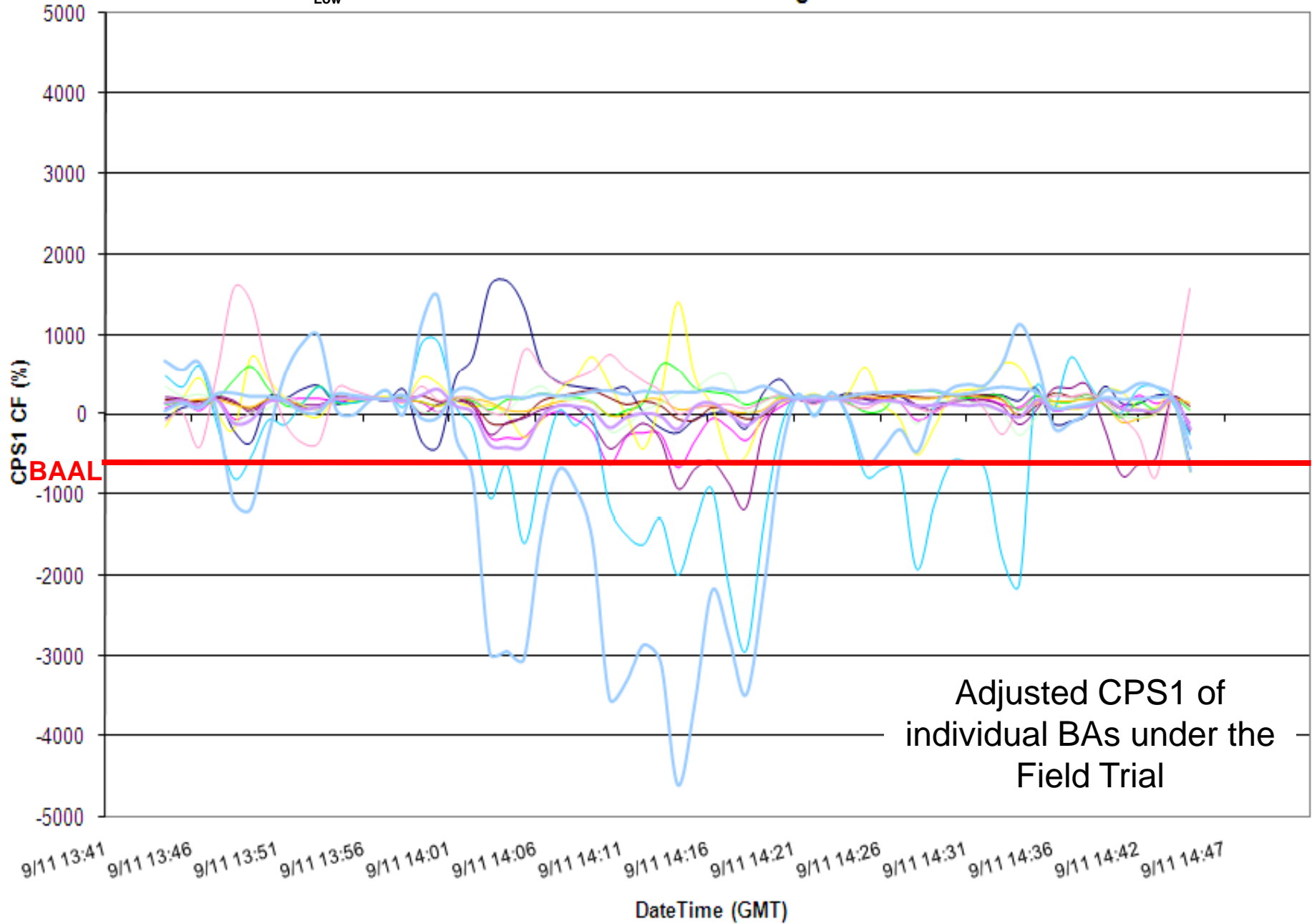
### EI Clock-Minute Average Frequency



Clock-minute Actual Frequency of Participants

9/11/2010 ending 10:19 EDT  
18-minute duration below BAAL<sub>Low</sub>

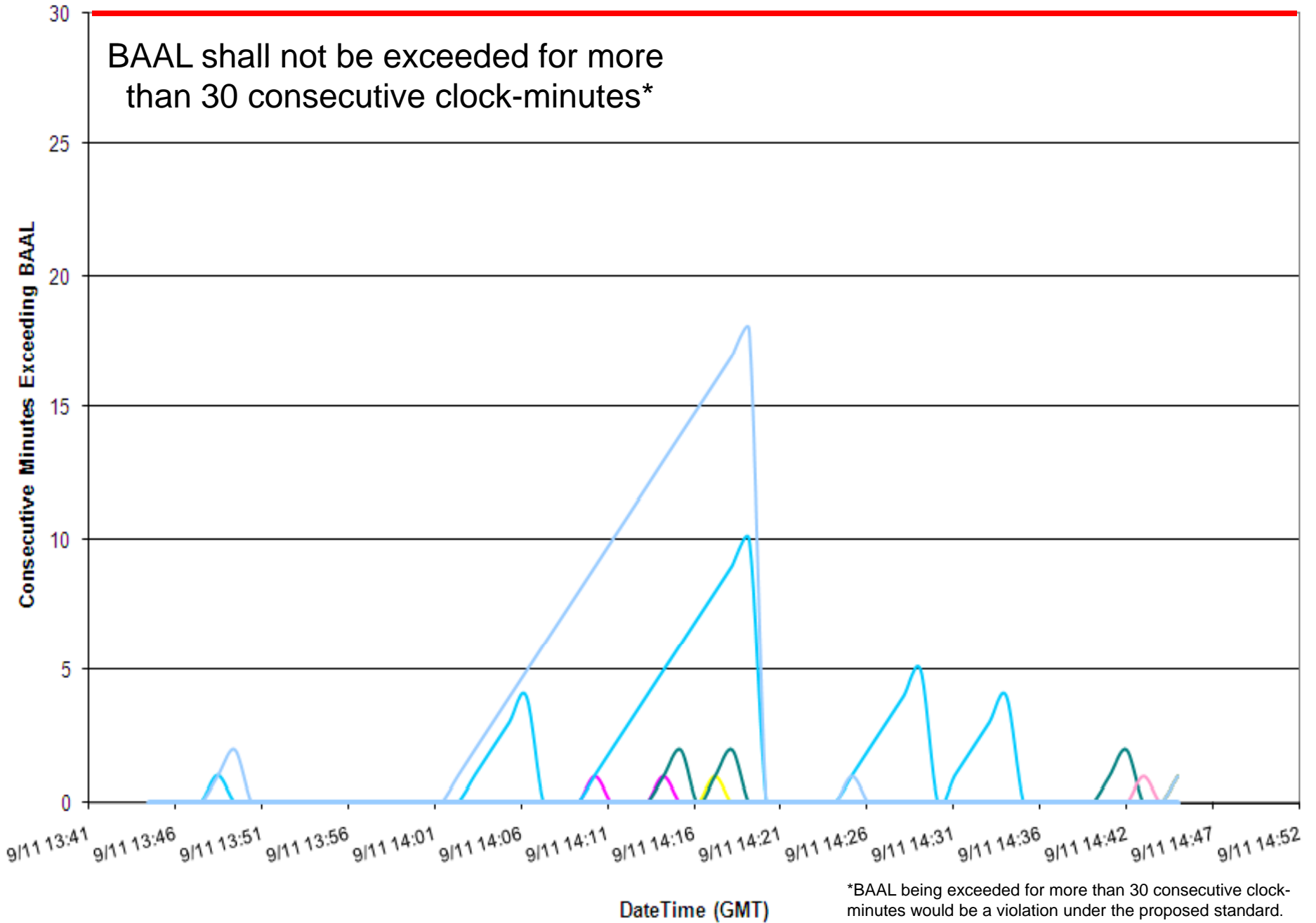
### ACPS1 One-Minute Averages



9/11/2010 ending 10:19 EDT  
18-minute duration below BAAL<sub>Low</sub>

Consecutive Minutes Exceeding BAAL

BAAL Violation\*



9/15/2010 ending 6:04 EDT

4-minute duration below FTL<sub>Low</sub>

### EI Clock-Minute Average Frequency

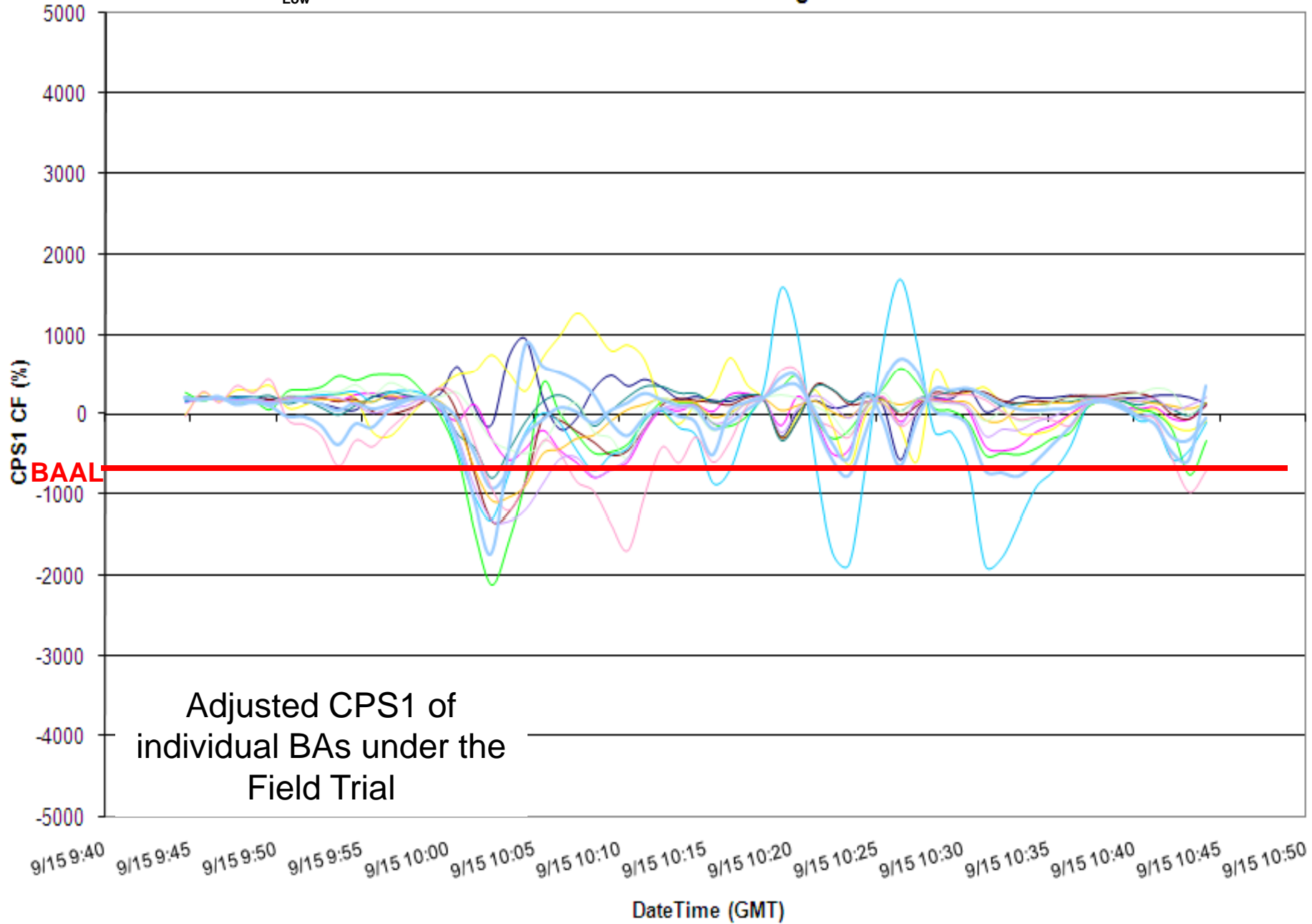


Clock-minute Actual Frequency of Participants

9/15/2010 ending 6:04 EDT

4-minute duration below FTL<sub>Low</sub>

### ACPS1 One-Minute Averages

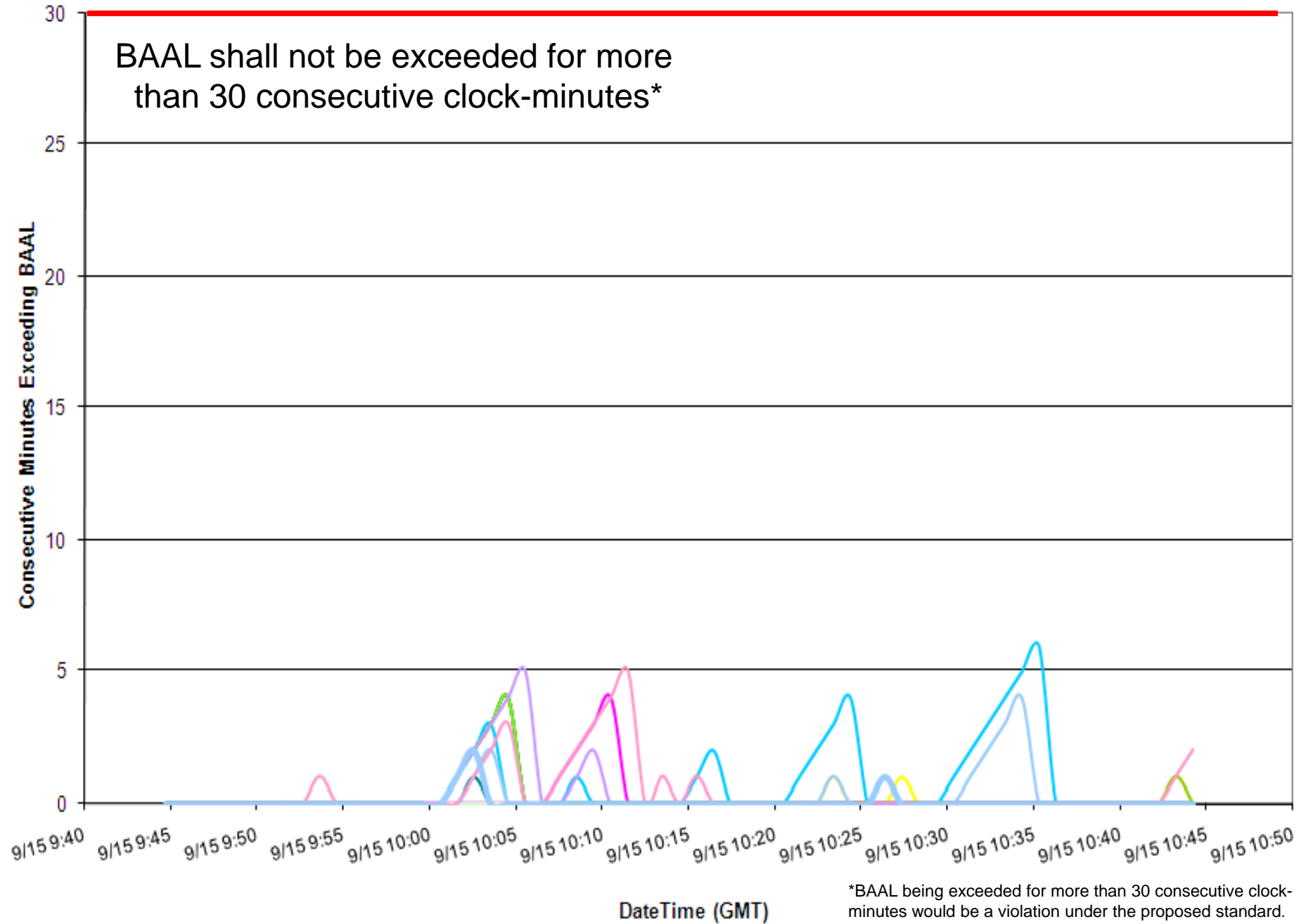


