~~**Controllable Load Resource**: Load resource capable of providing Regulation Service by controllably reducing or increasing consumption under dispatch control (similar to Automated Generation Control) and that immediately responds proportionally to frequency changes (similar to generator governor action).~~

~~**Emergency Interruptible Load Service (EILS)**: A special emergency service used during an Electrical Emergency Alert to reduce Load and assist in maintaining or restoring ERCOT System frequency.~~

~~**Generation Resource**: Generating unit or generation facility.~~

~~**Interconnection Minimum Frequency Response (IMFR):** The minimum frequency response limit for the Interconnection that is initially set at 420 MW/0.1 Hz.~~

Measurable Event (FME): ~~A sudden change in interconnection f~~Frequency Deviation ~~that will be~~ used to evaluate~~d for interconnection~~generating unit/generating facility Primary ~~f~~ Frequency ~~r~~Response performance and ~~will meet~~that meets one of the following conditions:

i) a ~~change in interconnection frequency~~ Frequency Deviation that has a pre-perturbation [the 16-second period of time before t(0)] average frequency to post-perturbation [the 34-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). See Attachment 1 for detailed criteria for this measurement.

or

ii) a change in a ~~Generation Resource~~generating unit/generating facility, DC tie or firm load pre-perturbation average ~~MW~~megawatt output to post-perturbation average ~~MW~~megawatt output absolute deviation greater than 550 MW (the 550 MW value may be adjusted by the BA to capture 30 to 40 events per year). See Attachment 1 for detailed criteria for this measurement.

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

~~**Perturbation**: Any disturbance of motion, course, arrangement, or state of equilibrium that causes a sudden change in frequency on the Bulk Electric System.~~

~~**Post-perturbation**: The 34-second period of time starting 20 seconds after t(0).~~

~~**Pre-perturbation**: The 16-second period of time before t(0).~~

Comment [s1]: Controllable Load Resource removed - currently there is only one in ERCOT and it is registered under a GO, also GOP - OXY

Comment [s2]: changed to generating unit/generating facility to be consistent with how it is terminology is used in NERC standards. Generation resources are therefore covered under the current GO registration.

~~**Regulation Service**: A service that is used to control the power output of Resources in response to a change in system frequency so as to maintain the target system frequency within predetermined limits.~~

~~**t(0)**: It is the time of the first observable change in Interconnection frequency at the beginning of a perturbation.~~

~~**Underfrequency Relay Load**: Load that is taken off-line by an underfrequency relay when the frequency goes below a predetermined frequency value for a predetermined number of cycles.~~

Primary Frequency Response:

The ~~automatic~~immediate ~~,~~proportional increase or decrease in real power output provided by ~~Generation Resource~~generating units/generating facilities~~,~~ ~~the automatic, proportional increase or decrease in real power consumption provided by Controllable Loads,~~ and the natural real power dampening response provided by Load in response to system F~~f~~requency ~~d~~Deviations. This response is in the direction that stabilizes frequency.

~~**Governor**~~

~~The electronic, digital or mechanical device that implements Primary Frequency Response of Generation Resources and Controllable Loads.~~

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A. Introduction

Reliability Standard Template

1. **Title:** Real Power Balancing Control Perf
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 replaces the CPS2 Waiver that was approved for ERCOT by NERC on November 21, 2002. Specifically, this standard replaces requirement 2 of BAL-001-0a per FERC Order 693.
4. **Applicability:**
   - **4.1.** Balancing Authorities (BA), Generator Owners (GO)
   - **4.2.** Existing facilities regulated by the U.S. Nuclear Regulatory Commission are exempt from Standard BAL-001-TRE-01.
5. **(Proposed) Effective Date:** After final regulatory approval and with the three-year implementation plan to allow generating unit/generating facility time to meet the requirements. See outline of implementation plan in Attachment 3.

