

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

Eastern Interconnection Update Discussion  
July 29, 2011

**DISCUSSION STARTING AT 2:30 PM EDT**

Bob Klueber – Midwest ISO

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                     | 9/1/2005   |
| Associated Electric Cooperative, Inc. (AECI)             | -45                 | SERC              | TVA                     | 4/1/2010   |
| Duke Energy Carolinas (DUK)                              | -196                | SERC              | VACS                    | 4/1/2009   |
| East Kentucky Power Cooperative (EKPC)                   | -42.73              | SERC              | TVA                     | 7/6/2005   |
| Entergy (EES)  | -227.1              | SERC              | ICTE                    | 7/6/2005   |
| LGE-KU (LGEE)  | -74                 | SERC              | TVA                     | 4/1/2008   |
| Independent Electricity System Operator (IESO)           | -245.8              | NPCC              | IESO                    | 3/1/2008   |
| Manitoba Hydro (MHEB)                                    | -43.3               | MRO               | MISO                    | 7/6/2005   |
| MISO (MISO)  | -1038.6             | MRO, RFC,<br>SERC | MISO                    | 1/6/2009   |
| PJM Interconnection (PJM)                                | -1358               | RFC               | PJM                     | 8/1/2005   |
| Santee Cooper (SC)                                       | -61.52              | SERC              | VACS                    | 3/1/2006   |
| Southern Company (SOCO)                                  | -445                | SERC              | SOCO                    | 10/15/2005 |
| Tennessee Valley Authority (TVA)                         | -317.6              | SERC              | TVA                     | 10/1/2005  |

# 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 |               | June 2011 Performance under Field Trial |               |
|------|--|---------------|---|---------------|
|      | Max MinCtLow   | Max MinCtHigh | Max MinCtLow                            | Max MinCtHigh |
| BA01 | 26   | 16            | 11                                      | 8             |
| BA02 | 17   | 17            | 5                                       | 9             |
| BA03 | 19   | 19            | 11                                      | 12            |
| BA04 | 10   | 20            | 8                                       | 10            |
| BA05 | 16   | 22            | 7                                       | 13            |
| BA06 | 15   | 23            | 4                                       | 8             |
| BA07 | 20   | 24            | 6                                       | 5             |
| BA08 | 28   | 26            | 16                                      | 18            |
| BA09 | 30   | 26            | 24                                      | 23            |
| BA10 | 24   | 31            | 24                                      | 18            |
| BA11 | 14   | 32            | 2                                       | 3             |
| BA12 | 29   | 40            | 18                                      | 23            |
| BA13 | 28   | 43            | 7                                       | 20            |

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<br>FTL_Low at<br>59.98 Hz<br>SF | Total<br>Minutes<br>FTL_Low at<br>60 Hz SF | Total<br>FTL_Low<br>Minutes | Percentage<br>Low During<br>TEC | FTL_Low<br>Events | FTL_Low<br>Max<br>Duration | Total<br>Minutes<br>FTL_High at<br>60.02 Hz<br>SF | Total<br>Minutes<br>FTL_High at<br>60 Hz SF | Total<br>FTL_High<br>Minutes | Percentage<br>High During<br>TEC | FTL_High<br>Events | FTL_High<br>Max<br>Duration | Total FTL_Low<br>and FTL_High<br>Minutes at 60<br>Hz SF | Total FTL_Low<br>and FTL_High<br>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                                       |

# 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 |
|------|-------|--------------------------------------|-----------------------------------|-----------------------|---------------------------|----------------|----------------------|---------------------------------------|------------------------------------|------------------------|----------------------------|-----------------|-----------------------|--|------------------------------------|
| 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                                 |
| 2010 | 10    | 1                                    | 60                                | 61                    | 1.64%                     | 40             | 5                    | 0                                     | 19                                 | 19                     | 0.00%                      | 15              | 4                     | 79   | 80                                 |
| 2010 | 11    | 0                                    | 59                                | 59                    | 0.00%                     | 44             | 3                    | 5                                     | 26                                 | 31                     | 16.13%                     | 20              | 3                     | 85   | 90                                 |
| 2010 | 12    | 8                                    | 12                                | 20                    | 40.00%                    | 18             | 2                    | 3                                     | 30                                 | 33                     | 9.09%                      | 20              | 5                     | 42   | 53                                 |
| 2011 | 1     | 5                                    | 30                                | 35                    | 14.29%                    | 25             | 3                    | 0                                     | 9                                  | 9                      | 0.00%                      | 6               | 4                     | 39   | 44                                 |
| 2011 | 2     | 1                                    | 21                                | 22                    | 4.55%                     | 18             | 2                    | 0                                     | 22                                 | 22                     | 0.00%                      | 15              | 3                     | 43   | 44                                 |
| 2011 | 3     | 1                                    | 42                                | 43                    | 2.33%                     | 31             | 3                    | 0                                     | 19                                 | 19                     | 0.00%                      | 10              | 7                     | 61   | 62                                 |
| 2011 | 4     | 0                                    | 61                                | 61                    | 0.00%                     | 38             | 6                    | 0                                     | 32                                 | 32                     | 0.00%                      | 18              | 4                     | 93   | 93                                 |
| 2011 | 5     | 9                                    | 33                                | 42                    | 21.43%                    | 27             | 5                    | 0                                     | 25                                 | 25                     | 0.00%                      | 22              | 3                     | 58   | 67                                 |
| 2011 | 6     | 7                                    | 13                                | 20                    | 35.00%                    | 14             | 3                    | 0                                     | 10                                 | 10                     | 0.00%                      | 8               | 2                     | 23   | 30                                 |

## Frequency Statistics

## Eastern Interconnection

| Year | Month | Total Minutes FTL_Low at 59.98 Hz SF | Total Minutes FTL_Low at 60 Hz SF | 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 | FTL_High Max Duration | Total FTL_Low and FTL_High Minutes at 60 Hz SF | Total FTL_Low and FTL_High Minutes |
|------|-------|--------------------------------------|-----------------------------------|------|-------|--------------------------------------|-----------------------------------|-----------------------|---------------------------|----------------|----------------------|-----------------------|--|------------------------------------|
| 2008 | 1     | 0                                    | 75                                | 2008 | 1     | 0                                    | 75                                | 75                    | 0.00%                     | 34             | 8                    | 3                     | 34   | 76                                 |
| 2008 | 2     | 18                                   | 71                                | 2008 | 2     | 18                                   | 71                                | 89                    | 20.22%                    | 46             | 8                    | 6                     | 48   | 89                                 |
| 2008 | 3     | 37                                   | 65                                | 2008 | 3     | 37                                   | 65                                | 102                   | 36.27%                    | 55             | 6                    | 11                    | 99   | 124                                |
| 2008 | 4     | 41                                   | 65                                | 2008 | 4     | 41                                   | 65                                | 106                   | 38.68%                    | 60             | 5                    | 3                     | 60   | 95                                 |
| 2008 | 5     | 67                                   | 39                                | 2008 | 5     | 67                                   | 39                                | 106                   | 63.21%                    | 63             | 4                    | 4                     | 22   | 35                                 |
| 2008 | 6     | 40                                   | 21                                | 2008 | 6     | 40                                   | 21                                | 61                    | 65.57%                    | 34             | 5                    | 3                     | 45   | 61                                 |
| 2008 | 7     | 42                                   | 17                                | 2008 | 7     | 42                                   | 17                                | 59                    | 71.19%                    | 29             | 7                    | 3                     | 45   | 47                                 |
| 2008 | 8     | 41                                   | 19                                | 2008 | 8     | 41                                   | 19                                | 60                    | 68.33%                    | 35             | 5                    | 6                     | 52   | 52                                 |
| 2008 | 9     | 25                                   | 44                                | 2008 | 9     | 25                                   | 44                                | 69                    | 36.23%                    | 39             | 4                    | 9                     | 66   | 66                                 |
| 2008 | 10    | 35                                   | 33                                | 2008 | 10    | 35                                   | 33                                | 68                    | 51.47%                    | 38             | 5                    | 3                     | 86   | 86                                 |
| 2008 | 11    | 13                                   | 9                                 | 2008 | 11    | 13                                   | 9                                 | 22                    | 59.09%                    | 13             | 5                    | 8                     | 62   | 70                                 |
| 2008 | 12    | 16                                   | 34                                | 2008 | 12    | 16                                   | 34                                | 50                    | 32.00%                    | 35             | 4                    | 3                     | 53   | 83                                 |
| 2009 | 1     | 2                                    | 26                                | 2009 | 1     | 2                                    | 26                                | 28                    | 7.14%                     | 16             | 4                    | 6                     | 50   | 64                                 |
| 2009 | 2     | 0                                    | 34                                | 2009 | 2     | 0                                    | 34                                | 34                    | 0.00%                     | 18             | 4                    | 2                     | 23   | 39                                 |
| 2009 | 3     | 0                                    | 41                                | 2009 | 3     | 0                                    | 41                                | 41                    | 0.00%                     | 23             | 5                    | 4                     | 42   | 53                                 |
| 2009 | 4     | 0                                    | 59                                | 2009 | 4     | 0                                    | 59                                | 59                    | 0.00%                     | 37             | 5                    | 3                     | 63   | 107                                |
| 2009 | 5     | 8                                    | 35                                | 2009 | 5     | 8                                    | 35                                | 43                    | 18.60%                    | 31             | 4                    | 4                     | 53   | 83                                 |
| 2009 | 6     | 30                                   | 28                                | 2009 | 6     | 30                                   | 28                                | 58                    | 51.72%                    | 28             | 5                    | 3                     | 45   | 56                                 |
| 2009 | 7     | 14                                   | 22                                | 2009 | 7     | 14                                   | 22                                | 36                    | 38.89%                    | 22             | 3                    | 6                     | 111  | 149                                |
| 2009 | 8     | 16                                   | 10                                | 2009 | 8     | 16                                   | 10                                | 26                    | 61.54%                    | 20             | 2                    | 6                     | 92   | 155                                |
| 2009 | 9     | 11                                   | 22                                | 2009 | 9     | 11                                   | 22                                | 33                    | 33.33%                    | 21             | 3                    | 4                     | 70   | 142                                |
| 2009 | 10    | 44                                   | 45                                | 2009 | 10    | 44                                   | 45                                | 89                    | 49.44%                    | 44             | 6                    | 2                     | 38   | 48                                 |
| 2009 | 11    | 30                                   | 19                                | 2009 | 11    | 30                                   | 19                                | 49                    | 61.22%                    | 33             | 3                    | 5                     | 49   | 57                                 |
| 2009 | 12    | 11                                   | 23                                | 2009 | 12    | 11                                   | 23                                | 34                    | 32.35%                    | 20             | 5                    | 3                     | 46   | 62                                 |
| 2010 | 1     | 36                                   | 26                                | 2010 | 1     | 36                                   | 26                                | 62                    | 58.06%                    | 35             | 6                    | 4                     | 78   | 78                                 |
| 2010 | 2     | 23                                   | 16                                | 2010 | 2     | 23                                   | 16                                | 39                    | 58.97%                    | 24             | 3                    | 4                     | 79   | 80                                 |
| 2010 | 3     | 38                                   | 71                                | 2010 | 3     | 38                                   | 71                                | 109                   | 34.86%                    | 65             | 6                    | 3                     | 85   | 90                                 |
| 2010 | 4     | 63                                   | 38                                | 2010 | 4     | 63                                   | 38                                | 101                   | 62.38%                    | 65             | 5                    | 5                     | 42   | 53                                 |
| 2010 | 5     | 72                                   | 30                                | 2010 | 5     | 72                                   | 30                                | 102                   | 70.59%                    | 60             | 6                    | 4                     | 39   | 44                                 |
| 2010 | 6     | 10                                   | 28                                | 2010 | 6     | 10                                   | 28                                | 38                    | 26.32%                    | 27             | 2                    | 3                     | 43   | 44                                 |
| 2010 | 7     | 8                                    | 19                                | 2010 | 7     | 8                                    | 19                                | 27                    | 29.63%                    | 17             | 4                    | 7                     | 61   | 62                                 |
| 2010 | 8     | 16                                   | 29                                | 2010 | 8     | 16                                   | 29                                | 45                    | 35.56%                    | 24             | 4                    | 4                     | 93   | 93                                 |
| 2010 | 9     | 0                                    | 56                                | 2010 | 9     | 0                                    | 56                                | 56                    | 0.00%                     | 31             | 4                    | 3                     | 58   | 67                                 |
| 2010 | 10    | 1                                    | 60                                | 2010 | 10    | 1                                    | 60                                | 61                    | 1.64%                     | 40             | 5                    | 2                     | 23   | 30                                 |
| 2010 | 11    | 0                                    | 59                                | 2010 | 11    | 0                                    | 59                                | 59                    | 0.00%                     | 44             | 3                    |                       |  |                                    |
| 2010 | 12    | 8                                    | 12                                | 2010 | 12    | 8                                    | 12                                | 20                    | 40.00%                    | 18             | 2                    |                       |  |                                    |
| 2011 | 1     | 5                                    | 30                                | 2011 | 1     | 5                                    | 30                                | 35                    | 14.29%                    | 25             | 3                    |                       |  |                                    |
| 2011 | 2     | 1                                    | 21                                | 2011 | 2     | 1                                    | 21                                | 22                    | 4.55%                     | 18             | 2                    |                       |  |                                    |
| 2011 | 3     | 1                                    | 42                                | 2011 | 3     | 1                                    | 42                                | 43                    | 2.33%                     | 31             | 3                    |                       |  |                                    |
| 2011 | 4     | 0                                    | 61                                | 2011 | 4     | 0                                    | 61                                | 61                    | 0.00%                     | 38             | 6                    |                       |  |                                    |
| 2011 | 5     | 9                                    | 33                                | 2011 | 5     | 9                                    | 33                                | 42                    | 21.43%                    | 27             | 5                    |                       |  |                                    |
| 2011 | 6     | 7                                    | 13                                | 2011 | 6     | 7                                    | 13                                | 20                    | 35.00%                    | 14             | 3                    |                       |  |                                    |

