



**The Reliability and Markets (R&M) Committee
is expected to consider
R&M Committee Agenda Item 6:**

***Recommendation regarding
2023 ERCOT Methodologies for Determining
Minimum Ancillary Service Requirements***

at its meeting on December 19, 2022.

**The Board of Directors is expected to hear
the R&M Committee's recommendation on
this matter at the Board meeting on
December 20, 2022.**

**Attached are the Board and Committee
materials in relation to these agenda items.**



Item 6: 2023 ERCOT Methodologies for Determining Minimum Ancillary Service Requirements

Nitika Mago

Manager, Balancing Operations Planning

Reliability and Markets Committee Meeting

ERCOT Public

December 19, 2022

Reliability and Markets Committee Request

Why this is being presented today:

ERCOT staff requests that the Reliability and Markets Committee recommend approval of, and the Board approve, the proposed 2023 Ancillary Service Methodology as described in the “ERCOT Methodologies for Determining Minimum Ancillary Service Requirements” document (Attachment A).

Background & Scope

Protocol 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...

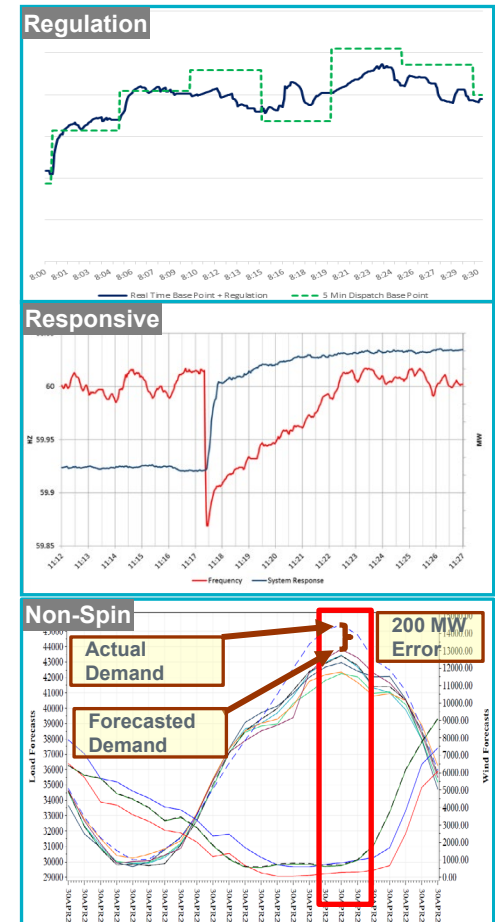
- ERCOT is not recommending any change to the methodology used for determining Regulation Service and Responsive Reserve Service (RRS).
- ERCOT is recommending
 - a methodology for computing ERCOT Contingency Reserve Service (ECRS), which is planned^{*} to be implemented in 2023;
 - one change to the methodology used for computing Non-Spinning Reserve Service (Non-Spin) before ECRS is implemented and three changes to the methodology used for computing Non-Spin after ECRS is implemented.

^{*}[Nov 11 PRS | Project Update](#)



Ancillary Services – An Introduction

- Ancillary Services are procured to ensure sufficient resource capacity is on-line, or able to be brought on-line in a timely manner, to balance the variability that cannot be covered by the 5-minute energy market.
- Currently, there are three types of Ancillary Services in ERCOT, namely:
 - Regulation Service: Regulation Service is capacity that can be deployed every 4 seconds to maintain frequency (i.e. balance supply & demand) between 5-min dispatch intervals.
 - Responsive Reserve Service (RRS): RRS is procured to ensure sufficient capacity is available to respond to frequency excursions during unit trips.
 - Non-Spinning Reserve Service (Non-Spin): Non-Spin is capacity that can be started or interrupted within 30 minutes to cover net load (load – wind - solar) forecast errors, replace loss of generation capacity, address risk of net load ramps, or when there is a limited amount of capacity available for Security-Constrained Economic Dispatch (SCED).
- ERCOT is in the process of implementing ECRS, which is scheduled for 2023 R3 (5/23 – 5/25) release*.
 - ERCOT Contingency Reserve Service (ECRS): ECRS is capacity that may be deployed to restore frequency within 10 minutes of a significant frequency deviation to recover deployed Regulation Service or to compensate for intra-hour net load forecast uncertainty and variability on days in which large amounts of online thermal ramping capability is not available.

