



**Item 13: Revision to 2022 ERCOT  
Methodologies for Determining Minimum  
Ancillary Service Methodology  
Requirements – Recommendation on  
Minimum Capacity of Non-Spin Required  
from SCED Dispatchable Resources**

*Nitika Mago*

Manager Balancing Operations Planning

Board of Directors Meeting

ERCOT Public

April 27, 2022

Gray-Box for NPRR1093 and NPRR1007

## 3.16 Standards for Determining Ancillary Service Quantities

(3) The ERCOT Board **shall review and approve** ERCOT's methodology for determining the minimum Ancillary Service requirements, *any minimum capacity required from SCED dispatchable Resources to provide Non-Spin*, the minimum capacity required from Resources providing Primary Frequency Response to provide RRS and the maximum amount of RRS that can be provided by Resources capable of FFR.

- NPRR1093 introduced Protocol changes that:
  - Allow Load Resources that are not controllable (NCLRs) to also provide Non-Spin;  
AND
  - Require ERCOT to determine if any minimum capacity is required from SCED dispatchable Resources to provide Non-Spin.
- ERCOT is in the process of implementing NPRR1093 and plans to implement NPRR1093 in late May 2022.
- As a result, a change to the *2022 Methodology for Determining Minimum Ancillary Service Requirements* (2022 AS Methodology) is needed to include the minimum capacity that is required from SCED dispatchable Resources to provide Non-Spinning Reserve Service (Non-Spin).

# Summary of proposed 2022 AS Methodology Change

- For 2022, the minimum amount of Non-Spin procured from SCED dispatchable Resources shall not be less than ERCOT's Most Severe Single Contingency (MSSC) value. ERCOT's current MSSC is set at [1,430 MW](#).
  - There is no identified technical need for a limit on the minimum amount of Non-Spin to be procured from SCED dispatchable Resources.
  - However, ERCOT recommends that a moderate limit be adopted until some operational experience with NCLRs that are providing Non-Spin can be attained.
  - ERCOT notes that the need for a limit due to reliability reasons will diminish as more NCLRs get qualified, start providing Non-Spin in Real Time and ERCOT gains more experience with these. Hence, ERCOT expects that this limit will eventually be reduced to zero.
- ERCOT is seeking ERCOT Board of Directors' approval of the 2022 Ancillary Service Methodology with the change noted above.



**Date:** April 21, 2022  
**To:** Board of Directors  
**From:** Nitika Mago, Manager, Balancing Operations Planning  
**Subject:** Revision to 2022 ERCOT Methodologies for Determining Minimum Ancillary Service Requirements – Recommendation on Minimum Capacity of Non-Spin Required from SCED Dispatchable Resources

**Issue for the ERCOT Board of Directors**

**ERCOT Board of Directors Meeting Date:** April 28, 2022

**Item No.:** 13

**Issue:**

Whether the ERCOT Board of Directors (Board) should approve the proposed revised 2022 ERCOT Methodologies for Determining Minimum Ancillary Service Requirements (2022 Updated AS Methodology) as presented herein, to be effective upon implementation of Nodal Protocol Revision Request (NPRR) 1093, Load Resource Participation in Non-Spinning Reserve.

**Background/History:**

Ancillary Services are necessary to maintain the reliability of the ERCOT System. The ERCOT Protocols define these Ancillary Services (AS) and paragraph (2) of Section 3.16 charge ERCOT with, at least annually, determining a methodology for the minimum levels of Ancillary Services required and “capacity limits” for certain AS subtypes. These “capacity limits” are defined in paragraphs (2) and (3) of Section 3.16 and include the minimum capacity required from Security-Constrained Economic Dispatch (SCED) dispatchable Resources to provide Non-Spinning Reserve (Non-Spin) Service, the minimum capacity required from Resources providing Primary Frequency Response to provide Responsive Reserve Service (RRS) and the maximum amount of RRS that can be provided by Resources capable of Fast Frequency Response. Paragraph (3) of Section 3.16 requires the Board to review and approve ERCOT’s methodology and any “capacity limits” included in the methodology.

ERCOT staff 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 change in the 2022 Updated AS Methodology is related to Non-Spin. The change shown in red-line in **Attachment A** identifies that the minimum amount of Non-Spin procured from SCED dispatchable Resources shall not be less than ERCOT’s Most Severe Single Contingency (MSSC) value. ERCOT’s current MSSC is set at 1,430 MW. This limit will be effective upon implementation of NPRR1093.

No change has been proposed to the methodology used to compute Regulation Service and RRS.