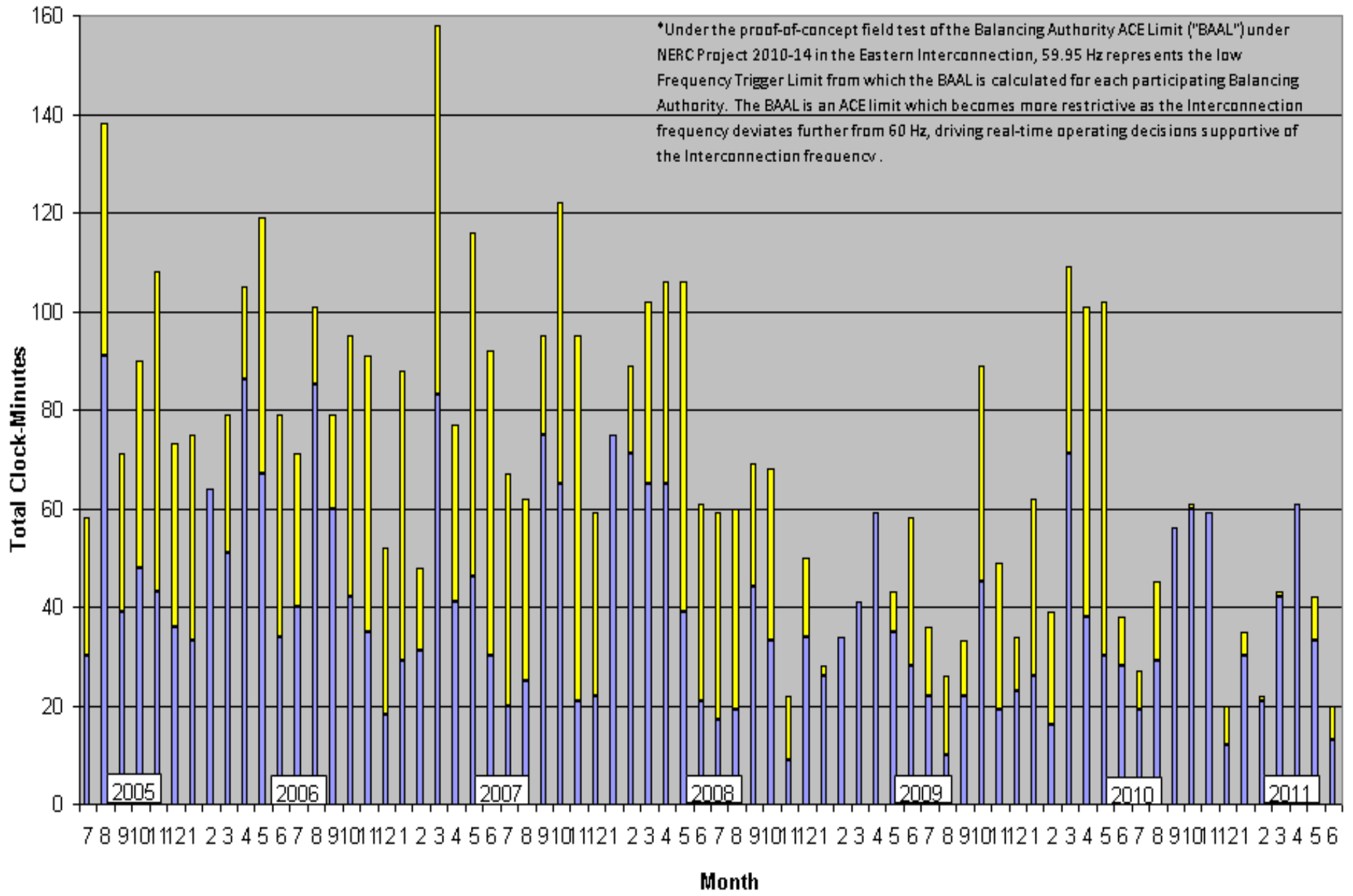
# Frequency Statistics

# Eastern Interconnection

| Year | Month | Month | Year | Month | 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 | Year | Month | Total FTL_Low and FTL_High Minutes |
|------|-------|-------|------|-------|---------------------------------------|------------------------------------|------------------------|----------------------------|-----------------|-----------------------|--|------------------------------------|------|-------|------------------------------------|
| 2008 | 1     | 1     | 2008 | 1     | 0                                     | 48                                 | 48                     | 0.00%                      | 24              | 4                     | 123  | 123                                | 2008 | 1     | 76                                 |
| 2008 | 2     | 2     | 2008 | 2     | 0                                     | 51                                 | 51                     | 0.00%                      | 24              | 8                     | 122  | 140                                | 2008 | 2     | 89                                 |
| 2008 | 3     | 3     | 2008 | 3     | 0                                     | 40                                 | 40                     | 0.00%                      | 34              | 2                     | 105  | 142                                | 2008 | 3     | 124                                |
| 2008 | 4     | 4     | 2008 | 4     | 0                                     | 59                                 | 59                     | 0.00%                      | 33              | 6                     | 124  | 165                                | 2008 | 4     | 95                                 |
| 2008 | 5     | 5     | 2008 | 5     | 0                                     | 40                                 | 40                     | 0.00%                      | 20              | 5                     | 79   | 146                                | 2008 | 5     | 35                                 |
| 2008 | 6     | 6     | 2008 | 6     | 0                                     | 35                                 | 35                     | 0.00%                      | 19              | 5                     | 56   | 96                                 | 2008 | 6     | 61                                 |
| 2008 | 7     | 7     | 2008 | 7     | 0                                     | 17                                 | 17                     | 0.00%                      | 12              | 3                     | 34   | 76                                 | 2008 | 7     | 47                                 |
| 2008 | 8     | 8     | 2008 | 8     | 0                                     | 29                                 | 29                     | 0.00%                      | 17              | 6                     | 48   | 89                                 | 2008 | 8     | 52                                 |
| 2008 | 9     | 9     | 2008 | 9     | 0                                     | 55                                 | 55                     | 0.00%                      | 21              | 11                    | 99   | 124                                | 2008 | 9     | 66                                 |
| 2008 | 10    | 10    | 2008 | 10    | 0                                     | 27                                 | 27                     | 0.00%                      | 19              | 3                     | 60   | 95                                 | 2008 | 10    | 86                                 |
| 2008 | 11    | 11    | 2008 | 11    | 0                                     | 13                                 | 13                     | 0.00%                      | 9               | 4                     | 22   | 35                                 | 2008 | 11    | 70                                 |
| 2008 | 12    | 12    | 2008 | 12    | 0                                     | 11                                 | 11                     | 0.00%                      | 8               | 3                     | 45   | 61                                 | 2008 | 12    | 83                                 |
| 2009 | 1     | 1     | 2009 | 1     | 0                                     | 19                                 | 19                     | 0.00%                      | 9               | 3                     | 45   | 47                                 | 2009 | 1     | 64                                 |
| 2009 | 2     | 2     | 2009 | 2     | 0                                     | 18                                 | 18                     | 0.00%                      | 11              | 6                     | 52   | 52                                 | 2009 | 2     | 39                                 |
| 2009 | 3     | 3     | 2009 | 3     | 0                                     | 25                                 | 25                     | 0.00%                      | 11              | 9                     | 66   | 66                                 | 2009 | 3     | 53                                 |
| 2009 | 4     | 4     | 2009 | 4     | 0                                     | 27                                 | 27                     | 0.00%                      | 20              | 3                     | 86   | 86                                 | 2009 | 4     | 107                                |
| 2009 | 5     | 5     | 2009 | 5     | 0                                     | 27                                 | 27                     | 0.00%                      | 15              | 8                     | 62   | 70                                 | 2009 | 5     | 83                                 |
| 2009 | 6     | 6     | 2009 | 6     | 0                                     | 25                                 | 25                     | 0.00%                      | 16              | 3                     | 53   | 83                                 | 2009 | 6     | 56                                 |
| 2009 | 7     | 7     | 2009 | 7     | 0                                     | 28                                 | 28                     | 0.00%                      | 16              | 6                     | 50   | 64                                 | 2009 | 7     | 78                                 |
| 2009 | 8     | 8     | 2009 | 8     | 0                                     | 13                                 | 13                     | 0.00%                      | 10              | 2                     | 23   | 39                                 | 2009 | 8     | 65                                 |
| 2009 | 9     | 9     | 2009 | 9     | 0                                     | 20                                 | 20                     | 0.00%                      | 14              | 4                     | 42   | 53                                 | 2009 | 9     | 149                                |
| 2009 | 10    | 10    | 2009 | 10    | 0                                     | 18                                 | 18                     | 0.00%                      | 10              | 3                     | 63   | 107                                | 2009 | 10    | 155                                |
| 2009 | 11    | 11    | 2009 | 11    | 0                                     | 34                                 | 34                     | 0.00%                      | 21              | 4                     | 53   | 83                                 | 2009 | 11    | 70                                 |
| 2009 | 12    | 12    | 2009 | 12    | 0                                     | 22                                 | 22                     | 0.00%                      | 15              | 3                     | 45   | 56                                 | 2009 | 12    | 142                                |
| 2010 | 1     | 1     | 2010 | 1     | 0                                     | 16                                 | 16                     | 0.00%                      | 9               | 3                     | 42   | 78                                 | 2010 | 1     | 48                                 |
| 2010 | 2     | 2     | 2010 | 2     | 0                                     | 26                                 | 26                     | 0.00%                      | 16              | 2                     | 42   | 65                                 | 2010 | 2     | 57                                 |
| 2010 | 3     | 3     | 2010 | 3     | 0                                     | 40                                 | 40                     | 0.00%                      | 22              | 6                     | 111  | 149                                | 2010 | 3     | 62                                 |
| 2010 | 4     | 4     | 2010 | 4     | 0                                     | 54                                 | 54                     | 0.00%                      | 34              | 6                     | 92   | 155                                | 2010 | 4     | 78                                 |
| 2010 | 5     | 5     | 2010 | 5     | 0                                     | 40                                 | 40                     | 0.00%                      | 29              | 4                     | 70   | 142                                | 2010 | 5     | 80                                 |
| 2010 | 6     | 6     | 2010 | 6     | 0                                     | 10                                 | 10                     | 0.00%                      | 9               | 2                     | 38   | 48                                 | 2010 | 6     | 90                                 |
| 2010 | 7     | 7     | 2010 | 7     | 0                                     | 30                                 | 30                     | 0.00%                      | 13              | 5                     | 49   | 57                                 | 2010 | 7     | 53                                 |
| 2010 | 8     | 8     | 2010 | 8     | 0                                     | 17                                 | 17                     | 0.00%                      | 11              | 3                     | 46   | 62                                 | 2010 | 8     | 44                                 |
| 2010 | 9     | 9     | 2010 | 9     | 0                                     | 22                                 | 22                     | 0.00%                      | 11              | 4                     | 78   | 78                                 | 2010 | 9     | 44                                 |
| 2010 | 10    | 10    | 2010 | 10    | 0                                     | 19                                 | 19                     | 0.00%                      | 15              | 4                     | 79   | 80                                 | 2010 | 10    | 62                                 |
| 2010 | 11    | 11    | 2010 | 11    | 5                                     | 26                                 | 31                     | 16.13%                     | 20              | 3                     | 85   | 90                                 | 2010 | 11    | 93                                 |
| 2010 | 12    | 12    | 2010 | 12    | 3                                     | 30                                 | 33                     | 9.09%                      | 20              | 5                     | 42   | 53                                 | 2010 | 12    | 67                                 |
| 2011 | 1     | 1     | 2011 | 1     | 0                                     | 9                                  | 9                      | 0.00%                      | 6               | 4                     | 39   | 44                                 | 2011 | 1     | 30                                 |
| 2011 | 2     | 2     | 2011 | 2     | 0                                     | 22                                 | 22                     | 0.00%                      | 15              | 3                     | 43   | 44                                 | 2011 | 2     | 67                                 |
| 2011 | 3     | 3     | 2011 | 3     | 0                                     | 19                                 | 19                     | 0.00%                      | 10              | 7                     | 61   | 62                                 | 2011 | 3     | 23                                 |
| 2011 | 4     | 4     | 2011 | 4     | 0                                     | 32                                 | 32                     | 0.00%                      | 18              | 4                     | 93   | 93                                 | 2011 | 4     |                                    |
| 2011 | 5     | 5     | 2011 | 5     | 0                                     | 25                                 | 25                     | 0.00%                      | 22              | 3                     | 58   | 67                                 | 2011 | 5     |                                    |
| 2011 | 6     | 6     | 2011 | 6     | 0                                     | 10                                 | 10                     | 0.00%                      | 8               | 2                     | 23   | 30                                 | 2011 | 6     |                                    |

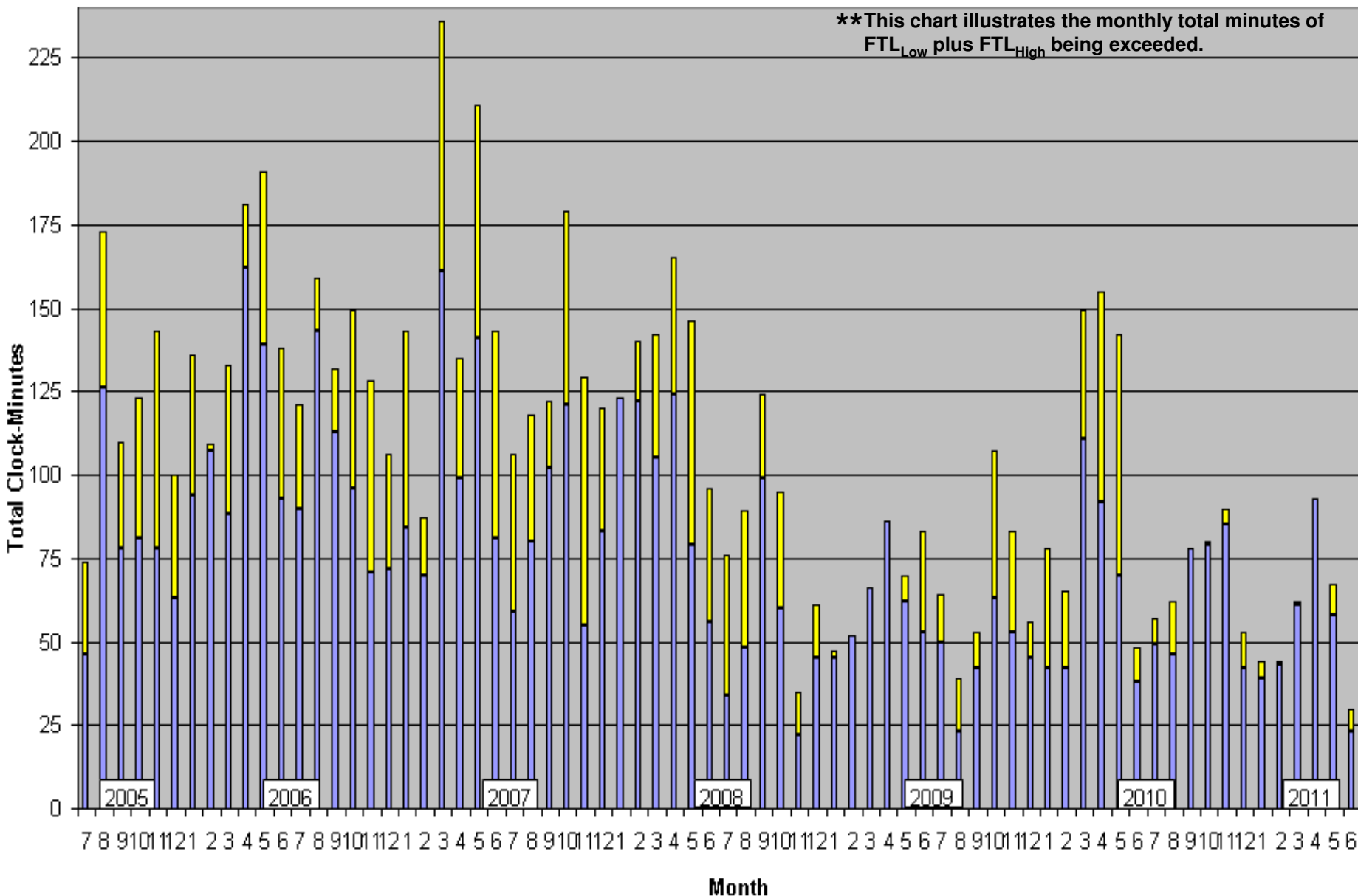
### Total Clock-Minutes of Frequency below 59.95 Hz\*

\*Under the proof-of-concept field test of the Balancing Authority ACE Limit ("BAAL") under NERC Project 2010-14 in the Eastern Interconnection, 59.95 Hz represents the low Frequency Trigger Limit from which the BAAL is calculated for each participating Balancing Authority. The BAAL is an ACE limit which becomes more restrictive as the Interconnection frequency deviates further from 60 Hz, driving real-time operating decisions supportive of the Interconnection frequency.