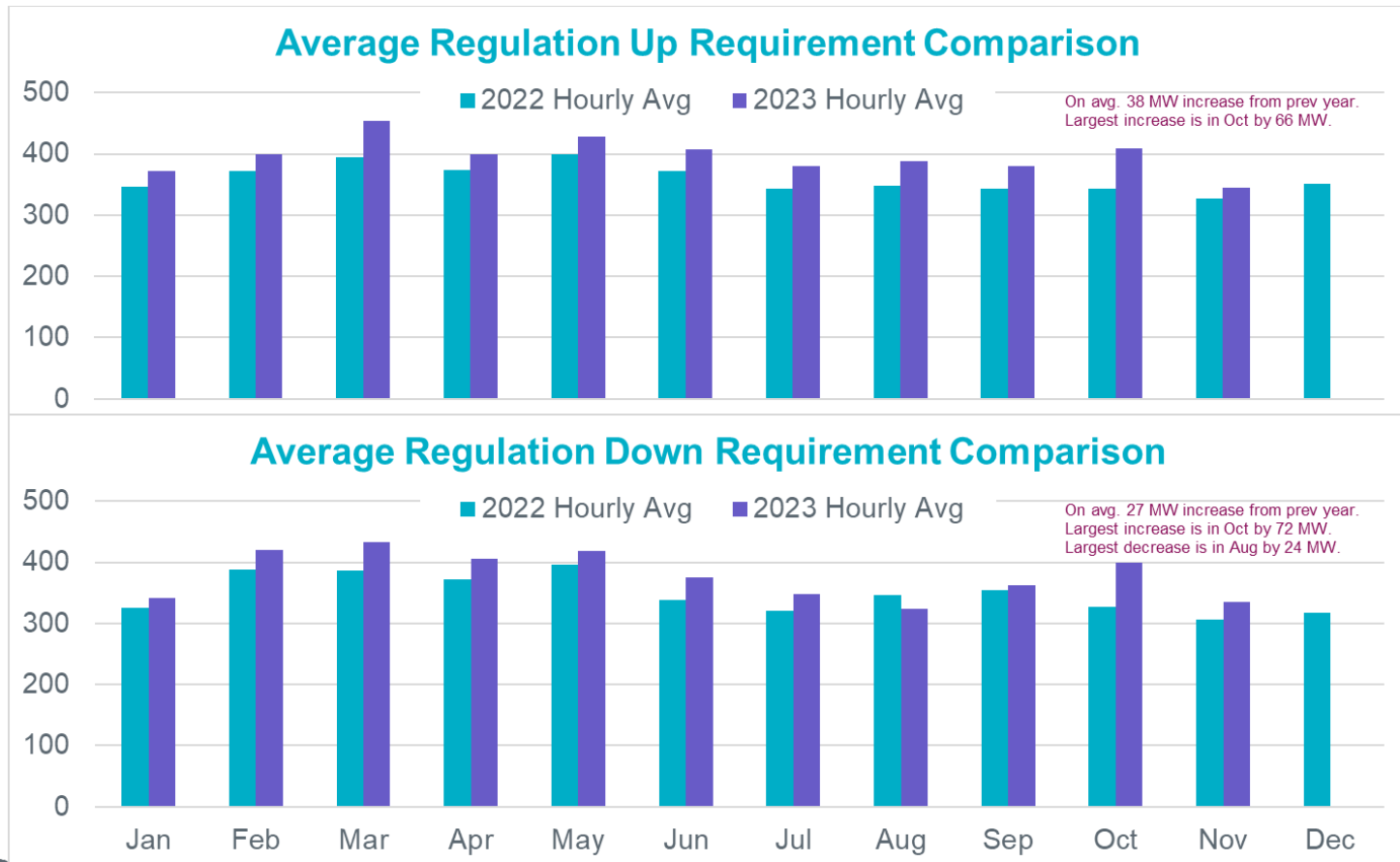


* Nov 11 PRS | Project Update



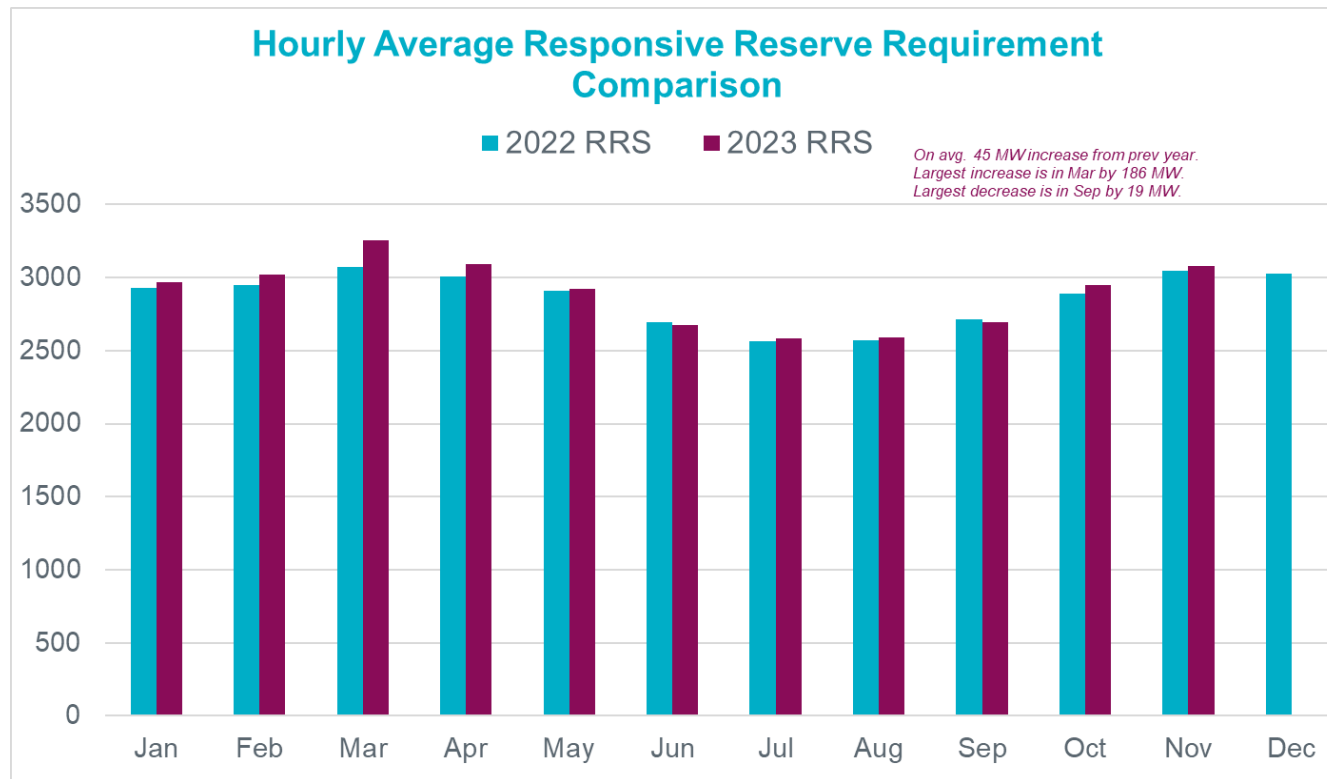
Regulation Service Methodology

- ERCOT is not proposing any change to the methodology used to compute the minimum Regulation Service requirements in 2023.
 - The preliminary Regulation quantities have been computed using 2021 and 2022 five-minute net load variability, updated Wind Adjustment and Solar Adjustment tables*.



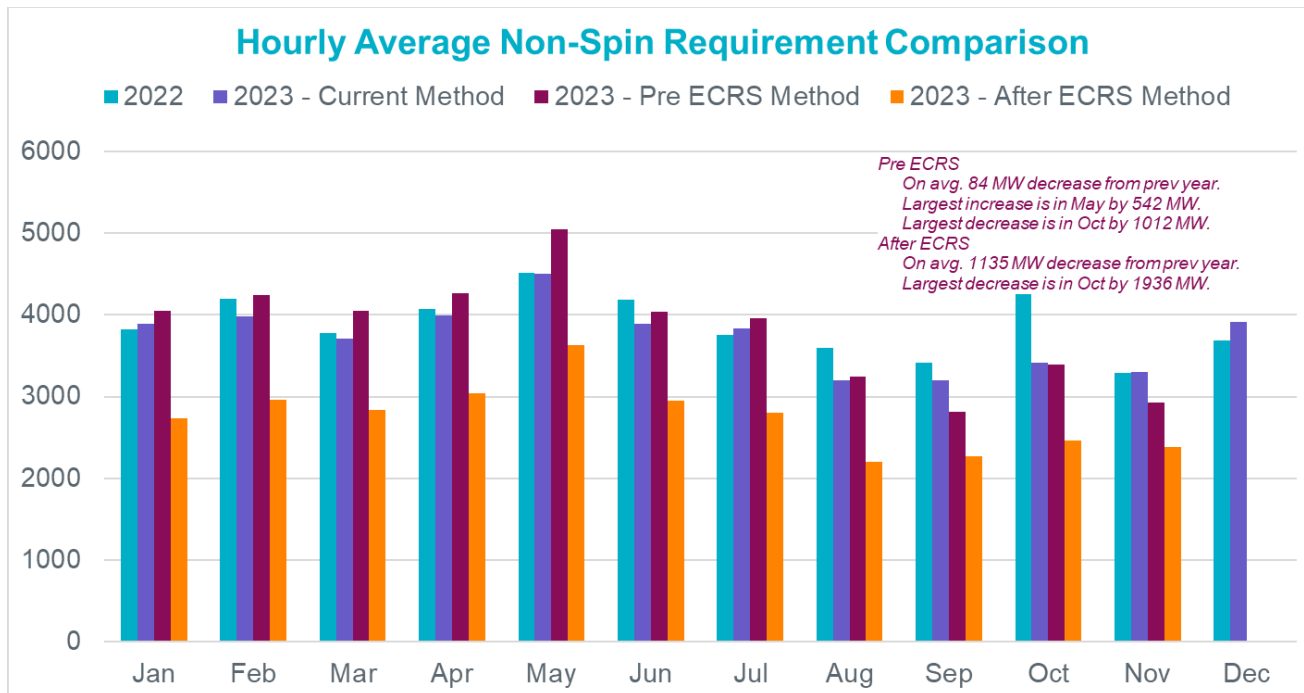
Responsive Reserve Service (RRS) Methodology

- ERCOT is not proposing any change to the methodology used to compute the minimum RRS requirements for 2023.
 - The preliminary RRS quantities have been computed using 2021 and 2022 system inertia conditions and updated RRS table*.
 - NERC's preliminary BAL-003 Interconnection Frequency Response Obligation (IFRO) for Operating Year (OY) 2023 assessment for ERCOT shows an increase in ERCOT's IFRO. To align with ERCOT's 2023 IFRO, minimum RRS-PFR limit for 2023 will change to 1,390 MW.



Non-Spinning Reserve Methodology

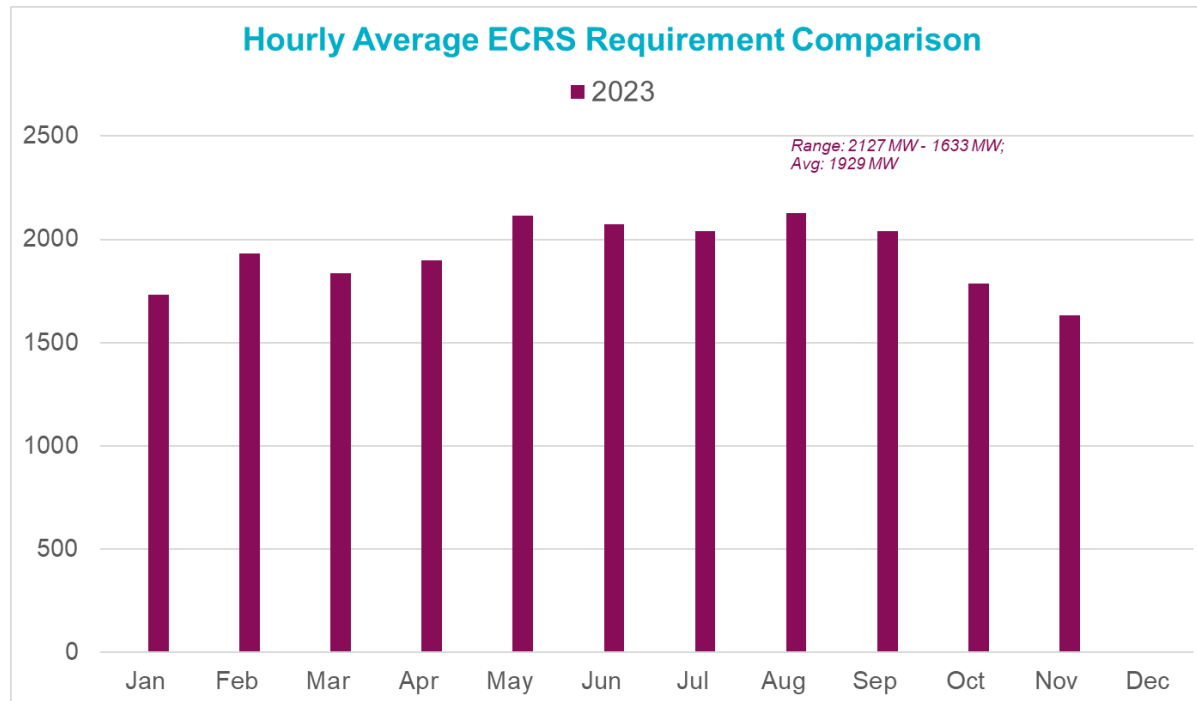
- ERCOT is proposing changes in the methodology used to compute minimum Non-Spin requirements in 2023,
 - Before ECRS is implemented:** Use 85th to 95th percentile of 10 HA max. net load forecast error
 - After ECRS* is implemented:** Use 75th to 95th percentile of 6 HA hourly avg. net load forecast error
 - The preliminary Non-Spin quantities have been computed using 2020, 2021 and 2022 net load and net load forecast, updated Wind and Solar Over-Forecast Error Adjustment tables and the updated Intra-day Outage table**.



- Lastly, in 2023, ERCOT will continue the practice of monitoring the weather near Real Time and may procure up to an additional 1,000 MW of Non-Spin for specific Operating Hours.

ECRS Requirements Methodology

- In 2023, ERCOT is proposing to compute ECRS requirements as the sum of capacity needed to recover frequency following a large unit trip and 85th to 95th percentile of 30 minutes ahead intra-hour net load forecast error.
 - An additional adjustment will be included to account for estimated increase in solar over forecast error due to future growth in installed solar capacity.
- Note that per the Nov 11 PRS | Project Update, ECRS is currently scheduled for 2023 R3 (5/23 – 5/25) release. Jan through Apr amounts in the chart below are for reference only. ECRS procurement will commence upon implementation of system changes associated with NPRR863.



Summary

- Following is a summary of the 2023 Ancillary Service Methodology,
 - ERCOT is not recommending any changes in the methodologies used to compute Regulation Service and RRS requirements for 2023.
 - To align with in ERCOT's 2023 IFRO, minimum RRS-PFR limit for 2023 will change to 1,390 MW.
 - ERCOT is recommending a methodology to compute ERCOT Contingency Reserve Service (ECRS), which is planned to be implemented in 2023.
 - Lastly, ERCOT is recommending one change to the methodology used for computing Non-Spinning Reserve Service (Non-Spin) before ECRS is implemented and three changes to the methodology used for computing Non-Spin after to ECRS is implemented.
- ERCOT is seeking that the Reliability and Markets Committee recommend approval of, and the Board approve, the 2023 Ancillary Service Methodology.