B. Requirements

~~**R1.** The BA shall calculate and report a twelve-month rolling average Interconnection Frequency Response, as measured in Attachment 2.~~

~~**1.1.**~~ The ~~Balancing Authority~~BA ~~for the ERCOT Interconnection~~ shall identify Frequency Measurable Events ~~(as defined in this regional standard) for Primary Frequency Response measurement of Generation Resources/~~ and ~~firm load.~~

~~1.2.~~**R1.** ~~Within 30 days of a Measurable Event, the Balancing Authority for the ERCOT Interconnection shall~~ submit a report to the Compliance Enforcement Authority for each Frequency Measurable Event identified. *[Violation Risk Factor = Medium] [Time Horizon = Operations Assessment]* ~~to the Compliance Enforcement Authority scan rate data necessary to analyze each Measurable Event identified in 1.1. This data shall include:~~

- ~~(1) Interconnection Frequency;~~
- ~~(2) Interconnection scheduled frequency used in the ACE equation;~~
- ~~(3) Regulation Service deployed;~~
- ~~(4) Responsive Reserve Service deployed;~~
- ~~(5) Available Responsive Reserve Service (Nodal only);~~
- ~~(6) Generation Resource MW value;~~
- ~~(7) Control Error (Schedule CE in Zonal, Generation Resource CE in Nodal);~~
- ~~(8) Generation Resource expected Primary Frequency Response;~~
- ~~(8.1) Expected Primary Frequency Response (MW/0.1Hz) for under-frequency event~~

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~~(8.2) Expected Primary Frequency Response (MW/0.1Hz) for over-frequency event~~

~~(8.3) Expected Primary Frequency Response (MW) based on current frequency~~

~~(9) Resource Regulation Service Allocation (Nodal only);~~

~~(10) Resource Economic Base Point (Nodal only);~~

~~(11) Resource High Operating Limit;~~

~~(12) Resource Low Operating Limit;~~

~~(13) Controllable Load Resource consumption MW;~~

~~(14) Load Acting As Resource MW;~~

~~(15) Load Acting As Resource deployed;~~

~~(16) Resource Responsive Reserve Service Responsibility (Nodal only);~~

~~(17) ERCOT Load;~~

~~(18) MW value for loss of individual Generation Resource(s) or Load that triggered the Measurable Event;~~

~~(19) Emergency Interruptible Load Service Deployed;~~

~~(20) Time (synchronous time stamp to the nearest second for the data above).~~

~~The BA shall analyze frequency and frequency movements and calculate the Interconnection Minimum Frequency Response (MW/0.1Hz) by January 1 of each year.~~

~~**1.3.** For each Measurable Event, the frequency response performance of each interconnected Generation Resource shall be compiled by the BA as measured in Attachment 3.~~

1.4. The BA shall calculate the ~~twelve~~12-month rolling average Primary ~~f~~Frequency ~~r~~Response performance of each ~~Generation Resource~~generating unit/generating facility using the Primary Frequency Response Evaluation Tool (Attachment 2) ~~and report these averages, quarterly to the Compliance Enforcement Authority.~~ . If the generating unit/generating facility has not participated in a minimum of (8) eight Frequency Measurable Events in a 12-month period, performance shall be based on a rolling eight Frequency Measurable Event average response. ~~The twelve-month rolling average frequency response of each resource would be based on a six-event minimum participation.~~ *[Violation Risk Factor = Medium] [Time Horizon = Operations Assessment]*~~Generation Resources less than 10 MW each, who at a single point of interconnection sum to an aggregate greater than 10 MW, shall be treated as a single Generation Resource.~~

R2. ~~The BA shall maintain a twelve-month rolling governor frequency responsive reserve greater than IMFR~~

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~~Comment [s6]: discussion around wind generation and distributed generation~~

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~~R2.~~R3. Each GO shall set the ~~g~~Governor parameters as follows: *[Violation Risk Factor = High] [Time Horizon = Operations Planning]*

~~2.1.~~3.1. Limit ~~g~~Governor deadbands within those listed in Table ~~2~~3.1.

