



## **Item 8: 2020 ERCOT Methodologies for Determining Minimum Ancillary Service Requirements**

*Nitika Mago*

Supervisor, Operations Analysis

Board of Directors Meeting

ERCOT Public

December 10, 2019

# Background & Scope

## 3.16 Standards for Determining Ancillary Service Quantities

- (2) ERCOT shall, **at least annually**, determine with supporting data, the methodology for determining the quantity requirements for each Ancillary Service needed for reliability...
- (3) The ERCOT Board **shall review and approve** ERCOT's methodology for determining the minimum Ancillary Service requirements...

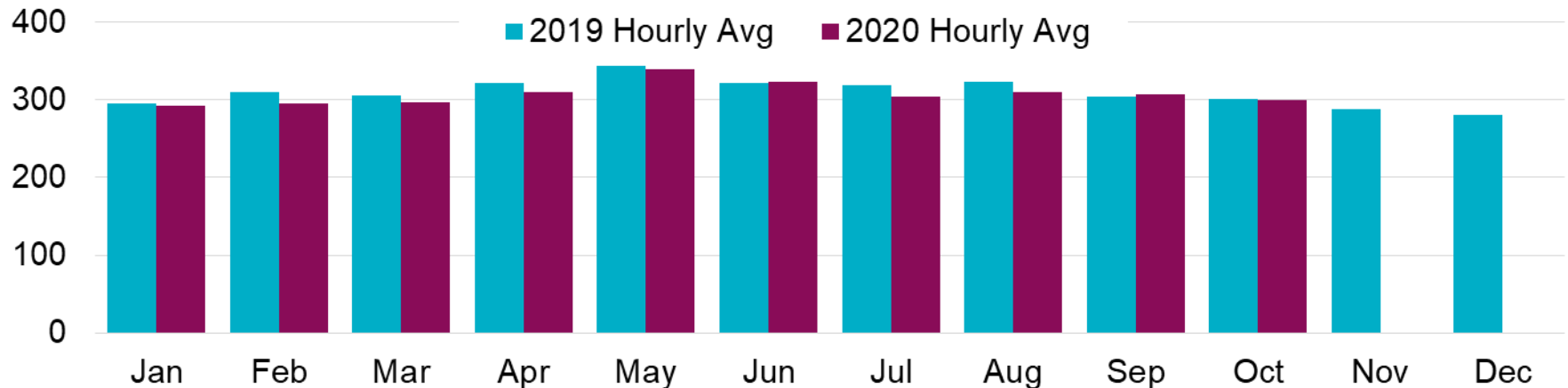
- ERCOT is not proposing any changes to the methodologies for determining Ancillary Service (A/S) quantities for 2020.

# Regulation Service Methodology – 2020

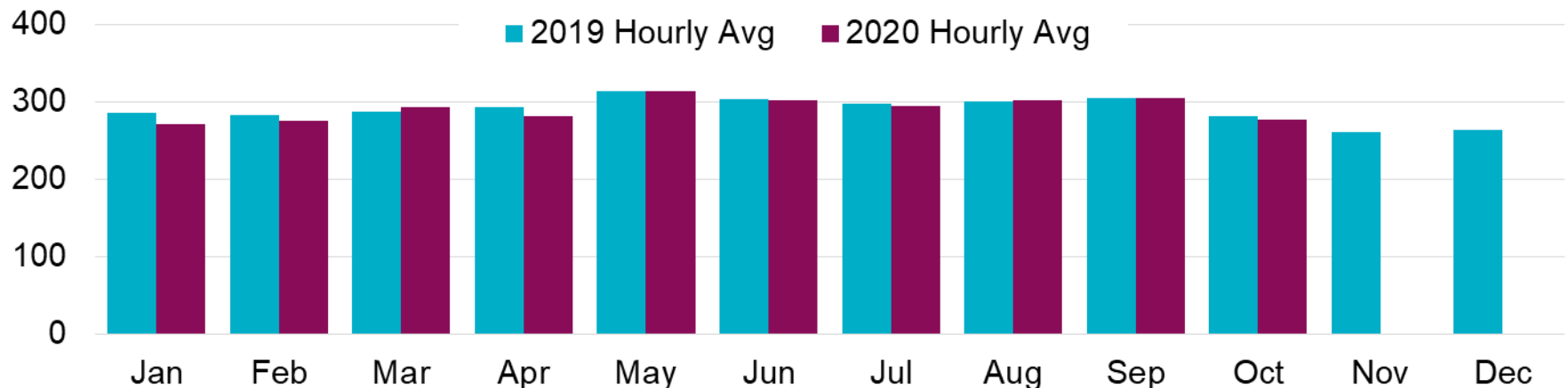
- The preliminary Regulation quantities for January 2020 through October 2020 in subsequent slides have been computed using current methodology (2018 and 2019 five-minute net load variability) and updated Wind Adjustment tables.
- Wind Adjustment Tables track incremental MWs of Regulation needed to account for additional variability per 1000 MW increase in installed Wind capacity.
  - These tables have been updated for 2020.

# Hourly Average Regulation Comparison

## Hourly Average Regulation Up Requirement Comparison



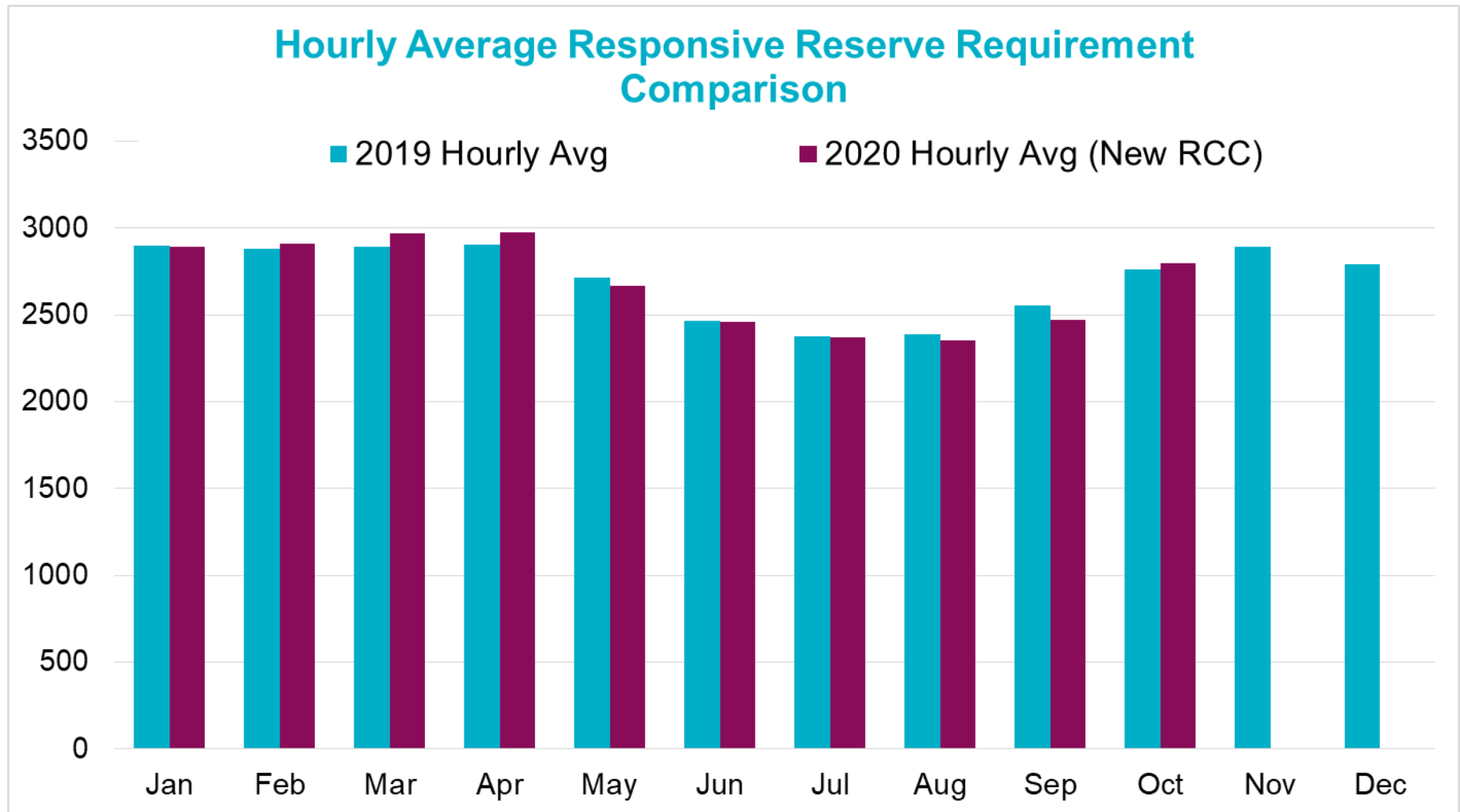
## Hourly Average Regulation Down Requirement Comparison