On April 13, 2022, the Technical Advisory Committee (TAC) endorsed the proposed 2020 Updated AS Methodology, to be effective upon implementation of NPRR1093.

**Key Factors Influencing Issue:**

Upon implementation of NPRR1093, Load Resources that are not controllable (NCLRs) will also be able to provide Non-Spin. While there is no identified technical need for a limit on the minimum amount of Non-Spin to be procured from SCED dispatchable Resources, a moderate limit is being recommended until some operational experience can be attained with NCLRs that are providing Non-Spin. It is worth noting that the need for a limit due to reliability reasons will diminish as more NCLRs get qualified, start providing Non-Spin in Real Time and more experience is gained. Hence, ERCOT expects that this limit will eventually be reduced to zero.

This change was endorsed by the Reliability and Operations Subcommittee (ROS), Wholesale Market Subcommittee (WMS) and TAC.

**Conclusion/Recommendation:**

ERCOT staff recommends that the Board approve the proposed revised 2022 ERCOT Methodologies for Determining Minimum Ancillary Service Requirements, attached as **Attachment A**, as endorsed by TAC, to be effective upon implementation of NPRR1093.



**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 revised 2022 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 upon implementation of Nodal Protocol Revision Request (NPRR) 1093, Load Resource Participation in Non-Spinning Reserve;

THEREFORE, BE IT RESOLVED, that ERCOT is hereby authorized and approved to implement the revised 2022 ERCOT Methodologies for Determining Minimum Ancillary Service Requirements, as set forth in **Attachment A**, as endorsed by TAC, to be effective upon implementation of NPRR1093.

**CORPORATE SECRETARY'S CERTIFICATE**

I, Jonathan M. Levine, Assistant Corporate Secretary of ERCOT, do hereby certify that, at its April 28, 2022 meeting, the Board passed a motion approving the above Resolution by \_\_\_\_\_.

IN WITNESS WHEREOF, I have hereunto set my hand this \_\_\_\_ day of April, 2022.

\_\_\_\_\_  
Jonathan M. Levine  
Assistant Corporate Secretary

# ERCOT Methodologies for Determining Minimum Ancillary Service Requirements

ERCOT Board approved on 12/10/2021

Effective Date of 01/01/2022

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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 (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 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 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 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 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.	0.9	1.3	1.4	1.6	2.3	2.2	0.7	1.7	4.2	3.7	1.7	1.7	3.9	2.8	1.7	1.6	2.8	2.0	-1.3	-0.9	0.4	-0.4	0.1	0.7
Feb.	1.2	2.0	2.0	1.9	2.1	2.1	1.3	2.2	4.6	4.4	2.8	2.5	2.7	2.4	1.8	1.9	2.8	3.5	1.1	0.0	-0.1	0.1	0.5	0.9
Mar.	1.4	1.9	1.8	1.9	2.0	2.3	1.7	2.5	4.5	4.1	2.7	2.3	2.0	1.5	0.8	0.7	1.0	1.5	1.5	1.5	0.1	0.1	0.6	1.1
Apr.	0.9	2.0	2.2	2.4	2.1	2.5	2.0	3.8	5.3	3.3	2.3	2.8	2.5	2.1	1.6	1.2	1.2	0.9	1.1	1.0	-0.5	-0.2	0.1	0.3
May	0.6	1.9	2.1	2.4	2.2	2.9	2.7	5.0	4.8	2.2	3.1	4.0	3.4	2.2	1.2	0.8	0.8	0.1	0.2	0.4	0.0	0.3	0.1	0.2
Jun.	0.0	1.1	1.5	2.4	2.7	3.3	3.4	5.9	3.3	1.9	4.5	5.0	3.4	1.9	0.8	0.5	0.3	-0.1	-0.2	0.2	0.6	0.1	0.0	0.0
Jul.	0.1	1.1	2.0	2.6	2.8	3.2	3.4	5.5	3.2	2.2	4.4	4.4	2.3	1.1	0.6	0.2	-0.1	-0.2	-0.2	0.1	0.8	0.1	0.0	0.0
Aug.	0.1	0.9	1.5	2.1	2.2	2.4	2.6	4.0	4.0	2.4	3.4	3.9	2.4	1.1	0.5	0.1	0.1	0.0	-0.1	-0.1	0.0	-0.1	0.0	0.0
Sep.	1.0	0.9	1.1	1.4	1.5	1.9	2.1	2.0	3.5	2.6	1.4	1.7	1.5	1.0	0.5	0.1	0.3	0.4	0.4	-0.3	-0.4	-0.3	0.0	0.0
Oct.	1.1	0.9	1.0	1.3	1.6	1.9	2.2	2.3	5.1	5.0	2.6	2.3	2.3	1.6	1.1	0.3	0.6	0.7	0.5	-0.3	-0.5	-0.3	0.0	0.3
Nov.	0.9	1.5	1.5	2.1	2.6	2.6	2.7	3.1	4.5	3.0	2.0	1.7	1.5	0.9	0.9	0.6	1.2	0.7	-0.6	-0.2	-0.1	0.2	0.1	0.3
Dec.	1.1	1.5	1.4	1.5	2.3	1.7	1.0	2.8	5.3	4.0	0.7	0.7	2.4	1.0	0.9	1.6	2.8	2.8	-0.9	0.1	0.5	0.6	0.7	0.6