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

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



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

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

| BA    | Date     | Time  | Time Zone | Freq Error | Actual Freq | Sched Freq | MinCt Low | MinCt High | ACPS1    |
|-------|----------|-------|-----------|------------|-------------|------------|-----------|------------|----------|
| BA-14 | 06/01/11 | 0:24  | EDT       | -0.0300    | 59.9700     | 60         | 11        | 0          | -2264.07 |
| BA-14 | 06/01/11 | 0:25  | EDT       | -0.0300    | 59.9700     | 60         | 12        | 0          | -2200.61 |
| BA-14 | 06/01/11 | 0:26  | EDT       | -0.0300    | 59.9700     | 60         | 13        | 0          | -2039.74 |
| BA-14 | 06/01/11 | 0:27  | EDT       | -0.0300    | 59.9700     | 60         | 14        | 0          | -1866.35 |
| BA-14 | 06/01/11 | 0:28  | EDT       | -0.0300    | 59.9700     | 60         | 15        | 0          | -1627.72 |
| BA-14 | 06/01/11 | 0:29  | EDT       | -0.0300    | 59.9700     | 60         | 16        | 0          | -1599.12 |
| BA-14 | 06/01/11 | 0:30  | EDT       | -0.0300    | 59.9700     | 60         | 17        | 0          | -1649.17 |
| BA-14 | 06/01/11 | 0:31  | EDT       | -0.0300    | 59.9700     | 60         | 18        | 0          | -1810.05 |
| BA-14 | 06/01/11 | 0:32  | EDT       | -0.0300    | 59.9700     | 60         | 19        | 0          | -1760.89 |
| BA-14 | 06/01/11 | 0:33  | EDT       | -0.0300    | 59.9700     | 60         | 20        | 0          | -1545.50 |
| BA-14 | 06/01/11 | 0:34  | EDT       | -0.0300    | 59.9700     | 60         | 21        | 0          | -1329.21 |
| BA-14 | 06/01/11 | 0:35  | EDT       | -0.0300    | 59.9700     | 60         | 22        | 0          | -1086.11 |
| BA-14 | 06/01/11 | 0:36  | EDT       | -0.0300    | 59.9700     | 60         | 23        | 0          | -784.02  |
| BA-14 | 06/01/11 | 0:37  | EDT       | -0.0300    | 59.9700     | 60         | 24        | 0          | -624.93  |
| BA-23 | 06/01/11 | 1:42  | EST       | 0.0211     | 60.0211     | 60         | 0         | 11         | -1746.11 |
| BA-23 | 06/01/11 | 1:43  | EST       | 0.0115     | 60.0115     | 60         | 0         | 12         | -944.10  |
| BA-23 | 06/01/11 | 1:44  | EST       | 0.0182     | 60.0182     | 60         | 0         | 13         | -1555.25 |
| BA-23 | 06/01/11 | 1:45  | EST       | 0.0227     | 60.0227     | 60         | 0         | 14         | -1998.36 |
| BA-23 | 06/01/11 | 1:46  | EST       | 0.0233     | 60.0233     | 60         | 0         | 15         | -2417.95 |
| BA-23 | 06/01/11 | 1:47  | EST       | 0.0115     | 60.0115     | 60         | 0         | 16         | -963.98  |
| BA-23 | 06/01/11 | 1:48  | EST       | 0.0122     | 60.0122     | 60         | 0         | 17         | -770.71  |
| BA-23 | 06/01/11 | 1:49  | EST       | 0.0121     | 60.0121     | 60         | 0         | 18         | -921.35  |
| BA-23 | 06/01/11 | 1:50  | EST       | 0.0117     | 60.0117     | 60         | 0         | 19         | -1111.16 |
| BA-23 | 06/01/11 | 1:51  | EST       | 0.0239     | 60.0239     | 60         | 0         | 20         | -2525.20 |
| BA-23 | 06/01/11 | 1:52  | EST       | 0.0239     | 60.0239     | 60         | 0         | 21         | -2463.92 |
| BA-23 | 06/01/11 | 1:53  | EST       | 0.0219     | 60.0219     | 60         | 0         | 22         | -2076.65 |
| BA-23 | 06/01/11 | 1:54  | EST       | 0.0286     | 60.0286     | 60         | 0         | 23         | -2159.28 |
| BA-18 | 06/01/11 | 11:40 | CDT       | -0.0284    | 59.9716     | 60         | 11        | 0          | -2488.40 |
| BA-18 | 06/01/11 | 11:41 | CDT       | -0.0181    | 59.9819     | 60         | 12        | 0          | -1588.45 |
| BA-18 | 06/01/11 | 11:42 | CDT       | -0.0131    | 59.9869     | 60         | 13        | 0          | -1061.13 |
| BA-18 | 06/01/11 | 11:43 | CDT       | -0.0085    | 59.9915     | 60         | 14        | 0          | -585.63  |
| BA-18 | 06/01/11 | 11:44 | CDT       | -0.0095    | 59.9905     | 60         | 15        | 0          | -687.96  |
| BA-18 | 06/01/11 | 11:45 | CDT       | -0.0239    | 59.9761     | 60         | 16        | 0          | -2116.18 |
| BA-18 | 06/01/11 | 11:46 | CDT       | -0.0216    | 59.9784     | 60         | 17        | 0          | -1903.14 |
| BA-18 | 06/01/11 | 11:47 | CDT       | -0.0126    | 59.9874     | 60         | 18        | 0          | -1028.75 |
| BA-18 | 06/01/11 | 11:48 | CDT       | -0.0220    | 59.9780     | 60         | 19        | 0          | -1976.09 |
| BA-18 | 06/01/11 | 11:49 | CDT       | -0.0260    | 59.9740     | 60         | 20        | 0          | -2483.39 |
| BA-18 | 06/01/11 | 11:50 | CDT       | -0.0294    | 59.9706     | 60         | 21        | 0          | -2877.36 |
| BA-18 | 06/01/11 | 11:51 | CDT       | -0.0262    | 59.9738     | 60         | 22        | 0          | -2522.66 |
| BA-18 | 06/01/11 | 11:52 | CDT       | -0.0222    | 59.9778     | 60         | 23        | 0          | -2212.12 |
| BA-18 | 06/01/11 | 11:53 | CDT       | -0.0135    | 59.9865     | 60         | 24        | 0          | -1068.78 |

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

Periods of the FTL being exceeded for 3 consecutive clock minutes or more:

| PrevailingTime | PTimeZone | FreqError | ActualFreq | SchedFreq |
|----------------|-----------|-----------|------------|-----------|
| 6/3/11 10:21   | EDT       | -0.0619   | 59.9381    | 60        |
| 6/3/11 10:22   | EDT       | -0.0586   | 59.9414    | 60        |
| 6/3/11 10:23   | EDT       | -0.0545   | 59.9455    | 60        |

| BA    | Date     | Time  | Time Zone | Freq Error | Actual Freq | Sched Freq | MinCt Low | MinCt High | ACPS1    |
|-------|----------|-------|-----------|------------|-------------|------------|-----------|------------|----------|
| BA-18 | 06/02/11 | 0:41  | CDT       | 0.0501     | 60.0501     | 60         | 0         | 11         | -4382.65 |
| BA-18 | 06/02/11 | 0:42  | CDT       | 0.0421     | 60.0421     | 60         | 0         | 12         | -3525.55 |
| BA-18 | 06/02/11 | 0:43  | CDT       | 0.0351     | 60.0351     | 60         | 0         | 13         | -2821.03 |
| BA-18 | 06/02/11 | 0:44  | CDT       | 0.0359     | 60.0359     | 60         | 0         | 14         | -3001.65 |
| BA-18 | 06/02/11 | 0:45  | CDT       | 0.0317     | 60.0317     | 60         | 0         | 15         | -2540.78 |
| BA-18 | 06/02/11 | 0:46  | CDT       | 0.0332     | 60.0332     | 60         | 0         | 16         | -2644.26 |
| BA-18 | 06/02/11 | 0:47  | CDT       | 0.0269     | 60.0269     | 60         | 0         | 17         | -2050.17 |
| BA-18 | 06/02/11 | 0:48  | CDT       | 0.0178     | 60.0178     | 60         | 0         | 18         | -1109.60 |
| BA-18 | 06/04/11 | 8:10  | CDT       | -0.0223    | 59.9777     | 60         | 11        | 0          | -3276.07 |
| BA-18 | 06/04/11 | 8:11  | CDT       | -0.0211    | 59.9789     | 60         | 12        | 0          | -2654.70 |
| BA-18 | 06/04/11 | 8:12  | CDT       | -0.0149    | 59.9851     | 60         | 13        | 0          | -1536.09 |
| BA-18 | 06/04/11 | 8:13  | CDT       | -0.0167    | 59.9833     | 60         | 14        | 0          | -1243.39 |
| BA-18 | 06/04/11 | 8:14  | CDT       | -0.0174    | 59.9826     | 60         | 15        | 0          | -1059.85 |
| BA-18 | 06/04/11 | 8:15  | CDT       | -0.0196    | 59.9804     | 60         | 16        | 0          | -890.59  |
| BA-18 | 06/04/11 | 21:50 | CDT       | 0.0248     | 60.0248     | 60         | 0         | 11         | -1637.93 |
| BA-18 | 06/04/11 | 21:51 | CDT       | 0.0225     | 60.0225     | 60         | 0         | 12         | -1522.58 |
| BA-18 | 06/04/11 | 21:52 | CDT       | 0.0224     | 60.0224     | 60         | 0         | 13         | -1548.51 |
| BA-18 | 06/04/11 | 21:53 | CDT       | 0.0198     | 60.0198     | 60         | 0         | 14         | -1452.01 |
| BA-18 | 06/04/11 | 21:54 | CDT       | 0.0181     | 60.0181     | 60         | 0         | 15         | -1418.69 |
| BA-18 | 06/04/11 | 21:55 | CDT       | 0.0367     | 60.0367     | 60         | 0         | 16         | -3499.69 |
| BA-18 | 06/04/11 | 21:56 | CDT       | 0.0413     | 60.0413     | 60         | 0         | 17         | -4064.11 |
| BA-18 | 06/04/11 | 21:57 | CDT       | 0.0239     | 60.0239     | 60         | 0         | 18         | -1821.15 |
| BA-18 | 06/04/11 | 21:58 | CDT       | 0.0217     | 60.0217     | 60         | 0         | 19         | -1238.39 |
| BA-18 | 06/04/11 | 21:59 | CDT       | 0.0206     | 60.0206     | 60         | 0         | 20         | -918.57  |
| BA-18 | 06/04/11 | 22:00 | CDT       | 0.0286     | 60.0286     | 60         | 0         | 21         | -1255.14 |
| BA-18 | 06/04/11 | 22:01 | CDT       | 0.0305     | 60.0305     | 60         | 0         | 22         | -1436.44 |
| BA-18 | 06/04/11 | 22:02 | CDT       | 0.0184     | 60.0184     | 60         | 0         | 23         | -815.66  |
| BA-04 | 06/05/11 | 6:07  | CDT       | 0.0179     | 60.0179     | 60         | 0         | 11         | -1427.36 |
| BA-04 | 06/05/11 | 6:08  | CDT       | 0.0301     | 60.0301     | 60         | 0         | 12         | -2721.76 |
| BA-04 | 06/05/11 | 6:09  | CDT       | 0.0313     | 60.0313     | 60         | 0         | 13         | -2737.34 |
| BA-04 | 06/05/11 | 6:10  | CDT       | 0.0339     | 60.0339     | 60         | 0         | 14         | -2450.29 |
| BA-04 | 06/05/11 | 6:11  | CDT       | 0.0359     | 60.0359     | 60         | 0         | 15         | -2354.15 |
| BA-04 | 06/05/11 | 6:12  | CDT       | 0.0380     | 60.0380     | 60         | 0         | 16         | -2712.61 |
| BA-04 | 06/05/11 | 6:13  | CDT       | 0.0397     | 60.0397     | 60         | 0         | 17         | -2713.35 |
| BA-04 | 06/05/11 | 6:14  | CDT       | 0.0309     | 60.0309     | 60         | 0         | 18         | -2118.61 |
| BA-04 | 06/05/11 | 6:15  | CDT       | 0.0212     | 60.0212     | 60         | 0         | 19         | -1269.05 |
| BA-04 | 06/05/11 | 6:16  | CDT       | 0.0136     | 60.0136     | 60         | 0         | 20         | -686.79  |