# Responsive Service Methodology (RRS) - 2020

- The preliminary RRS quantities for January 2020 through October 2020 in subsequent slides have been computed using 2018 and 2019 system inertia conditions and an updated RRS table.
- The RRS table tracks RRS requirements for different inertia conditions.
  - This table has been updated for 2020. For the update, a Resource Contingency Criteria (RCC) of 2805 MW has been used in associated studies.

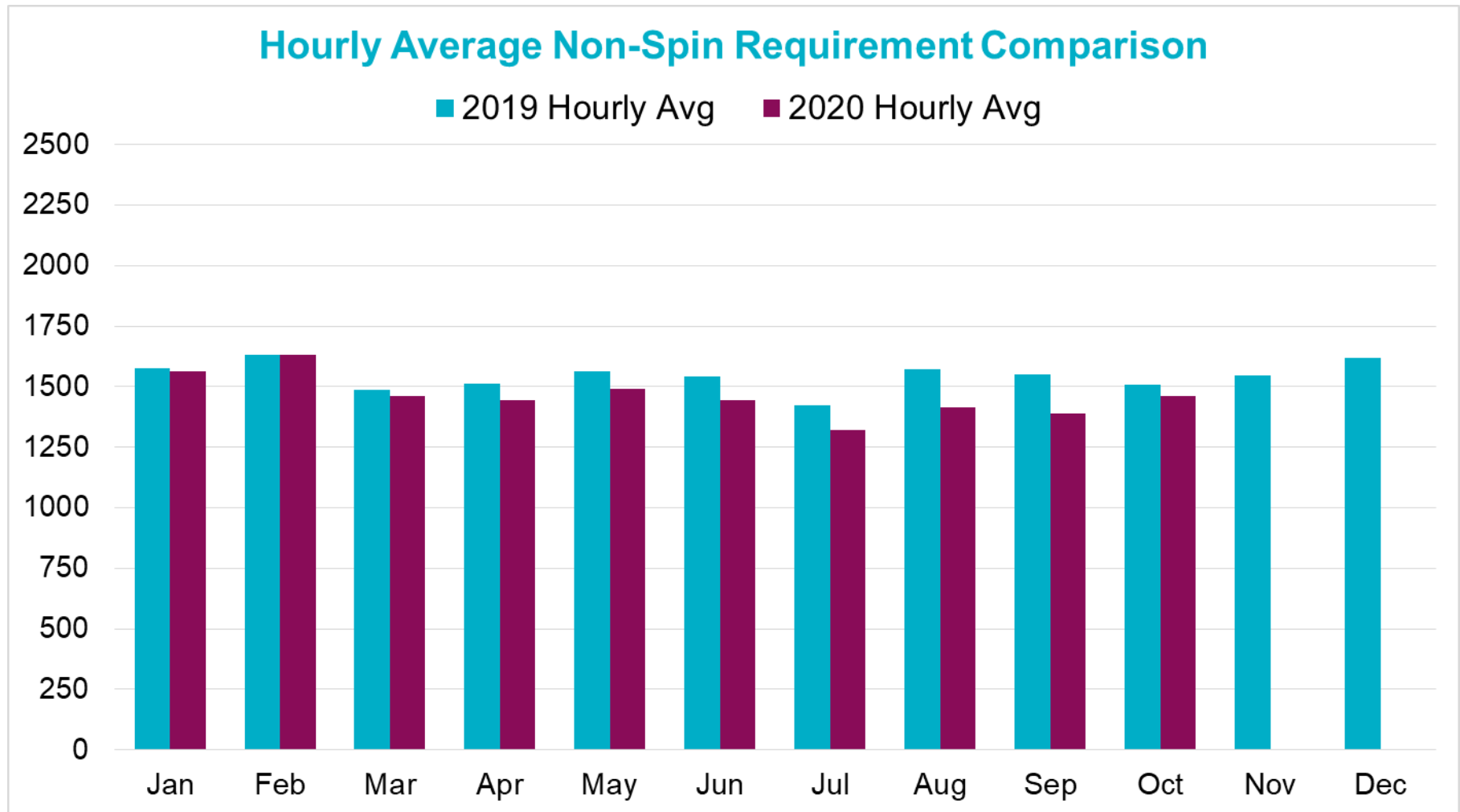
# Hourly Average RRS Comparison



# Non Spinning Reserve Methodology (Non-Spin) - 2020

- The preliminary Non-Spin quantities for January 2020 through October 2020 in subsequent slides have been computed using current methodology (2017, 2018 and 2019 Net load and Net load Forecast) and updated Wind Over-Forecast Error Adjustment tables.
- Wind Over-Forecast Error Adjustment Table track estimated increase in wind over forecast error per 1000 MW increase in installed Wind capacity.
  - This table has been updated for 2020.

# Hourly Average Non-Spin Comparison





## Summary

- Following is a summary of the 2020 Ancillary Service Methodology
  - ERCOT is not proposing any changes to the methodology for determining Ancillary Service quantities for 2020.
  - ERCOT is proposing a limit of 450 MW be applied on Resource providing Fast Frequency Response upon implementation of phase 1 of NPRR 863.
- ERCOT is seeking ERCOT Board of Directors' approval of the 2020 Ancillary Service Methodology as noted above.



**Date:** December 3, 2019  
**To:** Board of Directors  
**From:** Nitika Mago, Supervisor Operations Analysis  
**Subject:** 2020 ERCOT Methodologies for Determining Minimum Ancillary Service Requirements

**Issue for the ERCOT Board of Directors**

**ERCOT Board of Directors Meeting Date:** December 10, 2019

**Item No.:** 8

**Issue:**

Whether the ERCOT Board of Directors (Board) should approve the proposed 2020 ERCOT Methodologies for Determining Minimum Ancillary Service Requirements (2020 AS Methodology) as presented herein, to be effective January 1, 2020.

**Background/History:**

Ancillary Services are necessary to maintain the reliability of the ERCOT System. The ERCOT Protocols define these Ancillary Services and charge ERCOT with determining a methodology for the minimum levels of Ancillary Services required. Paragraph (2) of Section 3.16 requires ERCOT to review the methodology at least annually, and paragraph (3) of Section 3.16 requires the Board to review and approve ERCOT's methodology.

ERCOT staff presented the 2019 ERCOT Methodologies for Determining Minimum Ancillary Service Requirements (2019 AS Methodology) to the Board on December 11, 2018, which the Board approved to be effective January 1, 2019 as requested.

