Standard Development Roadmap

This section is maintained by the drafting team during the development of the standard and will be removed when the standard becomes effective.

Development Steps Completed:

1. The SAR for Project 2007-18, Reliability Based Controls, was posted for a 30-day formal comment period on May 15, 2007.

2. A revised SAR for Project 2007-05, Reliability Based Controls, was posted for a second 30-day formal comment period on September 10, 2007.

3. The Standards Committee approved Project 2007-18, Reliability Based Controls, to be moved to standard drafting on December 11, 2007.

4. The SAR for Project 2007-05, Balancing Authority Controls, was posted for a 30-day formal comment period on July 3, 2007.

5. The Standards Committee approved Project 2007-05, Balancing Authority Controls, to be moved to standard drafting on January 18, 2008.

6. The Standards Committee approved the merger of Project 2007-05, Balancing Authority Controls, and Project 2007-18, Reliability-based Controls, as Project 2010-14, Balancing Authority Reliability-based Controls, on July 28, 2010.

7. The NERC Standards Committee approved breaking Project 2010-14, Balancing Authority Reliability-based Controls, into two phases; and moving Phase 1 (Project 2010-14.1, Balancing Authority Reliability-based Controls – Reserves) into formal standards development on July 13, 2011.

8. The draft standard was posted for 30-day formal industry comment period from June 4, 2012 through July 3, 2012.
9. The draft standard was posted for a 45-day formal industry comment period and initial ballot from March 12, 2013 through April 25, 2013.

Proposed Action Plan and Description of Current Draft:

This is the second posting of the proposed new standard. This proposed draft standard will be posted for a 10-day re-circulation ballot from July XX, 2013 through July XX, 2013.

Future Development Plan:

Anticipated Actions	Anticipated Date
1. Recirculation Ballot	July 2013
2. NERC BOT adoption.	August 2013

Definitions of Terms Used in Standard
This section includes all newly defined or revised terms used in the proposed standard. Terms already defined in the Reliability Standards Glossary of Terms are not repeated here. New or revised definitions listed below become approved when the proposed standard is approved. When the standard becomes effective, these defined terms will be removed from the individual standard and added to the Glossary.

Regulation Reserve Sharing Group: A group whose members consist of two or more Balancing Authorities that collectively maintain, allocate, and supply the Rregulating Rreserve required for all member Balancing Authorities to use in meeting applicable regulating standards.

~~Regulation~~ **Reserve Sharing Group Reporting ACE:** At any given time of measurement for the applicable Regulation Reserve Sharing Group, the algebraic sum of the Reporting ACEs (or equivalent as calculated at such time of measurement) of the Balancing Authorities participating in the Regulation Reserve Sharing Group at the time of measurement.

Reporting ACE: The scan rate values of a Balancing Authority's Area Control Error (ACE) measured in MW, which includes the difference between the Balancing Authority's Nnet Aactual Interchange and its Net Sscheduled Iinterchange, plus its Frequency Bias obligation, plus any known meter error ~~plus Automatic Time Error Correction (ATEC – If operating in the Western Interconnection and in the ATEC mode)~~. In the Western Interconnection, Reporting ACE includes Automatic Time Error Correction (ATEC).

Reporting ACE is calculated as follows:

$$\text{Reporting ACE} = (NI_A - NI_S) - 10B(F_A - F_S) - I_{ME} \cancel{+ I_{ATEC}}$$

Reporting ACE is calculated in the Western Interconnection as follows:

$$\text{Reporting ACE} = (NI_A - NI_S) - 10B(F_A - F_S) - I_{ME} + I_{ATEC}$$

Where:

NI_A **(Actual Net Interchange)** is the algebraic sum of actual megawatt transfers across all Tie Lines and includes Pseudo-Ties. Balancing Authorities directly connected via asynchronous ties to another Interconnection may include or exclude megawatt transfers on those Ttie Llines in their actual interchange, provided they are implemented in the same manner for Net Interchange Schedule.

NI_S **(Scheduled Net Interchange)** is the algebraic sum of all scheduled megawatt transfers, including Dynamic Schedules, with adjacent Balancing Authorities, and taking into account the effects of schedule ramps. Balancing Authorities directly connected via asynchronous ties to another Interconnection may include or exclude megawatt transfers on those Ttie Llines in their scheduled Interchange, provided they are implemented in the same manner for Net Interchange Actual.