Date: December 12, 2022
To: ERCOT Board of Directors
From: Nitika Mago, Manager, Balancing Operations Planning
Subject: 2023 ERCOT Methodologies for Determining Minimum Ancillary Service Requirements

Issue for the ERCOT Board of Directors

ERCOT Board of Directors Meeting Date: December 20, 2022

Item No.: 13.3

Issue:

Whether the Board of Directors (Board) of Electric Reliability Council of Texas, Inc. (ERCOT) should approve the proposed 2023 ERCOT Methodologies for Determining Minimum Ancillary Service Requirements (2023 AS Methodology) as presented herein, to be effective January 1, 2023.

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 previously presented the 2022 ERCOT Methodologies for Determining Minimum Ancillary Service Requirements (2022 AS Methodology) to the Board on December 10, 2021, which the Board approved to be effective January 1, 2022 as requested.

The primary changes for the 2023 AS Methodology in comparison to 2022 AS Methodology are related to Non-Spinning Reserve (Non-Spin) Service and ERCOT Contingency Reserve Service (ECRS). No change has been proposed to the methodology used to compute Regulation Service and Responsive Reserve Service (RRS). The changes that 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 9, 2021.
 - Updates to Wind Adjustment tables and Solar Adjustment tables that track the incremental effects of increases in installed wind and solar capacity, respectively, on Regulation Service quantities.
- Responsive Reserve Service
 - No change—i.e., same methodology as approved on December 9, 2021.
- Non-Spinning Reserve Service

- Prior to NPRR863 implementation, update the hourly net load forecast uncertainty calculation to use ten hours ahead net load forecast.
- Upon NPRR863 implementation,
 - Update the hourly net load forecast uncertainty calculation to use six hours ahead net load forecast and the average net load.
 - Change in the percentile coverage for off-peak hours such that Non-Spin requirements for these hours is determined using 75th percentile of historical hourly net load forecast uncertainty.
- Updates to Wind Over-Forecast Error Adjustment Table and Solar Over-Forecast Error Adjustment Table that track estimated increase in over-forecast error per 1,000 MW increase in installed wind and solar capacity, respectively.
- Updates to Intra-day Forced Outage table that tracks incremental increase in Non-Spin needed to account for intra-day forced outages of thermal resources.
- ERCOT Contingency Reserve Service
 - Upon NPRR863 implementation, minimum requirements for ECRS will be computed as sum of capacity needed to recover frequency following a large unit trip and 85th to 95th percentile of 30 minutes ahead intra-hour net load forecast error. Also included is new Solar Intra-Hour Over-Forecast Error Adjustment Table that tracks the estimated increase in intra-hour solar over-forecast error per 1,000 MW increase in the installed solar capacity.

In addition to the changes proposed in 2023 AS Methodology as outlined above, **Attachment A** updates the minimum level of RRS from Resources providing RRS using Primary Frequency Response to 1,390 MW.

On December 5, 2022, the Technical Advisory Committee (TAC) endorsed the proposed 2023 AS Methodology, with an effective date of January 1, 2023. The Reliability and Markets (R&M) Committee is expected to review the proposed 2023 AS Methodology at its meeting on December 19, 2022, and is expected to recommend that the Board approve the proposed 2023 AS Methodology.

Key Factors Influencing Issue:

Regulation Service: The proposed changes to the Wind Adjustment tables and Solar Adjustment tables used to add incremental amounts of Regulation Service quantities are part of a routine update that ERCOT makes annually based on anticipated growth in installed wind and solar generation, respectively in 2023.

Non-Spinning Reserve Service: During tighter grid operating conditions, ERCOT has observed limited offline capacity with shorter lead times available to bring online. The proposed change to use the ten-hours ahead net load forecast prior to ECRS' implementation as a part of NPRR863 captures the uncertainties in net load forecasts (both hourly and intra-hour) within the time frame during which operational actions in

response to grid conditions may typically be taken. Upon implementation of NPRR863, ECRS will provide additional capacity that can respond within 10 minutes and will help in responding to the uncertainties associated with forecasting intra-hour net load. As a result, Non-Spin's use is expected to evolve upon implementation of ECRS as part of NPRR863. Hence, upon implementation of NPRR863, the Non-Spin methodology is proposed to be updated such that it better reflects the risks associated with the type of net load forecast uncertainties Non-Spin is expected to be used to cover.

The proposed changes to the Wind Over-Forecast Adjustment table and Solar Over-Forecast Adjustment table used to add incremental amounts of Non-Spin quantities are part of a routine update that ERCOT makes annually and are based on a projected increase in over-forecast error due to the anticipated growth in installed wind and solar generation, respectively in 2023. Similarly, the proposed changes to the Intra-day Forced Outage table used to add incremental amounts of Non-Spin quantities are part of a routine update that ERCOT makes annually as well and are based on forced outage data from thermal resources in 2022.

ERCOT Contingency Reserve Service: ECRS may be deployed to restore frequency within 10 minutes of a significant frequency deviation, to compensate for intra-hour net load forecast uncertainty and variability on days in which large amounts of online thermal ramping capability is not available, or when there is a limited amount of capacity available for Security-Constrained Economic Dispatch (SCED). The proposed approach to compute ECRS quantities accounts for capacity needed to recover frequency following a large unit trip and 85th to 95th percentile of historic 30 minutes ahead intra-hour net load forecast error.

ERCOT has seen significant growth in installed solar capacity from one year to the next; an increase in solar capacity also tends to increase the MW quantity of error in their respective intra-hour forecasts. Hence, ERCOT's reliance on historical solar forecast errors alone creates a possibility of under-estimation of the ECRS requirement. To address this, through the Solar Intra-Hour Over-Forecast Error Adjustment Table, the estimated impact of increase in over-forecast error from the expected growth in solar generation installed capacity will be included in the ECRS requirement.

These changes were endorsed by the Reliability and Operations Subcommittee (ROS) and TAC.

Conclusion/Recommendation:

ERCOT staff recommends, and the R&M Committee is expected to recommend, that the Board approve the proposed 2023 ERCOT Methodologies for Determining Minimum Ancillary Service Requirements, attached as **Attachment A**, as endorsed by TAC, to be effective January 1, 2023.



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

WHEREAS, Protocol Section 3.16 requires that the Board of Directors (Board) of Electric Reliability Council of Texas, Inc. (ERCOT), at least annually, review and approve the deems it desirable and in the best interest of ERCOT to annually review the ERCOT Methodologies for Determining Minimum Ancillary Service Requirements;

WHEREAS, the Reliability and Markets (R&M) Committee has reviewed the 2023 ERCOT Methodologies for Determining Minimum Ancillary Service Requirements (2023 AS Methodology) recommended by ERCOT staff and as endorsed by the Technical Advisory Committee (TAC), as set forth in **Attachment A**, to be effective on January 1, 2023, and has recommended that the Board approve the 2023 AS Methodology; and

WHEREAS, after due consideration of the alternatives, the Board deems it desirable and in the best interest of ERCOT to approve the 2023 AS Methodology as recommended by the R&M Committee; and

THEREFORE, BE IT RESOLVED, that ERCOT is hereby authorized and approved to implement the 2023 AS Methodology, as set forth in **Attachment A**, as recommended by the R&M Committee and as endorsed by TAC, to be effective on January 1, 2023.

CORPORATE SECRETARY'S CERTIFICATE

I, Jonathan M. Levine, Assistant Corporate Secretary of ERCOT, do hereby certify that, at its December 20, 2022 meeting, the Board passed a motion approving the above Resolution by _____.

IN WITNESS WHEREOF, I have hereunto set my hand this ____ day of December, 2022.

Jonathan M. Levine
Assistant Corporate Secretary

ERCOT Methodologies for Determining Minimum Ancillary Service Requirements

ERCOT Board approved on 4~~12/28~~20/2022

Effective Date of ~~51/27~~1/202~~23~~

TABLE OF CONTENTS

INTRODUCTION	2
REGULATION SERVICE REQUIREMENT DETAILS	3
NON-SPINNING RESERVE (NON-SPIN) REQUIREMENT DETAILS	10
RESPONSIVE RESERVE (RRS) REQUIREMENT DETAILS	17
ERCOT CONTINGENCY RESERVE SERVICE (ECRS) DETAILS	18

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 (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 20th 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 20th of each month for the upcoming month. If the Ancillary Service 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 Ancillary Service 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 95th 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 95th percentile of Reg-Up deployments for the same month of the previous two years, and the 95th 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 95th percentile of Reg-Down deployments for the same month of the previous two years and the 95th 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 and solar penetration, ERCOT will calculate the increase in installed wind and solar generation capacity, respectively. Then, depending on the month of the year and the hour of the day, ERCOT will add incremental MWs that are derived using the wind and solar adjustment tables and associated increase in wind and solar generation capacity, to the maximum values determined above. The wind and solar adjustment tables for 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 and solar data respectively. The increase in wind (or solar) generation capacity will be calculated by taking the total nameplate capacity of wind (or solar) resources in the ERCOT network model at the time of the procurement study and subtracting out the total nameplate capacity of wind (or solar) 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 20th 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%.

