

A. Introduction

1. **Title:** Primary Frequency Response in the ERCOT Region
2. **Number:** BAL-001-TRE-2
3. **Purpose:** To maintain Interconnection steady-state frequency within defined limits.
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-2.
- 4.2.2 Generating units/generating facilities while operating in synchronous condenser mode are exempt from Standard BAL-001-TRE-2.
- 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 (Control Performance Standard CPS2). In FERC Order 693, 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 8.5. 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 (FME) (that starts at $t(0)$).

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 (PFR) 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 best actual response between 46 and 60 seconds after $t(0)$ compared to the expected response based on the system frequency at a point 46 seconds after $t(0)$.

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

facility”.

6. Effective Date:

See implementation plan.

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 provide 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.

2.1. The performance of a combined cycle facility will be determined using an expected performance droop of 5.78%.

2.2. The calculation results shall be submitted to the Compliance Enforcement Authority and made available to the GO by the end of the month in which they were completed.

2.3. If a generating unit/generating facility has not participated in a minimum of (8) eight FMEs in a 12-month period, its 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 determine 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 determined 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.** After each calendar month in which one or more FMEs occurs, 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 calendar 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 and Hydro Turbines with Mechanical Governors	+/- 0.034 Hz
All Other Generating Units/Generating Facilities*	+/- 0.017 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%
Combustion Turbine (Simple Cycle and Single-Shaft Combined Cycle)	5%
Combustion Turbine (Combined Cycle)	4%
Steam Turbine*	5%
Diesel	5%
DC Tie Providing Ancillary Services	5%
Variable Renewable (Non-Hydro)	5%

*Requirements R6.1, R6.2, and R6.3 are not applicable to steam turbine(s) of a combined cycle resource.

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.

Where

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

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

MWGCS 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

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 GO has a valid reason for operating with the Governor not in service and 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 it notified the GOP as soon as practical each time it discovered a Governor not in service when the generating unit/generating facility was online and released for dispatch. Evidence may include but not be limited to: operator logs, voice logs, or electronic communications.

R8. Each GOP shall notify the BA as soon as practical but within 30 minutes of the discovery of a status change (in service, out of service) 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 change (in service, out of service) 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.

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.

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 initial Primary Frequency Response performance during an FME may be excluded from the rolling average calculation by the BA due to a legitimate operating condition that prevented normal Primary Frequency Response performance. Examples of legitimate operating conditions that may support exclusion of FMEs include, but are not limited to:

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

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

M9. Each GO shall have evidence that each of its generating units/generating facilities achieved a minimum rolling average of 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 was excluded from the rolling average calculation.

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.

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 sustained measurement 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 sustained Primary Frequency Response performance during an FME may be excluded from the rolling average calculation by the BA due to a legitimate operating condition that prevented normal Primary Frequency Response performance. Examples of legitimate operating conditions that may support exclusion of FMEs include, but are not limited to:

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

[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 was excluded from the rolling average calculation.

C. Compliance

1. Compliance Enforcement Authority

Texas Reliability Entity, Inc.

2. Compliance Monitoring Period and Reset Time Frame

- 2.1.** If a generating unit/generating facility completes a mitigation plan and implements corrective action(s) 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 FMEs 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 combined Frequency Response performance, and all evidence of actions taken to increase the Interconnection's combined Frequency Response performance, 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 for a calendar year.
R4	N/A	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 in which an FME occurred.
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

BAL-001-TRE-2 — Primary Frequency Response in the ERCOT Region

				was less than the IMFR.
R6	Any Governor parameter setting was > 10% and ≤ 20% outside setting range specified in R6.	Any Governor parameter setting was > 20% and ≤ 30% outside setting range specified in R6.	Any Governor parameter setting was > 30% and ≤ 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 upon discovery of its Governor out of service.
R8	The GOP notified the BA of a change in Governor status between 31 minutes and one hour after the GOP was notified of the discovery of the change.	The GOP notified the BA of a change in Governor status more than 1 hour but within 4 hours after the GOP was notified of the discovery of the change.	The GOP notified the BA of a change in Governor status more than 4 hours but within 24 hours after the GOP was notified of the discovery of the change.	The GOP failed to notify the BA of a change in Governor status within 24 hours after the GOP was notified of the 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 performance per R10 was < 0.75 and ≥ 0.65.	A GO's rolling average sustained Primary Frequency Response performance per R10 was < 0.65 and ≥ 0.55.	A GO's rolling average sustained Primary Frequency Response performance per R10 was < 0.55 and ≥ 0.45.	A GO's rolling average sustained Primary Frequency Response performance per R10 was < 0.45.

E. Associated Documents

1. Attachment 1 – 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 Member Representatives Committee (MRC) for consideration. The revision request will be posted in accordance with MRC procedures. The MRC shall discuss the revision request in a public meeting, and will accept and consider verbal and written comments pertaining to the request. The MRC 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	8/15/2013	Adopted by NERC Board of Trustees	
1	1/16/2014	FERC Order issued approving BAL-001-TRE-1. (Order becomes effective April 1, 2014.)	
2	MM/DD/YYYY		<p>Removed the requirement Governor droop and deadband settings for Steam Turbine(s) of combined cycle resources.</p> <p>Edited Requirements R9.3 and R10.3 to reflect the current process and legitimate operating conditions for submitting an FME exclusion request.</p> <p>Removed Attachment 1, which is the implementation plan for Regional Standard BAL-001-TRE-1.</p>