B **(Frequency Bias Setting)** is the Frequency Bias Setting (in negative MW/0.1 Hz) for the Balancing Authority.

10 is the constant factor that converts the Ffrequency Bbias Ssetting units to MW/Hz.

F_A **(Actual Frequency)** is the measured frequency in Hz.

F_S **(Scheduled Frequency)** is 60.0 Hz, except during a time correction.

I_{ME} **(Interchange Meter Error)** is the meter error correction factor and represents the difference between the integrated hourly average of the net interchange actual (NIA) and the cumulative hourly net iInterchange energy measurement (in megawatt-hours).

I_{ATEC} **(Automatic Time Error Correction)** is the addition of a component to the ACE equation <u>for the Western Interconnection </u>that modifies the control point for the purpose of continuously paying back Primary Inadvertent Interchange to correct accumulated time error. Automatic Time Error Correction is only applicable in the Western Iinterconnection.

$$I_{ATEC} = \frac{\mathrm{PII}_{accum}^{on/off\ peak}}{(1-Y)*H}$$ when operating in Automatic Time Error Correction control mode.

I_{ATEC} shall be zero when operating in any other AGC mode.

- $Y = B / B_S$.

- H = Number of hHours used to payback Primary Inadvertent Interchange energy. The value of H is set to 3.

- B_S = Frequency Bias for the Interconnection (MW / 0.1 Hz).

- Primary Inadvertent Interchange (PII_{hourly}) is (1-Y) * (II_{actual} - B * ΔTE/6)

- II_{actual} is the hourly Inadvertent Interchange for the last hour.

- ΔTE is the hourly change in system Time Error as distributed by the Interconnection Time Monitor. Where:

  ΔTE = $TE_{end\ hour}$ – $TE_{begin\ hour}$ – TD_{adj} – (t)*(TE_{offset})

- TD_{adj} is the Reliability Coordinator adjustment for differences with Interconnection Time Monitor control center clocks.

- t is the number of minutes of Manual Time Error Correction that occurred during the hour.

- TE_{offset} is 0.000 or +0.020 or -0.020.

- PII_{accum} is the Balancing Authority's accumulated PII_{hourly} in MWh. An On-Peak and Off-Peak accumulation accounting is required.

  Where:

$$\mathrm{PII}_{accum}^{on/off\ peak} = \text{last period's } \mathrm{PII}_{accum}^{on/off\,peak} + \mathbf{PII_{hourly}}$$

All NERC Interconnections with multiple Balancing Authorities operate using the principles of Tie-line Bias (TLB) Control and require the use of an ACE equation similar to the Reporting ACE defined above. Any modification(s) to this specified Reporting ACE equation that is(are) implemented for all BAs on an Iinterconnection and is(are) consistent with the following four principles will provide a valid alternative Reporting ACE equation consistent with the measures included in this standard.

1. All portions of the Iinterconnection are included in one area or another so that the sum of all area generation, loads and losses is the same as total system generation, load and losses.
2. The algebraic sum of all area Nnet Iinterchange Sschedules and all Nnet Iinterchange actual values is equal to zero at all times.
3. The use of a common Sscheduled Ffrequency F_S for all areas at all times.
4. The absence of metering or computational errors. (The inclusion and use of the I_{ME} term to account for known metering or computational errors.)

Interconnection: When capitalized, any one of the four major electric system networks in North America: Eastern, Western, ERCOT and Quebec.

A. Introduction

1. **Title:** **Real Power Balancing Control Performance**

2. **Number:** **BAL-001-2**

3. **Purpose:** To control Interconnection frequency within defined limits.

4. **Applicability:**

   4.1. Balancing Authority

      4.1.1 A Balancing Authority receiving Overlap Regulation Service is not subject to Control Performance Standard 1 (CPS1) or Balancing Authority ACE Limit (BAAL) compliance evaluation.

      4.1.2 A Balancing Authority that is a member of a Regulation Reserve Sharing Group is the Responsible Entity only in periods during which the Balancing Authority is not in active status under the applicable agreement or the governing rules for the Regulation Reserve Sharing Group.

   4.2. Regulation Reserve Sharing Group

5. **(Proposed) Effective Date:**

   5.1. First day of the first calendar quarter that is twelvesix months beyond the date that this standard is approved by applicable regulatory authorities, or in those jurisdictions where regulatory approval is not required, the standard becomes effective the first day of the first calendar quarter that is twelvesix months beyond the date this standard is approved by the NERC Board of Trustees', or as otherwise made effective pursuant to the laws applicable to such ERO governmental authorities.

