

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

SAR submitted April 15, 2008.
SAR posted for comment on April 24, 2008.
SAR approved May 27, 2008.
Drafting Team nominated and selected in June 2008.
First posting of standard on March 16, 2009.
Drafting Team held technical workshop on March 31, 2009.
Second posting of standard on February 12, 2010.
Drafting Team held technical workshop on March 3, 2010.
Drafting Team held a performance evaluation workshop on August 6, 2010.
Third posting requested at RSC Meeting September 1, 2010.
Third posting ended on November 11, 2010.
Drafting Team reviewed and revised the Standard on May 5-6, 2011.
Texas RE staff received comments from NERC Staff review and revised standard draft to address comments (5/24/11).
Drafting Team finalized Standard and approved final version on July 25, 2011.
RSC approved the Standard for ballot on August 5, 2011.
[TBA: Ballot results, Board approval, etc.]

Description of Current Draft

This drafting team has revised the draft based on comments received during the third comment period, further consideration of the performance metric calculations, and guidance from FERC staff and NERC staff. This draft will likely be posted for ballot in August 2011.

Future Development Plan:

Anticipated Actions	Anticipated Date
Respond to comments/revise draft	Nov. 2010 to May 2011
Present revised draft to RSC	August 2011
Form ballot pool and vote	August-September 2011
TRE Board Adopt (Tentative)	October 2011
NERC Submit (Tentative)	November 2011
FERC Approval (Tentative)	??

Definitions of Terms Used in Standard

Frequency Measurable Event (FME): An event that results in a Frequency Deviation, identified at the BA's sole discretion, and meeting one of the following conditions:

- i) a Frequency Deviation that has a pre-perturbation [the 16-second period of time before $t(0)$] average frequency to post-perturbation [the 32-second period of time starting 20 seconds after $t(0)$] average frequency absolute deviation greater than 100 mHz (the 100 mHz value may be adjusted by the BA to capture 30 to 40 events per year).

or

- ii) a cumulative change in generating unit/generating facility, DC tie and/or firm load pre-perturbation megawatt value to post-perturbation megawatt value absolute deviation greater than 550 MW (the 550 MW value may be adjusted by the BA to capture 30 to 40 events per year).

Governor: The electronic, digital or mechanical device that implements Primary Frequency Response of generating units/generating facilities or other system elements.

Primary Frequency Response (PFR): The immediate proportional increase or decrease in real power output provided by generating units/generating facilities and the natural real power dampening response provided by Load in response to system Frequency Deviations. This response is in the direction that stabilizes frequency.

A. Introduction

1. **Title:** Primary Frequency Response in the ERCOT Region
2. **Number:** BAL-001-TRE-1
3. **Purpose:** To maintain Interconnection steady-state frequency within defined limits by balancing real power demand and supply in real-time. This regional standard supplements the CPS2 Waiver that was approved for ERCOT by NERC on November 21, 2002. Specifically, this standard replaces requirement 2 of BAL-001-0a in the ERCOT Region per FERC Order 693.

4. **Applicability:**

4.1. Functional Entities:

1. Balancing Authority (BA)
2. Generator Owners (GO)
3. Generator Operators (GOP)

4.2. Exemptions:

- 4.2.1** Existing generating facilities regulated by the U.S. Nuclear Regulatory Commission prior to the Effective Date are exempt from Standard BAL-001-TRE-01.
- 4.2.2** Generating units/generating facilities while operating in synchronous condenser mode are exempt from Standard BAL-001-TRE-01.
- 4.2.3** Any generators that are not required by the BA to provide primary frequency response are exempt from this standard.

5. **Background:**

The ERCOT Interconnection was initially given a waiver of BAL-001 R2. In FERC Order 693 the NERC was directed to develop a Regional Standard as an alternate means of assuring frequency performance in the ERCOT Interconnection. NERC was explicitly directed to incorporate key elements of the existing Protocols, Section 5.9. This required governors to be in service and performing with an un-muted response to assure an Interconnection minimum Frequency Response to a Frequency Measurable Event.

This regional standard provides requirements related to identifying Frequency Measureable Events, calculating the Primary Frequency Response of each resource in the Region, calculating the Interconnection minimum Frequency Response and monitoring the actual Frequency Response of the Interconnection, setting Governor deadband and droop parameters, and providing Primary Frequency Response performance requirements.