No changes have been proposed to the methodologies for determining Ancillary Service quantities in the 2020 AS Methodology. The changes to the 2020 AS Methodology are shown in red-line in **Attachment A** and can be summarized as follows:

- **Regulation Service:**
  - No change, i.e., same methodology as approved on December 11, 2018.
  - Updates to Wind Adjustment tables that track incremental effect of actual increase in installed wind capacity in 2018 on Regulation Service quantities.
- **Responsive Reserve Service:**
  - No change, i.e., same methodology as approved on December 12, 2017.
  - Minimum RRS requirement in the AS Methodology ties to the minimum stated in the Operating Guide.
- **Non-Spinning Reserve Service:**
  - No change, i.e., same methodology as approved on December 11, 2018.
  - Updates to Wind Over-Forecast Error Adjustment Table that track estimated increase in wind over-forecast error per 1,000 MW increase in

installed wind capacity.

- The Board had approved removal of floor from the Non-Spinning Reserve Service methodology at its December 11, 2018 meeting, but the language related to the floor was only partially removed from the methodology document. This errata is being corrected.

The proposed 2020 AS Methodology will go into effect on January 1, 2020. Upon approval, the minimum Ancillary Service quantities for 2020 will be determined using the 2020 AS Methodology and posted on the Market Information System (MIS) by December 20, 2019.

On November 20, 2019, the Technical Advisory Committee (TAC) unanimously endorsed the proposed 2020 AS Methodology, with an effective date of January 1, 2020.

In addition to the changes proposed in 2020 AS Methodology as outline above, **Attachment A** identifies a limit of 450 MW on Resources providing Fast Frequency Response (FFR). This limit will be effective upon implementation of phase 1 of Nodal Protocol Revision Request (NPRR) 863, Creation of ERCOT Contingency Reserve Service and Revisions to Responsive Reserve.

**Key Factors Influencing Issue:**

The proposed changes to the Wind Adjustment tables used to add incremental amounts of Regulation Service quantities are based on actual wind generation data from 2019. This is a routine update that ERCOT makes annually based on the actual growth of installed wind generation.

Similarly, the proposed changes to the Wind Over-Forecast Adjustment table used to add incremental amounts of Non-Spinning Reserve Service quantities is a routine update that ERCOT makes annually and is based on a projected increase in wind over-forecast error due to the anticipated future growth in installed wind generation in 2020

These changes were endorsed unanimously by the Reliability and Operations Subcommittee (ROS), Wholesale Market Subcommittee (WMS) and TAC.

**Conclusion/Recommendation:**

ERCOT staff recommends that the Board approve the proposed 2020 ERCOT Methodologies for Determining Minimum Ancillary Service Requirements, attached as **Attachment A**, as endorsed by TAC, to be effective January 1, 2020.



**ELECTRIC RELIABILITY COUNCIL OF TEXAS, INC.**  
**BOARD OF DIRECTORS RESOLUTION**

WHEREAS, after due consideration of the alternatives, the Board of Directors (Board) of Electric Reliability Council of Texas, Inc. (ERCOT) deems it desirable and in the best interest of ERCOT to approve the 2020 *ERCOT Methodologies for Determining Minimum Ancillary Service Requirements*, as set forth in **Attachment A**, as endorsed by the Technical Advisory Committee (TAC), to be effective on January 1, 2020;

THEREFORE, BE IT RESOLVED, that ERCOT is hereby authorized and approved to implement the 2020 *ERCOT Methodologies for Determining Minimum Ancillary Service Requirements*, as set forth in **Attachment A**, as endorsed by TAC, to be effective on January 1, 2020.

**CORPORATE SECRETARY'S CERTIFICATE**

I, Vickie G. Leady, Assistant Corporate Secretary of ERCOT, do hereby certify that, at its December 10, 2019 meeting, the ERCOT Board passed a motion approving the above Resolution by \_\_\_\_\_.

IN WITNESS WHEREOF, I have hereunto set my hand this \_\_\_\_ day of December, 2019.

\_\_\_\_\_  
Vickie G. Leady  
Assistant Corporate Secretary

# ERCOT Methodologies for Determining Minimum Ancillary Service Requirements

ERCOT Board approved 12/~~XX11~~/201~~98~~

Effective Date of 01/01/20~~19~~

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## ***Introduction***

Paragraph (2) of Protocol Section 3.16, Standards for Determining Ancillary Service Quantities, requires that methodologies for determining the amounts of Ancillary Services to be required by ERCOT must be developed at least annually. Paragraph (3) of Protocol Section 3.16 requires approval of this methodology by the ERCOT Board of Directors.

This document discusses the various Ancillary Services for which requirements are to be developed. Further, detailed methodologies for determining those requirements are included as part of this document.

Specifically, methodologies are required for the determination of the quantities of Regulation Service, Non-Spinning Reserve Service (Non-Spin) and Responsive Reserve (RRS) that are required to maintain system reliability. Those procedures are discussed below.

These procedures are intended for determining each of the Ancillary Service requirements for all months of the upcoming year. This procedure will be performed annually. The Ancillary Service requirements are determined annually and will be posted to the Market Information System (MIS) by December 20<sup>th</sup> for the upcoming year. If necessary, any additional incremental adjustment to the posted Ancillary Service requirements for a particular month will be made using this procedure and will be posted to the MIS prior to the 20<sup>th</sup> of each month for the upcoming month. If the AS requirements identified through this process for a particular operating day are found to be insufficient based on the expected operating conditions for that day, ERCOT may make an updated AS requirements posting for that day if the need for incremental adjustments is identified day-ahead and may use the Supplemental Ancillary Service Market (SASM) process for similar adjustments made closer to real-time. For any additional months for which ERCOT is required to provide an Ancillary Service requirement forecast, the forecasted requirement will be set to the historical requirement for the same month of the previous year.

## ***Regulation Service Requirement Details***

### **Introduction**

Regulation Service consists of resources that can be deployed by ERCOT in response to changes in ERCOT System frequency to maintain the target ERCOT System frequency within predetermined limits according to the Operating Guides. ERCOT is required to evaluate normal requirements for Reg-Up Service and Reg-Down Service on an annual basis. It is ERCOT's practice to use historical rates of Regulation Service usage to perform evaluation and determine the required quantities for this service. Regulation Service is deployed in order to correct actual frequency to scheduled frequency and to ensure North American Electric Reliability Corporation (NERC) requirements are met.

### **Summary**

The Regulation Service requirements are calculated with the expectation that sufficient Regulation Service will be available to cover the 95<sup>th</sup> percentile of deployed regulation or net load variability. An adjustment may also be made based on historic CPS1 performance.

### **Procedure**

To evaluate Regulation Service requirements, ERCOT will collect historical Resource Asset Registration Form (RARF) information, CPS1 data, Regulation Service deployment data, aggregate output data, and ERCOT system load data. For determining the base Reg-Up requirements for a particular hour, ERCOT will take the largest of the 95<sup>th</sup> percentile of Reg-Up deployments for the same month of the previous two years, and the 95<sup>th</sup> percentile of the positive net load (load – wind – solar) changes for the same month of the previous two years. For determining the base Reg-Down requirements, ERCOT will take the largest of the 95<sup>th</sup> percentile of Reg-Down deployments for the same month of the previous two years and the 95<sup>th</sup> percentile of the negative net load (load – wind – solar) changes for the same month of the previous two years.

In order to consider the increased amount of wind penetration, ERCOT will calculate the increase in installed wind generation capacity. Then, depending on the month of the year and the hour of the day, ERCOT will add incremental MWs to the maximum values determined above. The tables of incremental MWs for Reg-Up and Reg-Down come from the study ERCOT performs annually, using similar techniques as the 2008 GE wind study, but using actual wind data. The increase in wind capacity will be calculated by taking the total nameplate capacity of wind resources in the ERCOT network model at the time of the procurement study and subtracting out the total nameplate capacity of wind resources in the ERCOT model at the end of the month being studied from the previous year.