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

| BA    | Date     | Time  | Time Zone | Freq Error | Actual Freq | Sched Freq | MinCt Low | MinCt High | ACPS1    |
|-------|----------|-------|-----------|------------|-------------|------------|-----------|------------|----------|
| BA-14 | 06/05/11 | 7:09  | EDT       | 0.0300     | 60.0300     | 60         | 0         | 11         | -2718.99 |
| BA-14 | 06/05/11 | 7:10  | EDT       | 0.0320     | 60.0320     | 60         | 0         | 12         | -2802.05 |
| BA-14 | 06/05/11 | 7:11  | EDT       | 0.0340     | 60.0340     | 60         | 0         | 13         | -2849.90 |
| BA-14 | 06/05/11 | 7:12  | EDT       | 0.0360     | 60.0360     | 60         | 0         | 14         | -2618.53 |
| BA-14 | 06/05/11 | 7:13  | EDT       | 0.0390     | 60.0390     | 60         | 0         | 15         | -2444.43 |
| BA-14 | 06/05/11 | 7:14  | EDT       | 0.0410     | 60.0410     | 60         | 0         | 16         | -2324.76 |
| BA-14 | 06/05/11 | 7:15  | EDT       | 0.0320     | 60.0320     | 60         | 0         | 17         | -1536.02 |
| BA-14 | 06/05/11 | 7:16  | EDT       | 0.0230     | 60.0230     | 60         | 0         | 18         | -811.37  |
| BA-18 | 06/06/11 | 22:14 | CDT       | 0.0072     | 60.0072     | 60         | 0         | 11         | -575.05  |
| BA-18 | 06/06/11 | 22:15 | CDT       | 0.0105     | 60.0105     | 60         | 0         | 12         | -956.83  |
| BA-18 | 06/06/11 | 22:16 | CDT       | 0.0265     | 60.0265     | 60         | 0         | 13         | -2805.60 |
| BA-18 | 06/06/11 | 22:17 | CDT       | 0.0355     | 60.0355     | 60         | 0         | 14         | -3939.12 |
| BA-18 | 06/06/11 | 22:18 | CDT       | 0.0406     | 60.0406     | 60         | 0         | 15         | -4526.48 |
| BA-18 | 06/06/11 | 22:19 | CDT       | 0.0371     | 60.0371     | 60         | 0         | 16         | -3939.74 |
| BA-18 | 06/06/11 | 22:20 | CDT       | 0.0360     | 60.0360     | 60         | 0         | 17         | -3688.71 |
| BA-18 | 06/06/11 | 22:21 | CDT       | 0.0408     | 60.0408     | 60         | 0         | 18         | -3992.30 |
| BA-18 | 06/06/11 | 22:22 | CDT       | 0.0383     | 60.0383     | 60         | 0         | 19         | -3643.40 |
| BA-18 | 06/06/11 | 22:23 | CDT       | 0.0248     | 60.0248     | 60         | 0         | 20         | -2106.16 |
| BA-13 | 06/16/11 | 15:16 | EST       | -0.0260    | 59.9740     | 60         | 11        | 0          | -1637.97 |
| BA-13 | 06/16/11 | 15:17 | EST       | -0.0290    | 59.9710     | 60         | 12        | 0          | -1340.68 |
| BA-13 | 06/16/11 | 15:18 | EST       | -0.0290    | 59.9710     | 60         | 13        | 0          | -1344.87 |
| BA-13 | 06/16/11 | 15:19 | EST       | -0.0290    | 59.9710     | 60         | 14        | 0          | -1246.35 |
| BA-13 | 06/16/11 | 15:20 | EST       | -0.0280    | 59.9720     | 60         | 15        | 0          | -1311.84 |
| BA-13 | 06/16/11 | 15:21 | EST       | -0.0150    | 59.9850     | 60         | 16        | 0          | -640.27  |
| BA-23 | 06/16/11 | 15:17 | EST       | -0.0260    | 59.9740     | 60         | 11        | 0          | -1815.33 |
| BA-23 | 06/16/11 | 15:18 | EST       | -0.0289    | 59.9711     | 60         | 12        | 0          | -2390.70 |
| BA-23 | 06/16/11 | 15:19 | EST       | -0.0287    | 59.9713     | 60         | 13        | 0          | -2312.25 |
| BA-23 | 06/16/11 | 15:20 | EST       | -0.0277    | 59.9723     | 60         | 14        | 0          | -2127.01 |
| BA-23 | 06/16/11 | 15:21 | EST       | -0.0280    | 59.9720     | 60         | 15        | 0          | -1847.26 |
| BA-23 | 06/16/11 | 15:22 | EST       | -0.0152    | 59.9848     | 60         | 16        | 0          | -1137.37 |
| BA-23 | 06/16/11 | 15:23 | EST       | -0.0089    | 59.9911     | 60         | 17        | 0          | -571.46  |
| BA-23 | 06/16/11 | 15:24 | EST       | -0.0179    | 59.9821     | 60         | 18        | 0          | -1315.10 |
| BA-18 | 06/23/11 | 22:08 | CDT       | -0.0156    | 59.9844     | 60         | 11        | 0          | -2286.95 |
| BA-18 | 06/23/11 | 22:09 | CDT       | -0.0086    | 59.9914     | 60         | 12        | 0          | -1151.62 |
| BA-18 | 06/23/11 | 22:10 | CDT       | -0.0125    | 59.9875     | 60         | 13        | 0          | -1749.72 |
| BA-18 | 06/23/11 | 22:11 | CDT       | -0.0088    | 59.9912     | 60         | 14        | 0          | -1130.96 |
| BA-18 | 06/23/11 | 22:12 | CDT       | -0.0157    | 59.9843     | 60         | 15        | 0          | -2186.48 |
| BA-18 | 06/23/11 | 22:13 | CDT       | -0.0090    | 59.9910     | 60         | 16        | 0          | -1098.50 |

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

| BA    | Date     | Time  | Time Zone | Freq Error | Actual Freq | Sched Freq | MinCt Low | MinCt High | ACPS1    |
|-------|----------|-------|-----------|------------|-------------|------------|-----------|------------|----------|
| BA-18 | 06/25/11 | 11:40 | CDT       | -0.0200    | 59.9800     | 60         | 11        | 0          | -2742.10 |
| BA-18 | 06/25/11 | 11:41 | CDT       | -0.0265    | 59.9735     | 60         | 12        | 0          | -3841.04 |
| BA-18 | 06/25/11 | 11:42 | CDT       | -0.0214    | 59.9786     | 60         | 13        | 0          | -2996.88 |
| BA-18 | 06/25/11 | 11:43 | CDT       | -0.0194    | 59.9806     | 60         | 14        | 0          | -2722.99 |
| BA-18 | 06/25/11 | 11:44 | CDT       | -0.0286    | 59.9714     | 60         | 15        | 0          | -4048.16 |
| BA-18 | 06/25/11 | 11:45 | CDT       | -0.0280    | 59.9720     | 60         | 16        | 0          | -3817.43 |
| BA-18 | 06/25/11 | 11:46 | CDT       | -0.0123    | 59.9877     | 60         | 17        | 0          | -1524.01 |
| BA-13 | 06/27/11 | 15:58 | EST       | 0.0580     | 60.0580     | 60         | 0         | 11         | -1577.55 |
| BA-13 | 06/27/11 | 15:59 | EST       | 0.0580     | 60.0580     | 60         | 0         | 12         | -1196.04 |
| BA-13 | 06/27/11 | 16:00 | EST       | 0.0520     | 60.0520     | 60         | 0         | 13         | -874.97  |
| BA-13 | 06/27/11 | 16:01 | EST       | 0.0490     | 60.0490     | 60         | 0         | 14         | -912.12  |
| BA-13 | 06/27/11 | 16:02 | EST       | 0.0440     | 60.0440     | 60         | 0         | 15         | -865.43  |
| BA-13 | 06/27/11 | 16:03 | EST       | 0.0390     | 60.0390     | 60         | 0         | 16         | -606.23  |
| BA-13 | 06/27/11 | 16:04 | EST       | 0.0410     | 60.0410     | 60         | 0         | 17         | -629.79  |
| BA-13 | 06/27/11 | 16:05 | EST       | 0.0460     | 60.0460     | 60         | 0         | 18         | -578.04  |
| BA-18 | 06/30/11 | 8:24  | CDT       | -0.0117    | 59.9883     | 60         | 11        | 0          | -991.54  |
| BA-18 | 06/30/11 | 8:25  | CDT       | -0.0198    | 59.9802     | 60         | 12        | 0          | -1796.21 |
| BA-18 | 06/30/11 | 8:26  | CDT       | -0.0167    | 59.9833     | 60         | 13        | 0          | -1493.22 |
| BA-18 | 06/30/11 | 8:27  | CDT       | -0.0206    | 59.9794     | 60         | 14        | 0          | -1858.87 |
| BA-18 | 06/30/11 | 8:28  | CDT       | -0.0149    | 59.9851     | 60         | 15        | 0          | -1250.74 |
| BA-18 | 06/30/11 | 8:29  | CDT       | -0.0082    | 59.9918     | 60         | 16        | 0          | -572.01  |