Under this standard, two Primary Frequency Response performance measures are calculated: “initial” and “sustained.” The initial PFR performance (R9) measures the actual response compared to the expected response in the period from 20 to 52 seconds after an FME starts. The sustained PFR performance (R10) measures the actual

response compared to the expected response during the event recovery period, when the frequency returns to normal.

In this regional standard the term “resource” is synonymous with “generating unit/generating facility”.

6. (Proposed) Effective Date:

After final regulatory approval and in accordance with the 30-month Implementation Plan to allow the BA and each generating unit/generating facility time to meet the requirements. See attached Implementation Plan (Attachment 1).

B. Requirements

- R1.** The BA shall identify Frequency Measurable Events (FMEs), and within 14 calendar days after each FME the BA shall notify the Compliance Enforcement Authority and make FME information (time of FME (t(0)), pre-perturbation average frequency, post-perturbation average frequency) publicly available.

[Violation Risk Factor = Lower] [Time Horizon = Operations Assessment]

- M1.** The BA shall have evidence it reported each FME to the Compliance Enforcement Authority and that it made FME information publicly available within 14 calendar days after the FME as required in Requirement R1.

- R2.** The BA shall calculate the Primary Frequency Response of each generating unit/generating facility in accordance with this standard and the Primary Frequency Response Reference Document.¹ This calculation shall be a 12-month rolling average of initial and sustained Primary Frequency Response performance. This calculation shall be completed each month for the preceding 12 calendar months. The calculation results shall be submitted to the Compliance Enforcement Authority by the end of the month in which they were completed. If the generating unit/generating facility has not participated in a minimum of (8) eight FMEs in a 12-month period, performance shall be based on a rolling eight FME average response.

[Violation Risk Factor = Lower] [Time Horizon = Operations Assessment]

- M2.** The BA shall have evidence it calculated and reported the rolling average initial and sustained Primary Frequency Response performance of each generating unit/generating facility monthly as required in Requirement R2.

- R3.** The BA shall calculate the Interconnection minimum Frequency Response (IMFR) in December of each year for the following year, and make the IMFR, the methodology for calculation and the criteria for determination of the IMFR publicly available.

¹ The Primary Frequency Response Reference Document contains the calculations that the BA will use to determine Primary Frequency Response performance of generating units/generating facilities. This reference document is a Texas RE-controlled document that is subject to revision by the Texas RE Board of Directors.

[Violation Risk Factor = Lower] [Time Horizon = Operations Planning]

M3. The BA shall demonstrate that the IMFR was calculated in December of each year per Requirement R3. The BA shall demonstrate that the IMFR, the methodology for calculation and the criteria for determination of the IMFR are publicly available.

R4. The BA shall determine and make publicly available the Interconnection’s combined Frequency Response performance for a rolling average of the last six (6) FMEs by the end of the following month.

[Violation Risk Factor = Medium] [Time Horizon = Operations Planning]

M4. The BA shall provide evidence that the rolling average of the Interconnection’s combined Frequency Response performance for the last six (6) FMEs was calculated and made public per Requirement R4.

R5. Following any FME that causes the Interconnection’s six-FME rolling average combined Frequency Response performance to be less than the IMFR, the BA shall direct any necessary actions to improve Frequency Response, which may include, but are not limited to, directing adjustment of Governor deadband and/or droop settings.

[Violation Risk Factor = Medium] [Time Horizon = Operations Planning]

M5. The BA shall provide evidence that actions were taken to improve the Interconnection’s Frequency Response if the Interconnection’s six-FME rolling average combined Frequency Response performance was less than the IMFR, per Requirement R5.

R6. Each GO shall set its Governor parameters as follows:

6.1. Limit Governor deadbands within those listed in Table 6.1, unless directed otherwise by the BA.

Table 6.1 Governor Deadband Settings

Generator Type	Max. Deadband
Steam Turbines with Mechanical Governors	+/- 0.034 Hz
All Other Generating Units/Generating Facilities	+/- 0.01666 Hz

- 6.2.** Limit Governor droop settings such that they do not exceed those listed in Table 6.2, unless directed otherwise by the BA.