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.	<u>1.30.9</u>	<u>1.21.3</u>	<u>1.41.4</u>	<u>1.61.6</u>	<u>1.82.3</u>	<u>1.02.2</u>	<u>1.80.7</u>	<u>1.81.7</u>	<u>3.14.2</u>	<u>2.13.7</u>	<u>1.21.7</u>	<u>1.41.7</u>	<u>1.53.9</u>	<u>1.72.8</u>	<u>1.71.7</u>	<u>1.81.6</u>	<u>2.62.8</u>	<u>2.62.0</u>	<u>-0.9- 1.3</u>	<u>-0.8- 0.9</u>	<u>0.60.4</u>	<u>1.4- 0.4</u>	<u>0.50.1</u>	<u>0.70.7</u>
Feb.	<u>1.91.2</u>	<u>1.42.0</u>	<u>1.32.0</u>	<u>1.21.9</u>	<u>1.52.1</u>	<u>1.22.1</u>	<u>1.01.3</u>	<u>1.62.2</u>	<u>2.44.6</u>	<u>2.14.4</u>	<u>1.32.8</u>	<u>1.52.5</u>	<u>2.12.7</u>	<u>2.42.4</u>	<u>2.21.8</u>	<u>2.11.9</u>	<u>2.42.8</u>	<u>1.93.5</u>	<u>0.31.1</u>	<u>= 0.20.0</u>	<u>0.6- 0.1</u>	<u>1.10.1</u>	<u>1.20.5</u>	<u>1.60.9</u>
Mar.	<u>1.61.4</u>	<u>1.71.9</u>	<u>1.71.8</u>	<u>1.71.9</u>	<u>1.72.0</u>	<u>2.02.3</u>	<u>2.01.7</u>	<u>2.82.5</u>	<u>3.74.5</u>	<u>2.84.1</u>	<u>2.32.7</u>	<u>2.42.3</u>	<u>2.52.0</u>	<u>2.71.5</u>	<u>2.20.8</u>	<u>1.90.7</u>	<u>1.91.0</u>	<u>1.51.5</u>	<u>1.11.5</u>	<u>1.01.5</u>	<u>0.80.1</u>	<u>0.40.1</u>	<u>0.50.6</u>	<u>0.81.1</u>
Apr.	<u>0.90.9</u>	<u>1.42.0</u>	<u>1.72.2</u>	<u>1.82.4</u>	<u>1.82.1</u>	<u>1.72.5</u>	<u>2.22.0</u>	<u>3.33.8</u>	<u>3.95.3</u>	<u>2.13.3</u>	<u>2.72.3</u>	<u>2.92.8</u>	<u>2.82.5</u>	<u>2.82.1</u>	<u>1.71.6</u>	<u>1.21.2</u>	<u>0.91.2</u>	<u>0.90.9</u>	<u>1.41.1</u>	<u>1.51.0</u>	<u>1.3- 0.5</u>	<u>0.6- 0.2</u>	<u>0.60.1</u>	<u>1.10.3</u>
May	<u>2.20.6</u>	<u>1.71.9</u>	<u>2.62.1</u>	<u>2.82.4</u>	<u>3.02.2</u>	<u>2.32.9</u>	<u>2.42.7</u>	<u>3.25.0</u>	<u>2.54.8</u>	<u>1.32.2</u>	<u>2.63.1</u>	<u>2.74.0</u>	<u>2.53.4</u>	<u>2.82.2</u>	<u>1.71.2</u>	<u>0.50.8</u>	<u>0.00.8</u>	<u>= 0.20.1</u>	<u>0.20.2</u>	<u>0.60.4</u>	<u>1.00.0</u>	<u>0.40.3</u>	<u>0.60.1</u>	<u>1.30.2</u>
Jun.	<u>0.30.0</u>	<u>1.11.1</u>	<u>2.21.5</u>	<u>2.62.4</u>	<u>3.12.7</u>	<u>2.73.3</u>	<u>2.73.4</u>	<u>4.15.9</u>	<u>3.23.3</u>	<u>2.11.9</u>	<u>3.14.5</u>	<u>2.65.0</u>	<u>1.63.4</u>	<u>1.31.9</u>	<u>0.90.8</u>	<u>0.10.5</u>	<u>= 0.20.3</u>	<u>-0.3- 0.1</u>	<u>-0.2- 0.2</u>	<u>0.10.2</u>	<u>= 0.20.6</u>	<u>= 0.30.1</u>	<u>0.10.0</u>	<u>0.30.0</u>
Jul.	<u>0.50.1</u>	<u>0.51.1</u>	<u>1.22.0</u>	<u>1.72.6</u>	<u>2.22.8</u>	<u>2.23.2</u>	<u>2.23.4</u>	<u>4.05.5</u>	<u>3.83.2</u>	<u>1.42.2</u>	<u>2.74.4</u>	<u>2.74.4</u>	<u>1.32.3</u>	<u>0.41.1</u>	<u>= 0.20.6</u>	<u>= 0.30.2</u>	<u>0.1- 0.1</u>	<u>0.3- 0.2</u>	<u>0.4- 0.2</u>	<u>0.50.1</u>	<u>= 0.10.8</u>	<u>= 0.40.1</u>	<u>= 0.10.0</u>	<u>= 0.10.0</u>
Aug.	<u>0.40.1</u>	<u>0.50.9</u>	<u>1.11.5</u>	<u>1.52.1</u>	<u>2.02.2</u>	<u>2.12.4</u>	<u>2.12.6</u>	<u>3.94.0</u>	<u>5.04.0</u>	<u>1.32.4</u>	<u>2.33.4</u>	<u>3.23.9</u>	<u>2.12.4</u>	<u>0.51.1</u>	<u>= 0.40.5</u>	<u>= 0.50.1</u>	<u>= 0.40.1</u>	<u>= 0.40.0</u>	<u>0.3- 0.1</u>	<u>0.4- 0.1</u>	<u>= 0.10.0</u>	<u>-0.1- 0.1</u>	<u>0.00.0</u>	<u>0.00.0</u>
Sep.	<u>0.31.0</u>	<u>0.70.9</u>	<u>1.11.1</u>	<u>1.61.4</u>	<u>2.21.5</u>	<u>2.21.9</u>	<u>2.02.1</u>	<u>3.12.0</u>	<u>6.33.5</u>	<u>3.52.6</u>	<u>2.11.4</u>	<u>2.81.7</u>	<u>2.11.5</u>	<u>0.81.0</u>	<u>0.40.5</u>	<u>0.50.1</u>	<u>0.40.3</u>	<u>0.00.4</u>	<u>0.10.4</u>	<u>-0.4- 0.3</u>	<u>-0.5- 0.4</u>	<u>-0.1- 0.3</u>	<u>0.00.0</u>	<u>0.00.0</u>
Oct.	<u>0.71.1</u>	<u>0.60.9</u>	<u>1.01.0</u>	<u>1.21.3</u>	<u>1.71.6</u>	<u>2.21.9</u>	<u>2.42.2</u>	<u>2.32.3</u>	<u>5.45.1</u>	<u>4.35.0</u>	<u>1.62.6</u>	<u>1.92.3</u>	<u>1.82.3</u>	<u>0.71.6</u>	<u>0.21.1</u>	<u>0.50.3</u>	<u>0.70.6</u>	<u>0.70.7</u>	<u>0.70.5</u>	<u>-0.3- 0.3</u>	<u>-0.5- 0.5</u>	<u>-0.1- 0.3</u>	<u>0.00.0</u>	<u>0.20.3</u>
Nov.	<u>0.30.9</u>	<u>0.31.5</u>	<u>0.81.5</u>	<u>1.32.1</u>	<u>1.72.6</u>	<u>1.82.6</u>	<u>2.32.7</u>	<u>2.93.1</u>	<u>5.54.5</u>	<u>4.23.0</u>	<u>2.12.0</u>	<u>2.51.7</u>	<u>2.21.5</u>	<u>1.30.9</u>	<u>0.80.9</u>	<u>1.00.6</u>	<u>1.41.2</u>	<u>0.10.7</u>	<u>-0.8- 0.6</u>	<u>-0.8- 0.2</u>	<u>-0.4- 0.1</u>	<u>0.00.2</u>	<u>0.00.1</u>	<u>= 0.10.3</u>
Dec.	<u>0.71.1</u>	<u>0.51.5</u>	<u>1.11.4</u>	<u>2.21.5</u>	<u>2.12.3</u>	<u>2.01.7</u>	<u>1.91.0</u>	<u>2.62.8</u>	<u>4.95.3</u>	<u>5.14.0</u>	<u>1.00.7</u>	<u>1.30.7</u>	<u>0.82.4</u>	<u>1.31.0</u>	<u>1.70.9</u>	<u>1.51.6</u>	<u>2.02.8</u>	<u>= 0.32.8</u>	<u>-1.2- 0.9</u>	<u>= 0.50.1</u>	<u>= 0.10.5</u>	<u>0.50.6</u>	<u>0.50.7</u>	<u>0.30.6</u>