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

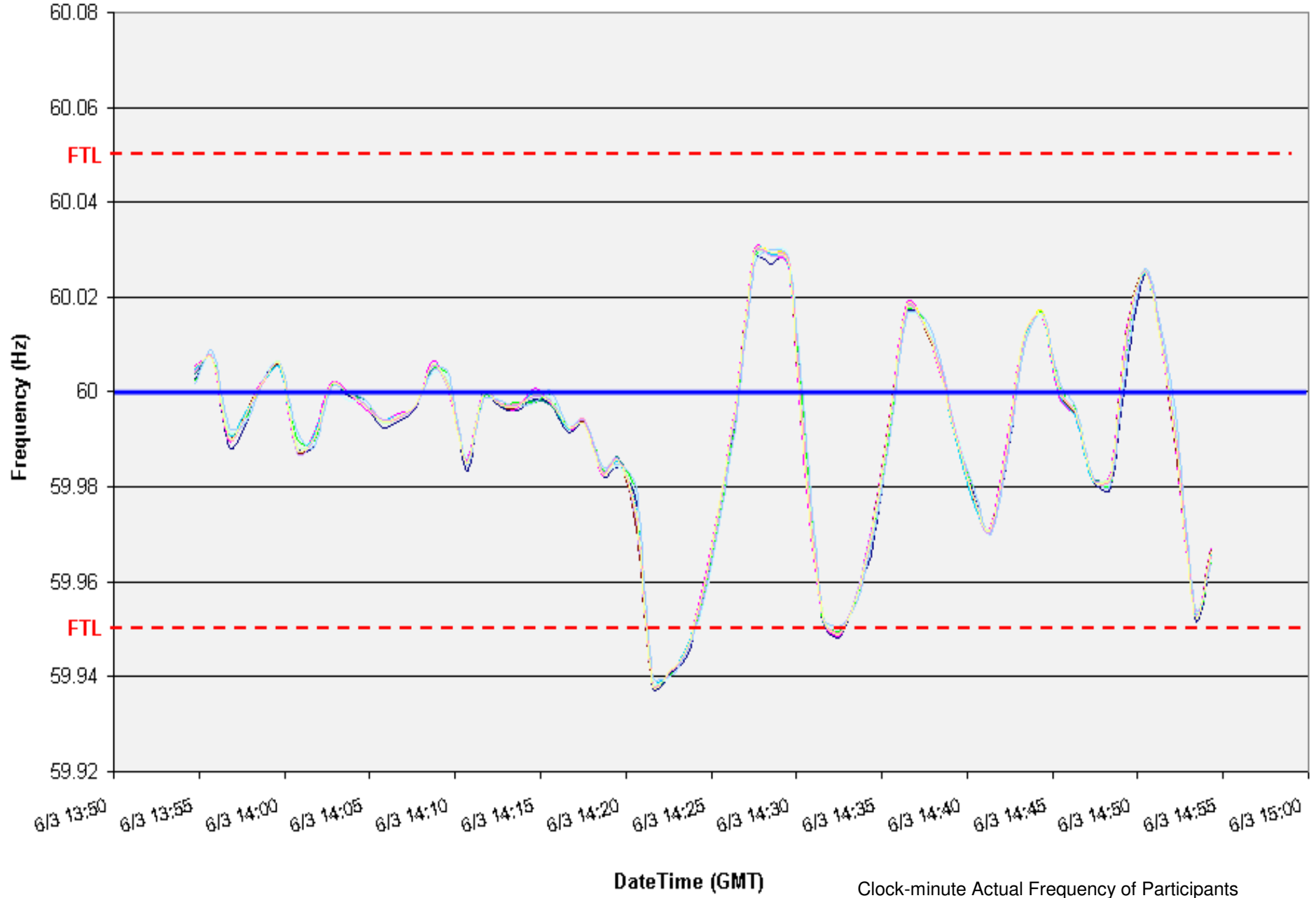


# EXAMPLE 1

06/03/2011 ending 10:23 EDT

3-minute duration below  $FTL_{Low}$

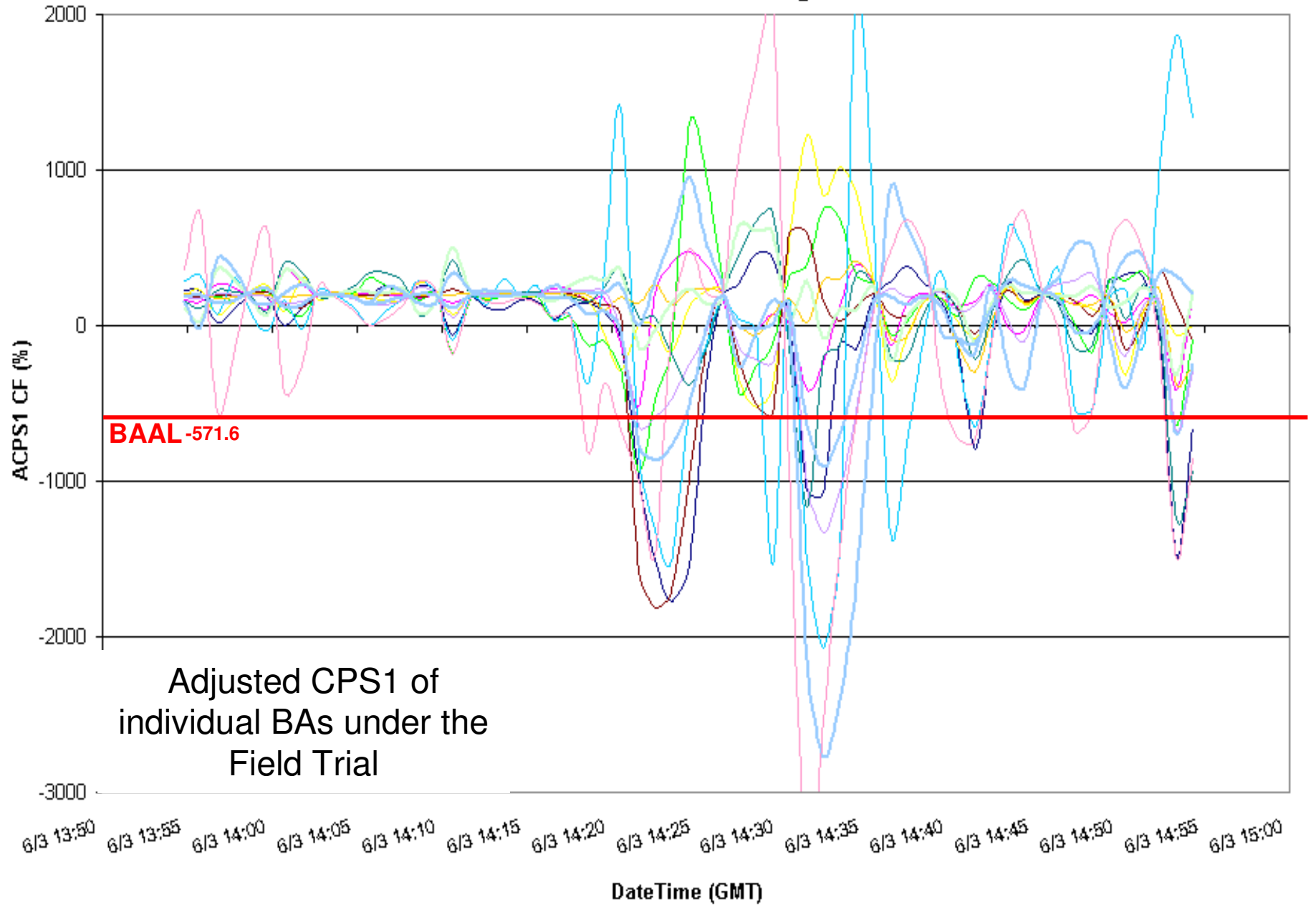
### EI Clock-Minute Average Frequency



06/03/2011 ending 10:23 EDT

3-minute duration below  $FTL_{Low}$

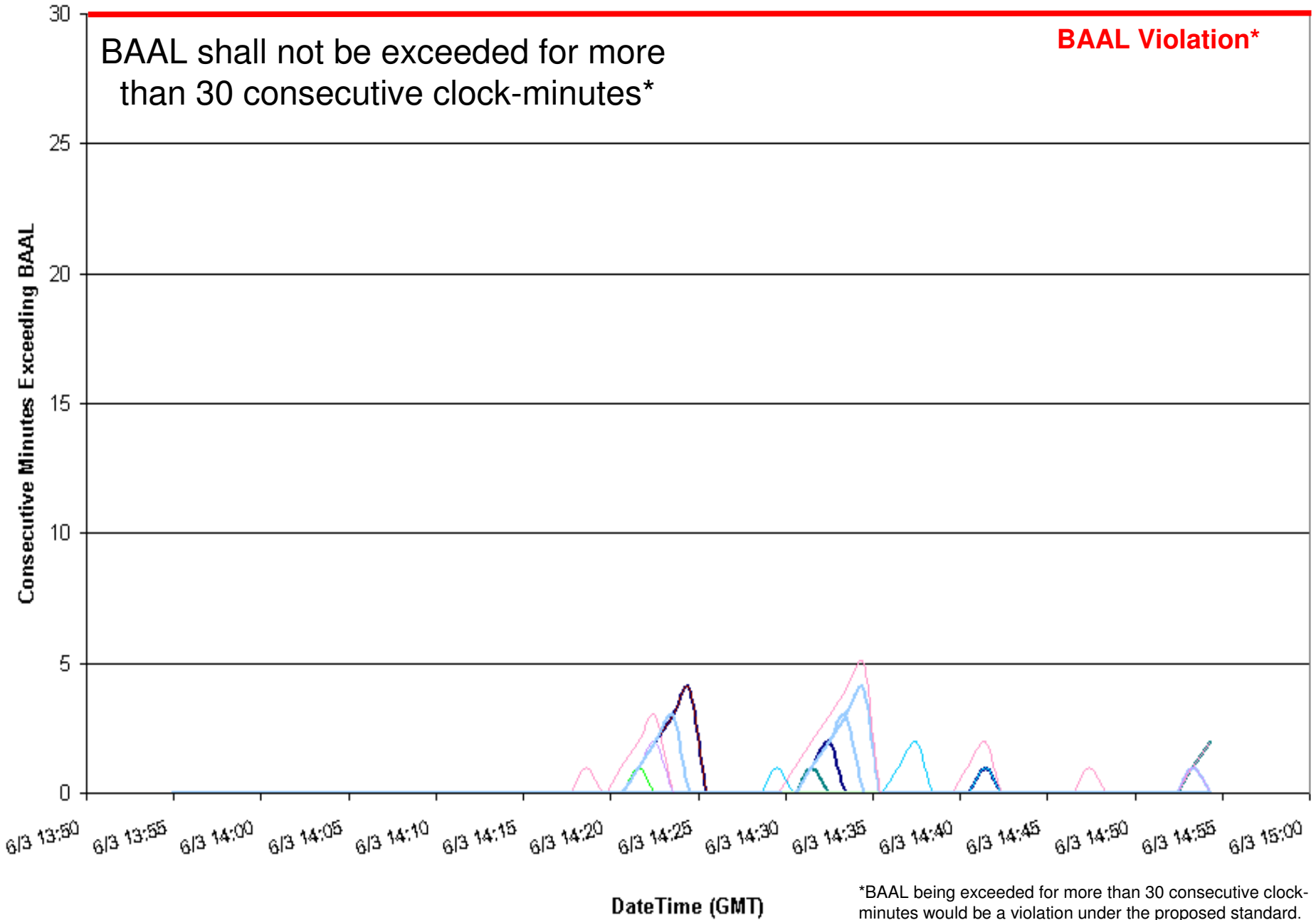
### ACPS1 Clock-Minute Averages



06/03/2011 ending 10:23 EDT

3-minute duration below  $FTL_{Low}$

### Consecutive Minutes Exceeding BAAL



# EXAMPLE 2

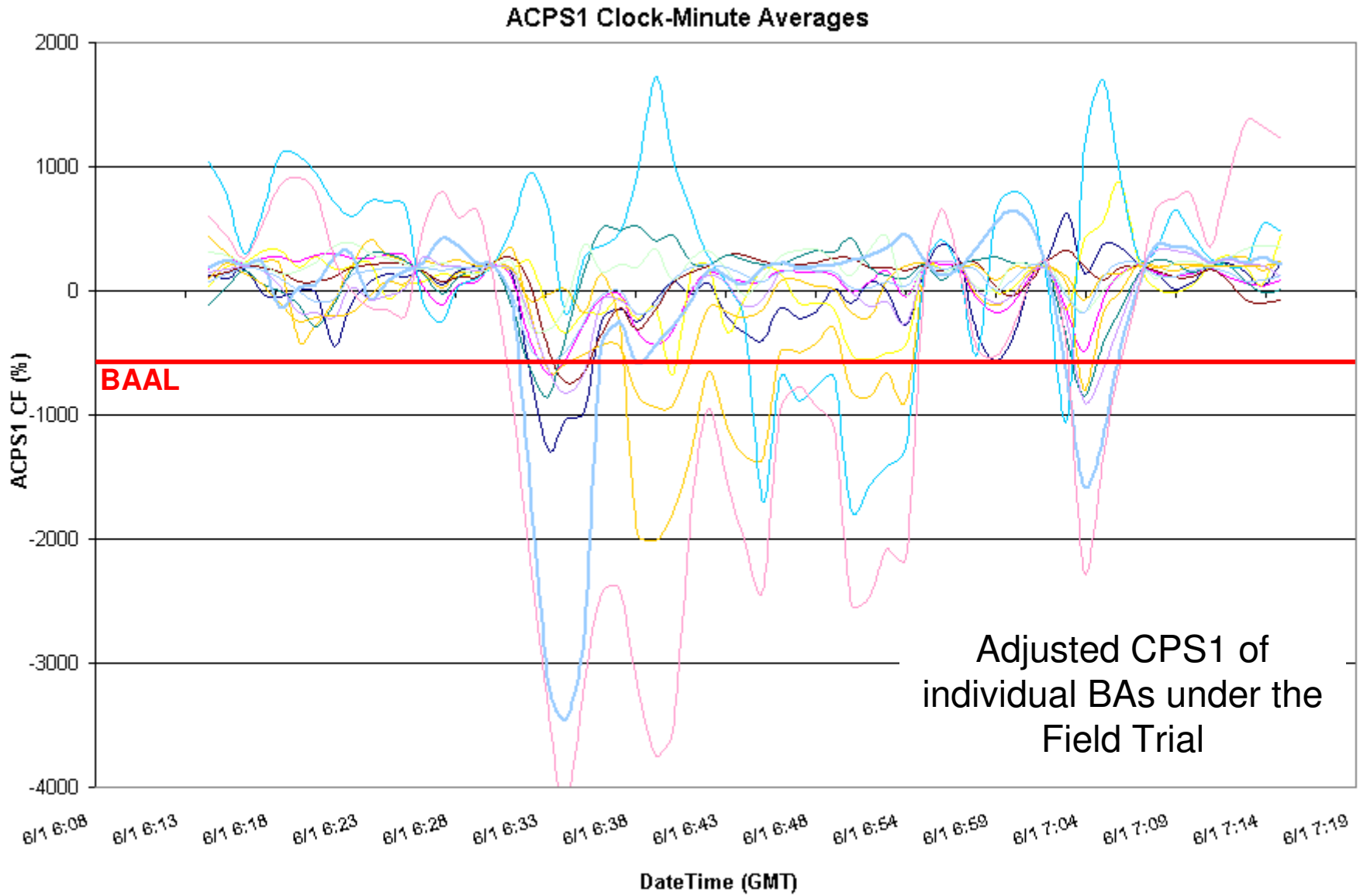
06/01/2011 ending 01:54 EST  
23-minute duration above BAAL<sub>High</sub>

### EI Clock-Minute Average Frequency



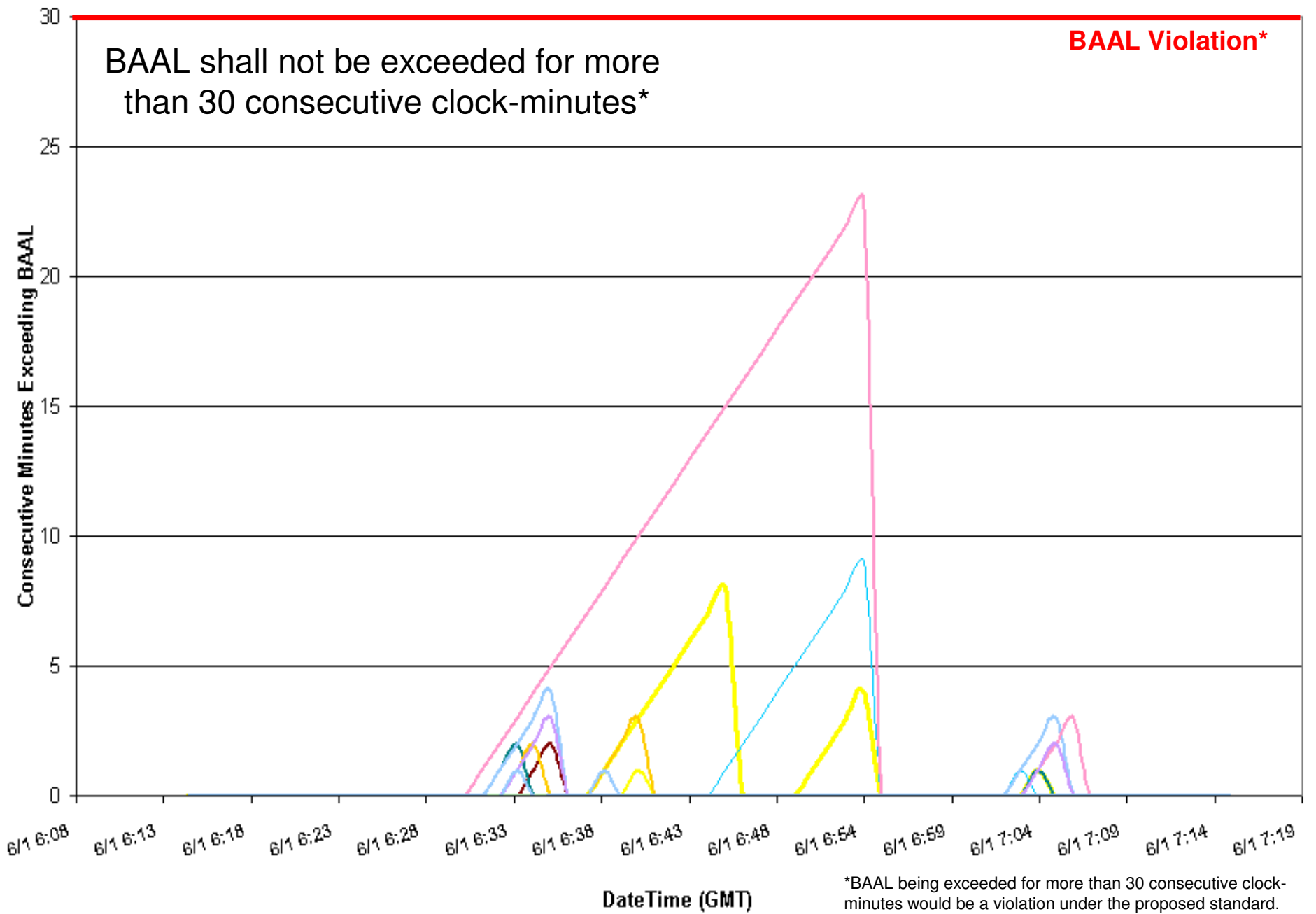
Clock-minute Actual Frequency of Participants