Table ~~3~~2.1 Governor Deadband Settings

Governor Type	Max. Deadband
Mechanical	+/- 0.036~~.00 mHz~~
Electronic	+/- 0.016~~.6766~~ mHz
Digital	+/- 0.016~~.667~~ mHz

~~2.2.~~3.2. Ensure that G~~g~~overnor droop ~~characteristics~~ settings do not exceed ~~the settings~~those listed in Table ~~3~~2.2.

Table ~~3~~2.2 Governor Droop Settings

Resource Type	Max. Droop % Setting
Hydro	5%
Nuclear	5%~~NA~~
Coal and Lignite	5%
Combustion Turbine (Simple Cycle)	5%
Combustion Turbine (Combined Cycle)	4%
Steam Turbine (Simple Cycle)	5%
Steam Turbine (Combined Cycle)	5%
Diesel	5%
Wind Turbine	5%
DC Tie Providing Ancillary Services	5%
Renewable (Non-Hydro)	5%
~~Controllable Load Resource~~	~~5%~~

~~2.3.~~3.3. For digital and electronic ~~governor~~Governors, once frequency deviation has exceeded the ~~governor~~Governor deadband from 60.000 Hz, ensure that the resource ~~governor~~Governor follows the slope derived from the formula below.

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

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

Where: MW_{GCS} is the maximum ~~megawatt~~megawatt control range of the ~~governor~~Governor control system ~~(GCS)~~.

R4. The GO shall meet a minimum ~~twelve~~12-month rolling average initial Primary ~~f~~Frequency ~~r~~Response performance on each ~~Generation Resource~~generating unit/generating facility based on an eight (8) Frequency Measurable Event minimum participation. If the generating unit/generating facility has not participated in a minimum of eight Frequency Measurable Events in a 12-month period, performance shall be based on a rolling eight Frequency Measurable Event average response. *[Violation Risk Factor = Medium] [Time Horizon = Operations Assessment]*

$Avg_{Period}[P.U.\ PFR_{Resource}] \geq 0.75$

~~w~~Where: P.U. $PFR_{Resource}$ is the per unit measure of the Primary ~~f~~Frequency R~~r~~esponse of a Resource during identified Frequency Measurable Events.

~~$P.U.FR_{Resource} = Actual\ Frequency\ Response_{ME} \div Expected\ Frequency\ Response_{ME}$~~

$P.U.\ PFR_{Resource} = \frac{Actual\ Primary\ Frequency\ Response}{Expected\ Primary\ Frequency\ Response}$

Expected Primary Frequency Response (EPFR): This is calculated when the frequency deviation exceeds the deadband.

$$Expected\ MW\ Change = \left[\frac{(HZ_{actual} - 60.0 + deadband)}{(60 * droop - deadband)} \times (-1) \times (Capacity)\right]$$

EPFR for Combustion Turbine

$$Expected\ MW\ Change + (HZ_{actual} - 60.0) \times 10 \times 0.00276 \times Generation\ Resource\ Capacity$$

EPFR for Steam Turbine

$$(Expected\ MW\ Change + Stored\ Energy Loss + Steam\ Expansion\ Loss) \times \frac{Actual\ Throttle\ Pressure}{Rated\ Throttle\ Pressure}$$

$$Stored\ Energy\ Loss = \left[Expected\ MW\ Change \times K \times \left(\frac{Capacity}{PSIG_{Rated}}\right)\right]$$

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$$Where\ K = \frac{Change\ in\ Pressure\ (\Delta PSIG)}{Change\ in\ MW\ (\Delta MW)}\ is\ in\ the\ range\ of\ 0.0 \rightarrow 0.5$$

$$Steam\ Expansion\ Loss = \left[Expected\ MW\ Change \times 2 \times MW_{post-perturbation} \times \left(\frac{K}{PSIG_{Rated}}\right)\right]$$

Actual Primary Frequency Response (APFR): This is the difference between Pre-perturbation Average MW and Post-perturbation Average MW.

$$Actual\ Primary\ Frequency\ Response = MW_{pre-perturbation} - MW_{post-perturbation}$$