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.	<u>1.40</u> ^{-0.0}	<u>0.70</u> ^{-0.2}	<u>0.70</u> ^{-0.8}	<u>-0.3</u> ^{-0.2}	<u>0.20</u> ^{-0.4}	<u>0.3</u> ^{-0.1}	<u>0.00</u> ^{-0.3}	<u>0.11</u> ^{-0.4}	<u>-1.7</u> ^{-1.8}	<u>-1.2</u> ^{-0.2}	<u>1.54</u> ^{-0.3}	<u>1.21</u> ^{-0.9}	<u>1.00</u> ^{-0.9}	<u>0.91</u> ^{-0.3}	<u>1.52</u> ^{-0.4}	<u>0.81</u> ^{-0.4}	<u>1.20</u> ^{-0.7}	<u>1.00</u> ^{-0.7}	<u>3.94</u> ^{-0.1}	<u>3.84</u> ^{-0.0}	<u>2.63</u> ^{-0.5}	<u>1.82</u> ^{-0.5}	<u>3.31</u> ^{-0.3}	<u>1.80</u> ^{-0.9}
Feb.	<u>0.82</u> ^{-0.8}	<u>0.41</u> ^{-0.4}	<u>0.31</u> ^{-0.1}	<u>0.00</u> ^{-0.7}	<u>0.30</u> ^{-0.5}	<u>0.20</u> ^{-0.3}	<u>0.30</u> ^{-0.2}	<u>0.40</u> ^{-0.2}	<u>-0.9</u> ^{-1.3}	<u>0.41</u> ^{-0.0}	<u>1.91</u> ^{-0.6}	<u>2.01</u> ^{-0.2}	<u>1.42</u> ^{-0.1}	<u>1.22</u> ^{-0.7}	<u>1.52</u> ^{-0.1}	<u>1.21</u> ^{-0.7}	<u>1.41</u> ^{-0.6}	<u>2.42</u> ^{-0.1}	<u>4.44</u> ^{-0.2}	<u>5.54</u> ^{-0.9}	<u>3.64</u> ^{-0.1}	<u>2.03</u> ^{-0.2}	<u>1.22</u> ^{-0.2}	<u>=</u> ^{-0.1}
Mar.	<u>2.82</u> ^{-0.2}	<u>0.21</u> ^{-0.0}	<u>=</u> ^{-0.2}	<u>=</u> ^{-0.8}	<u>0.10</u> ^{-0.6}	<u>0.10</u> ^{-0.5}	<u>0.10</u> ^{-0.4}	<u>0.10</u> ^{-0.5}	<u>-0.7</u> ^{-0.5}	<u>1.91</u> ^{-0.4}	<u>2.41</u> ^{-0.4}	<u>1.50</u> ^{-0.7}	<u>1.00</u> ^{-0.7}	<u>1.41</u> ^{-0.1}	<u>2.01</u> ^{-0.5}	<u>2.21</u> ^{-0.5}	<u>2.22</u> ^{-0.0}	<u>2.62</u> ^{-0.0}	<u>3.62</u> ^{-0.0}	<u>4.72</u> ^{-0.9}	<u>4.45</u> ^{-0.1}	<u>4.14</u> ^{-0.5}	<u>2.93</u> ^{-0.1}	<u>3.11</u> ^{-0.9}
Apr.	<u>1.11</u> ^{-0.1}	<u>0.00</u> ^{-0.8}	<u>=</u> ^{-0.4}	<u>=</u> ^{-0.3}	<u>=</u> ^{-0.4}	<u>0.40</u> ^{-0.5}	<u>0.10</u> ^{-0.4}	<u>0.20</u> ^{-0.1}	<u>0.2</u> ^{-0.1}	<u>2.51</u> ^{-0.5}	<u>2.50</u> ^{-0.9}	<u>1.40</u> ^{-0.4}	<u>0.60</u> ^{-0.4}	<u>1.11</u> ^{-0.0}	<u>1.81</u> ^{-0.7}	<u>2.31</u> ^{-0.6}	<u>2.82</u> ^{-0.2}	<u>3.12</u> ^{-0.5}	<u>3.12</u> ^{-0.8}	<u>3.62</u> ^{-0.9}	<u>4.86</u> ^{-0.3}	<u>5.55</u> ^{-0.7}	<u>3.34</u> ^{-0.0}	<u>1.92</u> ^{-0.2}
May	<u>0.72</u> ^{-0.3}	<u>=</u> ^{-0.7}	<u>=</u> ^{-0.3}	<u>-0.9</u> ^{-0.2}	<u>=</u> ^{-0.2}	<u>=</u> ^{-0.5}	<u>=</u> ^{-0.2}	<u>-0.3</u> ^{-0.2}	<u>0.60</u> ^{-0.6}	<u>1.31</u> ^{-0.0}	<u>1.00</u> ^{-0.1}	<u>0.40</u> ^{-0.0}	<u>0.20</u> ^{-0.1}	<u>0.80</u> ^{-0.5}	<u>1.31</u> ^{-0.5}	<u>2.32</u> ^{-0.4}	<u>3.23</u> ^{-0.4}	<u>3.83</u> ^{-0.7}	<u>3.84</u> ^{-0.7}	<u>3.54</u> ^{-0.1}	<u>4.36</u> ^{-0.2}	<u>5.66</u> ^{-0.1}	<u>3.14</u> ^{-0.7}	<u>1.03</u> ^{-0.4}
Jun.	<u>0.91</u> ^{-0.3}	<u>=</u> ^{-0.6}	<u>=</u> ^{-0.2}	<u>-1.5</u> ^{-0.7}	<u>-1.2</u> ^{-0.8}	<u>-1.0</u> ^{-0.5}	<u>-0.9</u> ^{-0.4}	<u>-0.9</u> ^{-0.4}	<u>0.20</u> ^{-0.4}	<u>0.30</u> ^{-0.3}	<u>0.00</u> ^{-0.0}	<u>=</u> ^{-0.0}	<u>=</u> ^{-0.2}	<u>0.10</u> ^{-0.8}	<u>0.62</u> ^{-0.0}	<u>1.62</u> ^{-0.9}	<u>2.54</u> ^{-0.2}	<u>3.14</u> ^{-0.8}	<u>3.45</u> ^{-0.3}	<u>3.03</u> ^{-0.5}	<u>3.83</u> ^{-0.8}	<u>5.85</u> ^{-0.3}	<u>3.54</u> ^{-0.2}	<u>1.91</u> ^{-0.5}
Jul.	<u>0.91</u> ^{-0.2}	<u>=</u> ^{-0.4}	<u>-1.2</u> ^{-0.4}	<u>-1.6</u> ^{-0.7}	<u>-1.7</u> ^{-1.0}	<u>-1.5</u> ^{-1.2}	<u>-1.3</u> ^{-1.3}	<u>-1.0</u> ^{-0.9}	<u>0.00</u> ^{-0.0}	<u>0.20</u> ^{-0.0}	<u>=</u> ^{-0.0}	<u>=</u> ^{-0.0}	<u>=</u> ^{-0.2}	<u>0.51</u> ^{-0.1}	<u>1.22</u> ^{-0.4}	<u>1.83</u> ^{-0.2}	<u>2.44</u> ^{-0.5}	<u>2.75</u> ^{-0.1}	<u>3.15</u> ^{-0.3}	<u>2.54</u> ^{-0.3}	<u>3.83</u> ^{-0.9}	<u>5.04</u> ^{-0.8}	<u>3.33</u> ^{-0.7}	<u>2.12</u> ^{-0.2}
Aug.	<u>0.51</u> ^{-0.1}	<u>=</u> ^{-0.0}	<u>-1.3</u> ^{-0.6}	<u>-1.6</u> ^{-0.7}	<u>-1.6</u> ^{-1.1}	<u>-1.5</u> ^{-1.2}	<u>-1.3</u> ^{-1.4}	<u>-0.9</u> ^{-0.9}	<u>-0.2</u> ^{-0.2}	<u>0.40</u> ^{-0.0}	<u>0.10</u> ^{-0.1}	<u>=</u> ^{-0.0}	<u>0.00</u> ^{-0.0}	<u>1.00</u> ^{-0.3}	<u>1.81</u> ^{-0.0}	<u>2.22</u> ^{-0.0}	<u>2.93</u> ^{-0.2}	<u>3.23</u> ^{-0.4}	<u>3.13</u> ^{-0.5}	<u>2.24</u> ^{-0.0}	<u>4.85</u> ^{-0.3}	<u>4.65</u> ^{-0.7}	<u>3.14</u> ^{-0.0}	<u>1.62</u> ^{-0.8}
Sep.	<u>0.60</u> ^{-0.1}	<u>=</u> ^{-0.0}	<u>-1.1</u> ^{-0.6}	<u>-1.3</u> ^{-0.6}	<u>-1.2</u> ^{-0.5}	<u>-1.3</u> ^{-0.4}	<u>-0.9</u> ^{-0.4}	<u>-0.6</u> ^{-0.2}	<u>-0.7</u> ^{-0.4}	<u>-0.20</u> ^{-0.1}	<u>0.00</u> ^{-0.4}	<u>=</u> ^{-0.3}	<u>=</u> ^{-0.1}	<u>0.70</u> ^{-0.3}	<u>1.70</u> ^{-0.9}	<u>1.81</u> ^{-0.6}	<u>2.21</u> ^{-0.9}	<u>2.81</u> ^{-0.8}	<u>3.32</u> ^{-0.0}	<u>4.84</u> ^{-0.0}	<u>7.25</u> ^{-0.6}	<u>5.24</u> ^{-0.3}	<u>2.72</u> ^{-0.5}	<u>0.80</u> ^{-0.8}
Oct.	<u>0.31</u> ^{-0.2}	<u>=</u> ^{-0.0}	<u>-0.9</u> ^{-0.6}	<u>-0.9</u> ^{-0.7}	<u>-0.8</u> ^{-0.4}	<u>-0.8</u> ^{-0.3}	<u>-0.4</u> ^{-0.1}	<u>-0.4</u> ^{-0.2}	<u>-1.1</u> ^{-0.6}	<u>-0.50</u> ^{-0.5}	<u>0.70</u> ^{-0.6}	<u>0.70</u> ^{-0.6}	<u>0.60</u> ^{-0.2}	<u>0.60</u> ^{-0.3}	<u>1.30</u> ^{-0.4}	<u>1.21</u> ^{-0.0}	<u>1.61</u> ^{-0.5}	<u>2.41</u> ^{-0.9}	<u>4.03</u> ^{-0.3}	<u>6.36</u> ^{-0.0}	<u>6.26</u> ^{-0.0}	<u>3.33</u> ^{-0.7}	<u>1.72</u> ^{-0.0}	<u>0.61</u> ^{-0.9}
Nov.	<u>0.80</u> ^{-0.8}	<u>0.1</u> ^{-0.1}	<u>-0.3</u> ^{-0.6}	<u>-0.2</u> ^{-0.3}	<u>=</u> ^{-0.4}	<u>=</u> ^{-0.0}	<u>=</u> ^{-0.4}	<u>-0.7</u> ^{-0.3}	<u>-1.6</u> ^{-1.1}	<u>-0.40</u> ^{-0.4}	<u>0.71</u> ^{-0.0}	<u>0.70</u> ^{-0.9}	<u>0.80</u> ^{-0.8}	<u>0.81</u> ^{-0.0}	<u>1.21</u> ^{-0.2}	<u>0.91</u> ^{-0.3}	<u>0.71</u> ^{-0.3}	<u>2.01</u> ^{-0.9}	<u>5.54</u> ^{-0.7}	<u>5.65</u> ^{-0.7}	<u>4.14</u> ^{-0.3}	<u>2.23</u> ^{-0.1}	<u>1.71</u> ^{-0.8}	<u>1.80</u> ^{-0.5}
Dec.	<u>1.20</u> ^{-0.7}	<u>1.30</u> ^{-0.6}	<u>0.2</u> ^{-0.9}	<u>-0.3</u> ^{-0.3}	<u>=</u> ^{-0.3}	<u>=</u> ^{-0.8}	<u>0.40</u> ^{-0.7}	<u>0.40</u> ^{-0.0}	<u>-2.0</u> ^{-3.1}	<u>-0.9</u> ^{-1.3}	<u>1.13</u> ^{-0.4}	<u>0.72</u> ^{-0.8}	<u>1.63</u> ^{-0.4}	<u>1.82</u> ^{-0.3}	<u>1.71</u> ^{-0.5}	<u>1.51</u> ^{-0.9}	<u>0.91</u> ^{-0.4}	<u>1.00</u> ^{-0.6}	<u>6.04</u> ^{-0.7}	<u>3.64</u> ^{-0.6}	<u>2.93</u> ^{-0.2}	<u>2.32</u> ^{-0.3}	<u>1.92</u> ^{-0.2}	<u>2.71</u> ^{-0.8}