06/01/2011 ending 01:54 EST  
23-minute duration above BAAL<sub>High</sub>



06/01/2011 ending 01:54 EST  
23-minute duration above BAAL<sub>High</sub>

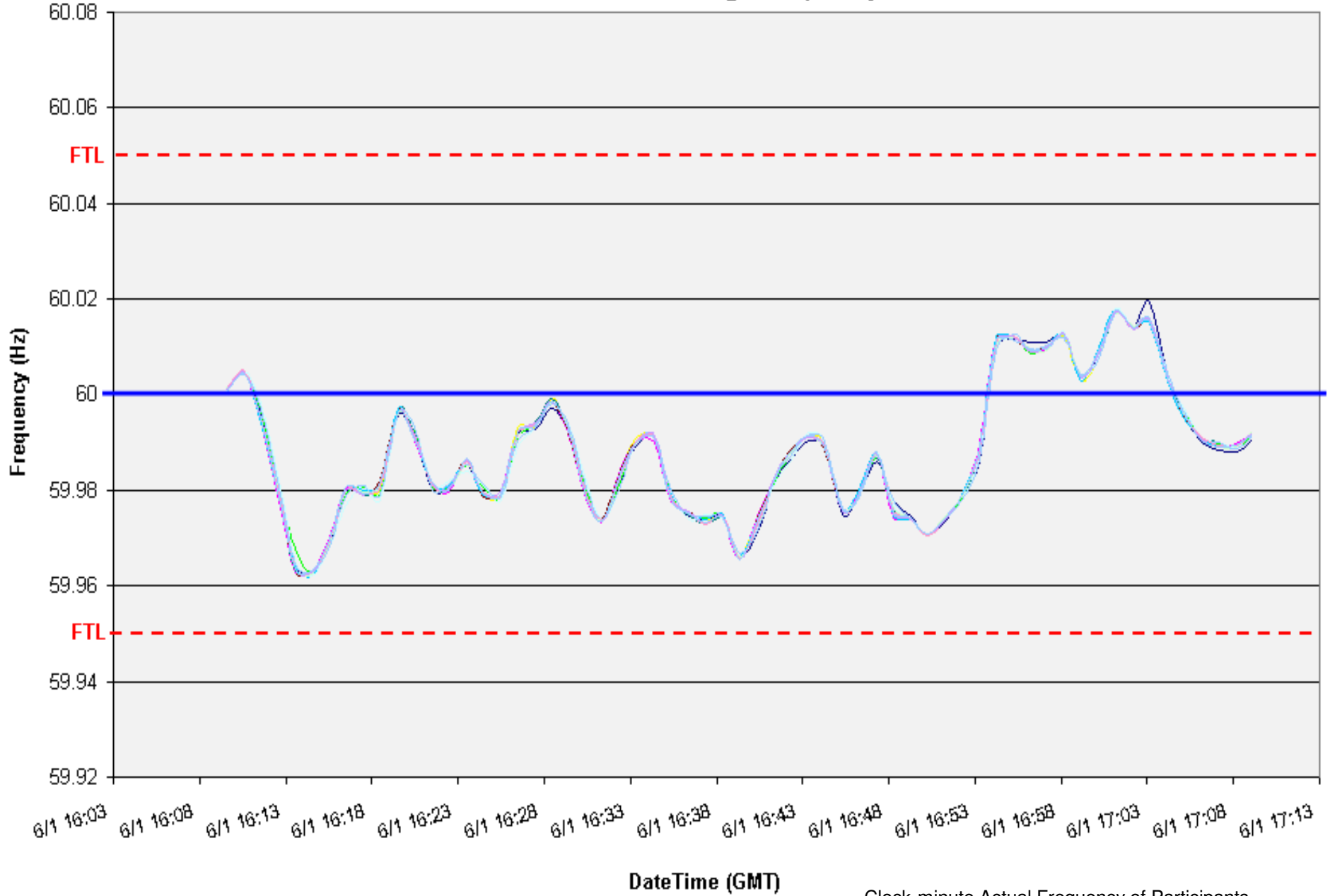
### Consecutive Minutes Exceeding BAAL



# EXAMPLE 3

06/01/2011 ending 11:53 CDT  
24-minute duration below BAAL<sub>Low</sub>

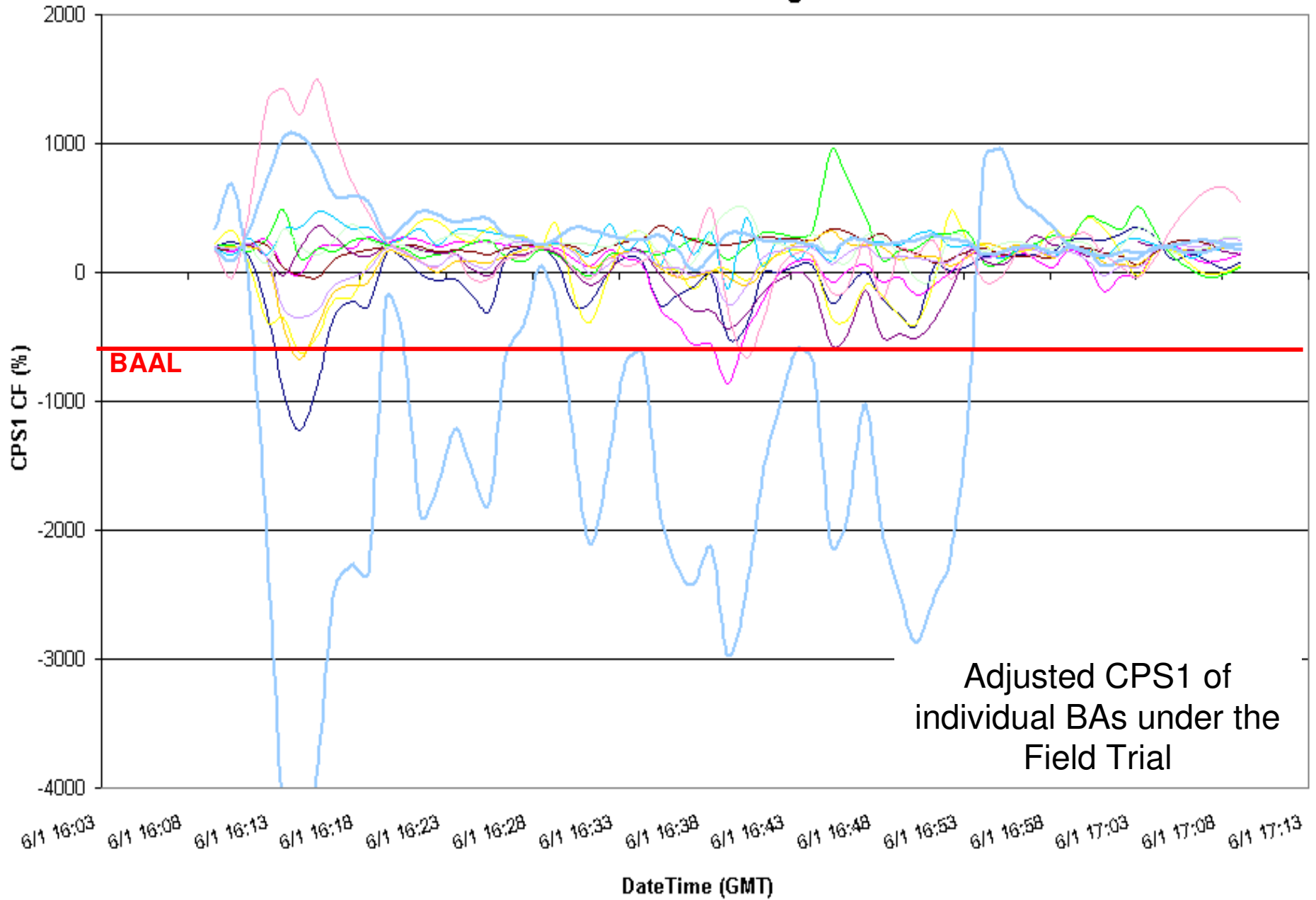
### EI Clock-Minute Average Frequency



Clock-minute Actual Frequency of Participants

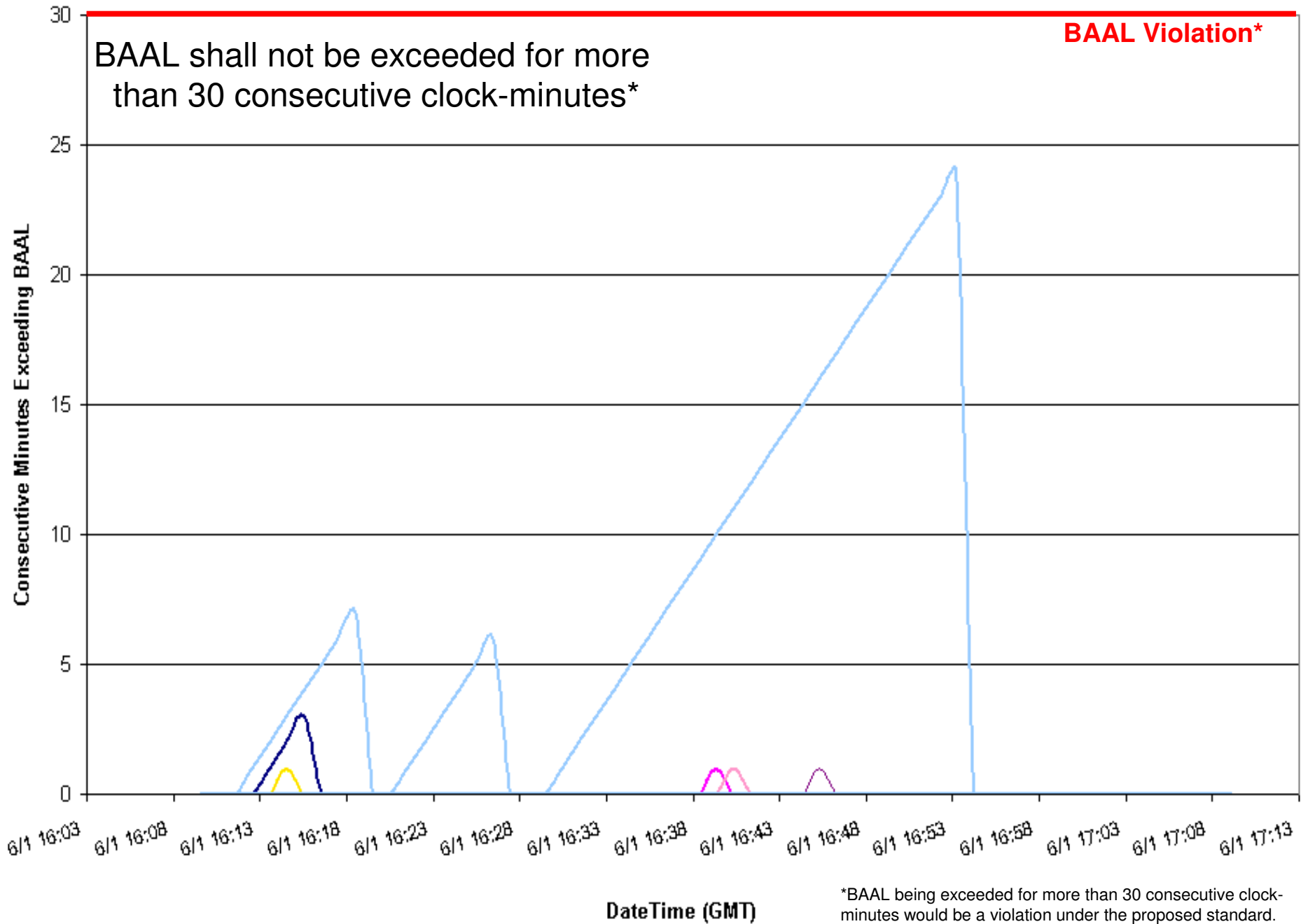
06/01/2011 ending 11:53 CDT  
24-minute duration below BAAL<sub>Low</sub>