**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.	0.0	0.2	0.8	-0.2	0.1	-0.1	0.3	1.4	-1.8	-0.2	4.3	1.9	0.9	1.3	2.4	1.4	0.7	0.7	4.1	4.0	3.5	2.5	1.3	0.9
Feb.	2.8	1.4	1.1	0.7	0.5	0.3	0.2	0.2	-1.3	1.0	1.6	1.2	2.1	2.7	2.1	1.7	1.6	2.1	4.2	4.9	4.1	3.2	2.2	2.0
Mar.	2.2	1.0	0.7	0.8	0.6	0.5	0.4	0.5	-0.5	1.4	1.4	0.7	0.7	1.1	1.5	1.5	2.0	2.0	2.0	2.9	5.1	4.5	3.1	1.9
Apr.	1.1	0.8	0.4	0.3	0.4	0.5	0.4	0.1	-0.1	1.5	0.9	0.4	0.4	1.0	1.7	1.6	2.2	2.5	2.8	2.9	6.3	5.7	4.0	2.2
May	2.3	0.7	0.3	-0.2	0.2	0.5	0.2	-0.2	0.6	1.0	0.1	0.0	0.1	0.5	1.5	2.4	3.4	3.7	4.7	4.1	6.2	6.1	4.7	3.4
Jun.	1.3	0.6	0.2	-0.7	-0.8	-0.5	-0.4	-0.4	0.4	0.3	0.0	0.0	0.2	0.8	2.0	2.9	4.2	4.8	5.3	3.5	3.8	5.3	4.2	1.5
Jul.	1.2	0.4	-0.4	-0.7	-1.0	-1.2	-1.3	-0.9	0.0	0.0	0.0	0.0	0.2	1.1	2.4	3.2	4.5	5.1	5.3	4.3	3.9	4.8	3.7	2.2
Aug.	1.1	0.1	-0.6	-0.7	-1.1	-1.2	-1.4	-0.9	-0.2	0.0	0.1	0.0	0.0	0.3	1.0	2.0	3.2	3.4	3.5	4.0	5.3	5.7	4.0	2.8
Sep.	0.1	0.1	-0.6	-0.6	-0.5	-0.4	-0.4	-0.2	-0.4	0.1	0.4	0.3	0.1	0.3	0.9	1.6	1.9	1.8	2.0	4.0	5.6	4.3	2.5	0.8
Oct.	1.2	0.0	-0.6	-0.7	-0.4	-0.3	-0.1	-0.2	-0.6	0.5	0.6	0.6	0.2	0.3	0.4	1.0	1.5	1.9	3.3	6.0	6.0	3.7	2.0	1.9
Nov.	0.8	-0.1	-0.6	-0.3	0.0	0.0	0.4	-0.3	-1.1	0.4	1.0	0.9	0.8	1.0	1.2	1.3	1.3	1.9	4.7	5.7	4.3	3.1	1.8	0.5
Dec.	0.7	0.6	-0.9	-0.3	0.3	0.8	0.7	0.0	-3.1	-1.3	3.4	2.8	3.4	2.3	1.5	1.9	1.4	0.6	4.7	4.6	3.2	2.3	2.2	1.8