Incremental MW Adjustment to Prior-Year Up-Regulation Value, per 1000 MW of Incremental Solar Generation Capacity, to Account for Solar 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.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.49	11.36	12.09	15.68	10.79	16.21	16.61	24.81	18.49	0.90	0.00	0.00	0.00	0.00	0.00
Feb.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.33	9.39	9.24	12.99	14.51	16.41	17.41	25.01	25.41	20.81	5.62	0.00	0.00	0.00	0.00	0.00
Mar.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.42	8.31	11.61	15.21	17.11	19.21	19.21	20.71	21.22	23.61	20.61	11.74	0.00	0.00	0.00	0.00
Apr.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	10.51	9.28	10.77	12.81	10.98	10.06	14.09	19.31	17.51	23.01	14.86	1.40	0.00	0.00	0.00
May	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.91	13.37	12.51	11.85	8.75	10.25	14.51	13.28	12.91	16.81	17.97	13.45	6.41	0.00	0.00	0.00
Jun.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	8.96	6.16	5.95	7.67	7.46	8.96	12.97	15.88	17.18	17.51	17.98	8.51	0.00	0.00	0.00
Jul.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.26	5.63	5.53	10.26	8.16	9.67	11.88	13.57	13.71	14.37	16.36	8.22	0.00	0.00	0.00
Aug.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.04	5.85	7.87	9.67	11.01	12.08	12.39	11.39	15.81	15.18	14.35	3.21	0.00	0.00	0.00
Sep.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.41	5.43	8.57	9.39	11.68	12.21	12.31	10.89	15.79	15.59	8.12	0.30	0.00	0.00	0.00
Oct.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.83	7.05	7.34	6.05	6.24	7.05	12.27	13.09	15.08	12.85	1.90	0.00	0.00	0.00	0.00
Nov.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.84	5.94	5.54	7.27	5.44	5.13	10.08	8.28	18.11	8.83	0.00	0.00	0.00	0.00	0.00	0.00
Dec.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.22	5.56	8.16	8.95	4.94	9.27	12.11	15.91	18.01	10.05	0.00	0.00	0.00	0.00	0.00	0.00

Incremental MW Adjustment to Prior-Year Down-Regulation Value, per 1000 MW of Incremental Solar Generation Capacity, to Account for Solar 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.	0.00-0	0.00-0 0	0.00-0	0.00-0	0.00-0	0.00-0	0.00-0	0.30-0	15.65 -9	22.41 -1	11.89 6	15.54 2.6	9.34 -4	10.67 3	12.94 5.5	12.64 3.7	8.99 2	- 2.13 3	-0.4 0.5	0.00-0 0	0.00-0 0	0.00-0 0	0.00-0 -0	0.00-0
Feb.	0.00-0	0.00-0 0	0.00-0	0.00-0	0.00-0	0.00-0	0.00-0	3.01 -4	21.24 0.4	15.44 -8	13.34 2.2	11.89 7	13.64 5.6	13.14 4.6	15.14 5.6	15.54 9.1	17.44 7.5	5.05 9	- 0.50 0	0.00-0 0	0.00-0 0	0.00-0 0	0.00-0 -0	0.00-0
Mar.	0.00-0	0.00-0 0	0.00-0	0.00-0	0.00-0	0.00-0	0.00-0	4.11 -6	14.16 -1	20.44 -8	14.34 6.3	14.74 3.3	20.64 7.2	13.24 5.7	15.24 4.7	14.34 7.7	21.24 7.9	15.54 6.7	7.79 8	0.82 4	-0.5 0.4	0.00-0 0	0.00-0 -0	0.00-0
Apr.	0.00-0	0.00-0 0	0.00-0	0.00-0	0.00-0	0.00-0	0.00-0	5.51 -4	18.47 -9	16.54 -8	13.79 4	13.54 0.8	10.94 0.5	10.47 8	11.24 0.0	11.84 0.2	15.64 5.9	13.34 4.8	13.34 4.5	- 1.43 2	0.00-0 0	0.00-0 0	0.00-0 -0	0.00-0
May	0.00-0	0.00-0 0	0.00-0	0.00-0	0.00-0	0.00-0	0.00-0	13.74 9	17.94 0.3	11.88 8	10.66 4	12.69 3	12.94 1.4	10.95 3	10.88 -8	10.57 -0	9.77 2	9.88 4	9.37 7	- 2.80 0	-1.4 0.4	0.00-0 0	0.00-0 -0	0.00-0
Jun.	0.00-0	0.00-0 0	0.00-0	0.00-0	0.00-0	0.00-0	0.00-0	13.94 1	17.39 -5	12.08 9	8.66 -9	7.98 -9	10.57 -1	8.35 -8	7.37 0	8.98 0	10.39 -9	9.08 7	10.06 -5	- 0.41 1	-2.7 0.3	0.00-0 0	0.00-0 -0	0.00-0
Jul.	0.00-0	0.00-0 0	0.00-0	0.00-0	0.00-0	0.00-0	0.00-0	8.81 -8	16.58 -7	12.26 7	5.93 -9	4.44 -3	4.76 2	8.57 -8	9.17 6	11.17 -6	8.78 6	12.84 0.9	7.85 9	- 3.70 1	-2.5 1.0	0.00-0 0	0.00-0 -0	0.00-0
Aug.	0.00-0	0.00-0 0	0.00-0	0.00-0	0.00-0	0.00-0	0.00-0	6.71 -2	14.78 -3	11.81 -4	8.68 -0	6.27 -2	6.67 8	7.59 -3	7.38 4	9.84 -4	11.69 -9	8.74 -3	2.55 7	-4.7 0.9	0.00-0 3	0.00-0 0	0.00-0 -0	0.00-0
Sep.	0.00-0	0.00-0 0	0.00-0	0.00-0	0.00-0	0.00-0	0.00-0	1.30 -5	13.25 -6	10.96 6	10.69 9	8.47 -8	8.89 7	8.59 -5	8.74 -4	10.41 0.3	7.64 -8	9.09 6	1.24 4	-1.1 1.3	0.00-0 0	0.00-0 0	0.00-0 -0	0.00-0
Oct.	0.00-0	0.00-0 0	0.00-0	0.00-0	0.00-0	0.00-0	0.00-0	0.20 -0	13.05 -1	13.76 7	6.55 -0	9.25 -9	7.06 6	6.85 -2	8.46 4	9.07 2	10.14 0.3	5.35 3	-4.8 0.9	- 0.20 2	0.00-0 0	0.00-0 0	0.00-0 -0	0.00-0

Attachment A

Nov.	0.00-0	0.00-0	0.00-0	0.00-0	0.00-0	0.00-0	0.00-0	8.02-7	17.19	9.87-3	6.07-4	6.76-1	7.76-1	5.94-5	7.61-0	6.29-1	2.15-3	-	0.00-0	0.00-0	0.00-1	0.00-0	0.00-0	0.00-0
		0							.0				1		.9	1	3	1.40-9	0	0	1	0	.0	
Dec.	0.00-0	0.00-0	0.00-0	0.00-0	0.00-0	0.00-0	0.00-0	1.70-5	17.91	14.09-3	6.58-2	5.46-6	5.26-0	7.97-8	8.48-9	8.91-1	3.45-9	-	0.00-0	0.00-0	0.00-0	0.00-0	0.00-0	0.00-0
		0							1.2	3			0		9	.2	9	0.60-4	0	0	0	0	.0	

Non-Spinning Reserve (Non-Spin) Requirement Details

Introduction

Non-Spinning Reserve (Non-Spin) consists of Generation Resources capable of being ramped to a specified output level within 30 minutes or Controllable 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 four consecutive hours. Non-Spin may also be provided by Load Resources that are not Controllable Load Resources and are capable of reducing consumption based on an ERCOT Extensible Markup Language (XML) instruction within 30 minutes and maintaining that deployment until recalled. 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 and/or solar are ~~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 to protect against forecast uncertainty and Forced Outages of thermal Resources within an Operating Day.

~~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 net load (load — wind — solar) increased more than forecasted.~~

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 4-hour blocks. The net load uncertainty for the analyzed days for all hours which are considered to be part of a 4-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) for the block minus the average Reg-Up requirement during the same block of hours (“Non-Spin block”). The Non-Spin requirement for each hour in the month is calculated by adding an adjustment that accounts for intra-day Forced Outage of thermal Resources to the previously calculated “Non-Spin block” quantity that the hour falls in.

ERCOT will post the monthly amounts for Non-Spin requirements for the upcoming year on the MIS. Following this posting, ERCOT will monitor the weather and net load forecast (i.e. load, wind and solar forecasts) near Real-Time and may procure up to an additional 1,000 MW of Non-Spin for Operating Hours that are (a) identified as having an increased potential of high forecast variability, (b) there is a risk that the actual net load during these Operating Hours could be higher than forecast (after making appropriate forecast model selection) and (c) the expected available capacity and expected reserves including the posted minimum Non-Spin requirements during these Operating Hours is not sufficient to cover the projected net load forecast uncertainty risk.

The minimum amount of Non-Spin procured from SCED dispatchable Resources in any hour shall not be less than ERCOT’s Most Severe Single Contingency (MSSC) value.

