



## **Item 9: 2017 Methodology for Determining Minimum Ancillary Service Requirements**

*Sandip Sharma*  
ERCOT Manager, Operations Planning

Board of Directors Meeting

ERCOT Public  
Dec 13, 2016

# Background

- Protocol Section 3.16 - Standards for Determining Ancillary Service Quantities
  - ERCOT shall, at least annually, review the quantity and requirements for each Ancillary Service needed for reliability
  - The ERCOT Board shall review and approve ERCOT's methodology for determining the minimum Ancillary Service requirements
- ERCOT is proposing changes to the 2017 Regulation Service Methodology.
- ERCOT is not proposing any changes to the methodologies of determining RRS and Non-Spin quantities.

# Regulation Service Methodology Changes

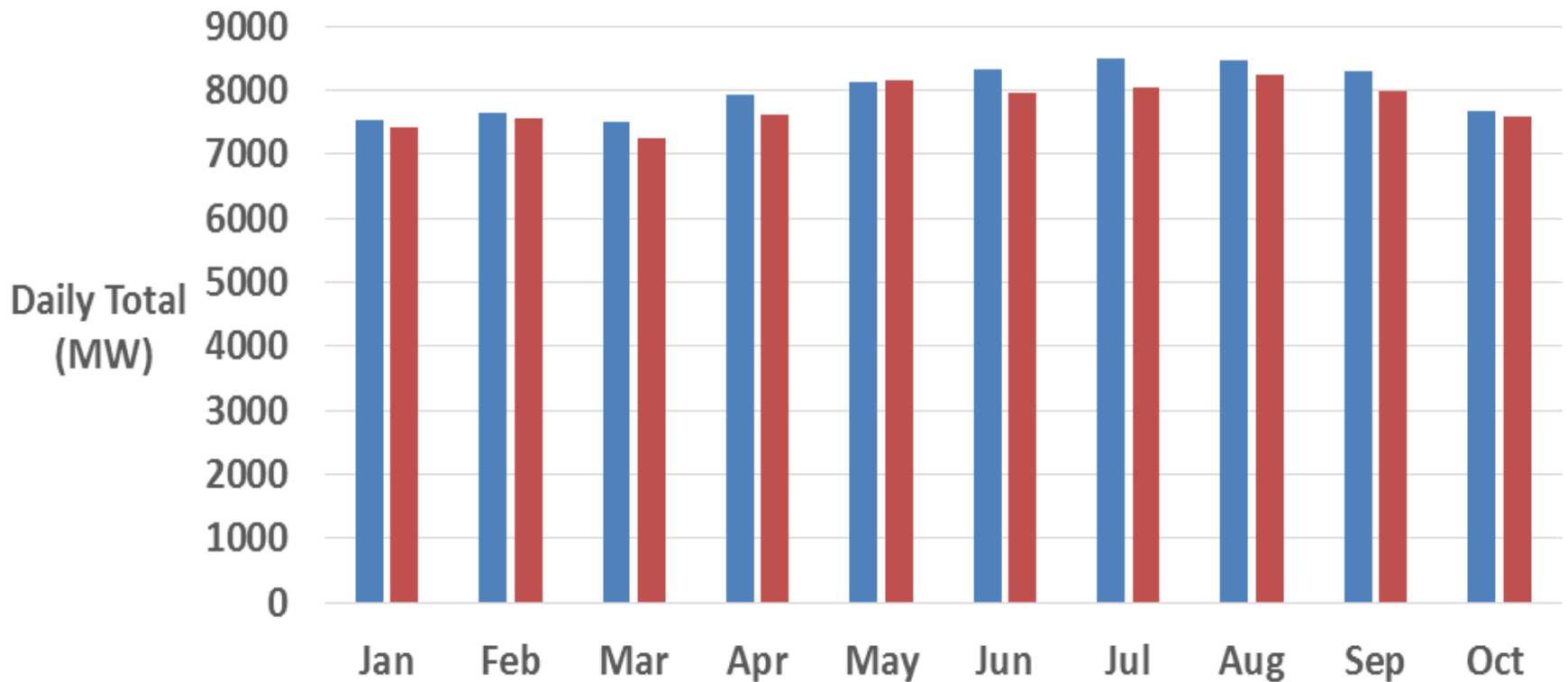
ERCOT is proposing the following changes to the 2017 Regulation Service Methodology,

1. Remove exhaustion rate feedback from the regulation procurement analysis
2. Estimate 5-minute net load variability by including solar generation (net load = load – wind generation – solar generation).
3. The annual updates to GE Tables to reflect incremental installed wind generation.

