



Item 9.2: 2018 Methodology for Determining Minimum Ancillary Service Requirements

Nitika Mago

Supervisor, Operations Analysis

Board of Directors Meeting

ERCOT Public

December 12, 2017

Background & Scope

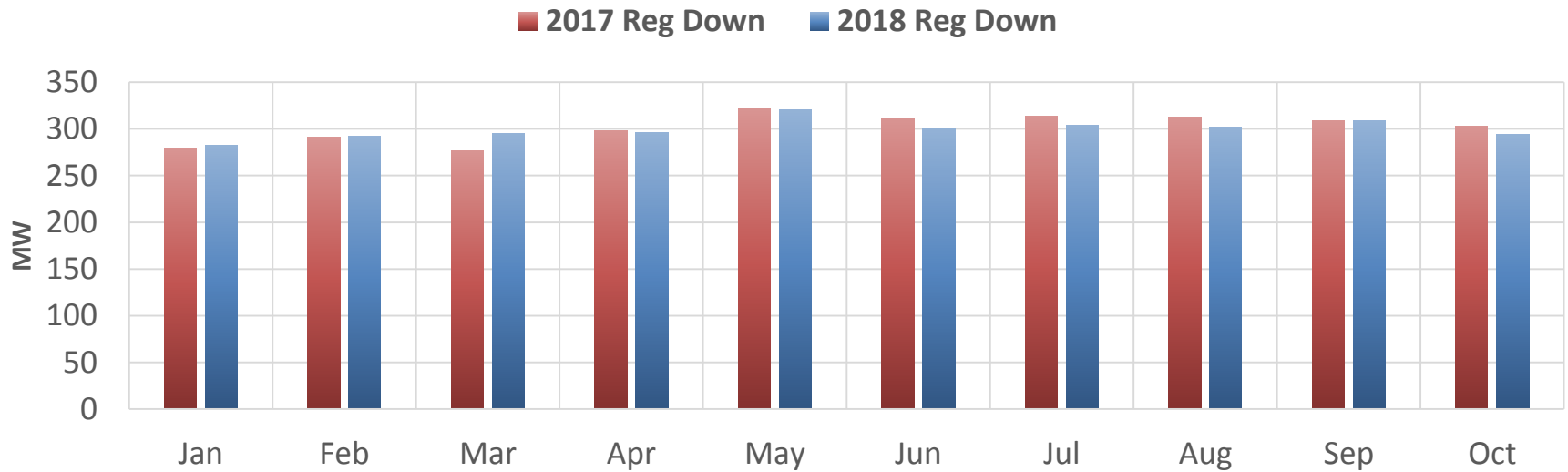
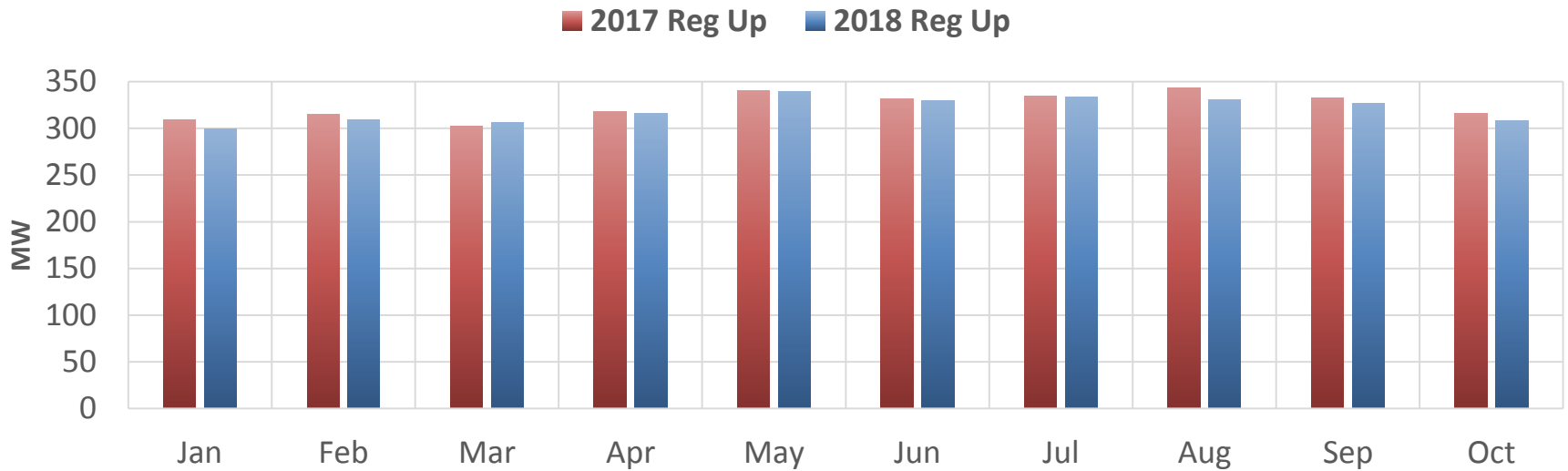
3.16 Standards for Determining Ancillary Service Quantities