~~Expected Frequency Response$_{ME}$ is calculated:~~

~~For each Generation Resource, the Δ of the Post Perturbation expected MW change and the Pre Perturbation MW change as evaluated at the Post Perturbation Interconnection frequency and the Pre Perturbation Interconnection frequency. The evaluation will include Generation Resource droop setting, governor deadband setting, approved limiting factor and operating range of the governor.~~

~~Resource Limiting Factor: Steam Turbines~~

~~During the measurement period of a steam turbine Generation Resource, several conditions contribute to greater than 5% droop performance. These include but are not limited to:~~

- ~~Inlet steam pressure change from nominal due to the sudden change in steam demand from the steam generator. This will be a steam pressure increase during high frequency and a steam pressure decrease during low frequency events. Both will contribute to higher than 5% droop performance.~~
- ~~Turbine valve opening percentage at the time of the Measurable Event will impact droop performance. The higher percent open the steam inlet valves at the time of the Measurable Event the more affect (1) above has on the performance.~~
- ~~Operation of a turbine at less than rated inlet steam pressure will also impact droop performance. Variable inlet pressure operation at a inlet valve position less than 80% will result in droop performance higher than 5%. This is different than variable pressure operation at valves wide open.~~

~~Resource Limiting Factor: Combustion Turbines~~

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~~During the measurement period of a combustion turbine Generation Resource droop performance will be impacted due to the change in speed of the resource. During low frequency events the turbine speed will reduce with frequency thus reducing the mass flow through the compressor. During high frequency events the turbine speed will increase with frequency thus increasing the mass flow through the compressor. Both will cause the droop performance to be higher than the droop setting.~~

~~Actual Frequency Response$_{ME}$ is calculated:~~

~~For each Generation Resource, the Δ of the Post Perturbation actual MW value and the Pre Perturbation MW value as measured at the Post Perturbation Interconnection frequency and the Pre Perturbation Interconnection frequency during a Measurable Event.~~

~~Average Period is one year or a minimum of six (6) events.~~

~~[formulas to go in Requirement]~~

~~The~~ P.U. ~~F~~frequency ~~response~~ Response ~~for a specific event of a Generation Resource may be excluded~~ from the average calculation ~~if the GO provides documented evidence such as design limitations, equipment conditions, or temporary operating conditions that limited the response during a specific event. [Reference Attachment of exceptions – Attachment X]~~

Pre-perturbation Average MW: Actual MW averaged from t(-16) to t(-2)

$$MW_{pre-perturbation} = \frac{\sum_{t(-16)}^{t(-2)} MW}{8}$$

Post-perturbation Average MW: Actual MW averaged from t(20) to t(52)

$$MW_{post-perturbation} = \frac{\sum_{t(52)}^{t(20)} MW}{17}$$

R5. The GO shall meet a minimum 12-month rolling average sustained Primary Frequency Response performance on each generating unit/generating facility based on an eight (8) Frequency Measurable Event minimum participation. If the generating unit/generating facility has not participated in a minimum of eight Frequency Measurable Events in a 12-month period, performance shall be based on a rolling eight Frequency Measurable Event average response. *[Violation Risk Factor = Medium] [Time Horizon = Operations Assessment]*

Event Recovery Time (ERT): Time at which Frequency Returns to Pre-perturbation Frequency or Scheduled Frequency, whichever is lower

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Pre-perturbation Average MW: Actual MW averaged from t(-16) to t(-2)

$$MW_{pre-perturbation} = \frac{\sum_{t(-16)}^{t(-2)} MW}{8}$$

Post-perturbation Average MW: Actual MW averaged from t(20) to t(52)

$$MW_{post-perturbation} = \frac{\sum_{t(52)}^{t(20)} MW}{17}$$

MW_{ERT} = Instantaneous MW at ERT

$$\Delta MW = MW_{pre-perturbation} - MW_{ERT}$$

$$\#Scans = ERT - t(0) - 2$$

$$Expected\ 60\ Hz\ MW_t = \left(\frac{t}{2}\right)\left(\frac{\Delta MW}{\#Scans}\right) + MW_{pre-perturbation}$$