# Proposed Regulation-Up Requirement

## Comparison of Regulation-up for 2016 and 2017

■ 2016 ■ 2017



# Responsive Reserve Service (RRS)

- The preliminary RRS quantities for 2017 are based on historical (2015 and 2016) inertia data using **current methodology**.
- 2017 RRS quantities reflect system inertia based on gross MW telemetry. In previous years net MW telemetry was used for this analysis.
- Reliability and Operations Subcommittee (ROS), at its September 8, 2016 meeting, approved ERCOT's recommendation for removal of the Reserve Discount Factor (RDF). **The RRS quantities for 2017 reflect the removal of the RDF.**

# Non-Spin Reserve Service (Non-Spin)

- The preliminary Non-Spin quantities are based on historical (2014, 2015 and 2016) net forecast error data **using the current methodology.**

# Summary

- Following is a summary of the 2017 Ancillary Service Methodology.
  - Two changes to the Regulation Service methodology;
  - GE Tables for evaluating effect of incremental wind generation capacity will be updated; and
  - RRS and Non-Spin Methodologies for 2017 are the same as approved in June 2016.
  
- ERCOT is seeking Board approval of 2017 Ancillary Service Methodology.

# Questions and Answers







**Date:** December 6, 2016  
**To:** Board of Directors  
**From:** Sandip Sharma, Manager of Operations Planning  
**Subject:** 2017 Methodology for Determining Minimum Ancillary Service Requirements

**Issue for the ERCOT Board of Directors**

**ERCOT Board of Directors Meeting Date:** December 13, 2016

**Item No.:** 9

**Issue:**

Whether the ERCOT Board of Directors (Board) should approve the proposed *ERCOT Methodologies for Determining Minimum Ancillary Service Requirements* (AS Methodology) as presented herein, to be effective January 1, 2017.

**Background/History:**

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

ERCOT staff presented the 2016 AS Methodology to the Board on December 8, 2015, which the Board approved to be effective January 1, 2016 as requested. ERCOT staff presented a revised 2016 AS Methodology to the Board on June 14, 2016, which the Board approved to be effective July 1, 2016 as requested.

The primary changes for the 2017 AS Methodology are related to Regulation Service. No changes have been proposed to Responsive Reserve Service (RRS) and Non-Spinning Reserve Service (Non-Spin). The changes are shown in red-line in Attachment A and can be summarized as follows:

- Regulation Service:
  - Remove exhaustion rate feedback from the regulation procurement analysis;
  - Update the five-minute net load variability calculation to include solar generation; and
  - Update the factors used to adjust the Regulation Service quantities for additional installed wind generation.
- Responsive Reserve Service:
  - No change, i.e., same methodology as approved on June 14, 2016.
- Non-Spinning Reserve Service:
  - No change, i.e., same methodology as approved on June 14, 2016.



Under the proposed 2017 AS Methodology, the proposed changes for Regulation Service will go into effect on January 1, 2017.

On October 27, 2016, the Technical Advisory Committee (TAC) unanimously endorsed the proposed 2017 AS Methodology, with an effective date of January 1, 2017.

**Key Factors Influencing Issue:**

The removal of the historical Regulation Service exhaustion rate is intended to eliminate procuring large quantities of Regulation Service a year and/or two years after prolonged deployment of Regulation Service occurred (likely due to generation forced outage event) in an hour of a particular month.

While solar penetration in ERCOT is in its early stages, it is expected to grow significantly in the next few years. The inclusion of solar generation in the net load variability calculation will start capturing the impacts of these additional variable resources on the overall Regulation Service requirements in 2017 and beyond.

The proposed changes to the factors used to adjust the Regulation Service procurement amounts are based on actual wind generation data from 2016. This is a routine update that ERCOT makes annually based on the growth of installed wind generation.

The 2017 AS Methodology, including the ERCOT-recommended changes, were endorsed in stakeholder meetings, including the October 6, 2016 Reliability and Operations Subcommittee (ROS) meeting, the October 17, 2016 Wholesale Market Subcommittee (WMS) meeting, and the October 27, 2016 TAC meeting.

**Conclusion/Recommendation:**

ERCOT staff recommends that the Board approve the proposed 2017 *ERCOT Methodologies for Determining Minimum Ancillary Service Requirements*, attached as Attachment A, as endorsed by the TAC, to be effective January 1, 2017.