### ACPS1 One-Minute Averages



06/01/2011 ending 11:53 CDT  
24-minute duration below BAAL<sub>Low</sub>

### Consecutive Minutes Exceeding BAAL

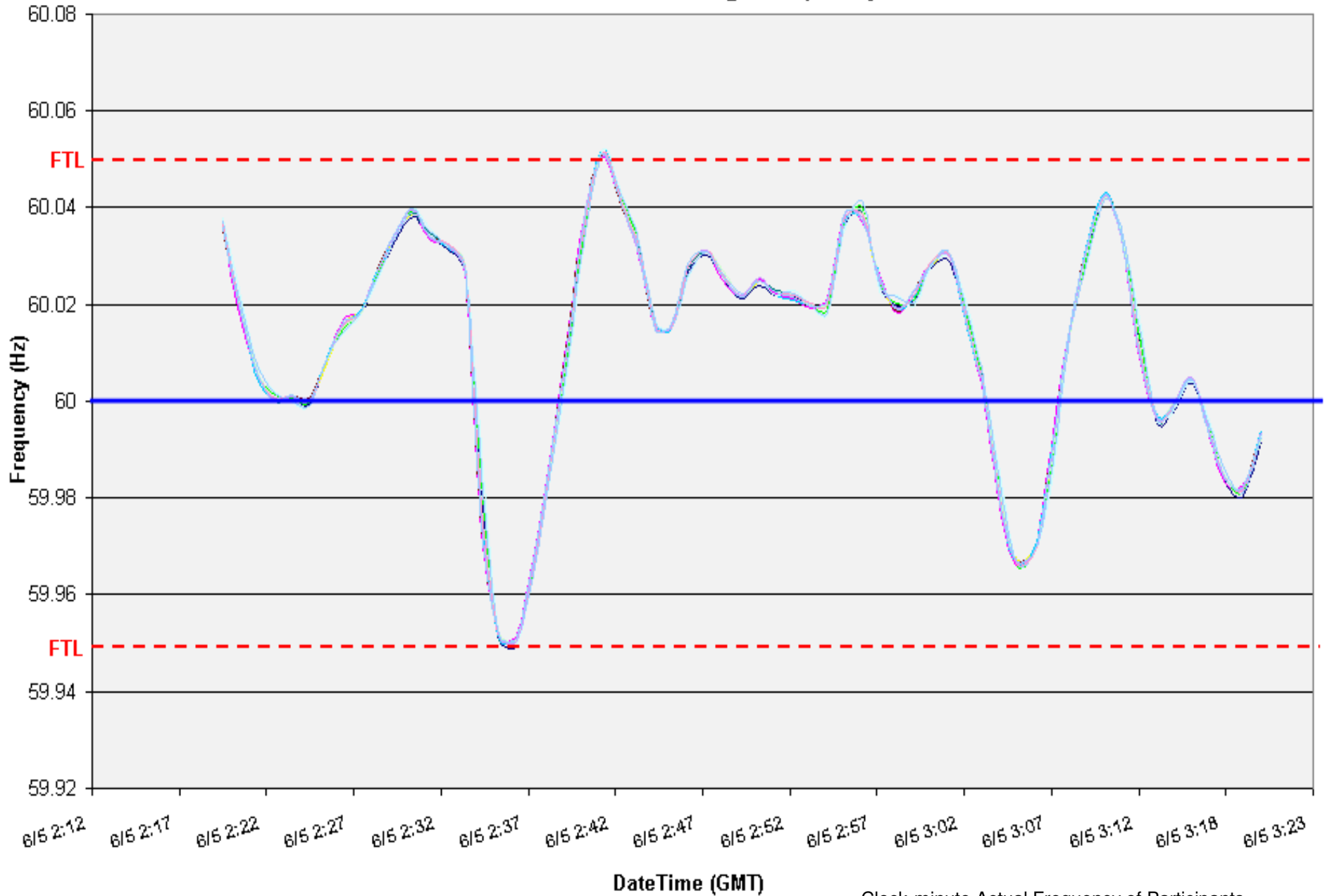


# EXAMPLE 4

06/04/2011 ending 22:02 CDT

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

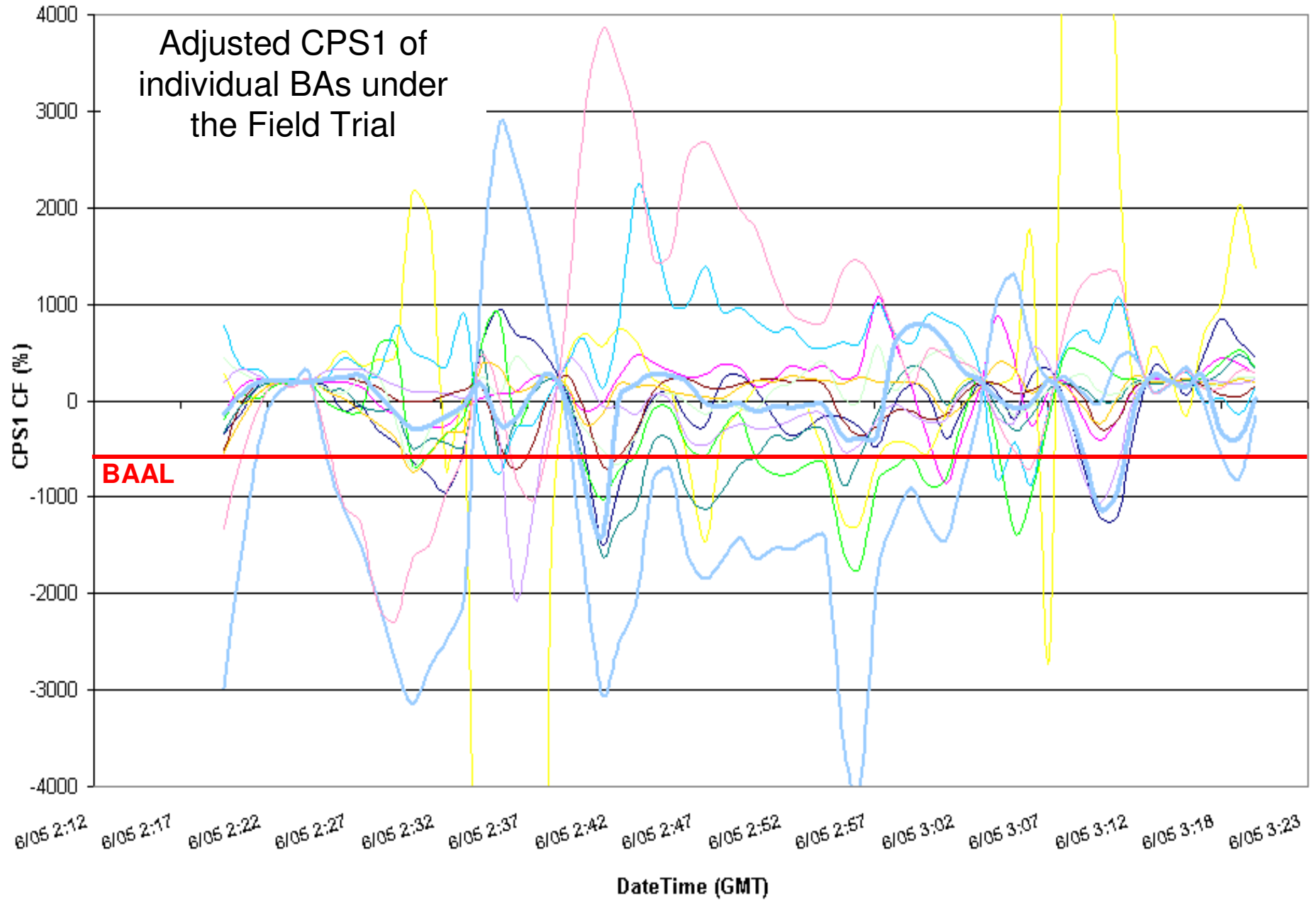
### EI Clock-Minute Average Frequency



Clock-minute Actual Frequency of Participants

06/04/2011 ending 22:02 CDT  
23-minute duration above BAAL<sub>High</sub>

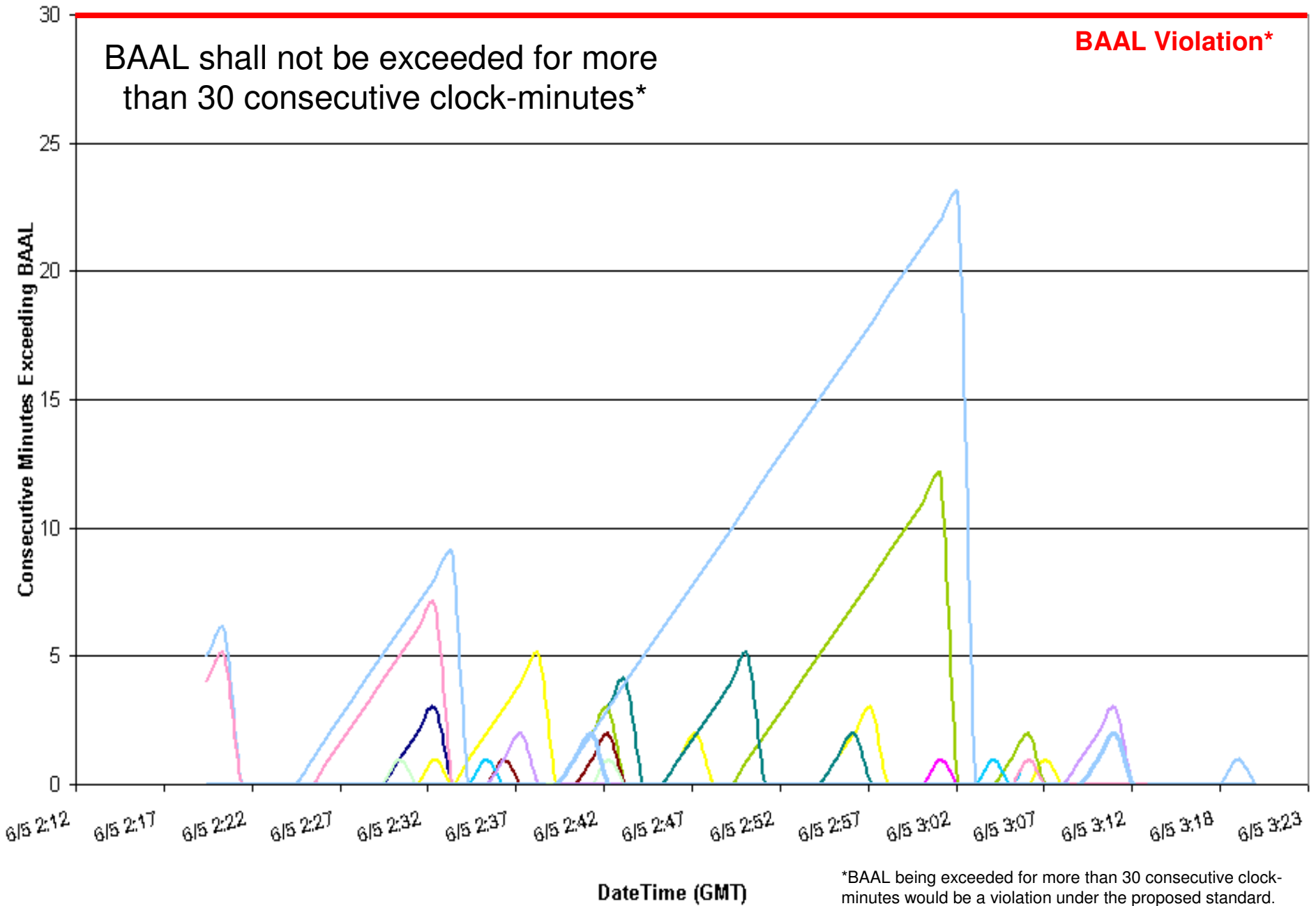
### ACPS1 One-Minute Averages



06/04/2011 ending 22:02 CDT

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

### Consecutive Minutes Exceeding BAAL



# EXAMPLE 5

06/05/2011 ending 06:16 CDT

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

### EI Clock-Minute Average Frequency

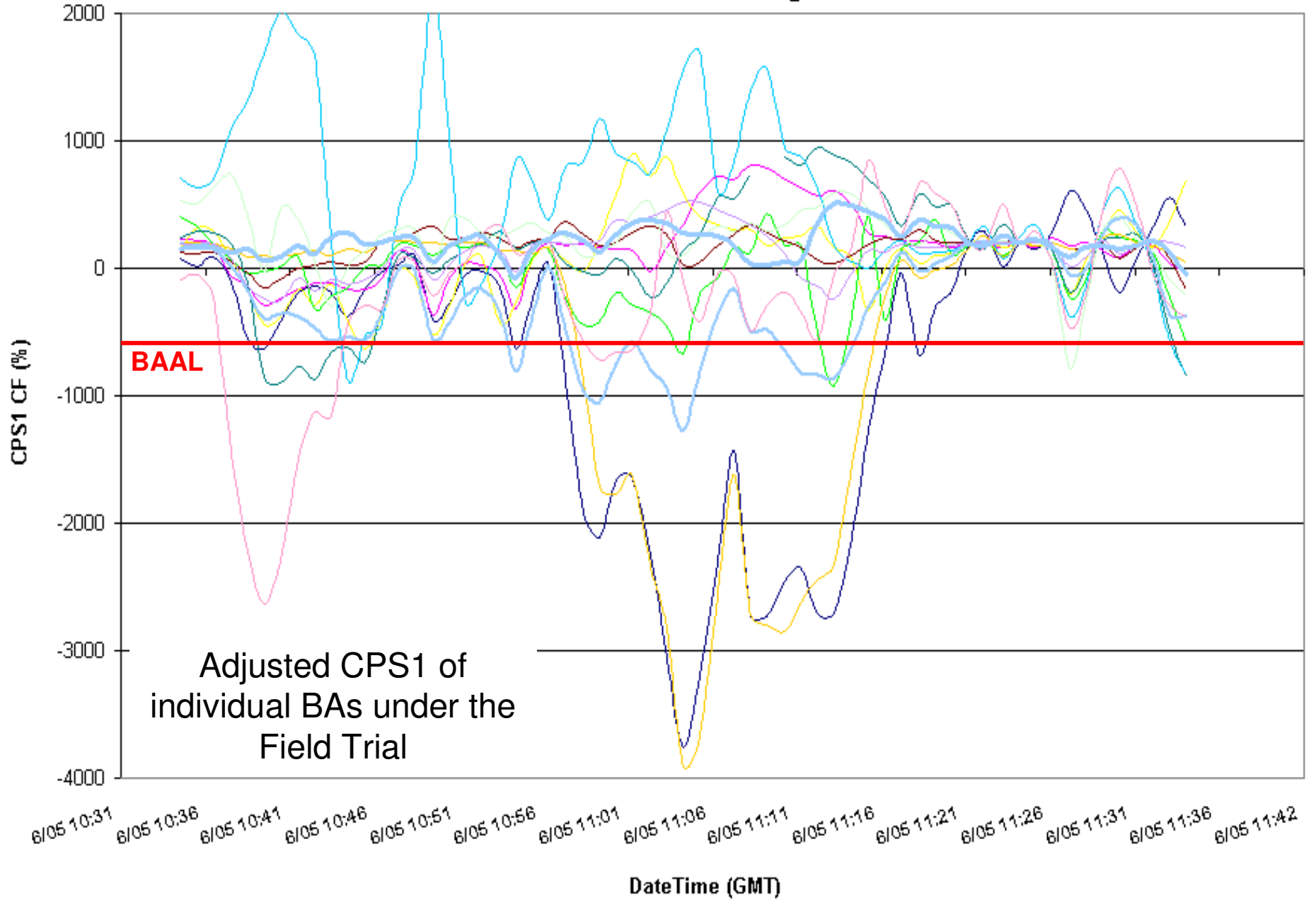


Clock-minute Actual Frequency of Participants

06/05/2011 ending 06:16 CDT

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

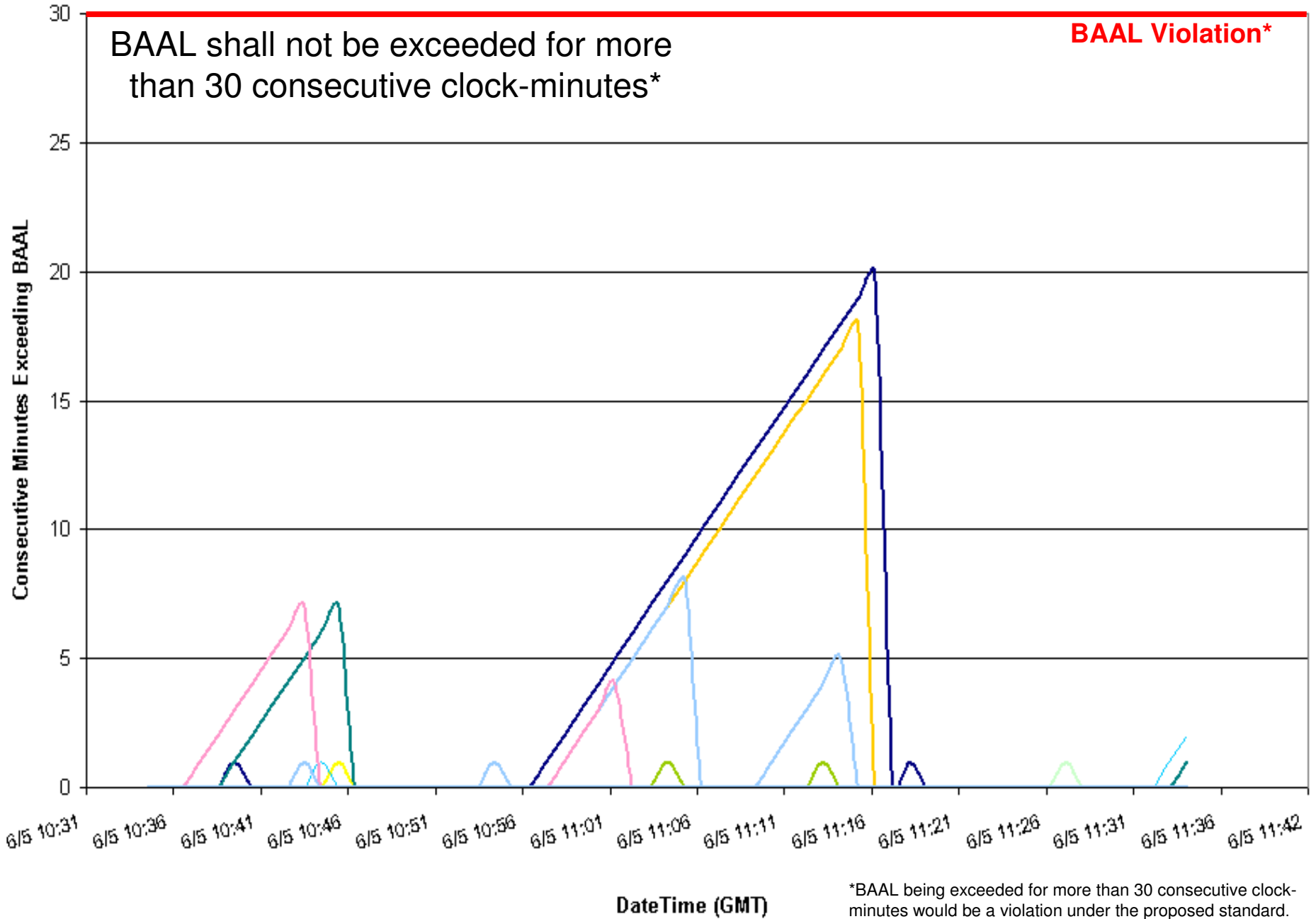
### ACPS1 One-Minute Averages



06/05/2011 ending 06:16 CDT

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

### Consecutive Minutes Exceeding BAAL



# EXAMPLE 6

06/06/2011 ending 22:23 CDT  
20-minute duration above BAAL<sub>High</sub>

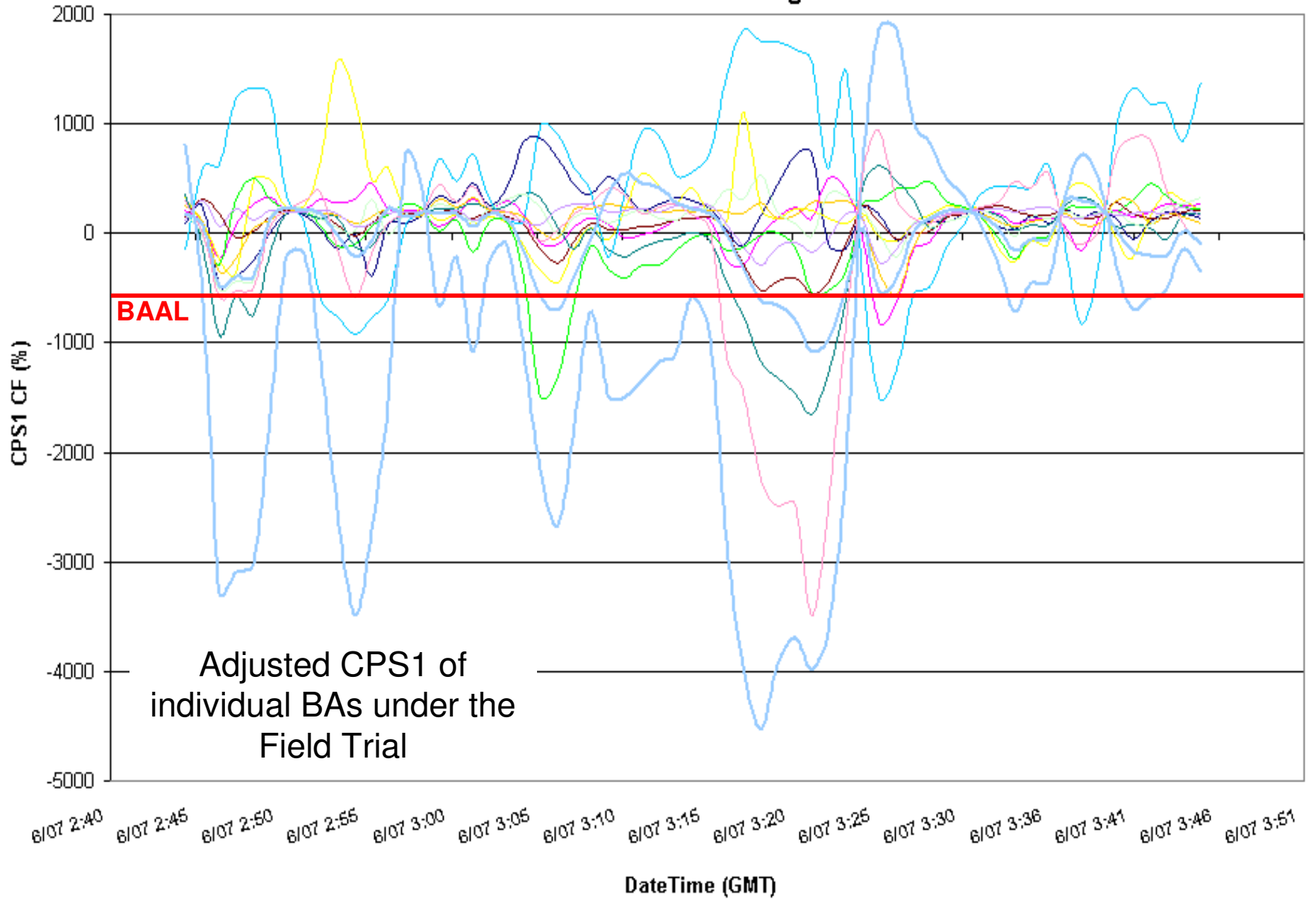
### EI Clock-Minute Average Frequency



Clock-minute Actual Frequency of Participants

06/06/2011 ending 22:23 CDT  
20-minute duration above BAAL<sub>High</sub>

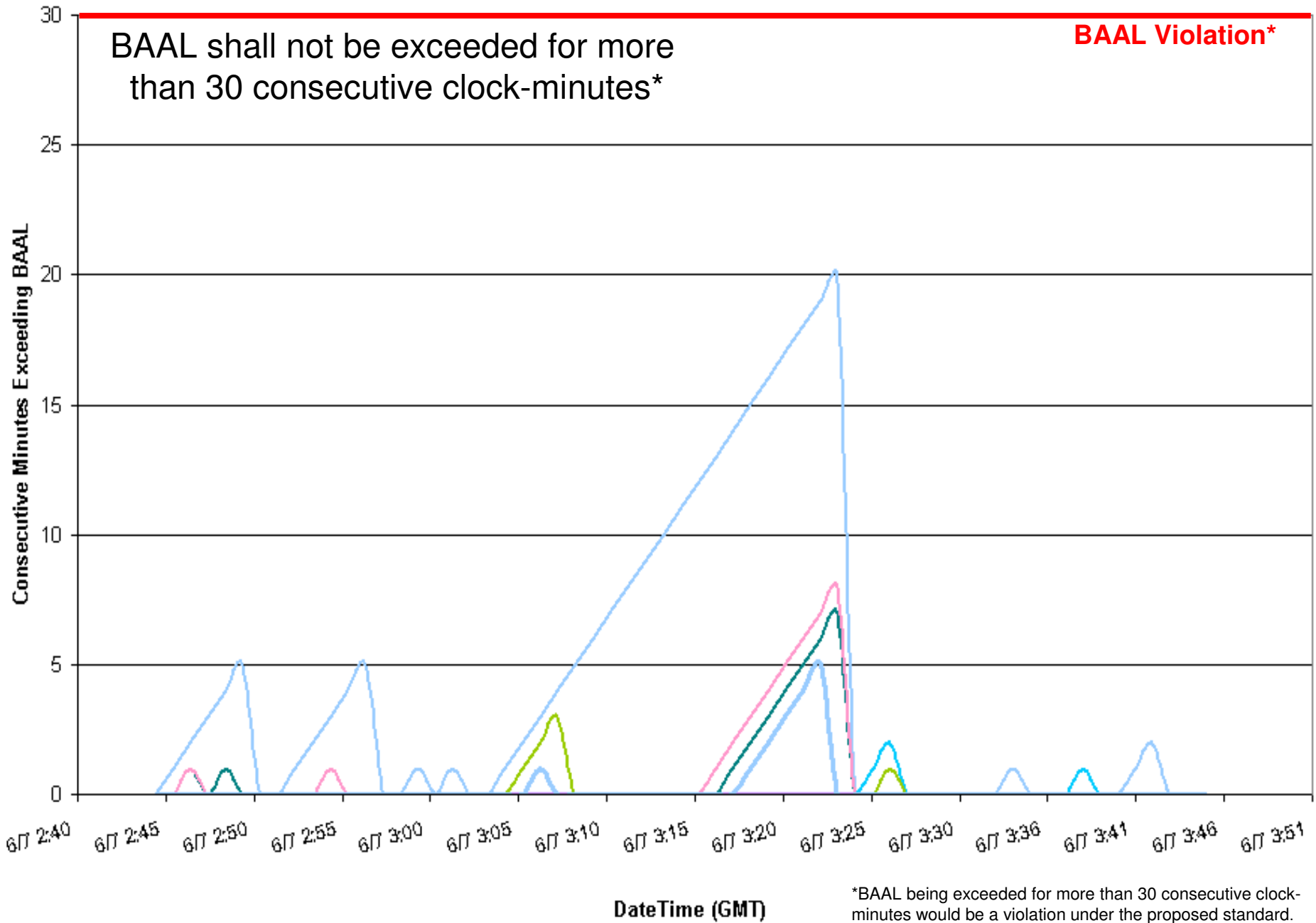
### ACPS1 One-Minute Averages



06/06/2011 ending 22:23 CDT

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

### Consecutive Minutes Exceeding BAAL



# 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   |
|---|--|----------|--|---|--|--|
| 6/5/11 5:57   | 6/5/11 6:16  | CDT      | 0:20   | 0   | 1  | BAAL High<br>1) Coal unit ramped up to 458 MW (unplanned); 100+ under forecast, 400+ MW schedule change & steel mill dropped approximately 300 MW.<br>2) Directed coal unit to reduce output to 300 MW. There was not enough time to do E-sales; however, declared a Low Load Emergency at 06:15. The Low Load Emergency steps for the IPPs & QFs did not start until 07:00 per procedure. |
| 6/24/11 9:40  | 6/24/11 9:50   | CDT      | 0:11   | 0   | 0  | BAAL Low<br>Technicians performing maintenance at substation inadvertently initiated a generation reduction of 360 MW, which then also tripped 2 breakers causing outage of a wind farm.   |
| 6/4/11 21:50  | 6/4/11 22:01   | EST      | 0:12   | 0   | 0  | BAAL High<br>No note placed in operators log, load curve decreasing, no anomalies known  |
| 6/1/11 21:43  | 6/1/11 21:55   | EST      | 0:13   | 0   | 0  | BAAL High  |
| 6/3/11 13:04  | 6/3/11 13:15   | EST      | 0:12   | 0   | 0  | BAAL Low   |
| 6/16/11 15:06   | 6/16/11 15:21  | EST      | 0:16   | 0   | 0  | BAAL Low   |
| 6/18/11 9:03  | 6/18/11 9:13   | EST      | 0:11   | 0   | 0  | BAAL Low   |
| 6/27/11 15:48   | 6/27/11 16:05  | EST      | 0:18   | 0   | 0  | BAAL High<br>A large industrial customer (steel mill) experienced a brief pause in process, causing ACE to exceed BAAL-high. The operator decreased generation and the customer restarted their process which brought ACE within limits.   |

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

| 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   |
|---|--|----------|--|---|--|--|
| 6/1/11 0:14   | 6/1/11 0:37  | EDT      | 0:24   | 0   | 0  | BAAL Low<br>Coming out of Market Suspension, Ramped 100 mws in taking fleet to min. then immediately ramped out 250 mws. Fleet slow to respond to change in direction at low load.   |
| 6/1/11 1:57   | 6/1/11 2:08  | EDT      | 0:12   | 0   | 0  | BAAL High<br>Significant change in Imbalance energy in, preceded by quick out change, just enough to slow response at low load.  |
| 6/5/11 6:59   | 6/5/11 7:16  | EDT      | 0:18   | 0   | 0  | BAAL High<br>IPP's off schedule  |