B. Requirements

R1. The Responsible Entity shall operate such that the Control Performance Standard 1 (CPS1), calculated in accordance with Attachment 1, is greater than or equal to 100 percent for the applicable Interconnection in which it operates for each preceding 12 consecutive calendar -month period, evaluated monthly. *[Violation Risk Factor: Medium] [Time Horizon: Real-time Operations]*

R2. Each Balancing Authority shall operate such that its clock-minute average of Reporting ACE does not exceed its clock-minute Balancing Authority ACE Limit (BAAL) for more than 30 consecutive clock-minutes, as calculated in accordance with Attachment 2, for the applicable Interconnection in which the Balancing Authority operates.*[Violation Risk Factor: Medium] [Time Horizon: Real-time Operations]*

C. Measures

M1. The Responsible Entity shall provide evidence, upon request, such as dated calculation output from spreadsheets, Energy Management sSystem logs, software programs, or

other evidence (either in hard copy or electronic format) to demonstrate compliance with Requirement R1.

M2. Each Balancing Authority shall provide evidence, upon request, such as dated calculation output from spreadsheets, ~~Energy Management s~~System logs, software programs, or other evidence (either in hard copy or electronic format) to demonstrate compliance with Requirement R2.

D. Compliance

1. Compliance Monitoring Process

1.1. Compliance Enforcement Authority

As defined in the NERC Rules of Procedure, "Compliance Enforcement Authority" means NERC or the Regional Entity in their respective roles of monitoring and enforcing compliance with the NERC Reliability Standards.

1.2. Data Retention

The following evidence retention periods identify the period of time an entity is required to retain specific evidence to demonstrate compliance. For instances where the evidence retention period specified below is shorter than the time since the last audit, the ~~C~~compliance ~~E~~enforcement ~~Aa~~uthority may ask an entity to provide other evidence to show that it was compliant for the full-time period since the last audit.

The Responsible Entity shall retain data or evidence to show compliance for the current year, plus three previous calendar years unless, directed by its ~~C~~compliance ~~E~~enforcement ~~Aa~~uthority, to retain specific evidence for a longer period of time as part of an investigation. Data required for the calculation of Regulation Reserve Sharing Group Reporting Ace, or Reporting ACE, CPS1, and BAAL shall be retained in digital format at the same scan rate at which the Reporting ACE is calculated for the current year, plus three previous calendar years.

If a Responsible Entity is found noncompliant, it shall keep information related to the noncompliance until found compliant, or for the time period specified above, whichever is longer.

The ~~C~~compliance ~~E~~enforcement ~~Aa~~uthority shall keep the last audit records and all subsequent requested and submitted records.

1.3. Compliance Monitoring and Assessment Processes

Compliance Audits

Self-Certifications

Spot Checking

Compliance Investigation

Self-Reporting

Complaints

1.4. Additional Compliance Information

None.

2. Violation Severity Levels

R #	Lower VSL	Moderate VSL	High VSL	Severe VSL
R1	The CPS 1 value of the Responsible Entity, <u>for the preceding</u> ~~on a rolling~~ 12 <u>consecutive calendar-</u> month <u>period</u>~~basis~~, is less than 100 percent but greater than or equal to 95 percent for the applicable Interconnection.	The CPS 1 value of the Responsible Entity, <u>for the preceding</u>~~on a rolling~~ 12 <u>consecutive calendar-</u> month <u>period</u>~~basis~~, is less than 95 percent, but greater than or equal to 90 percent for the applicable Interconnection.	The CPS 1 value of the Responsible Entity, <u>for the preceding</u> ~~on a rolling~~ 12 <u>consecutive calendar-</u> month <u>period</u>~~basis~~, is less than 90 percent, but greater than or equal to 85 percent for the applicable Interconnection.	The CPS 1 value of the Responsible Entity, <u>for the preceding</u> ~~on a rolling~~ 12 <u>consecutive calendar-</u> month <u>period</u>~~basis~~, is less than 85 percent for the applicable Interconnection.
R2	The Balancing Authority exceeded its clock-minute BAAL for more than 30 consecutive clock minutes but for 45 consecutive clock-minutes or less <u>for the applicable Interconnection</u>.	The Balancing Authority exceeded its clock-minute BAAL for greater than 45 consecutive clock minutes but for 60 consecutive clock-minutes or less <u>for the applicable Interconnection</u>.	The Balancing Authority exceeded its clock-minute BAAL for greater than 60 consecutive clock minutes but for 75 consecutive clock-minutes or less <u>for the applicable Interconnection</u>.	The Balancing Authority exceeded its clock-minute BAAL for greater than 75 consecutive clock-minutes <u>for the applicable Interconnection</u>.