Procedure

ERCOT will determine the Non-Spin requirement using the 85th to 95th 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 ~~six-ten~~ hours prior to each Operating Hour. The net load uncertainty is then defined as the difference between the highest 5-minute net load within the hour and the forecasted net load.

[Replace the paragraph above with the following upon system implementation of NPRR863]

ERCOT will determine the Non-Spin requirement using the 75th to 95th 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 six hours prior to each Operating Hour. The net load uncertainty is then defined as the difference between the average 5-minute net load within the hour 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 85th percentile and 95th percentile will be assigned to the net load forecast uncertainty calculated previously. Periods where the risk of net load ramp is highest will use 95th percentile and 85th percentile for periods with lowest risks.

[Replace the paragraph above with the following upon system implementation of NPRR863]

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 75th percentile and 95th percentile will be assigned to the net load forecast uncertainty calculated previously. Periods where the risk of net load ramp is highest will use 95th percentile and 75th percentile for periods with lowest risks.

ERCOT has seen significant growth in installed wind and solar capacity from one year to the next; an increase in wind and solar capacity also tends to increase the MW quantity of error in their respective forecasts. Hence, ERCOT's reliance on historical wind and solar 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 and solar generation installed capacity into the future Non-Spin requirement. The net wind 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 wind adjustment to the Non-Spin value per 1000 MW increase in wind installed capacity is calculated as the change in 50th 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 net solar impact is calculated by a multiplication of the projected solar 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 solar generation capacity. The incremental MW solar adjustment to the Non-Spin value per 1000 MW increase in solar installed capacity is calculated as the change in 50th percentile of the historical solar over-forecast error for 4-hour blocks of each month in the past 3 years, which is then normalized to per 1000 MW of installed solar capacity. The tables below reflect the additional Non-Spin adjustments per 1000 MW of installed wind and solar capacity.

To account for increased capacity needs due to unplanned generation Outages that occur during an Operating Day, ERCOT will include an incremental adjustment in the Non-Spin requirements that accounts for intra-day Forced Outages of thermal Resources. This Forced Outage adjustment is calculated as the 75th percentile of the historical intra-day Forced Outages (accumulated since midnight) for six-hour blocks of each month in the past three years. The table below reflects additional Non-Spin adjustments to account for intra-day Forced Outages of thermal Resources. 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 and intra-day Forced Outages.

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>3133</u>	<u>3133</u>	<u>3133</u>	<u>3133</u>	<u>3133</u>	<u>3133</u>	<u>3334</u>	<u>3334</u>	<u>3334</u>	<u>3334</u>	<u>2628</u>	<u>2628</u>	<u>2628</u>	<u>2628</u>	<u>2728</u>	<u>2728</u>	<u>2728</u>	<u>2728</u>	<u>3537</u>	<u>3537</u>	<u>3537</u>	<u>3537</u>	<u>3133</u> 3	<u>3133</u>
Feb.	<u>3133</u>	<u>3133</u>	<u>3133</u>	<u>3133</u>	<u>3133</u>	<u>3133</u>	<u>3334</u>	<u>3334</u>	<u>3334</u>	<u>3334</u>	<u>2628</u>	<u>2628</u>	<u>2628</u>	<u>2628</u>	<u>2728</u>	<u>2728</u>	<u>2728</u>	<u>2728</u>	<u>3537</u>	<u>3537</u>	<u>3537</u>	<u>3537</u>	<u>3133</u> 3	<u>3133</u>
Mar.	<u>3435</u>	<u>3435</u>	<u>3638</u>	<u>3638</u>	<u>3638</u>	<u>3638</u>	<u>3234</u>	<u>3234</u>	<u>3234</u>	<u>3234</u>	<u>2728</u>	<u>2728</u>	<u>2728</u>	<u>2728</u>	<u>2829</u>	<u>2829</u>	<u>2829</u>	<u>2829</u>	<u>3436</u>	<u>3436</u>	<u>3436</u>	<u>3436</u>	<u>3435</u> 5	<u>3435</u>
Apr.	<u>3435</u>	<u>3435</u>	<u>3638</u>	<u>3638</u>	<u>3638</u>	<u>3638</u>	<u>3234</u>	<u>3234</u>	<u>3234</u>	<u>3234</u>	<u>2728</u>	<u>2728</u>	<u>2728</u>	<u>2728</u>	<u>2829</u>	<u>2829</u>	<u>2829</u>	<u>2829</u>	<u>3436</u>	<u>3436</u>	<u>3436</u>	<u>3436</u>	<u>3435</u> 5	<u>3435</u>
May	<u>3435</u>	<u>3435</u>	<u>3638</u>	<u>3638</u>	<u>3638</u>	<u>3638</u>	<u>3234</u>	<u>3234</u>	<u>3234</u>	<u>3234</u>	<u>2728</u>	<u>2728</u>	<u>2728</u>	<u>2728</u>	<u>2829</u>	<u>2829</u>	<u>2829</u>	<u>2829</u>	<u>3436</u>	<u>3436</u>	<u>3436</u>	<u>3436</u>	<u>3435</u> 5	<u>3435</u>
Jun.	<u>3336</u>	<u>3336</u>	<u>3135</u>	<u>3135</u>	<u>3135</u>	<u>3135</u>	<u>3133</u>	<u>3133</u>	<u>3133</u>	<u>3133</u>	<u>2022</u>	<u>2022</u>	<u>2022</u>	<u>2022</u>	<u>2122</u>	<u>2122</u>	<u>2122</u>	<u>2122</u>	<u>2934</u>	<u>2934</u>	<u>2934</u>	<u>2934</u>	<u>3336</u> 6	<u>3336</u>
Jul.	<u>3336</u>	<u>3336</u>	<u>3135</u>	<u>3135</u>	<u>3135</u>	<u>3135</u>	<u>3133</u>	<u>3133</u>	<u>3133</u>	<u>3133</u>	<u>2022</u>	<u>2022</u>	<u>2022</u>	<u>2022</u>	<u>2122</u>	<u>2122</u>	<u>2122</u>	<u>2122</u>	<u>2934</u>	<u>2934</u>	<u>2934</u>	<u>2934</u>	<u>3336</u> 6	<u>3336</u>
Aug.	<u>3336</u>	<u>3336</u>	<u>3135</u>	<u>3135</u>	<u>3135</u>	<u>3135</u>	<u>3133</u>	<u>3133</u>	<u>3133</u>	<u>3133</u>	<u>2022</u>	<u>2022</u>	<u>2022</u>	<u>2022</u>	<u>2122</u>	<u>2122</u>	<u>2122</u>	<u>2122</u>	<u>2934</u>	<u>2934</u>	<u>2934</u>	<u>2934</u>	<u>3336</u> 6	<u>3336</u>
Sep.	<u>2729</u>	<u>2729</u>	<u>2729</u>	<u>2729</u>	<u>2729</u>	<u>2729</u>	<u>2829</u>	<u>2829</u>	<u>2829</u>	<u>2829</u>	<u>2123</u>	<u>2123</u>	<u>2123</u>	<u>2123</u>	<u>2323</u>	<u>2323</u>	<u>2323</u>	<u>2323</u>	<u>2728</u>	<u>2728</u>	<u>2728</u>	<u>2728</u>	<u>2729</u> 9	<u>2729</u>
Oct.	<u>2729</u>	<u>2729</u>	<u>2729</u>	<u>2729</u>	<u>2729</u>	<u>2729</u>	<u>2829</u>	<u>2829</u>	<u>2829</u>	<u>2829</u>	<u>2123</u>	<u>2123</u>	<u>2123</u>	<u>2123</u>	<u>2323</u>	<u>2323</u>	<u>2323</u>	<u>2323</u>	<u>2728</u>	<u>2728</u>	<u>2728</u>	<u>2728</u>	<u>2729</u> 9	<u>2729</u>
Nov.	<u>2729</u>	<u>2729</u>	<u>2729</u>	<u>2729</u>	<u>2729</u>	<u>2729</u>	<u>2829</u>	<u>2829</u>	<u>2829</u>	<u>2829</u>	<u>2123</u>	<u>2123</u>	<u>2123</u>	<u>2123</u>	<u>2323</u>	<u>2323</u>	<u>2323</u>	<u>2323</u>	<u>2728</u>	<u>2728</u>	<u>2728</u>	<u>2728</u>	<u>2729</u> 9	<u>2729</u>
Dec.	<u>3133</u>	<u>3133</u>	<u>3133</u>	<u>3133</u>	<u>3133</u>	<u>3133</u>	<u>3334</u>	<u>3334</u>	<u>3334</u>	<u>3334</u>	<u>2628</u>	<u>2628</u>	<u>2628</u>	<u>2628</u>	<u>2728</u>	<u>2728</u>	<u>2728</u>	<u>2728</u>	<u>3537</u>	<u>3537</u>	<u>3537</u>	<u>3537</u>	<u>3133</u> 3	<u>3133</u>

Incremental MW Adjustment to Non-Spinning Reserve Service, per 1000 MW of Incremental Solar 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.	00	00	00	00	00	00	14	14	14	14	5028	5028	5028	5028	3626	3626	3626	3626	00	00	00	00	00	00
Feb.	00	00	00	00	00	00	14	14	14	14	5028	5028	5028	5028	3626	3626	3626	3626	00	00	00	00	00	00
Mar.	00	00	00	00	00	00	1829	1829	1829	1829	6154	6154	6154	6154	6156	6156	6156	6156	34	34	34	34	00	00
Apr.	00	00	00	00	00	00	1829	1829	1829	1829	6154	6154	6154	6154	6156	6156	6156	6156	34	34	34	34	00	00
May	00	00	00	00	00	00	1829	1829	1829	1829	6154	6154	6154	6154	6156	6156	6156	6156	34	34	34	34	00	00
Jun.	00	00	00	00	00	00	1347	1347	1347	1347	3820	3820	3820	3820	3228	3228	3228	3228	64	64	64	64	00	00
Jul.	00	00	00	00	00	00	1347	1347	1347	1347	3820	3820	3820	3820	3228	3228	3228	3228	64	64	64	64	00	00
Aug.	00	00	00	00	00	00	1347	1347	1347	1347	3820	3820	3820	3820	3228	3228	3228	3228	64	64	64	64	00	00
Sep.	00	00	00	00	00	00	24	24	24	24	3149	3149	3149	3149	2047	2047	2047	2047	00	00	00	00	00	00
Oct.	00	00	00	00	00	00	24	24	24	24	3149	3149	3149	3149	2047	2047	2047	2047	00	00	00	00	00	00
Nov.	00	00	00	00	00	00	24	24	24	24	3149	3149	3149	3149	2047	2047	2047	2047	00	00	00	00	00	00
Dec.	00	00	00	00	00	00	14	14	14	14	5028	5028	5028	5028	3626	3626	3626	3626	00	00	00	00	00	00