- (2) ERCOT shall, **at least annually**, determine with supporting data, the methodology for determining the quantity requirements for each Ancillary Service needed for reliability...
 - (3) The ERCOT Board **shall review and approve** ERCOT's methodology for determining the minimum Ancillary Service requirements...
- ERCOT is not proposing any changes to the methodology for determining Regulation Service & Responsive Reserve quantities for 2018.
 - ERCOT is proposing changes to the methodology for determining Non-Spin Reserve for 2018.

Regulation Service Methodology – 2018

- The preliminary Regulation quantities for 2018 have been computed using current methodology (2016 and 2017 five-minute net load variability) and Wind Adjustment tables.
- The Wind Adjustment tables (previously called “GE Tables”) track incremental MWs of Regulation needed to account for additional variability per 1,000 MW increase in installed Wind capacity.
 - This table has been updated for 2018.

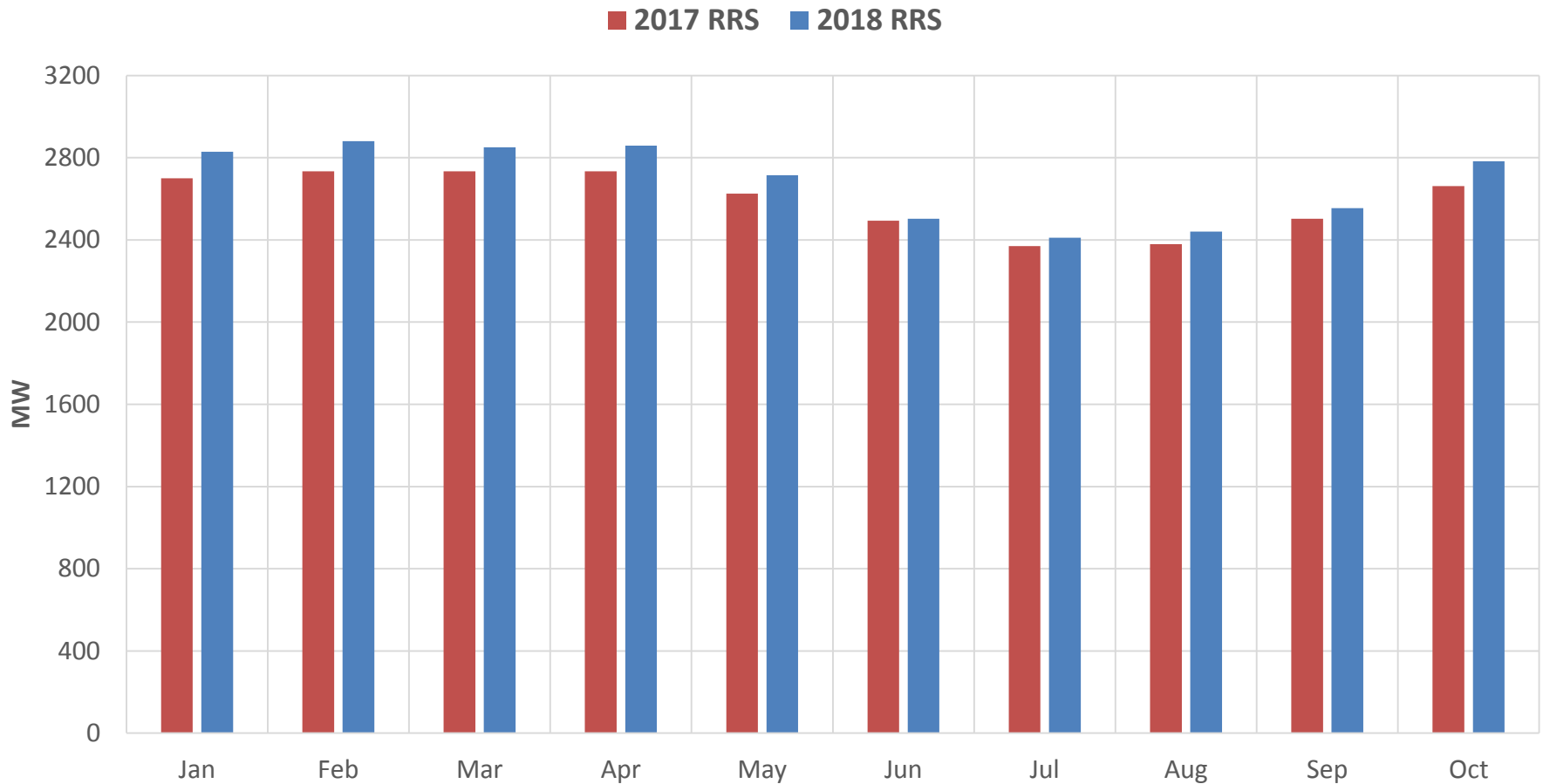
Hourly Average Regulation Comparison



Responsive Reserve Service (RRS) Methodology - 2018

- The preliminary RRS quantities for January 2018 thru October 2018 have been computed using current methodology (2016 and 2017 system inertia conditions) and updated RRS table.
 - The preliminary RRS quantities for 2018 do not reflect any potential impact of recent Notices of Suspension of Operations (NSOs).