E. Regional Variances

None.

F. Associated Documents

BAL-001-2, Real Power Balancing Control Performance Standard Background Document

Version History

Version	Date	Action	Change Tracking
0	February 8, 2005	BOT Approval	New
0	April 1, 2005	Effective Implementation Date	New
0	August 8, 2005	Removed "Proposed" from Effective Date	Errata
0	July 24, 2007	Corrected R3 to reference M1 and M2 instead of R1 and R2	Errata
0a	December 19, 2007	Added Appendix 2 – Interpretation of R1 approved by BOT on October 23, 2007	Revised
0a	January 16, 2008	In Section A.2., Added "a" to end of standard number In Section F, corrected automatic numbering from "2" to "1" and removed "approved" and added parenthesis to "(October 23, 2007)"	Errata
0	January 23, 2008	Reversed errata change from July 24, 2007	Errata
0.1a	October 29, 2008	Board approved errata changes; updated version number to "0.1a"	Errata
0.1a	May 13, 2009	Approved by FERC	
1		Inclusion of BAAL and WECC Variance and exclusion of CPS2	Revision

<div align="center">

Attachment 1
Equations Supporting Requirement R1 and Measure M1

</div>

CPS1 is calculated as follows:

<div align="center">

CPS1 = (2 - CF) * 100%

</div>

The frequency-related compliance factor (CF), is a ratio of the accumulating clock-minute compliance parameters for the most recent preceding ~~consecutive~~ 12 consecutive calendar months, divided by the square of the target frequency bound:

$$CF = \frac{CF_{12\text{-}month}}{(\varepsilon 1_I)^2}$$

Where $\varepsilon 1_I$ is the constant derived from a targeted frequency bound for each Interconnection as follows:

- Eastern Interconnection $\varepsilon 1_I$ = 0.018 Hz

- Western Interconnection $\varepsilon 1_I$ = 0.0228 Hz

- ERCOT Interconnection $\varepsilon 1_I$ = 0.030 Hz

- Quebec Interconnection $\varepsilon 1_I$ = 0.021 Hz

The rating index $CF_{12\text{-}month}$ is derived from the most recent preceding ~~consecutive~~ 12 consecutive calendar months of data. The accumulating clock-minute compliance parameters are derived from the one-minute averages of Reporting ACE, Frequency Error, and Frequency Bias Settings.

A clock-minute average is the average of the reporting Balancing Authority's valid measured variable (i.e., for Reporting ACE (RACE) and for Frequency Error) for each sampling cycle during a given clock--minute.

$$\left(\frac{RACE}{-10B}\right)_{clock\text{-}minute} = \frac{\left(\dfrac{\sum RACE_{sampling\ cycles\ in\ clock\text{-}minute}}{n_{sampling\ cycles\ in\ clock\text{-}minute}}\right)}{-10B}$$

And,

$$\Delta F_{clock\text{-}minute} = \frac{\sum \Delta F_{sampling\ cycles\ in\ clock\text{-}minute}}{n_{sampling\ cycles\ in\ clock\text{-}minute}}$$

The Balancing Authority's clock-minute compliance factor ($CF_{clock\text{-}minute}$) calculation is:

$$CF_{\text{clock-minute}} = \left[\left(\frac{RACE}{-10B} \right)_{\text{clock-minute}} * \Delta F_{\text{clock-minute}} \right]$$

Normally, 60 clock-minute averages of the reporting Balancing Authority's Reporting ACE and Frequency Error will be used to compute the hourly average compliance factor (CF $_{\text{clock-hour}}$).

$$CF_{\text{clock-hour}} = \frac{\sum CF_{\text{clock-minute}}}{n_{\text{clock-minute samples in hour}}}$$