ERCOT will post these monthly amounts for Regulation Service requirements for the upcoming year on the MIS.

If any incremental changes to the annually posted amounts are needed then the revised amounts for the following month will be posted to the MIS prior to the 20<sup>th</sup> of the current month. ERCOT may include adjustments for hours in a month considering monthly average for CPS1 and 12-

month rolling average CPS1 scores. If it is determined that during the course of the year that the ERCOT monthly average for CPS1 score was less than 140% for a specific month, ERCOT will apply an extra 10% of both Reg-Up and Reg-Down for hours in which the CPS1 score was less than 140%. Additionally, if the ERCOT 12-month rolling average CPS1 score is less than 140%, for the next month ERCOT will procure an extra 10% of both Reg-Up and Reg-Down for hours in which the hourly CPS1 score was less than 140%. This value will increase to 20% if the CPS1 score falls below 100%.



## Attachment A

Incremental MW Adjustment to Prior-Year Up-Regulation Value, per 1000 MW of Incremental Wind Generation Capacity, to Account for Wind Capacity Growth																								
Hour Ending																								
Month	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Jan.	2.23.1	2.44.0	2.73.2	2.42.3	3.03.3	2.84.3	1.71.0	0.53.6	4.12.9	5.03.4	0.70.8	1.81.5	2.43.7	1.13.3	2.22.3	3.64.0	2.13.2	4.01.2	1.84.8	4.00.1	0.21.4	0.71.7	1.10.4	3.03.3
Feb.	2.32.9	3.22.4	2.73.7	3.63.4	4.73.0	3.43.0	3.01.5	3.64.4	4.25.4	4.96.0	4.76.2	5.63.9	6.82.0	5.01.8	3.91.8	2.32.4	1.43.6	2.33.9	0.61.6	0.62.0	0.92.0	2.14.9	2.24.5	2.53.0
Mar.	2.34.3	3.83.1	4.24.7	4.54.3	4.04.0	3.02.3	3.31.2	4.45.5	4.14.0	3.93.4	4.76.4	5.94.9	6.82.8	4.62.5	2.72.1	2.23.1	2.04.4	3.83.6	4.81.3	3.42.0	1.21.9	1.32.3	2.82.4	2.74.6
Apr.	1.44.0	3.14.3	3.65.7	3.35.2	2.74.2	3.13.3	4.83.3	4.95.3	2.13.8	2.74.0	4.75.4	4.64.3	4.02.5	2.32.3	1.43.0	2.03.6	2.03.9	2.54.9	4.76.2	4.05.4	2.71.9	2.71.3	4.51.8	2.42.0
May	4.32.1	7.24.8	6.86.3	4.64.6	3.74.5	3.25.2	7.68.1	7.68.1	4.64.1	5.83.7	7.45.1	5.03.8	2.41.9	2.01.0	2.82.4	2.12.6	1.83.1	2.74.4	4.45.7	3.45.8	2.42.4	1.21.3	1.31.3	0.53.1
Jun.	2.42.9	5.44.6	6.66.2	5.13.9	5.23.9	4.52.7	6.54.8	4.55.4	4.33.3	6.44.0	7.55.0	5.23.4	2.61.4	2.60.5	2.51.9	1.21.4	0.91.7	1.81.9	2.52.9	3.03.2	1.50.5	0.70.1	0.90.3	1.6-0.1
Jul.	2.82.5	2.95.3	3.35.1	3.44.1	3.34.6	3.72.9	7.16.2	5.65.5	3.92.1	6.02.9	6.23.8	3.52.6	1.51.5	1.11.0	2.01.1	2.0-0.1	0.60.4	0.60.3	1.51.8	2.52.8	0.70.1	0.30.2	1.00.5	3.01.8
Aug.	2.41.5	2.03.4	2.33.9	3.93.5	4.42.7	4.41.9	7.35.4	7.15.1	2.91.4	4.22.5	6.73.1	5.81.7	4.81.0	2.70.8	3.70.1	3.20.0	1.23.0	0.74.1	1.84.7	1.74.2	0.30.9	0.20.2	0.40.4	1.31.5
Sep.	3.01.3	2.42.9	2.73.2	2.53.0	2.42.5	3.01.7	5.03.7	5.66.8	1.74.7	3.24.5	5.54.2	3.43.7	1.82.2	0.61.3	1.00.1	0.10.5	0.92.0	1.82.4	2.72.2	0.90.9	-0.20.5	0.20.0	0.80.1	0.40.1
Oct.	3.22.0	3.04.0	3.63.6	3.43.5	3.34.7	3.53.1	3.22.9	5.06.4	2.56.8	1.25.0	2.13.3	2.23.3	2.52.7	2.42.1	2.11.2	0.72.3	2.34.0	3.83.4	4.40.6	2.6-0.5	1.11.3	0.40.5	1.30.5	5.81.7
Nov.	2.83.1	2.43.5	2.43.5	2.73.5	2.93.5	3.12.8	2.12.6	4.54.7	4.76.5	2.85.1	1.53.6	1.63.7	2.94.5	3.52.8	3.92.6	3.63.5	5.33.9	5.12.6	1.9-0.2	1.1-0.4	1.40.5	1.30.8	1.11.4	3.20.7
Dec.	2.13.8	2.22.9	3.11.4	1.53.2	1.82.8	0.84.7	2.51.7	4.63.0	3.66.3	1.53.9	3.96.1	4.53.9	3.93.8	2.83.6	7.13.5	4.23.2	5.38.1	6.34.2	-2.80.0	-0.91.3	-0.6-0.2	2.60.8	2.00.9	1.00.3

**Incremental MW Adjustment to Prior-Year Down-Regulation Value, per 1000 MW of Incremental Wind Generation Capacity, to Account for Wind Capacity Growth**