**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 2017 *ERCOT Methodologies for Determining Minimum Ancillary Service Requirements*, as endorsed by the Technical Advisory Committee (TAC), to be effective on January 1, 2017;

THEREFORE, BE IT RESOLVED, that ERCOT is hereby authorized and approved to implement the 2017 *ERCOT Methodologies for Determining the Minimum Ancillary Service Requirements*, as endorsed by TAC, to be effective on January 1, 2017.

**CORPORATE SECRETARY'S CERTIFICATE**

I, Vickie G. Leady, Assistant Corporate Secretary of ERCOT, do hereby certify that, at its December 13, 2016 meeting, the ERCOT Board passed a motion approving the above Resolution by \_\_\_\_\_.

IN WITNESS WHEREOF, I have hereunto set my hand this \_\_\_ day of December, 2016.

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

# ERCOT Methodologies for Determining Minimum Ancillary Service Requirements

ERCOT Board approved ~~06/14~~12/13/2016

Effective Date of ~~07~~1/01/2016~~7~~

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## ***Introduction***

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

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

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

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

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

### **Introduction**

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

### **Summary**

The Regulation Service requirements are calculated with the expectation that sufficient Regulation Service will be available to cover the 95<sup>th</sup> percentile of deployed regulation or net load variability. ~~If the exhaustion rate exceeded 1.2% in any given hour, ERCOT will procure an extra 10% of Reg Up or Reg Down as appropriate, for that hour. If the exhaustion rate exceeded 2% in any given hour, ERCOT will procure an extra 20% for that hour.~~ An adjustment may also be made based on historic CPS1 performance.

### **Procedure**

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

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

~~These Regulation Service requirements may be increased for hours in which the desired 1.2% exhaustion rate is exceeded. If the exhaustion rate exceeded 1.2% in any given hour, ERCOT will procure an extra 10% of Reg Up or Reg Down as appropriate, for that hour. If the~~

~~exhaustion rate exceeded 2% in any given hour, ERCOT will procure an extra 20% for that hour.~~ 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.	5.62-5	2.12-0	4.31-8	5.7-0.8	3.40-0	2.40-8	-0.2-2.5	0.73-6	4.32-0	3.41-6	1.73-9	4.30-3	2.43-5	2.4-0.1	3.2-0.7	1.33-3	4.03-0	0.44-8	0.50-4	2.50-8	2.02-6	1.20-5	1.22-5	5.81-0
Feb.	3.31-6	2.93-7	3.04-2	3.14-7	2.03-4	-0.32-7	-0.32-0	4.82-4	12.7-0.9	6.5-0.7	3.86-2	3.10-4	3.50-9	2.51-7	3.03-2	1.54-9	4.41-7	5.83-7	1.54-4	-1.00-0	0.30-9	-0.3-1.2	0.51-6	3.24-8
Mar.	4.50-9	6.13-3	7.81-3	7.55-6	3.63-9	3.64-4	-1.6-2.4	7.45-4	6.19-2	7.13-8	4.43-1	3.43-6	4.02-5	7.93-1	8.03-0	4.0-0.8	5.21-8	4.33-8	2.2-0.8	1.9-3.2	3.1-3.0	0.3-0.8	1.3-2.4	4.1-3.2
Apr.	4.96-7	5.83-4	6.95-3	6.47-4	8.55-2	6.92-1	2.80-9	7.11-6	6.43-5	3.64-4	5.45-6	6.36-1	2.20-4	1.21-0	2.90-4	1.22-9	2.05-4	5.92-9	1.61-8	2.63-2	1.64-1	2.13-4	-0.80-9	5.43-8
May	11.82-5	8.96-2	8.96-8	7.96-3	8.86-1	2.23-8	6.38-5	6.15-8	1.86-9	6.63-4	5.63-7	5.02-4	4.60-2	3.62-7	2.93-2	-1.01-7	2.00-8	2.412-4	5.85-9	7.14-1	3.15-6	0.70-7	3.23-1	18.53-0
Jun.	2.22-8	5.13-9	3.58-3	4.61-9	5.11-7	3.97-9	7.610-2	6.98-3	3.35-5	6.42-0	4.83-0	3.60-4	0.51-9	0.2-0.5	0.30-8	2.61-0	2.12-3	4.10-5	3.83-1	2.81-5	0.3-0.1	-0.4-0.1	0.90-0	6.26-4
Jul.	1.81-8	2.14-0	2.45-2	2.72-7	3.24-8	2.03-9	10.87-0	8.96-9	3.84-9	3.45-6	5.06-3	4.72-9	2.10-8	0.82-1	-2.2-1.3	0.72-0	1.61-1	1.5-0.6	1.10-7	2.12-3	0.5-1.5	0.0-0.3	1.70-3	1.21-2
Aug.	3.43-6	2.56-6	3.64-7	2.85-9	4.82-9	4.83-4	6.97-1	6.34-6	2.11-0	5.15-9	4.34-4	3.52-2	0.91-7	-1.41-2	0.80-9	1.90-6	0.01-9	0.60-3	2.4-0.4	0.82-8	0.1-0.3	-0.1-0.9	0.51-3	0.5-0.1
Sep.	4.4-0.5	2.90-6	2.31-7	3.81-7	3.82-8	4.34-0	5.4-0.3	5.94-8	0.01-7	5.84-8	5.26-7	2.75-1	0.62-6	0.11-1	1.04-7	0.31-5	1.7-1.6	0.60-6	-1.81-7	-1.52-0	0.30-2	0.30-3	1.00-0	1.81-9
Oct.	2.62-5	5.72-4	5.7-0.6	6.33-2	5.93-5	1.91-1	3.91-7	7.49-1	6.85-3	-2.42-5	2.25-1	-0.12-8	1.03-9	-1.83-3	-0.4-1.1	0.21-1	1.91-3	2.75-4	0.87-1	1.1-2.6	0.1-1.7	-0.23-1	1.01-0	1.04-0
Nov.	1.91-4	5.62-1	1.33-5	0.90-5	3.10-7	1.13-6	-0.61-1	2.82-6	4.57-0	4.25-7	5.51-7	3.75-9	2.73-1	3.43-3	4.41-5	2.64-6	6.64-0	4.21-0	1.5-2.1	1.3-0.4	1.7-0.8	0.86-0	3.82-4	1.21-6
Dec.	4.43-2	5.22-6	3.22-6	2.91-0	1.32-0	3.60-5	0.05-8	2.31-0	4.83-9	5.85-2	5.92-1	-1.91-0	3.24-7	3.62-8	4.12-9	2.53-8	5.84-9	1.20-3	3.30-0	2.40-0	1.7-0.5	0.60-8	0.82-5	1.42-2