9/15/2010 ending 6:04 EDT

4-minute duration below FTL<sub>Low</sub>

Consecutive Minutes Exceeding BAAL

BAAL Violation\*



# Balancing Authority ACE Limit Proof-of-Concept Field Trial

Examples of circumstances when BAAL was exceeded and actions taken if appropriate

Clock-minute of ACE exceeding the BAAL (mm/dd/yy hh:mm)	Clock-minute of ACE returning within the BAAL (mm/dd/yy hh:mm)	TimeZone	Total duration of ACE exceeding the BAAL (minutes)	Event associated with a DCS-Reportable Event? (0=No, 1=Yes)	Event associated with a resource loss other than a DCS-Reportable Event? (0=No, 1=Yes)	Brief explanation of circumstances and notable actions taken if applicable
9/6/10 6:03	9/6/10 6:25	CDT	0:22	0	0	System was experiencing low load with large coal units on minimums coupled with high frequency. Curtailed wind farms 80 MW to reduce ACE within BAAL.
9/7/10 11:32	9/7/10 11:46	EST	0:14	0	0	Generation was unable to keep up with the Steel load. The operator increased generation to return ACE within acceptable bounds.
9/9/10 21:42	9/9/10 21:52	CDT	0:10	0	1	ACE @ +400-500 and units on AGC can't ramp down fast enough to make a difference. Schedule change @ 22:00 @ +467 and @ 22:05 +467 totalling +934 going out. M_Unit 3 having unit issues (clogged polishers) and had to hold load. P_Unit 1 unstable due to hydraulic leak and had to keep stable. S_Unit 2 holding load @ 100 due to cleaning water box and can't move load.  Instructed I_Unit 1 to manually drop load to help recover.
9/13/10 5:03	9/13/10 5:18	EST	0:15	0	0	BAAL Low Event. The frequency was low. Two generating units were coming up as the load was increasing. An industrial customer was generating load and the morning load was rising. Recovery was impacted by lighting load and the load from the industrial customer.
9/13/10 12:32	9/13/10 12:45	EPT	0:13	0	0	Generation failed to keep up with 300 mw out change
9/15/10 23:15	9/15/10 23:26	EPT	0:11	0	0	Generation failed to keep up with 300 instantaneous in change along with a 75 mw EIS in change over 5 minutes.

# **Balancing Authority ACE Limit Proof-of-Concept Field Trial**

## Discussion

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