Hour Ending																								
Month	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Jan.	<del>0.32</del> <sub>-7</sub>	<del>1.3</del> <sub>-0.6</sub>	<del>1.9</del> <sub>1.8</sub>	<del>1.1</del> <sub>-0.6</sub>	<del>0.0</del> <sub>1.0</sub>	<del>-</del> <sub>1.7</sub> <del>1.5</del>	<del>2.6</del> <sub>2.1</sub>	<del>2.5</del> <sub>1.2</sub>	<del>-</del> <sub>0.3</sub> <del>1.0</del>	<del>-3.3</del> <sub>0.8</sub>	<del>4.3</del> <sub>1.6</sub>	<del>1.3</del> <sub>-0.9</sub>	<del>-</del> <sub>0.1</sub> <del>1.5</del>	<del>2.4</del> <sub>-0.1</sub>	<del>2.0</del> <sub>0.9</sub>	<del>1.8</del> <sub>1.1</sub>	<del>-</del> <sub>0.7</sub> <del>1.1</del>	<del>1.2</del> <sub>-0.7</sub>	<del>8.4</del> <sub>5.1</sub>	<del>6.0</del> <sub>4.5</sub>	<del>2.3</del> <sub>5.8</sub>	<del>2.9</del> <sub>2.6</sub>	<del>1.5</del> <sub>-0.2</sub>	<del>-</del> <sub>0.4</sub> <del>0.5</del>
Feb.	<del>3.8</del> <sub>3.0</sub>	<del>0.9</del> <sub>0.3</sub>	<del>0.4</del> <sub>0.1</sub>	<del>1.2</del> <sub>1.4</sub>	<del>1.4</del> <sub>1.1</sub>	<del>1.2</del> <sub>1.2</sub>	<del>2.6</del> <sub>0.8</sub>	<del>0.6</del> <sub>-0.6</sub>	<del>-1.2</del> <sub>-2.0</sub>	<del>-0.6</del> <sub>0.8</sub>	<del>1.8</del> <sub>2.6</sub>	<del>0.9</del> <sub>2.0</sub>	<del>1.0</del> <sub>1.8</sub>	<del>0.6</del> <sub>2.1</sub>	<del>1.7</del> <sub>1.5</sub>	<del>1.8</del> <sub>1.3</sub>	<del>1.6</del> <sub>1.0</sub>	<del>2.5</del> <sub>1.9</sub>	<del>4.8</del> <sub>4.7</sub>	<del>5.0</del> <sub>6.8</sub>	<del>3.9</del> <sub>6.8</sub>	<del>3.0</del> <sub>5.5</sub>	<del>2.7</del> <sub>-0.2</sub>	<del>2.0</del> <sub>0.9</sub>
Mar.	<del>1.6</del> <sub>1.7</sub>	<del>1.4</del> <sub>0.4</sub>	<del>-0.4</del> <sub>-0.4</sub>	<del>0.3</del> <sub>0.9</sub>	<del>0.7</del> <sub>0.4</sub>	<del>1.1</del> <sub>-0.4</sub>	<del>1.8</del> <sub>0.0</sub>	<del>0.5</del> <sub>-0.9</sub>	<del>1.9</del> <sub>-0.6</sub>	<del>3.6</del> <sub>2.2</sub>	<del>2.4</del> <sub>1.8</sub>	<del>0.6</del> <sub>0.7</sub>	<del>1.3</del> <sub>0.1</sub>	<del>1.2</del> <sub>0.2</sub>	<del>1.6</del> <sub>1.1</sub>	<del>2.0</del> <sub>1.3</sub>	<del>3.0</del> <sub>3.6</sub>	<del>3.3</del> <sub>2.9</sub>	<del>3.2</del> <sub>3.4</sub>	<del>6.4</del> <sub>6.7</sub>	<del>6.1</del> <sub>8.8</sub>	<del>4.6</del> <sub>7.0</sub>	<del>4.7</del> <sub>-0.0</sub>	<del>3.8</del> <sub>2.5</sub>
Apr.	<del>-</del> <sub>0.6</sub> <del>2.4</del>	<del>0.4</del> <sub>0.8</sub>	<del>-0.3</del> <sub>-0.5</sub>	<del>0.3</del> <sub>-0.8</sub>	<del>0.3</del> <sub>0.9</sub>	<del>0.4</del> <sub>1.3</sub>	<del>-</del> <sub>0.3</sub> <del>1.2</del>	<del>-</del> <sub>0.5</sub> <del>0.9</del>	<del>0.6</del> <sub>1.6</sub>	<del>0.6</del> <sub>1.5</sub>	<del>0.6</del> <sub>-0.1</sub>	<del>0.3</del> <sub>-1.6</sub>	<del>0.8</del> <sub>-0.3</sub>	<del>1.5</del> <sub>0.4</sub>	<del>1.5</del> <sub>1.0</sub>	<del>3.0</del> <sub>4.3</sub>	<del>3.7</del> <sub>4.6</sub>	<del>5.6</del> <sub>6.3</sub>	<del>5.5</del> <sub>5.4</sub>	<del>6.0</del> <sub>6.6</sub>	<del>5.4</del> <sub>8.2</sub>	<del>4.3</del> <sub>6.0</sub>	<del>4.1</del> <sub>-0.7</sub>	<del>1.1</del> <sub>1.4</sub> <del>9</del>
May	<del>-</del> <sub>1.5</sub> <del>2.7</del>	<del>0.6</del> <sub>1.3</sub>	<del>-</del> <sub>0.3</sub> <del>0.8</del>	<del>-0.5</del> <sub>0.5</sub>	<del>-</del> <sub>0.7</sub> <del>0.9</del>	<del>-</del> <sub>1.0</sub> <del>1.5</del>	<del>-</del> <sub>1.6</sub> <del>1.3</del>	<del>0.9</del> <sub>1.8</sub>	<del>0.3</del> <sub>2.4</sub>	<del>-1.5</del> <sub>0.8</sub>	<del>-0.2</del> <sub>-0.2</sub>	<del>-0.5</del> <sub>-0.7</sub>	<del>-0.8</del> <sub>-0.3</sub>	<del>0.2</del> <sub>0.9</sub>	<del>1.3</del> <sub>1.7</sub>	<del>3.9</del> <sub>4.6</sub>	<del>4.3</del> <sub>5.3</sub>	<del>5.6</del> <sub>5.4</sub>	<del>5.7</del> <sub>7.7</sub>	<del>4.2</del> <sub>5.4</sub>	<del>5.2</del> <sub>6.6</sub>	<del>4.6</del> <sub>7.0</sub>	<del>3.2</del> <sub>-0.8</sub>	<del>1.5</del> <sub>3.3</sub>
Jun.	<del>1.5</del> <sub>1.2</sub>	<del>0.2</del> <sub>1.1</sub>	<del>-</del> <sub>1.5</sub> <del>1.2</del>	<del>-</del> <sub>2.4</sub> <del>0.8</del>	<del>-</del> <sub>2.0</sub> <del>0.8</del>	<del>-</del> <sub>1.6</sub> <del>0.1</del>	<del>-1.9</del> <sub>0.3</sub>	<del>-</del> <sub>0.1</sub> <del>0.0</del>	<del>-0.6</del> <sub>-0.1</sub>	<del>-1.8</del> <sub>-1.0</sub>	<del>-1.5</del> <sub>-0.7</sub>	<del>-1.4</del> <sub>-0.2</sub>	<del>-</del> <sub>0.1</sub> <del>0.5</del>	<del>1.0</del> <sub>3.1</sub>	<del>2.0</del> <sub>1.3</sub>	<del>3.6</del> <sub>5.7</sub>	<del>5.6</del> <sub>5.9</sub>	<del>6.3</del> <sub>5.0</sub>	<del>5.1</del> <sub>5.3</sub>	<del>2.8</del> <sub>5.5</sub>	<del>5.4</del> <sub>6.0</sub>	<del>6.1</del> <sub>6.6</sub>	<del>5.1</del> <sub>-0.6</sub>	<del>3.3</del> <sub>2.7</sub>
Jul.	<del>-</del> <sub>0.2</sub> <del>1.9</del>	<del>-</del> <sub>0.2</sub> <del>0.3</del>	<del>-1.5</del> <sub>-1.0</sub>	<del>-1.9</del> <sub>-1.4</sub>	<del>-2.6</del> <sub>-0.6</sub>	<del>-1.9</del> <sub>-0.3</sub>	<del>-</del> <sub>1.3</sub> <del>0.0</del>	<del>-</del> <sub>0.7</sub> <del>0.0</del>	<del>-0.4</del> <sub>-0.6</sub>	<del>-1.5</del> <sub>-1.2</sub>	<del>-1.3</del> <sub>-0.2</sub>	<del>-0.5</del> <sub>-0.1</sub>	<del>1.3</del> <sub>1.3</sub>	<del>2.9</del> <sub>2.1</sub>	<del>3.4</del> <sub>1.0</sub>	<del>3.1</del> <sub>1.4</sub>	<del>4.1</del> <sub>4.5</sub>	<del>3.6</del> <sub>3.6</sub>	<del>3.6</del> <sub>2.2</sub>	<del>2.8</del> <sub>4.4</sub>	<del>5.4</del> <sub>5.3</sub>	<del>6.1</del> <sub>6.6</sub>	<del>4.8</del> <sub>-0.9</sub>	<del>0.5</del> <sub>4.6</sub>
Aug.	<del>-</del> <sub>0.6</sub> <del>1.6</del>	<del>-1.1</del> <sub>-0.6</sub>	<del>-2.1</del> <sub>-1.4</sub>	<del>-1.9</del> <sub>-1.6</sub>	<del>-1.8</del> <sub>-0.8</sub>	<del>-1.2</del> <sub>-0.6</sub>	<del>-0.7</del> <sub>-0.1</sub>	<del>-0.6</del> <sub>-0.6</sub>	<del>0.4</del> <sub>-0.4</sub>	<del>-1.3</del> <sub>-0.4</sub>	<del>-</del> <sub>1.3</sub> <del>0.1</del>	<del>0.5</del> <sub>0.2</sub>	<del>1.0</del> <sub>0.0</sub>	<del>1.2</del> <sub>1.6</sub>	<del>2.1</del> <sub>1.3</sub>	<del>2.5</del> <sub>1.4</sub>	<del>2.9</del> <sub>1.1</sub>	<del>2.6</del> <sub>1.7</sub>	<del>4.0</del> <sub>3.5</sub>	<del>5.0</del> <sub>4.8</sub>	<del>6.4</del> <sub>6.8</sub>	<del>5.7</del> <sub>5.0</sub>	<del>4.5</del> <sub>-0.1</sub>	<del>1.4</del> <sub>2.2</sub>
Sep.	<del>-</del> <sub>1.2</sub> <del>0.6</del>	<del>-1.5</del> <sub>-0.9</sub>	<del>-1.3</del> <sub>-1.7</sub>	<del>-1.4</del> <sub>-1.4</sub>	<del>-1.0</del> <sub>-1.0</sub>	<del>-0.7</del> <sub>-0.1</sub>	<del>-0.4</del> <sub>-0.1</sub>	<del>-1.0</del> <sub>-1.0</sub>	<del>0.8</del> <sub>-0.2</sub>	<del>0.3</del> <sub>-0.9</sub>	<del>-0.4</del> <sub>-0.9</sub>	<del>0.4</del> <sub>-0.7</sub>	<del>0.2</del> <sub>-0.1</sub>	<del>0.9</del> <sub>2.8</sub>	<del>1.8</del> <sub>1.5</sub>	<del>2.1</del> <sub>1.7</sub>	<del>3.9</del> <sub>4.3</sub>	<del>3.4</del> <sub>3.8</sub>	<del>4.5</del> <sub>5.7</sub>	<del>5.5</del> <sub>5.8</sub>	<del>5.6</del> <sub>7.7</sub>	<del>4.7</del> <sub>5.5</sub>	<del>3.9</del> <sub>-0.1</sub>	<del>-</del> <sub>0.9</sub> <del>2.9</del>
Oct.	<del>0.8</del> <sub>0.1</sub>	<del>-</del> <sub>0.2</sub> <del>0.1</del>	<del>-0.1</del> <sub>-1.4</sub>	<del>-0.4</del> <sub>-1.0</sub>	<del>-0.5</del> <sub>-0.7</sub>	<del>-</del> <sub>0.5</sub> <del>0.8</del>	<del>0.6</del> <sub>-0.1</sub>	<del>0.3</del> <sub>-1.0</sub>	<del>1.1</del> <sub>-0.1</sub>	<del>1.0</del> <sub>0.5</sub>	<del>-</del> <sub>0.2</sub> <del>0.4</del>	<del>0.0</del> <sub>-0.2</sub>	<del>-0.2</del> <sub>-0.6</sub>	<del>0.1</del> <sub>0.5</sub>	<del>1.0</del> <sub>1.5</sub>	<del>1.0</del> <sub>1.1</sub>	<del>1.5</del> <sub>1.7</sub>	<del>0.7</del> <sub>1.8</sub>	<del>4.5</del> <sub>5.7</sub>	<del>5.7</del> <sub>5.3</sub>	<del>5.1</del> <sub>5.7</sub>	<del>3.1</del> <sub>3.8</sub>	<del>2.2</del> <sub>-0.4</sub>	<del>2.8</del> <sub>1.6</sub>