**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.	3.75-4	3.33-3	1.51-4	-0.84-5	0.91-6	1.91-3	-0.30-8	-2.0-0.1	-3.5-0.9	-3.3-1.3	1.21-5	2.16-3	0.55-5	-0.82-3	-0.41-7	0.33-2	0.5-0.5	1.8-0.1	5.85	4.52-4	4.61-3	3.01-2	0.5-0.2	4.20-6	
Feb.	4.33-4	1.42-5	0.7-1.8	7.12-6	3.91-6	2.91-8	4.4-0.8	1.4-0.2	-3.2-2.3	6.23-7	4.50-4	1.01-2	4.33-5	3.62-8	2.83-4	3.35-3	2.45-4	0.11-7	8.35-2	6.75-9	8.52-8	6.62-8	6.54-1	4.13-6	
Mar.	3.31-5	2.73-5	1.02-1	1.73-5	0.7-1.1	4.5-2.1	1.5-1.5	3.4-2.5	2.9-4.4	1.4-0.7	1.3-0.3	1.10-3	4.5-1.5	0.5-1.5	0.61-6	0.63-8	1.30-1	1.9-1.9	1.0-0.4	4.49-4	5.02-6	3.27	5.26-2	1.71-4	
Apr.	4.04-2	2.61-8	2.5-1.9	2.00	5.0-0.3	2.80-9	0.7-0.3	1.9-0.9	-1.53-5	2.30-2	-1.20	0.14-9	1.53-9	-1.45-1	0.13-2	2.55-2	7.86-3	5.47-1	3.95-1	9.31-0.9	7.21-1	7.86	3.87-3	8.81-9	
May	4.48	4.95-6	3.12-9	4.22-7	1.91-1	1.53-1	2.51-4	3.11	1.51-3	1.0-0.6	2.9-0.3	1.50-4	0.82-8	2.2-0.5	5.22-6	5.84-9	6.55-9	3.94-7	3.65-8	7.33-7	6.56-7	9.47	4.95-1	5.29-5	
Jun.	1.52-7	2.4-1.2	-0.42-6	-0.31-5	0.40-1	0.92-2	1.3-3.2	-0.21-5	0.13	0.5-2.4	0.01-2	0.71-1	0.62-2	4.31-9	6.21-5	4.72-1	5.83-7	2.1-4.1	3.03-1	3.70-1	8.07-7	7.15-3	2.94-1	0.53-1	
Jul.	2.43-7	6.10-2	-2.2-0.8	-1.6-1.9	-1.2-0.6	-1.5-1.6	-0.7-3.4	0.0-2	0.60-5	-0.7-0.3	-0.2-1.4	-0.2-1.5	0.61-4	2.50-5	1.23-9	3.87-8	6.25-5	3.85-4	4.45-2	3.02-1	6.89-7	8.25-7	4.36-1	3.81-7	
Aug.	-0.43-5	2.22-1	-1.60-8	-1.3-2.2	-1.5-0.6	-1.8-0.4	2.12-5	-0.3-0.6	0.6-0.4	-0.6-1.1	0.4-1.7	-1.8-1	0.43	2.45-2	2.73-3	1.81-8	6.04-4	1.41-5	2.13-6	3.57-5	5.61-0.6	7.84-1	0.94-4	8.64-5	
Sep.	-0.11	0.60-8	-1.3-1.2	-1.8-1.1	-0.9-0.9	3.11-5	-0.50	-0.81-2	0.93-5	-0.8-1	-0.30-5	0.42-9	3.01-0.8	-2.00-5	3.73-5	3.94-5	3.83-5	3.20-7	-0.33-6	7.37-9	6.24-4	11.21-4	-0.9-1	1.22-8	
Oct.	0.90	0.85	2.84	2.73-2	0.50-3	0.01-6	6.11-8	2.2-1.5	1.81	1.71-4	-0.7-1.7	1.2-0.2	1.0-0.9	1.81-7	3.06-9	4.20-2	2.27-7	-1.71-8	6.69-6	10.5-6.1	5.64-8	1.35-7	0.92-2	-0.12-8	
Nov.	1.47-4	4.26-5	3.52-1	4.76-5	1.91-6	2.33	1.34	1.3-0.3	-2.7-4.6	0.2-1.7	5.01	5.00	0.70	0.71-2	4.24-4	2.43-1	0.7-3.6	-0.9-0.2	6.95	7.95-5	-1.56-6	3.73-2	4.65-2	-0.12-5	
Dec.	ERCOT Methodologies for Determining Minimum Ancillary Service Requirements	8.41-1	2.22-1	1.84-7	1.90-5	2.31-1	2.8-1.1	1.30-7	1.42-1	3.50-7	-0.5-1.3	5.3-1	0.70-1.4	0.10-3	0.10-3	2.82-2	-3.1-0.1	0.62-5	3.90-9	8.95	6.85-1	4.02-3	3.92-2	3.1-0.9	5.45-4