Initial Primary Frequency Response in P.U. ($IPFR_{p.u.}$)

$$IPFR_{p.u.} = \frac{\left(MW_{post-perturbation} - MW_{pre-perturbation}\right)}{EPFR}$$

$$If\left(IPFR_{p.u.} > 1.0\right)\ then\ IPFR_{p.u.} = 1.0$$

$$If\left(IPFR_{p.u.} < 0.15\right)\ then\ IPFR_{p.u.} = 0.0\ (No\ eavaluation\ is\ required)$$

Event Average Expected MW

$$MW_{EAE} = \frac{\sum_{t(-2)}^{t(ERT)}\left(Expected\ 60\ Hz\ MW_t + EPFR_t \times IPFR_{p.u.}\right)}{\#Scans}$$

Event Average Actual MW

$$MW_{EAA} = \frac{\sum_{t(-2)}^{t(ERT)}(MW_t)}{\#Scans}$$

$$P.U.\ PFR_{Resource} = \frac{MW_{EAA}}{MW_{EAE}}$$

$$Avg_{Period}[P.U.\ PFR_{Resource}] \geq 0.75$$

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C. Measures

~~M1.~~ ~~Text~~

M1. The BA shall have evidence it reported each Frequency Measurable Event to the Compliance Enforcement Authority within 30 days of the FME as required in R1. The data provided to the Compliance Enforcement Authority may include but is not limited to that listed in Attachment 1.

M2. The BA shall have evidence it reported the rolling average Primary Frequency Response performance of each generating unit/generating facility monthly to the Compliance Enforcement Authority as required in R2.

M3. The GO shall have evidence that it set the ~~governor~~Governor parameters in accordance with R~~2~~3. Examples of evidence ~~could~~ include but are not limited to:

- Governor test reports.
- Governor setting sheets.
- performance monitoring reports.

M3.1 The GO shall have evidence that it set the Governor deadbands as required in Table 3.1 in Requirement R3.

M3.2 The GO shall have evidence that the accepted Governor droop characteristics did not exceed the settings in Table 3.2 in Requirement R3.

~~M2.~~M3.3 The GO shall have evidence that when frequency deviation has exceeded the Governor deadband from 60.00 Hz the Governor follows the approved slopes derived from the prescribed formulas for 4% droop and 5% droop.

- ~~governor test reports~~
- ~~governor setting sheets~~
- ~~performance monitoring reports~~
- ~~Other The list above is not all inclusive of evidence required to show compliance with the Reliability Standard.~~

M4. ~~by recalculating the twelve-month rolling average excluding these specific measurable events. The GO should use this evidence to eliminate the Measurable Event from the twelve-month rolling average.~~Each GO shall have evidence that each of its generating units/generating facilities achieved a minimum performance level of 0.75 P.U. $PFR_{Resource}$ per R4 and documented evidence of any Frequency Measurable Events where generating unit performance should be excluded.

~~M3.~~M5. Each GO shall have evidence that each of its generating units/generating facilities sustained a minimum performance level of 0.75 P.U. $PFR_{Resource}$ per R5 and documented evidence of any Frequency Measurable Events where generating unit

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performance should be excluded. On a single event, if M4 is <0.15 P.U. $PFR_{Resource,}$ then M5 is not measured.

D. Compliance

1. Compliance Monitoring Process

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1.1. Compliance Enforcement Authority

~~Text~~Texas Regional Entity

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1.1. Compliance Monitoring Period and Reset Time Frame

1.1.1 If a generating unit/generating facility fails any requirement or measure of this standard, the GO will submit mitigation plans for the failing generating unit/generating facility with a timeline not to exceed 90 days from the notification of failing performance.

1.1.2 Each generating unit/generating facility will have a rolling event average performance as stated in R4 and R5 of this Standard. If a generating unit/generating facility completes a mitigation plan and implements corrective action that corrects past failing performance as measured by this standard, the rolling event average will be reset on the next successful performance during a Frequency Measurable Event and the generating unit/generating facility will begin a new rolling event average performance. If the generating unit/generating facility fails the next Frequency Measurable Event performance, the GO will submit a follow-up mitigation plan with a timeline not to exceed 30 days from the notification of failing performance.