<b>Nov.</b>	<u>1.8</u> <u>0.1</u>	<u>0.50</u> <u>0</u>	<u>0.5</u> <u>0.6</u>	<u>0.5</u> <u>0.6</u>	<u>0.1</u> <u>0.5</u>	<u>0.4</u> <u>0.1</u>	<u>2.5</u> <u>0.3</u>	<u>-0.8</u> <u>1.8</u>	<u>-3.1</u> <u>2.9</u>	<u>-1.60</u> <u>7</u>	<u>0.22</u> <u>0</u>	<u>1.82</u> <u>3</u>	<u>2.51</u> <u>3</u>	<u>1.50</u> <u>7</u>	<u>0.60</u> <u>7</u>	<u>0.90</u> <u>7</u>	<u>1.21</u> <u>7</u>	<u>1.22</u> <u>1</u>	<u>5.46</u> <u>2</u>	<u>5.56</u> <u>0</u>	<u>4.83</u> <u>8</u>	<u>3.82</u> <u>8</u>	<u>2.32</u> <u>1</u>	<u>2.10</u> <u>0</u>
<b>Dec.</b>	<u>6.43</u> <u>5</u>	<u>1.33</u> <u>1</u>	<u>2.61</u> <u>9</u>	<u>2.90</u> <u>8</u>	<u>0.80</u> <u>2</u>	<u>-0.7</u> <u>0.8</u>	<u>1.22</u> <u>1</u>	<u>0.02</u> <u>1</u>	<u>-3.4</u> <u>5.4</u>	<u>-2.2</u> <u>3.6</u>	<u>3.21</u> <u>0</u>	<u>3.14</u> <u>0</u>	<u>3.13</u> <u>6</u>	<u>0.73</u> <u>6</u>	<u>0.90</u> <u>6</u>	<u>1.4</u> <u>0.1</u>	<u>1.02</u> <u>0</u>	<u>3.0</u> <u>0.5</u>	<u>7.36</u> <u>0</u>	<u>5.54</u> <u>0</u>	<u>6.03</u> <u>6</u>	<u>6.43</u> <u>8</u>	<u>3.96</u> <u>.6</u>	<u>5.73</u> <u>5</u>

## *Non-Spinning Reserve Service (Non-Spin) Requirement Details*

### **Introduction**

Non-Spinning Reserve Service (Non-Spin) consists of Generation Resources capable of being ramped to a specified output level within 30 minutes or Load Resources that are capable of being interrupted within 30 minutes and that are capable of running (or being interrupted) at a specified output level for at least one hour. Non-Spin may be deployed to replace loss of generating capacity, to compensate for Load forecast and/or forecast uncertainty on days in which large amounts of reserve are not available online, to address the risk of net load ramp, or when there is a limited amount of capacity available for Security-Constrained Economic Dispatch (SCED).

Historically, the need for Non-Spin has occurred during hot weather, during cold weather, during unexpected changes in weather or following large unit trips to replenish reserves.

The periods when load is increasing and wind is decreasing requires other generation resources to increase output or come online quickly to compensate for the sudden net load increases. As a result, net load ramp risk should be accounted for in the determination of Non-Spin requirements. While net load forecast analysis may cover reserves required for forecast uncertainty, it may not necessarily cover exposure to the loss of generation and net load ramp risk. Due to this risk, it may be necessary for ERCOT to have additional reserves available during high risk using a variable percentile to protect against forecast uncertainty.

Examples of circumstances when Non-Spin has been used are:

- Across peak hours during spring and fall months when hotter than expected weather with large amounts of capacity offline resulted in Energy Emergency Alert (EEA) events;
- Afternoons during summer seasons when high loads and unit outages outstripped the capability of base load and normal cyclic units;
- Cold weather events when early morning load pickup outpaced the ability of generation to follow;
- Major unit trips when large amounts of spinning reserve were not online; and
- During periods when the wind decreased and load demand increased.