| 6/6/11 13:37  | 6/6/11 13:47   | EDT      | 0:11   | 0   | 0  | BAAL Low<br>Not enough generation on AGC   |
| 6/28/11 17:21   | 6/28/11 17:31  | EDT      | 0:11   | 0   | 0  | BAAL High<br>Loss of import from IPP, to much assistance too late requested.   |
| 6/1/11 11:30  | 6/1/11 11:53   | CDT      | 0:24   | 0   | 0  | BAAL Low<br>500 MW Combined Cycle Unit ramping up slower than expected. Negative ACE and frequency low. Raised 100 MW peaker to full load at 11:29. Started 2nd 100 MW peaker at 11:46 (16 minutes in), which synced at 11:53. |
| 6/1/11 21:47  | 6/1/11 21:57   | CDT      | 0:11   | 0   | 0  | BAAL High  |
| 6/2/11 0:04   | 6/2/11 0:14  | CDT      | 0:11   | 0   | 0  | BAAL High  |
| 6/2/11 0:17   | 6/2/11 0:29  | CDT      | 0:13   | 0   | 0  | BAAL High  |
| 6/2/11 0:31   | 6/2/11 0:48  | CDT      | 0:18   | 0   | 0  | BAAL High  |
| 6/3/11 13:05  | 6/3/11 13:19   | CDT      | 0:15   | 0   | 0  | BAAL Low   |
| 6/4/11 8:00   | 6/4/11 8:15  | CDT      | 0:16   | 0   | 0  | BAAL Low   |
| 6/4/11 21:40  | 6/4/11 22:02   | CDT      | 0:23   | 0   | 0  | BAAL High<br>500 MW Combined Cycle Unit ramping down too slowly and load falling out. High frequency and high ACE. Backing off 250 MW combined cycle unit and 600 MW coal unit to correct.                                     |
| 6/6/11 14:06  | 6/6/11 14:19   | CDT      | 0:14   | 0   | 0  | BAAL Low   |
| 6/6/11 22:04  | 6/6/11 22:23   | CDT      | 0:20   | 0   | 0  | BAAL High  |

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

| 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   |
|---|--|----------|--|---|--|--|
| 6/9/11 9:06   | 6/9/11 9:17  | CDT      | 0:12   | 0   | 0  | BAAL Low   |
| 6/9/11 10:24  | 6/9/11 10:36   | CDT      | 0:13   | 0   | 0  | BAAL Low   |
| 6/9/11 10:53  | 6/9/11 11:05   | CDT      | 0:13   | 0   | 0  | BAAL High  |
| 6/10/11 14:43   | 6/10/11 14:57  | CDT      | 0:15   | 0   | 0  | BAAL Low   |
| 6/13/11 11:30   | 6/13/11 11:40  | CDT      | 0:11   | 0   | 0  | BAAL Low   |
| 6/13/11 12:32   | 6/13/11 12:44  | CDT      | 0:13   | 0   | 0  | BAAL Low   |
| 6/15/11 15:43   | 6/15/11 15:56  | CDT      | 0:14   | 0   | 0  | BAAL Low   |
| 6/17/11 22:02   | 6/17/11 22:12  | CDT      | 0:11   | 0   | 0  | BAAL Low   |
| 6/20/11 22:27   | 6/20/11 22:39  | CDT      | 0:13   | 0   | 0  | BAAL High  |
| 6/21/11 10:03   | 6/21/11 10:17  | CDT      | 0:15   | 0   | 0  | BAAL Low   |
| 6/23/11 21:58   | 6/23/11 22:13  | CDT      | 0:16   | 0   | 1  | BAAL Low   |
| 6/25/11 11:30   | 6/25/11 11:46  | CDT      | 0:17   | 0   | 0  | BAAL Low   |
| 6/29/11 12:12   | 6/29/11 12:25  | CDT      | 0:14   | 0   | 0  | BAAL Low   |
| 6/29/11 13:01   | 6/29/11 13:14  | CDT      | 0:14   | 0   | 0  | BAAL High  |
| 6/30/11 8:14  | 6/30/11 8:29   | CDT      | 0:16   | 0   | 0  | BAAL Low   |
| 6/1/11 1:32   | 6/1/11 1:54  | EST      | 0:23   | 0   | 0  | BAAL High<br>Two industrial customers were at the bottom and frequency was high. We were selling 400 MW off-peak non-firm. The controller responded by cutting generation at several stations. The recovery was impacted by the speed at which the generators reduced generation. In addition, frequency was not dropping. |
| 6/3/11 11:32  | 6/3/11 11:44   | EST      | 0:13   | 0   | 0  | BAAL Low   |
| 6/9/11 18:47  | 6/9/11 18:59   | EST      | 0:13   | 0   | 0  | BAAL High  |
| 6/9/11 21:46  | 6/9/11 21:59   | EST      | 0:14   | 0   | 0  | BAAL High  |
| 6/16/11 15:07   | 6/16/11 15:23  | EST      | 0:17   | 0   | 0  | BAAL Low   |
| 6/29/11 13:03   | 6/29/11 13:13  | EST      | 0:11   | 0   | 0  | BAAL High  |
| 6/30/11 2:36  | 6/30/11 2:46   | EST      | 0:11   | 0   | 0  | BAAL High  |

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

## Discussion

Bob Klueber

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

[bklueber@midwestiso.org](mailto:bklueber@midwestiso.org)