Table 6.2 Governor Droop Settings

Generator Type	Max. Droop % Setting
Hydro	5%
Nuclear	5%
Coal and Lignite	5%
Combustion Turbine (Simple Cycle and Single-Shaft Combined Cycle)	5%
Combustion Turbine (Combined Cycle)	4%
Steam Turbine (Simple Cycle)	5%
Steam Turbine (Combined Cycle)*	5%
Diesel	5%
Wind Powered Generator	5%
DC Tie Providing Ancillary Services	5%
Renewable (Non-Hydro)	5%

*Steam Turbines of a combined cycle resources are required to comply with Requirements R6.1, R6.2 and R6.3. Compliance with Requirements R9 and R10 will be determined through evaluation of the combined cycle facility using an expected performance droop of 5.78%.

- 6.3.** For digital and electronic Governors, once frequency deviation has exceeded the Governor deadband from 60.000 Hz, the Governor setting shall follow the slope derived from the formula below.

$$\text{For 5\% Droop: } \text{Slope} = \frac{MW_{GCS}}{(3.0 \text{ Hz} - \text{Governor Deadband Hz})}$$

$$\text{For 4\% Droop: } \text{Slope} = \frac{MW_{GCS}}{(2.4 \text{ Hz} - \text{Governor Deadband Hz})}$$

where MW_{GCS} is the maximum megawatt control range of the Governor control system. For mechanical Governors, droop will be proportional from the deadband by design.

[Violation Risk Factor = Medium] [Time Horizon = Operations Planning]

- M6.** Each GO shall have evidence that it set its Governor parameters in accordance with Requirement R6. Examples of evidence include but are not limited to:
- Governor test reports
 - Governor setting sheets

- Performance monitoring reports

M6.1 The GO shall have evidence that it set the Governor deadbands as required in Table 6.1 in Requirement R6.

M6.2 The GO shall have evidence that the Governor droop characteristics did not exceed the settings in Table 6.2 in Requirement R6.

M6.3 The GO shall have evidence that when frequency deviation has exceeded the Governor deadband from 60.00 Hz, the Governor setting follows the approved slopes derived from the prescribed formulas for 4% droop and 5% droop.

R7. Each GO shall operate each generating unit/generating facility that is connected to the interconnected transmission system with the Governor in service and responsive to frequency when the generating unit/generating facility is online and released for dispatch, unless the GOP has been notified that the Governor is not in service.

[Violation Risk Factor = Medium] [Time Horizon = Real-time Operations]

M7. Each GO shall have evidence that each generating unit/generating facility had its Governor in service when the generating unit/generating facility was online and released for dispatch as described in Requirement R7, and evidence of a valid reason if it was not in service.

R8. Each GOP shall notify the BA as soon as practical but within 30 minutes of the discovery of a status or capability change of a Governor.

[Violation Risk Factor = Medium][Time Horizon = Real-time Operations]

M8. Each GOP shall have evidence that it notified the BA within 30 minutes of each discovery of a status or capability change of a Governor.

R9. Each GO shall meet a minimum 12-month rolling average initial Primary Frequency Response performance of 0.75 on each generating unit/generating facility, based on participation in at least eight FMEs. The performance of a combined-cycle facility will be determined using an expected performance droop of 5.78%.

R9 measures *initial* unit PFR performance (A-value to B-value). This requirement specifies a certain level of average measured performance over a 12-month period.

9.1. The initial Primary Frequency Response performance shall be the ratio of the Actual Primary Frequency Response to the Expected Primary Frequency Response during the initial measurement period following the FME. The initial Primary Frequency Response performance for each FME shall be between 0.0 and 2.0.

- 9.2.** If a generating unit/generating facility has not participated in a minimum of eight FMEs in a 12-month period, performance shall be based on a rolling eight-FME average.
- 9.3.** A generating unit/generating facility's Primary Frequency Response performance during an FME may be excluded from the rolling average calculation by the Compliance Enforcement Authority due to a legitimate operating condition that prevented normal Primary Frequency Response performance.