### **Summary**

Analysis for Non-Spin requirements are conducted using data from the same month of previous three years. For the purpose of determining the amount of Non-Spin to purchase for each hour of the day, hours will be placed into four hour blocks. The net load uncertainty for the analyzed days for all hours which are considered to be part of a four hour block will be calculated and a percentile will be assigned to this block of hours based on the risk of net load ramp. The same calculation will be done separately for each block. The Non-Spin requirement for the month for

each block is calculated using the assigned percentile (based on risk of net load ramp) block minus the average Reg-Up requirement during the same block of hours.

~~After this analysis has been completed, ERCOT will apply a floor on the final Non-Spin requirement equal to the largest unit. This floor will only be applied to On-Peak Hours, which are hour ending 7 through 22.~~ ERCOT will post the monthly amounts for Non-Spin requirements for the upcoming year on the MIS.

## Procedure

ERCOT will determine the Non-Spin requirement using the 70<sup>th</sup> to 95<sup>th</sup> percentile of hourly net load uncertainty from the same month of the previous three years. Net load is defined as the ERCOT load minus the estimated un-curtailed total output from Intermittent Renewable Resource (IRR), which includes both Wind-powered Generation Resources (WGRs) and Photo-Voltaic Generation Resources (PVGR) at a point in time. The forecast of net load is computed by subtracting the aggregate IRR High Sustained Limits (HSLs) in the Current Operating Plans (COPs) from the Mid-Term Load Forecast (MTLF). The COPs and MTLF used are the updated values as of three hours prior to each Operating Hour. The net load uncertainty is then defined as the difference between the net load and the forecasted net load.

The risk of net load ramp is determined based on the change in net load over an hour divided by highest observed net load for the season. The fixed value of percentile ranging between 70<sup>th</sup> percentile and 95<sup>th</sup> percentile will be assigned to the net load forecast uncertainty calculated previously. Periods where the risk of net load ramp is highest will use 95<sup>th</sup> percentile compared to 70<sup>th</sup> percentile for periods with lowest risks.

ERCOT has seen significant growth in installed wind capacity from one year to the next; an increase in wind capacity also tend to increase the MW quantity of forecast error. Hence, ERCOT's reliance on historical wind forecast errors alone creates a possibility of under-estimation of the Non-Spin requirement.

To address this, ERCOT will include the impact of increase in over-forecast error from the expected growth in wind generation installed capacity into the future Non-Spin requirement. The net impact is calculated by a multiplication of the projected wind capacity growth between the same month of current year and the next year, and incremental MW adjustment to Non-Spin value per 1000 MW of incremental wind generation capacity. The incremental MW adjustment to the Non-Spin value per 1000 MW is calculated as the change in 50<sup>th</sup> percentile of the historical wind over-forecast error for 4-hour blocks of each month in the past 5 years, which is then normalized to per 1000 MW of installed wind capacity. The table below reflects the additional Non-Spin adjustments per 1000 MW of installed wind capacity.

ERCOT will purchase Non-Spin such that the combination of Non-Spin and Reg-Up Services cover the uncertainties of net load forecast errors depending on the net load ramp risk.

## Attachment A

Incremental MW Adjustment to Non-Spinning Reserve Service, per 1000 MW of Incremental Wind Generation Capacity																								
Hour Ending																								
Month	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Jan.	<u>4242</u>	<u>4242</u>	<u>4343</u>	<u>4343</u>	<u>4343</u>	<u>4343</u>	<u>4444</u>	<u>4444</u>	<u>4444</u>	<u>4444</u>	<u>3838</u>	<u>3838</u>	<u>3838</u>	<u>3838</u>	<u>3333</u>	<u>3333</u>	<u>3333</u>	<u>3333</u>	<u>4545</u>	<u>4545</u>	<u>4545</u>	<u>4545</u>	<u>424</u> <u>2</u>	<u>4242</u>
Feb.	<u>4242</u>	<u>4242</u>	<u>4343</u>	<u>4343</u>	<u>4343</u>	<u>4343</u>	<u>4444</u>	<u>4444</u>	<u>4444</u>	<u>4444</u>	<u>3838</u>	<u>3838</u>	<u>3838</u>	<u>3838</u>	<u>3333</u>	<u>3333</u>	<u>3333</u>	<u>3333</u>	<u>4545</u>	<u>4545</u>	<u>4545</u>	<u>4545</u>	<u>424</u> <u>2</u>	<u>4242</u>
Mar.	<u>4747</u>	<u>4747</u>	<u>4848</u>	<u>4848</u>	<u>4848</u>	<u>4848</u>	<u>5050</u>	<u>5050</u>	<u>5050</u>	<u>5050</u>	<u>3636</u>	<u>3636</u>	<u>3636</u>	<u>3636</u>	<u>3737</u>	<u>3737</u>	<u>3737</u>	<u>3737</u>	<u>4646</u>	<u>4646</u>	<u>4646</u>	<u>4646</u>	<u>474</u> <u>7</u>	<u>4747</u>
Apr.	<u>4747</u>	<u>4747</u>	<u>4848</u>	<u>4848</u>	<u>4848</u>	<u>4848</u>	<u>5050</u>	<u>5050</u>	<u>5050</u>	<u>5050</u>	<u>3636</u>	<u>3636</u>	<u>3636</u>	<u>3636</u>	<u>3737</u>	<u>3737</u>	<u>3737</u>	<u>3737</u>	<u>4646</u>	<u>4646</u>	<u>4646</u>	<u>4646</u>	<u>474</u> <u>7</u>	<u>4747</u>
May	<u>4747</u>	<u>4747</u>	<u>4848</u>	<u>4848</u>	<u>4848</u>	<u>4848</u>	<u>5050</u>	<u>5050</u>	<u>5050</u>	<u>5050</u>	<u>3636</u>	<u>3636</u>	<u>3636</u>	<u>3636</u>	<u>3737</u>	<u>3737</u>	<u>3737</u>	<u>3737</u>	<u>4646</u>	<u>4646</u>	<u>4646</u>	<u>4646</u>	<u>474</u> <u>7</u>	<u>4747</u>
Jun.	<u>5050</u>	<u>5050</u>	<u>4747</u>	<u>4747</u>	<u>4747</u>	<u>4747</u>	<u>4343</u>	<u>4343</u>	<u>4343</u>	<u>4343</u>	<u>3030</u>	<u>3030</u>	<u>3030</u>	<u>3030</u>	<u>2727</u>	<u>2727</u>	<u>2727</u>	<u>2727</u>	<u>3232</u>	<u>3232</u>	<u>3232</u>	<u>3232</u>	<u>505</u> <u>0</u>	<u>5050</u>
Jul.	<u>5050</u>	<u>5050</u>	<u>4747</u>	<u>4747</u>	<u>4747</u>	<u>4747</u>	<u>4343</u>	<u>4343</u>	<u>4343</u>	<u>4343</u>	<u>3030</u>	<u>3030</u>	<u>3030</u>	<u>3030</u>	<u>2727</u>	<u>2727</u>	<u>2727</u>	<u>2727</u>	<u>3232</u>	<u>3232</u>	<u>3232</u>	<u>3232</u>	<u>505</u> <u>0</u>	<u>5050</u>
Aug.	<u>5050</u>	<u>5050</u>	<u>4747</u>	<u>4747</u>	<u>4747</u>	<u>4747</u>	<u>4343</u>	<u>4343</u>	<u>4343</u>	<u>4343</u>	<u>3030</u>	<u>3030</u>	<u>3030</u>	<u>3030</u>	<u>2727</u>	<u>2727</u>	<u>2727</u>	<u>2727</u>	<u>3232</u>	<u>3232</u>	<u>3232</u>	<u>3232</u>	<u>505</u> <u>0</u>	<u>5050</u>
Sep.	<u>4242</u>	<u>4242</u>	<u>4545</u>	<u>4545</u>	<u>4545</u>	<u>4545</u>	<u>4343</u>	<u>4343</u>	<u>4343</u>	<u>4343</u>	<u>3232</u>	<u>3232</u>	<u>3232</u>	<u>3232</u>	<u>2929</u>	<u>2929</u>	<u>2929</u>	<u>2929</u>	<u>3939</u>	<u>3939</u>	<u>3939</u>	<u>3939</u>	<u>424</u> <u>2</u>	<u>4242</u>
Oct.	<u>4242</u>	<u>4242</u>	<u>4545</u>	<u>4545</u>	<u>4545</u>	<u>4545</u>	<u>4343</u>	<u>4343</u>	<u>4343</u>	<u>4343</u>	<u>3232</u>	<u>3232</u>	<u>3232</u>	<u>3232</u>	<u>2929</u>	<u>2929</u>	<u>2929</u>	<u>2929</u>	<u>3939</u>	<u>3939</u>	<u>3939</u>	<u>3939</u>	<u>424</u> <u>2</u>	<u>4242</u>
Nov.	<u>4242</u>	<u>4242</u>	<u>4545</u>	<u>4545</u>	<u>4545</u>	<u>4545</u>	<u>4343</u>	<u>4343</u>	<u>4343</u>	<u>4343</u>	<u>3232</u>	<u>3232</u>	<u>3232</u>	<u>3232</u>	<u>2929</u>	<u>2929</u>	<u>2929</u>	<u>2929</u>	<u>3939</u>	<u>3939</u>	<u>3939</u>	<u>3939</u>	<u>424</u> <u>2</u>	<u>4242</u>
Dec.	<u>4242</u>	<u>4242</u>	<u>4343</u>	<u>4343</u>	<u>4343</u>	<u>4343</u>	<u>4444</u>	<u>4444</u>	<u>4444</u>	<u>4444</u>	<u>3838</u>	<u>3838</u>	<u>3838</u>	<u>3838</u>	<u>3333</u>	<u>3333</u>	<u>3333</u>	<u>3333</u>	<u>4545</u>	<u>4545</u>	<u>4545</u>	<u>4545</u>	<u>424</u> <u>2</u>	<u>4242</u>

