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.
- 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.

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 45-day formal comment period beginning on March 12, 2013 through April 25, 2013.

Future Development Plan:

Anticipated Actions	Anticipated Date
Second posting	March/April 2013
2. Initial Ballot	April 2013
3. Recirculation Ballot	October 2013
4. NERC BOT adoption.	November 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 operating the regulating reserve required for eachall member Balancing member Balancing Authorityies to -use in meeting the applicable regulating standards requirements associated with Control Performance Standard 1.

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 (as calculated at such time of measurement) of all-the Balancing Authorities participating inthat make up the Regulation Reserve Sharing Group at the time of measurement. Balancing Authority ACE Limit (BAAL): The limit beyond which a Balancing Authority contributes more than its share of Interconnection frequency control reliability risk. This definition applies to a high limit (BAAL_{Limb}) and a low limit (BAAL_{Low}).

Reporting ACE: The scan rate values of a Balancing Authority's Area Control Error (ACE) measured in MW, as defined in BAL-001, which includes the difference between the Balancing Authority's <u>net</u> actual Interchange and its scheduled Interchange, plus its Frequency Bias obligation, plus any known meter error <u>plus Automatic Time Error Correction (ATEC – If</u> operating in the Western Interconnection and in the ATEC mode).

Reporting ACE is calculated as follows:

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

Where:

NIA (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 tie lines 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 tie lines 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 frequency bias setting 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 Interchange energy measurement (in megawatt-hours).

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

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

<u>Jatec shall be zero when operating in any other AGC mode.</u>

- $Y = B / B_S$.
- H = Number of Hours 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 * ΔΤΕ/6)
- Il_{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:

$$\Delta TE = TE_{end\ hour} - TE_{begin\ hour} - TD_{adj} - (t)*(TE_{offset})$$

- TD_{adi} 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:

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

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 interconnection 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.

- All portions of the interconnection 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 net interchange schedules and all net interchange actual values is equal to zero at all times.
- 3. The use of a common scheduled frequency 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, <u>ERCOTTexas</u> and Quebec.

A. Introduction

1. Title: Real Power Balancing Control Performance

2. Number: <u>BAL-001-1</u>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 period during which the Balancing
 Authority is not in active status under the applicable agreement or
 governing rules for the Regulation Reserve Sharing Group.

4.2. Regulation Reserve Sharing Group

4.1.1 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.

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 Regulation Service.

4.1.2 A Balancing Authority receiving Overlap Regulation Service is not subject to CPS1 or BAAL compliance evaluation.

5. (Proposed) Effective Date:

5.1. First day of the first calendar quarter that is six 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 six months beyond the date this standard is approved by the NERC Board of Trustees', or as otherwise made pursuant to the laws applicable to such ERO governmental authorities.

B. Requirements

R1. The Responsible EntityEach Balancing Authority shall operate such that the Balancing Authority's-Control Performance Standard 1 (CPS1), as applicable and as calculated in accordance with Attachment 1, is greater than or equal to 100 percent for the applicable Interconnection in which it operates for each 12-month period, evaluated monthly, to support Interconnection frequency. [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), as calculated in Attachment 2, for the applicable Interconnection in which the Balancing Authority-it or Regulation Reserve Sharing Group operates to-support Interconnection frequency. [Violation Risk Factor: Medium] [Time Horizon: Real-time Operations]

C. Measures

- M1. The Responsible Entity Each Balancing Authority shall provide evidence, upon request such as dated calculation output from spreadsheets, Energy Management System 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 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. The regional entity is the compliance enforcement authority, except where the responsible entity works for the regional entity. Where the responsible entity works for the regional entity, the regional entity will establish an agreement with the ERO, or another entity approved by the ERO and FERC (i.e., another regional entity), to be responsible for compliance enforcement.

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 compliance enforcement authority may ask an entity to provide other evidence to show that it was compliant for the full-time period since the last audit.

The <u>Responsible Entity-Balancing Authority</u> shall retain data or evidence to show compliance for the current year, plus three previous calendar years unless, directed by its compliance enforcement authority, to retain specific evidence for a longer period of time as part of an investigation. Data required for the calculation of <u>Regulation Reserve Sharing Group Reporting Ace, or Reporting ACE</u>, CPS1, and BAAL shall be retained in digital format at the same scan rate at

which the Reporting A<u>CE</u>ee is calculated for the current year, plus three previous calendar years.