~~2. Not applicable.~~

~~2.1.~~1.2. **Data Retention**

The Balancing Authority and Generator Owner 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:

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- Each BA shall retain a list of identified Frequency Measurable Events since its last compliance audit for R1, M1.

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- Each BA shall retain all monthly reports since its last compliance audit for R2, M2.
- Each GO shall retain evidence since last compliance audit for R3, M3.
- Each GO shall retain evidence since last compliance audit for R4, M4.
- Each GO shall retain evidence since last compliance audit for R5, M5.

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

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~~3.1.~~1.3. **Compliance Monitoring and Assessment Processes**

Compliance Audits

Self-Certifications

Spot Checking

Compliance Violation Investigations

Self-Reporting

Complaints

Periodic Data Submittals as required

Exception Reporting as necessary

~~4. Text~~

~~4.1.~~1.4. **Additional Compliance Information**

~~Text~~N/A at this time

2. Violation Severity Levels

R #	Lower VSL	Moderate VSL	High VSL	Severe VSL
R1	A Frequency Measurable Event is not reported > 30 days but ≤ 50 days of identification of the event.	A Frequency Measurable Event is not reported > 50 days but ≤ 70 days of identification of the event.	A Frequency Measurable Event is not reported > 70 days but ≤ 90 days of identification of the event.	A Frequency Measurable Event is not reported > 90 days of identification of the event.
R2	Monthly reports submitted > 30 days but ≤ 50 days from the end of the reporting month.	Monthly reports submitted > 50 days but ≤ 70 days from the end of the reporting month.	Monthly reports submitted > 70 days but ≤ 90 days from the end of the reporting month.	Monthly reports submitted > 90 days from the end of the reporting month.
R3	Any Governor parameter setting >10% and ≤20% outside setting range specified in R3.	Any Governor parameter setting >20% and ≤30% outside setting range specified in R3.	Any Governor parameter setting >30% and ≤40% outside setting range specified in R3.	Any Governor parameter setting >40% outside setting range specified in R3 – OR – the electronic or digital Governor was set to step into the curve.
R4	Rolling average per R4 is ≤0.75 and ≥0.65.	Rolling average per R4 is ≤0.65 and ≥0.55.	Rolling average per R4 is ≤0.55 and ≥0.45.	Rolling average per R4 is ≤0.45.
R5	Rolling average per R5 is ≤0.75 and ≥0.65.	Rolling average per R5 is ≤0.65 and ≥0.55.	Rolling average per R5 is ≤0.55 and ≥0.45.	Rolling average per R5 is ≤0.45.

E. Regional Variances

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This is a regional variance to NERC Standard BAL-001-0a, specifically replacing R2. Instead of complying with R2 in BAL-001-0a (CPS2), the BA and GO in the ERCOT Interconnection maintain Interconnection steady-state frequency within defined limits by balancing real power demand and supply in real-time by the methods, requirements, and measures described in this regional standard and associated attachments and documents.

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F. Associated Documents

Version History

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Attachment 1

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The type of data provided to the Compliance Enforcement Authority for analyzing each Frequency Measurable Event that has been identified by the BA may include but not limited to that listed below:

(1) Interconnection Frequency;

(2) Interconnection scheduled frequency used in the ACE equation;

(3) Regulation Service deployed;

(4) Responsive Reserve Service deployed;

(5) Available Responsive Reserve Service (Nodal only);

(6) Generating unit/generating facility megawatt value;

(7) Control Error (Schedule CE in Zonal, Generation Resource Energy Deployment Performance (GREDP) in Nodal);

(8) Generating unit/generating facility expected Primary Frequency Response;

(9) Resource Regulation Service Allocation (Nodal only);

(10) Resource Economic Base Point (Nodal only);

(11) Resource High Operating Limit;

(12) Resource Low Operating Limit;

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(13) Load Acting As Resource megawatt;

(14) Load Acting As Resource deployed;

(15) Resource Responsive Reserve Service Responsibility (Nodal only);

(16) ERCOT Load;

(17) Megawatt value for loss of individual generating unit/generating facility(s) or Load that triggered the Frequency Measurable Event;

(18) Emergency Interruptible Load Service Deployed;

(19) Time (synchronous time stamp to the nearest second for the data above).