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	0	0	0	0	0	0	0	0.3	9.7	6.5	9.9	8.9	9	11.1	14.1	15.1	9.1	0.3	0	0	0	0	0
Feb.	0	0	0	0	0	0	0	-0.6	3	9.6	10	9.2	13.5	16.7	14.3	18.1	17.6	12.3	2.1	0	0	0	0	0
Mar.	0	0	0	0	0	0	0	-0.1	2.5	11.3	13.5	14.2	18.4	18.9	19.4	15.4	20.1	19.3	17.2	4.7	0	0	0	0
Apr.	0	0	0	0	0	0	0	-0.4	2	10.2	8.6	7.4	11.2	8.1	6.7	9.2	15.4	11.8	17.5	6.9	0.4	0	0	0
May	0	0	0	0	0	0	0	-2.2	1.5	7.7	10.2	5.3	5.8	5.5	11.3	8.3	10.3	10.7	7.4	5.5	1.9	0	0	0
Jun.	0	0	0	0	0	0	0	-2.2	2.5	6.5	6.2	5.1	7.6	6.4	6.4	7.9	8.4	8	13.1	8	1.9	0	0	0
Jul.	0	0	0	0	0	0	0	-1.8	0	6.4	3.1	3.2	6	6.7	7.2	8.4	7.1	10.6	7.2	6.9	2.1	0	0	0
Aug.	0	0	0	0	0	0	0	-1.9	-0.7	4.9	5.4	7.3	7.9	11.3	8.7	9.5	9.5	11.3	8.7	5.5	1.4	0	0	0
Sep.	0	0	0	0	0	0	0	-1	-0.7	1.2	3.9	7.5	9.5	8.8	11.1	11.7	9.6	9.2	9.3	2.7	0.3	0	0	0
Oct.	0	0	0	0	0	0	0	-0.1	-1.7	3.8	5.6	4.3	5.2	4.7	5.8	7.6	9.1	8.3	5.9	0.6	0	0	0	0
Nov.	0	0	0	0	0	0	0	-0.8	4.7	4.8	4.9	7.1	4.6	3.9	8.8	8.5	10.5	3	0	0	0	0	0	0
Dec.	0	0	0	0	0	0	0	-0.5	2.6	6.5	6.6	5.7	4.5	7.5	10.6	13.7	11.2	5.1	0	0	0	0	0	0

**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.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.9	12.1	9.6	12.6	11.4	7.3	15.5	13.7	9.2	3.3	-0.5	0.0	0.0	0.0	0.0	0.0
Feb.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	10.4	11.8	12.2	9.7	15.6	14.6	15.6	19.1	17.5	5.9	0.0	0.0	0.0	0.0	0.0	0.0
Mar.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.6	6.1	16.8	16.3	13.3	17.2	15.7	14.7	17.7	17.9	16.7	9.8	2.4	-0.4	0.0	0.0	0.0
Apr.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4	7.9	11.8	9.4	10.8	10.5	7.8	10.0	10.2	15.9	14.8	14.5	3.2	0.0	0.0	0.0	0.0
May	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.9	10.3	8.8	6.4	9.3	11.4	5.3	8.8	7.0	7.2	8.4	7.7	0.0	-0.4	0.0	0.0	0.0
Jun.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.1	9.5	8.9	6.9	8.9	7.1	5.8	7.0	8.0	9.9	8.7	6.5	1.1	-0.3	0.0	0.0	0.0
Jul.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.8	8.7	6.7	3.9	4.3	6.2	7.8	7.6	7.6	8.6	10.9	5.9	0.1	-1.0	0.0	0.0	0.0
Aug.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	8.3	10.4	8.0	7.2	7.8	9.3	8.4	10.4	9.9	11.3	5.7	-0.9	0.3	0.0	0.0	0.0
Sep.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	5.6	6.6	9.9	7.8	9.7	9.5	10.4	10.3	10.8	9.6	4.4	-1.3	0.0	0.0	0.0	0.0
Oct.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.1	6.7	5.0	5.9	6.6	5.2	6.4	7.2	10.3	5.3	-0.9	0.2	0.0	0.0	0.0	0.0
Nov.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.7	9.0	7.3	7.4	6.1	6.1	4.5	10.9	9.1	5.3	0.9	0.0	0.0	0.1	0.0	0.0	0.0
Dec.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	11.2	9.3	8.2	6.6	6.0	7.8	8.9	11.2	5.9	0.4	0.0	0.0	0.0	0.0	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 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 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 85<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 six 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.

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 85<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 and 85<sup>th</sup> 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 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 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 50<sup>th</sup> 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 75<sup>th</sup> 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.