Incremental MW Adjustment to Non-Spinning Reserve Service to account for Intra-day Forced Outages of thermal resources

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.	35553 1	3555 31	35553 1	35553 1	35553 1	35553 1	73076 6	73076 6	7307 66	73076 6	73076 6	73076 6	8249 18	82491 8	8249 18	8249 18	8249 18	8249 18	7217 42	7217 42	7217 42	7217 42	72174 2	721742
Feb.	43057 2	4305 72	43057 2	43057 2	43057 2	43057 2	76992 7	76992 7	7699 27	76992 7	76992 7	76992 7	9008 19	90081 9	9008 19	9008 19	9008 19	9008 19	6587 64	6587 64	6587 64	6587 64	65876 4	658764
Mar.	51852 7	5185 27	51852 7	51852 7	51852 7	51852 7	77485 8	77485 8	7748 58	77485 8	77485 8	77485 8	8057 39	80573 9	8057 39	8057 39	8057 39	8057 39	7036 77	7036 77	7036 77	7036 77	70367 7	703677
Apr.	64361 0	6436 10	64361 0	64361 0	64361 0	64361 0	93686 8	93686 8	9368 68	93686 8	93686 8	93686 8	7928 70	79287 0	7928 70	7928 70	7928 70	7928 70	7528 83	7528 83	7528 83	7528 83	75288 3	752883
May	66460 1	6646 01	66460 1	66460 1	66460 1	66460 1	97784 6	97784 6	9778 46	97784 6	97784 6	97784 6	9849 11	98491 1	9849 11	9849 11	9849 11	9849 11	8838 52	8838 52	8838 52	8838 52	88385 2	883852
Jun.	63361 7	6336 17	63361 7	63361 7	63361 7	63361 7	85291 2	85291 2	8529 12	85291 2	85291 2	85291 2	9879 98	98799 8	9879 98	9879 98	9879 98	9879 98	1015 1129	1015 1129	1015 1129	1015 1129	10151 129	101511 29
Jul.	54551 2	5455 12	54551 2	54551 2	54551 2	54551 2	76063 6	76063 6	7606 36	76063 6	76063 6	76063 6	6456 56	64565 6	6456 56	6456 56	6456 56	6456 56	8758 34	8758 34	8758 34	8758 34	87583 4	875834
Aug.	48539 2	4853 92	48539 2	48539 2	48539 2	48539 2	57646 8	57646 8	5764 68	57646 8	57646 8	57646 8	4774 72	47747 2	4774 72	4774 72	4774 72	4774 72	6287 05	6287 05	6287 05	6287 05	62870 5	628705
Sep.	48848 9	4884 89	48848 9	48848 9	48848 9	48848 9	89583 9	89583 9	8958 39	89583 9	89583 9	89583 9	7387 13	73871 3	7387 13	7387 13	7387 13	7387 13	7298 41	7298 41	7298 41	7298 41	72984 1	729841
Oct.	46744 0	4674 40	46744 0	46744 0	46744 0	46744 0	79568 1	79568 1	7956 81	79568 1	79568 1	79568 1	8807 40	88074 0	8807 40	8807 40	8807 40	8807 40	8247 88	8247 88	8247 88	8247 88	82478 8	824788
Nov.	58561 3	5856 13	58561 3	58561 3	58561 3	58561 3	76779 5	76779 5	7677 95	76779 5	76779 5	76779 5	9709 70	97097 0	9709 70	9709 70	9709 70	9709 70	1020 1018	1020 1018	1020 1018	1020 1018	10201 018	102010 18
Dec.	52552 6	5255 26	52552 6	52552 6	52552 6	52552 6	76677 8	76677 8	7667 78	76677 8	76677 8	76677 8	8246 28	82462 8	8246 28	8246 28	8246 28	8246 28	5646 06	5646 06	5646 06	5646 06	56460 6	564606

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, solar, 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 1,24390 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. A floor of 2,800 MW will be applied to RRS quantities during the peak hours. During the peak hours, this additional RRS will help maintain an increased operating margin and operate the grid more conservatively. 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 85th 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 4-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*s. 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 Qualified Scheduling Entity's (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.

[Insert the Section below upon system implementation of NPRR863]

ERCOT Contingency Reserve Service (ECRS) Details

Introduction

ECRS is a service that is provided using capacity that can be sustained at a specified level for two consecutive hours. ECRS may be provided by unloaded, On-Line Generation Resource capacity; Quick Start Generation Resources (QSGRs); Load Resources that may or may not be controlled by high-set, underfrequency relays; Controllable Load Resources; and Generation Resources operating in synchronous condenser fast-response mode as defined in the Operating Guides. ECRS may be deployed to restore frequency within 10 minutes of a significant frequency deviation to recover deployed Regulation Service, to compensate for intra-hour net load forecast uncertainty and variability on days in which large amounts of online thermal ramping capability is not available, or when there is a limited amount of capacity available for Security-Constrained Economic Dispatch (SCED).~~and is intended to~~

Help restore the frequency to 60 Hz within ten minutes of a significant frequency deviation;

Provide energy to avoid or during the implementation of an EEA;

Provide backup to Reg-Up; and

Provide energy upon detection of insufficient available capacity for net load ramps.

Procedure

ERCOT will procure amounts of ECRS that vary by hour of the day and by month. ERCOT will determine the ECRS requirement as the sum of capacity needed to recover frequency following a large unit trip and capacity needed to cover for intra-hour net load forecast errors.

The frequency recovery related capacity for ECRS is computed for each hour in every month as capacity needed following a supply-side trip to recover frequency; will be based on expected diurnal load, solar, and wind patterns; and will cover 70% of historic system inertia conditions for each hour for the month.

Intra-hour net load forecast is utilized in establishing Base Points for SCED dispatchable Resources. ERCOT has observed larger intra-hour net load forecast errors during times when there are sudden net load ramps. Through including intra-hour net load forecast errors in calculating ECRS quantities, uncertainty in forecasting intra-hour net load (and hence, intra-hour net load ramps) will be accounted for. Specifically, the intra-hour net load forecast error related capacity for ECRS is computed using the 85th to 95th percentile of intra-hour net load uncertainty from the same hour and same month in the previous two 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). The forecast of net load is computed by subtracting the Intra-Hour Wind Power Forecast (IHWPF) and Intra-Hour Photo Voltaic Power Forecast

(IHPPF) from the Intra-Hour Load Forecast (IHLF). The IHWPF, IHPPF and IHLF used are the updated values as of thirty minutes prior to each Security Constrained Economic Dispatch (SCED) interval. The net load uncertainty is then defined as the difference between the average net load within the SCED interval 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 85th percentile and 95th percentile will be assigned to the net load forecast uncertainty calculated previously. Periods where the risk of net load ramp is highest will use 95th percentile and 85th percentile for periods with lowest risks.

ERCOT has seen significant growth in installed solar capacity from one year to the next; an increase in solar capacity also tends to increase the MW quantity of error in their respective forecasts. Hence, ERCOT's reliance on historical solar forecast errors alone creates a possibility of under-estimation of the ECRS requirement. To address this, ERCOT will include the estimated impact of increase in over-forecast error from the expected growth in solar generation installed capacity into the future ECRS requirement. The net solar impact is calculated by a multiplication of the projected solar capacity growth between the same month of current year and the next year, and incremental MW adjustment to ECRS value per 1000 MW of incremental solar generation capacity. The incremental MW solar adjustment to the ECRS value per 1000 MW increase in solar installed capacity is calculated as the change in 50th percentile of the historical solar over-forecast error for 4-hour blocks of each month in the past 2 years, which is then normalized to per 1000 MW of installed solar capacity. The tables below reflects the additional ECRS adjustments per 1000 MW of installed solar capacity.

[Insert the table below upon system implementation of NPRR863]

Incremental MW Adjustment to ERCOT Contingency Reserve Service, per 1000 MW of Incremental Solar 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.	0	0	0	0	0	0	0	0	0	0	25	25	25	25	19	19	19	19	0	0	0	0	0	0
Feb.	0	0	0	0	0	0	023	023	023	023	16	16	16	16	39	39	39	39	3	3	3	3	0	0
Mar.	0	0	0	0	0	0	0	0	0	0	32	32	32	32	37	37	37	37	10	10	10	10	0	0
Apr.	0	0	0	0	0	0	0	0	0	0	18	18	18	18	42	42	42	42	13	13	13	13	0	0
May	0	0	0	0	0	0	0	0	0	0	20	20	20	20	48	48	48	48	15	15	15	15	0	0
Jun.	0	0	0	0	0	0	0	0	0	0	32	32	32	32	30	30	30	30	36	36	36	36	0	0
Jul.	0	0	0	0	0	0	047	047	047	047	25	25	25	25	21	21	21	21	16	16	16	16	0	0
Aug.	0	0	0	0	0	0	03	03	03	03	24	24	24	24	38	38	38	38	17	17	17	17	0	0
Sep.	0	0	0	0	0	0	0	0	0	0	17	17	17	17	27	27	27	27	7	7	7	7	0	0
Oct.	0	0	0	0	0	0	0	0	0	0	7	7	7	7	19	19	19	19	0	0	0	0	0	0
Nov.	0	0	0	0	0	0	0	0	0	0	22	22	22	22	25	25	25	25	0	0	0	0	0	0
Dec.	0	0	0	0	0	0	0	0	0	0	39	39	39	39	42	42	42	42	0	0	0	0	0	0