The reporting Balancing Authority shall be able to recalculate and store each of the respective clock-hour averages (CF $_{\text{clock-hour average-month}}$) and the data samples for each 24-hour period (one for each clock-hour; i.e., hour ending (HE) 0100, HE 0200, ..., HE 2400). To calculate the monthly compliance factor (CF $_{\text{month}}$):

$$CF_{\text{clock-hour average-month}} = \frac{\sum\limits_{\text{days-in-month}} [(CF_{\text{clock-hour}})(n_{\text{one-minute samples in clock-hour}})]}{\sum\limits_{\text{days-in month}} [n_{\text{one-minute samples in clock-hour}}]}$$

$$CF_{\text{month}} = \frac{\sum\limits_{\text{hours-in-day}} [(CF_{\text{clock-hour average-month}})(n_{\text{one-minute samples in clock-hour averages}})]}{\sum\limits_{\text{hours-in day}} [n_{\text{one-minute samples in clock-hour averages}}]}$$

To calculate the 12-month compliance factor (CF $_{\text{12 month}}$):

$$CF_{\text{12-month}} = \frac{\sum\limits_{i=1}^{12} (CF_{\text{month-i}})(n_{(\text{one-minute samples in month})-i})]}{\sum\limits_{i=1}^{12} [n_{(\text{one-minute samples in month})-i}]}$$

To ensure that the average Reporting ACE and Frequency Error calculated for any one-minute interval is representative of that time interval, it is necessary that at least 50 percent of both the Reporting ACE and Frequency Error sample data during the one-minute interval is valid. If the recording of Reporting ACE or Frequency Error is interrupted such that less than 50 percent of the one-minute sample period data is available or valid, then that one-minute interval is excluded from the CPS1 calculation.

A Balancing Authority providing Overlap Regulation Service to another Balancing Authority calculates its CPS1 performance after combining its Reporting ACE and Frequency Bias

Settings with the Reporting ACE and Frequency Bias Settings of the Balancing Authority receiving the Regulation Service.

Attachment 2

Equations Supporting Requirement R2 and Measure M2

When actual frequency is equal to Scheduled Frequency, BAAL$_{High}$ and BAAL$_{Low}$ do not apply.

When actual frequency is less than Scheduled Frequency, BAAL$_{High}$ does not apply, and BAAL$_{Low}$ is calculated as:

$$BAAL_{Low} = \left(-10B_i \times (FTL_{Low} - F_S)\right) \times \frac{(FTL_{Low} - F_S)}{(F_A - F_S)}$$

When actual frequency is greater than Scheduled Frequency, BAAL$_{Low}$ does not apply and the BAAL$_{High}$ is calculated as:

$$BAAL_{High} = \left(-10B_i \times (FTL_{High} - F_S)\right) \times \frac{(FTL_{High} - F_S)}{(F_A - F_S)}$$

Where:

BAAL$_{Low}$ is the Low Balancing Authority ACE Limit (MW)

BAAL$_{High}$ is the High Balancing Authority ACE Limit (MW)

10 is a constant to convert the Frequency Bias Setting from MW/0.1 Hz to MW/Hz

B_i is the Frequency Bias Setting for a Balancing Authority (expressed as MW/0.1 Hz)

F_A is the measured frequency in Hz.

F_S is the scheduled frequency in Hz.

FTL_{Low} is the Low Frequency Trigger Limit (calculated as F_S - $3\varepsilon1_I$ Hz)

FTL_{High} is the High Frequency Trigger Limit (calculated as F_S + $3\varepsilon1_I$ Hz)

Where $\varepsilon1_I$ is the constant derived from a targeted frequency bound for each Interconnection as follows:

- Eastern Interconnection $\varepsilon1_I$ = 0.018 Hz
- Western Interconnection $\varepsilon1_I$ = 0.0228 Hz
- ERCOT Interconnection $\varepsilon1_I$ = 0.030 Hz
- Quebec Interconnection $\varepsilon1_I$ = 0.021 Hz

To ensure that the average actual frequency calculated for any one-minute interval is representative of that time interval, it is necessary that at least 50% of the actual frequency sample data during that one-minute interval is valid. If the recording of actual frequency is interrupted such that less than 50 percent of the one-minute sample period

data is available or valid, then that one-minute interval is excluded from the BAAL calculation and the 30-minute clock would be reset to zero.

A Balancing Authority providing Overlap Regulation Service to another Balancing Authority calculates its BAAL performance after combining its Frequency Bias Setting with the Frequency Bias Setting of the Balancing Authority receiving Overlap Regulation Service.