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~~The measurement of frequency response can be challenging. There are conditions when the mathematical calculations that perform the measurement of performance do not account for all control functions of a Generation Resource. If frequency response is visually apparent during these ramps and the direction of the ramp causes the measurement of the frequency response to be below the minimum performance level, the Event may be removed from the Generation Resource's 12 month rolling average performance measure. The following situations are known to cause measurement techniques to improperly measure performance:~~

~~1) Previous AGC or manual control to change the Generation Resource output. If the Generation Resource is ramping from one output level to another during a measurable frequency deviation, frequency response may be difficult to measure. This is true if the ramp direction is in the same direction as the frequency deviation, that is, the Generation Resource is in a down ramp during a low frequency deviation (see Figure 1 below) or up ramp during a high frequency deviation. This is especially true for Generation Resources that have high ramp rates in comparison to their maximum capability. All Generation Resources shall be responsive to all frequency deviations exceeding the governor deadband while ramping.~~

~~2) Conventional steam driven turbines will have some initial steam pressure drop following large low frequency deviations. This pressure drop should be minimized by the control functions of the steam generator while remaining within the thermal and physical limits of the steam generator. (see Figure 2 below) The same effect is true for high frequency deviations. Steam generator pressure will rise from the frequency response of the turbine thereby reducing the net frequency response of the turbine. The Generator Owner may provide an estimation of this effect in the form of a "parameter" curve to be added to the measurement spreadsheet that accounts for this stored energy limitation.~~

~~3) Steam turbines of combined cycle Generation Resources. These turbines depend on the waste heat of combustion turbines to provide additional steam supply for their frequency response. The cycle time of the heat recovery boiler is typically longer than the performance measure of this standard and performance of these Generation Resources will measure below normal droop characteristic curves.~~

~~4) Generation Resources located at the same site as the Generation Resource that causes the perturbation may have a shift in site auxiliary load assignment during the measurement period. This may result in a decrease in "Net" output of the Generation Resources and affect the measurement of frequency response. In this scenario Gross megawatt values for Generation Resource output and Gross High Operating Limit may be used for the evaluation of the frequency response measurement of the Generation Resource.~~

~~5) Generation Resources may have auxiliary equipment that must be placed in service throughout the load range of the Generation Resource. If the Generation Resource is operating at an output level that requires placing in service auxiliary equipment, frequency response of the Generation Resource may be limited. This may result in below minimum frequency response performance. The Generation Owner shall document this limitation on each occurrence during a Measurable Event. Once the equipment is placed in service, full frequency response is expected.~~

~~6) Generation Resources operating near the High Operating Limit (HOL) of the Generation Resource can measure below the minimum frequency response performance level. The expected performance shall be limited to the HOL of the Generation Resource.~~

Comment [j12]: See Garland, Q5 Comment on visually apparent.

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~~7) Generation Resources operating at extremely low output levels may have limited frequency response. This output level may be defined as the Emergency Low Operating Limit, and responding to frequency deviations may place the Generation Resource at risk. The Generator Owner shall identify and document these operating ranges.~~
~~8) Generation Resources operating at extremely high output levels may have limited frequency response. This output level may be defined as the Emergency High Operating Limit, and responding to frequency deviations may place the Generation Resource at risk. The Generator Owner shall identify and document these operating ranges. Generation Resources operating in this range shall not be assigned Responsive Reserve Service since frequency response is not available. This may include these operating conditions:~~
~~a. Over pressure operation of the steam generator~~
~~b. Duct burner operation of combined cycle Generation Resources~~
~~c. Steam augmentation of combustion turbines and the injection of steam into the turbine combustors.~~

~~9) Address cogenearation facility internal load changes during measureable events. See Randy Jones comment c, Q1.~~

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