If a <u>Responsible Entity Balancing Authority</u> 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 compliance enforcement authority 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 RResponsible Entity,'s or thea Balancing Authority's, area value of CPS1, on a rolling 12-month 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, on a rolling 12-month 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, on a rolling 12-month 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, on a rolling 12-month basis, is less than 85 percent for the applicable Interconnection.
R2	The Balancing Authority	The Balancing Authority	The Balancing Authority	The Balancing Authority exceeded its clock-

exceeded its	exceeded its	exceeded its	minute BAAL for greater
clock-minute	clock-minute	clock-minute	than 75 consecutive
BAAL for more	BAAL for greater	BAAL for greater	clock-minutes.
than 30	than 45	than 60	
consecutive	consecutive	consecutive	
clock minutes	clock minutes	clock minutes	
but <u>for</u> less than	but <u>for</u> less than	but <u>for less than</u>	
or equal to 45	or equal to 60	or equal to 75	
consecutive	consecutive	consecutive	
clock minutes <u>or</u>	clock minutes <u>or</u>	clock minutes <u>or</u>	
<u>less</u> .	<u>less</u> .	<u>less</u> .	

E. Regional Variances

None.

F. Associated Documents

BAL 001 1BAL-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	Errata
		In Section F, corrected automatic numbering from "2" to "1" and removed "approved" and added parenthesis to "(October 23, 2007)"	
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

Standard BAL 001 1BAL-001-2 – Real Power Balancing Control Performance

0.1a	May 13, 2009	Approved by FERC	
1		Inclusion of BAAL and WECC Variance and exclusion of CPS2	Revision

BAL-001-1BAL-001-2 January 1, 2013

Attachment 1 Equations Supporting Requirement R1 and Measure M1

CPS1 is calculated as follows:

$$CPS1 = (2 - CF) * 100\%$$

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

$$CF = \frac{CF}{(\epsilon 1_1)^2}$$

where Where ϵ_1 is the constant derived from a targeted frequency bound for each Interconnection as follows:

- Eastern Interconnection ε₁ = 0.018 Hz
- Western Interconnection ε₁ = 0.0228 Hz
- ERCOT Interconnection ε₁ = 0.030 Hz
- Quebec Interconnection ε₁ = 0.021 Hz

The rating index CF_{12-month} is derived from the most recent consecutive 12<u>-calendar</u> 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.

Reporting ACE is calculated as follows:

Where:

NI_A (Net Interchange Actual) 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 tie lines in their actual interchange, provided they are implemented in the same manner for Net Interchange Schedule.

NIs (Net Interchange Schedule) 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 tie lines 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 frequency bias setting units to MW/Hz.

 F_A (Actual Frequency) is the measured frequency in Hz, with minimum resolution of +/-0.0005 Hz.

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

 $_{\text{NME}}$ (Net Meter Error) is the meter error correction factor and represents the difference between the integrated hourly average of the net interchange actual (NI_A) and the cumulative hourly net Interchange energy measurement (in megawatt-hours).

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.

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

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

and And,

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

The Balancing Authority's clock-minute compliance factor (CF clock-minute) calculation is:

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

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

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 clock-hour).

$$CF_{
m clock ext{-}hour} = rac{\sum CF_{
m clock ext{-}minute}}{n_{
m clock ext{-}minute\, samples\, in\, hour}}$$

The reporting Balancing Authority shall be able to recalculate and store each of the respective clock-hour averages (CF 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 month):

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

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

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

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

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.

Standard BAL 001 1BAL-001-2 – Real Power Balancing Control Performance

A Balancing Authority receiving Overlap Regulation Service is not subject to CPS1compliance evaluation.

BAL-001-1BAL-001-2 Page 13 of 15

Attachment 2

Equations Supporting Requirement R2 and Measure M2

When actual frequency is equal to <u>Scheduled Frequency</u> BAAL_{High} and BAAL_{Low} do not apply.

When actual frequency is less than <u>Scheduled Frequency</u>60 Hz, BAAL_{High} does not apply, and BAAL_{Low} is calculated as:

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

$$BAAL_{Low} = \left(-10B_i \times \left(FTL_{Low} - 60\right)\right) \times \frac{\left(FTL_{Low} - 60\right)}{\left(F_A - 60\right)}$$

When actual frequency is greater than <u>Scheduled Frequency</u> 60 Hz, BAAL_{Low} does not apply and the BAAL_{High} is calculated as:

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

$$BAAL_{High} = \left(-10B_i \times \left(FTL_{High} - 60\right)\right) \times \frac{\left(FTL_{High} - 60\right)}{\left(F_A - 60\right)}$$

Where:

BAALLow is the Low Balancing Authority ACE Limit (MW)

BAALHigh 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, with a minimum resolution of +/- 0.0005 Hz.

F_s is the scheduled frequency in Hz.

FTL_{Low} is the Low Frequency Trigger Limit (calculated as <u>F</u>_S 60-<u>3</u>ε1₁ Hz)

FTL_{High} is the High Frequency Trigger Limit (calculated as $F_{S}60$ + $3\epsilon 1$ Hz)

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

- Eastern Interconnection $\varepsilon 1_1 = 0.018 \text{ Hz}$
- Western Interconnection ε1_I = 0.0228 Hz
- ERCOT Interconnection ε1₁ = 0.030 Hz

Quebec Interconnection ε1_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.

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 Regulation Service.

A Balancing Authority receiving Overlap Regulation Service is not subject to BAAL compliance evaluation.