[Violation Risk Factor = Medium] [Time Horizon = Operations Assessment]

M9. Each GO shall have evidence that each of its generating units/generating facilities achieved an average initial Primary Frequency Response performance level of at least 0.75 as described in Requirement R9. Each GO shall have documented evidence of any FMEs where the generating unit performance should be excluded from the rolling average calculation. Examples of legitimate operating conditions that may support exclusion of FMEs include:

- Operation at or near auxiliary equipment operating limits (such as boiler feed pumps, condensate pumps, pulverizers, and forced draft fans);
- Data telemetry failure. The Compliance Enforcement Authority may request raw data from the GO as a substitute.

R10. Each GO shall meet a minimum 12-month rolling average sustained Primary Frequency Response performance of 0.75 on each generating unit/generating facility, based on participation in at least eight FMEs. The performance of a combined cycle facility will be determined using an expected performance droop of 5.78%.

R10 measures *sustained* unit PFR performance (frequency recovery period). This requirement specifies a certain level of average measured performance over

- 10.1.** The sustained Primary Frequency Response performance shall be the ratio of the Actual Primary Frequency Response to the Expected Primary Frequency Response during the event recovery period following the FME.
- 10.2.** If a generating unit/generating facility has not participated in a minimum of eight FMEs in a 12-month period, performance shall be based on a rolling eight-FME average.
- 10.3.** A generating unit/generating facility's Primary Frequency Response performance during an FME may be excluded from the rolling average calculation due to a legitimate operating condition that prevented normal Primary Frequency Response performance.

[Violation Risk Factor = Medium] [Time Horizon = Operations Assessment]

M10. Each GO shall have evidence that each of its generating units/generating facilities achieved a minimum rolling average of sustained Primary Frequency Response performance of at least 0.75 as described in Requirement R10. Each GO shall have documented evidence of any Frequency Measurable Events where generating unit performance should be excluded from the rolling average calculation. Examples of legitimate operating conditions that may support exclusion of FMEs include:

- Operation at or near auxiliary equipment operating limits (such as boiler feed pumps, condensate pumps, pulverizers, and forced draft fans);
- Data telemetry failure. The Compliance Enforcement Authority may request raw data from the GO as a substitute.

C. Compliance

1. Compliance Enforcement Authority

Texas Reliability Entity

2. Compliance Monitoring Period and Reset Time Frame

2.1. If a generating unit/generating facility completes a mitigation plan and implements corrective action to meet requirements R9 and R10 of the standard, and if approved by the BA and Compliance Enforcement Authority, then the generating unit/generating facility may begin a new rolling event average performance on the next performance during an FME. This will count as the first event in the performance calculation and the entity will have an average frequency performance score after 12 successive months or eight events per R9 and R10.

3. Data Retention

3.1. The Balancing Authority, Generator Owner, and Generator Operator shall keep data or evidence to show compliance, as identified below, unless directed by its Compliance Enforcement Authority to retain specific evidence for a longer period of time as part of an investigation:

- The BA shall retain a list of identified Frequency Measurable Events and shall retain FME information since its last compliance audit for Requirement R1, Measure M1.
- The BA shall retain all monthly PFR performance reports since its last compliance audit for Requirement R2, Measure M2.
- The BA shall retain all annual IMFR calculations, and related methodology and criteria documents, relating to time periods since its last compliance audit for Requirement R3, Measure M3.
- The BA shall retain all data and calculations relating to the Interconnection's Frequency Response, and all evidence of actions taken

to increase the Interconnection’s Frequency Response, since its last compliance audit for Requirements R4 and R5, Measures M4 and M5.

- Each GOP shall retain evidence since its last compliance audit for Requirement R8, Measure M8.
- Each GO shall retain evidence since its last compliance audit for Requirements R6, R7, R9 and R10, Measures M6, M7, M9 and M10.

If an entity is found non-compliant, it shall retain information related to the non-compliance until found compliant, or for the duration specified above, whichever is longer.

The Compliance Enforcement Authority shall keep the last audit records and all requested and submitted subsequent records.