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

### **Introduction**

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

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

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

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

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

### **Summary**

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

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

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

### **Procedure**

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

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

ERCOT 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. For On-Peak Hours (hours ending 7 through 22), ERCOT will also set a floor on the Non-Spin requirement equal to the capacity of the single largest contingency.

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

The ERCOT Operating Guides set the minimum RRS requirement at 2,300 MW for all hours under normal conditions. ERCOT will procure amounts of RRS that vary by hour of the day and by month. These RRS amounts will be published by month in six separate blocks covering four hour intervals. These amounts will be based on expected diurnal load and wind patterns for the month, will cover 70% of historic system inertia conditions for each block of hours for the month, and will use the equivalency ratio for RRS between Load Resources and Generation Resources to establish the conditions for each block of hours. The equivalency ratio will be used to establish the total reserves assuming the Day-Ahead Market (DAM) will use a one to one equivalency ratio and a 50% limit for Load Resources when procuring the RRS. ERCOT will procure additional 200 MW of RRS for each percent of Reserve Discount Factor (RDF) when ERCOT estimates RDF to be less than 1. This adjustment will only apply for those 4-hour blocks where the 85<sup>th</sup> percentile of weighted average temperature is greater than 95°F. RDFs are reviewed and adjusted based on the generators performance during an unannounced test. RRS amount will be published as a monthly requirement along with the equivalency ratio for each four hour block. 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 in the DAM for each hour of the year.

One type of Responsive Reserve is Interruptible Responsive Reserve. Interruptible Responsive Reserve is provided by Load Resources that are automatically interrupted when system frequency decreases to 59.7 Hz. The amount of RRS procured from these types of Resources during any given hour will be limited to 50% of the total RRS requirement for that hour. The ERCOT Protocols state, “[t]he amount of Resources on high-set under-frequency relays providing RRS will be limited to 50% of the total ERCOT RRS requirement. ERCOT may reduce this limit if it believes that this amount will have a negative impact on reliability or if this limit would require additional Regulation Service to be deployed.”

Self-arranged RRS used to fulfill a QSE’s RRS requirement will be limited to 50% from Load Resources excluding Controllable Load Resources.

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