### ***Responsive Reserve (RRS) Requirement Details***

Nodal Operating Guide Section 2.3.1.1, Obligation, sets the minimum RRS requirement for all hours under normal conditions. ERCOT will procure amounts of RRS that vary by hour of the day and by month. These RRS amounts will be published by month in six separate blocks covering four hour intervals. These amounts will be based on expected diurnal load and wind patterns for the month, will cover 70% of historic system inertia conditions for each block of hours for the month, and will use the equivalency ratio for RRS between Load Resources and Generation Resources to establish the conditions for each block of hours. The equivalency ratio will be used to establish the total reserves assuming the Day-Ahead Market (DAM) will use a one to one equivalency ratio. The minimum level of RRS procured from Resources providing RRS using Primary Frequency Response shall be determined for each month by ERCOT through the use of studies and shall not be less than 1,150 MWs. The remaining capacity required for RRS will be procured from all Resources qualified to provide RRS including Load Resources. DAM will limit the RRS procured from Load Resources to 60% of the total RRS requirement. ERCOT may increase the minimum capacity required from Resources providing RRS using Primary Frequency Response if it believes that the current posted quantity will have a negative impact on reliability or if it would require additional Regulation Service to be deployed. ERCOT will procure additional 200 MW of RRS for each percent of Reserve Discount Factor (RDF) when ERCOT estimates RDF to be less than 1. This adjustment will only apply for those 4-hour blocks where the 85<sup>th</sup> percentile of weighted average temperature is greater than 95°F. RDFs are reviewed and adjusted based on the generators performance during an unannounced test. RRS amount will be published as a monthly requirement along with the equivalency ratio for each four hour block. Additionally, ERCOT will make incremental adjustments to account for Resources operating in synchronous condenser fast response mode providing RRS. This adjustment will only apply to those 4-hour blocks when system inertia is typically expected to be less than 250 GW. ERCOT will post these monthly amounts for the upcoming year on the MIS. These annually published amounts are the minimum quantity that will be procured in the DAM for each hour of the year.

One type of Responsive Reserve is Interruptible Responsive Reserve. Interruptible Responsive Reserve is provided by Load Resources that are automatically interrupted when system frequency decreases to 59.7 Hz. The amount of RRS procured from these types of Resources during any given hour will be limited to 60% of the total RRS requirement for that hour. The ERCOT Protocols state, “[t]he amount of Resources on high-set under-frequency relays providing RRS will be limited to 60% of the total ERCOT RRS requirement.

Self-arranged RRS used to fulfill a QSE’s RRS requirement will be limited to 60% from Load Resources excluding Controllable Load Resources.

If the percentage level for Load Resources, excluding Controllable Load Resources, specified in the Protocols is changed, that change will be reflected in these requirements.

***[NPRR863 and NPRR960: Replace the section “Responsive Reserve (RRS) Requirement***

*Details” above with the following upon system implementation of NPRR863:]*

***Responsive Reserve (RRS) Requirement Details***

Nodal Operating Guide Section 2.3.1.1, Obligation, sets the minimum RRS requirement for all hours under normal conditions. ERCOT will procure amounts of RRS that vary by hour of the day and by month. These RRS amounts will be published by month in six separate blocks covering four hour intervals. These amounts will be based on expected diurnal load and wind patterns for the month, will cover 70% of historic system inertia conditions for each block of hours for the month, and will use the equivalency ratio for RRS between Load Resources and Generation Resources to establish the conditions for each block of hours. The equivalency ratio will be used to establish the total reserves assuming the Day-Ahead Market (DAM) will use a one to one equivalency ratio. The minimum level of RRS procured from Resources providing RRS using Primary Frequency Response shall be determined for each month by ERCOT through the use of studies and shall not be less than 1,150 MWs. The remaining capacity required for RRS will be procured from all Resources qualified to provide RRS including Load Resources. The maximum amount of RRS that can be provided by Resources providing Fast Frequency Response (FFR) is limited to 450 MW. DAM will limit the combined RRS procured from Load Resources controlled by high set under frequency relay and Resources providing FFR to 60% of the total RRS requirement. ERCOT may increase the minimum capacity required from Resources providing RRS using Primary Frequency Response if it believes that the current posted quantity will have a negative impact on reliability or if it would require additional Regulation Service to be deployed. ERCOT will procure additional 200 MW of RRS for each percent of Reserve Discount Factor (RDF) when ERCOT estimates RDF to be less than 1. This adjustment will only apply for those 4-hour blocks where the 85<sup>th</sup> percentile of weighted average temperature is greater than 95°F. RDFs are reviewed and adjusted based on the generators performance during an unannounced test. RRS amount will be published as a monthly requirement along with the equivalency ratio for each four hour block. Additionally, ERCOT will make incremental adjustments to account for Resources operating in synchronous condenser fast response mode providing RRS. This adjustment will only apply to those 4-hour blocks when system inertia is typically expected to be less than 250 GW. ERCOT will post these monthly amounts for the upcoming year on the MIS. These annually published amounts are the minimum quantity that will be procured in the DAM for each hour of the year.

Self-arranged RRS used to fulfill a QSE’s RRS requirement will be limited to 60% from Resources providing FFR and Load Resources excluding Controllable Load Resources.

If the percentage level for Resources providing FFR and Load Resources, excluding Controllable Load Resources, specified in the Protocols is changed, that change will be reflected in these requirements.