4. Compliance Monitoring and Assessment Processes

- Compliance Audits
- Self-Certifications
- Spot Checking
- Compliance Violation Investigations
- Self-Reporting
- Complaints

D. Violation Severity Levels

R#	Lower VSL	Moderate VSL	High VSL	Severe VSL
R1	The BA reported an FME more than 14 days but less than 31 days after identification of the event.	The BA reported an FME more than 30 days but less than 51 days after identification of the event.	The BA reported an FME more than 50 days but less than 71 days after identification of the event.	The BA reported an FME more than 70 days after identification of the event.
R2	The BA submitted a monthly report more than one month but less than 51 days after the end of the reporting month.	The BA submitted a monthly report more than 50 days but less than 71 days after the end of the reporting month.	The BA submitted a monthly report more than 70 days but less than 91 days after the end of the reporting month.	The BA failed to submit a monthly report within 90 days after the end of the reporting month.
R3	The BA did not make the calculation and criteria for determination of the IMFR publicly available.	The BA did not make the IMFR publicly available.	The BA did not calculate the IMFR for the following year in December.	The BA did not calculate the IMFR.

BAL-001-TRE-1-FINAL— Primary Frequency Response in the ERCOT Region

R4	N/A		The BA did not make public the six-FME rolling average Interconnection combined Frequency Response by the end of the following month.	The BA did not calculate the six-FME rolling average Interconnection combined Frequency Response for any month.
R5	N/A	N/A	N/A	The BA did not take action to improve Frequency Response when the Interconnection's rolling-average combined Frequency Response performance was less than the IMFR.
R6	Any Governor parameter setting was $> 10\%$ and $\leq 20\%$ outside setting range specified in R6.	Any Governor parameter setting was $> 20\%$ and $\leq 30\%$ outside setting range specified in R6.	Any Governor parameter setting was $> 30\%$ and $\leq 40\%$ outside setting range specified in R6.	Any Governor parameter setting was $> 40\%$ outside setting range specified in R6, – OR – an electronic or digital Governor was set to step into the droop curve.
R7	N/A	N/A	N/A	The GO operated with its Governor out of service and did not notify the GOP.
R8	The GOP notified the BA of a change in Governor status or capability between 31 minutes and one hour after discovery of the change.	The GOP notified the BA of a change in Governor status or capability more than 1 hour but within 4 hours after discovery of the change.	The GOP notified the BA of a change in Governor status or capability more than 4 hours after discovery of the change.	The GOP failed to notify the BA of a change in Governor status or capability after discovery of the change.
R9	A GO's rolling average initial Primary Frequency Response performance per R9 was < 0.75 and ≥ 0.65 .	A GO's rolling average initial Primary Frequency Response performance per R9 was < 0.65 and ≥ 0.55 .	A GO's rolling average initial Primary Frequency Response performance per R9 was < 0.55 and ≥ 0.45 .	A GO's rolling average initial Primary Frequency Response performance per R9 was < 0.45 .
R10	A GO's rolling average sustained Primary Frequency Response	A GO's rolling average sustained Primary Frequency Response	A GO's rolling average sustained Primary Frequency Response	A GO's rolling average sustained Primary Frequency Response

	performance per R10 was < 0.75 and ≥ 0.65.	performance per R10 was < 0.65 and ≥ 0.55.	performance per R10 was < 0.55 and ≥ 0.45.	performance per R10 was < 0.45.
--	--	--	--	---------------------------------

E. Associated Documents

1. Attachment 1 – Implementation Plan.
2. Attachment 2 – Primary Frequency Response Reference Document, including Flow Charts A and B.
 - a. This document provides implementation details for calculating Primary Frequency Response performance as required by Requirements R2, R9 and R10. This reference document is a Texas RE-controlled document that is subject to revision by the Texas RE Board of Directors. It is not part of the FERC-approved regional standard.
 - b. The following process will be used to revise the Primary Frequency Response Reference Document. A Primary Frequency Response Reference Document revision request may be submitted to the Texas RE Reliability Standards Manager, who will present the revision request to the Texas RE Reliability Standards Committee (RSC) for consideration. The revision request will be posted in accordance with RSC procedures. The RSC shall discuss the revision request in a public meeting, and will accept and consider verbal and written comments pertaining to the request. The RSC will make a recommendation to the Texas RE Board of Directors, which may adopt the revision request, reject it, or adopt it with modifications. Any approved revision to the Primary Frequency Response Reference Document shall be filed with NERC and FERC for informational purposes.

Version History

Version	Date	Action	Change Tracking
1	7-25-11	Approved by SDT and submitted to Texas RE RSC for approval to post for regional ballot	