## 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.	33	33	33	33	33	33	34	34	34	34	28	28	28	28	28	28	28	28	37	37	37	37	33	33
Feb.	33	33	33	33	33	33	34	34	34	34	28	28	28	28	28	28	28	28	37	37	37	37	33	33
Mar.	35	35	38	38	38	38	34	34	34	34	28	28	28	28	29	29	29	29	36	36	36	36	35	35
Apr.	35	35	38	38	38	38	34	34	34	34	28	28	28	28	29	29	29	29	36	36	36	36	35	35
May	35	35	38	38	38	38	34	34	34	34	28	28	28	28	29	29	29	29	36	36	36	36	35	35
Jun.	36	36	35	35	35	35	33	33	33	33	22	22	22	22	22	22	22	22	31	31	31	31	36	36
Jul.	36	36	35	35	35	35	33	33	33	33	22	22	22	22	22	22	22	22	31	31	31	31	36	36
Aug.	36	36	35	35	35	35	33	33	33	33	22	22	22	22	22	22	22	22	31	31	31	31	36	36
Sep.	29	29	29	29	29	29	29	29	29	29	23	23	23	23	23	23	23	23	28	28	28	28	29	29
Oct.	29	29	29	29	29	29	29	29	29	29	23	23	23	23	23	23	23	23	28	28	28	28	29	29
Nov.	29	29	29	29	29	29	29	29	29	29	23	23	23	23	23	23	23	23	28	28	28	28	29	29
Dec.	33	33	33	33	33	33	34	34	34	34	28	28	28	28	28	28	28	28	37	37	37	37	33	33

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.	0	0	0	0	0	0	1	1	1	1	28	28	28	28	26	26	26	26	0	0	0	0	0	0
Feb.	0	0	0	0	0	0	1	1	1	1	28	28	28	28	26	26	26	26	0	0	0	0	0	0
Mar.	0	0	0	0	0	0	29	29	29	29	51	51	51	51	56	56	56	56	1	1	1	1	0	0
Apr.	0	0	0	0	0	0	29	29	29	29	51	51	51	51	56	56	56	56	1	1	1	1	0	0
May	0	0	0	0	0	0	29	29	29	29	51	51	51	51	56	56	56	56	1	1	1	1	0	0
Jun.	0	0	0	0	0	0	17	17	17	17	20	20	20	20	28	28	28	28	4	4	4	4	0	0
Jul.	0	0	0	0	0	0	17	17	17	17	20	20	20	20	28	28	28	28	4	4	4	4	0	0
Aug.	0	0	0	0	0	0	17	17	17	17	20	20	20	20	28	28	28	28	4	4	4	4	0	0
Sep.	0	0	0	0	0	0	4	4	4	4	19	19	19	19	17	17	17	17	0	0	0	0	0	0
Oct.	0	0	0	0	0	0	4	4	4	4	19	19	19	19	17	17	17	17	0	0	0	0	0	0
Nov.	0	0	0	0	0	0	4	4	4	4	19	19	19	19	17	17	17	17	0	0	0	0	0	0
Dec.	0	0	0	0	0	0	1	1	1	1	28	28	28	28	26	26	26	26	0	0	0	0	0	0

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.	531	531	531	531	531	531	766	766	766	766	766	766	918	918	918	918	918	918	742	742	742	742	742	742
Feb.	572	572	572	572	572	572	927	927	927	927	927	927	819	819	819	819	819	819	764	764	764	764	764	764
Mar.	527	527	527	527	527	527	858	858	858	858	858	858	739	739	739	739	739	739	677	677	677	677	677	677
Apr.	610	610	610	610	610	610	868	868	868	868	868	868	870	870	870	870	870	870	883	883	883	883	883	883
May	601	601	601	601	601	601	846	846	846	846	846	846	911	911	911	911	911	911	852	852	852	852	852	852
Jun.	617	617	617	617	617	617	912	912	912	912	912	912	998	998	998	998	998	998	1129	1129	1129	1129	1129	1129
Jul.	512	512	512	512	512	512	636	636	636	636	636	636	656	656	656	656	656	656	834	834	834	834	834	834
Aug.	392	392	392	392	392	392	468	468	468	468	468	468	472	472	472	472	472	472	705	705	705	705	705	705
Sep.	489	489	489	489	489	489	839	839	839	839	839	839	713	713	713	713	713	713	841	841	841	841	841	841
Oct.	440	440	440	440	440	440	681	681	681	681	681	681	740	740	740	740	740	740	788	788	788	788	788	788
Nov.	613	613	613	613	613	613	795	795	795	795	795	795	970	970	970	970	970	970	1018	1018	1018	1018	1018	1018
Dec.	526	526	526	526	526	526	778	778	778	778	778	778	628	628	628	628	628	628	606	606	606	606	606	606

### ***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 1,240 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 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 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.