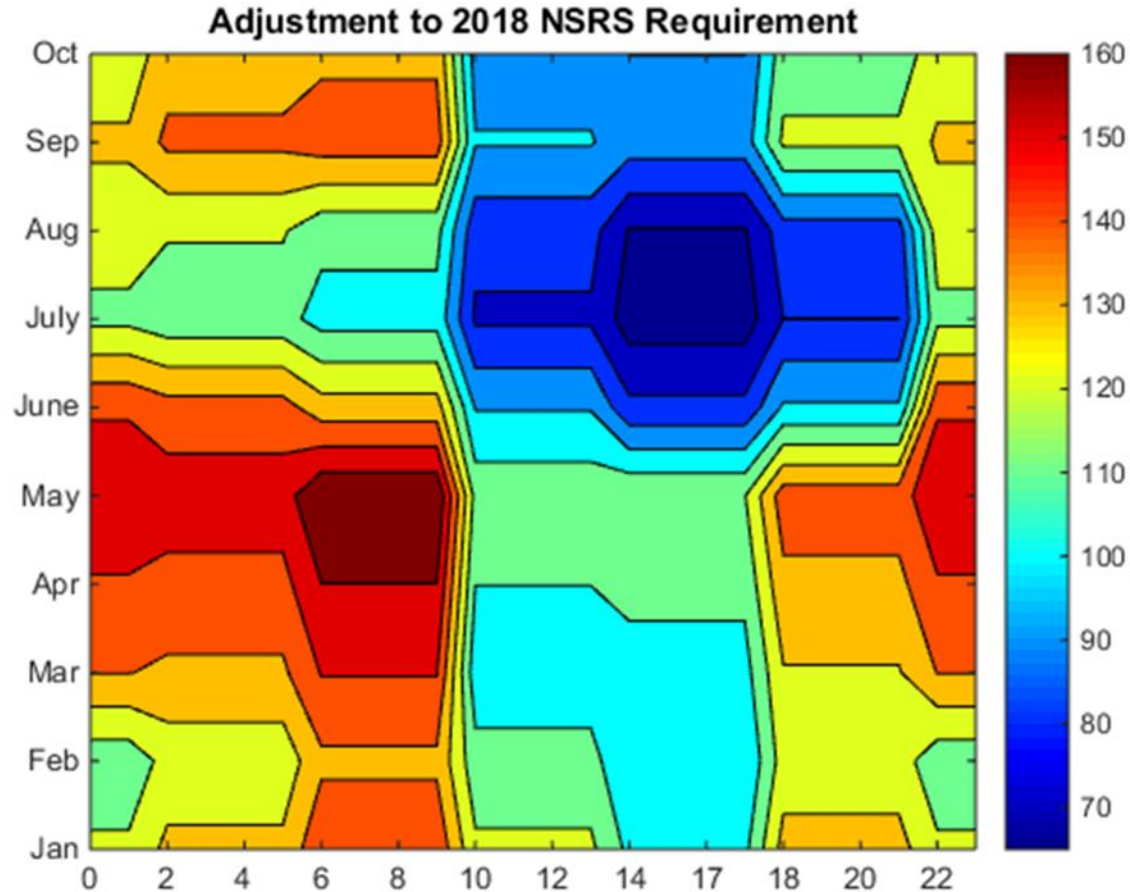
Hourly Average RRS Comparison



Non-Spinning Reserve Service (NSRS) Methodology - 2018

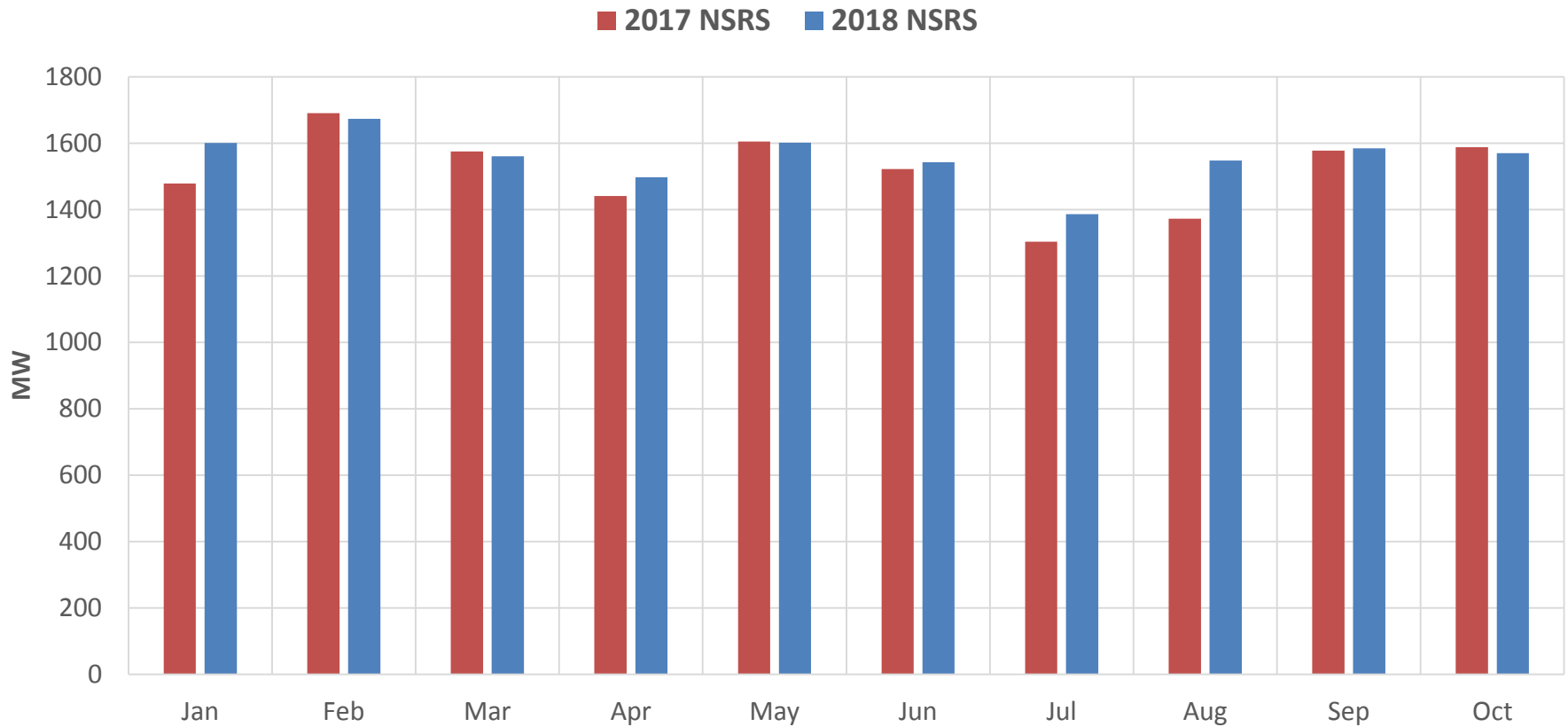
- ERCOT is proposing two changes to the Non-Spinning Reserve Service Methodology for 2018.
 1. Include solar generation and solar forecast in the calculations for Net Load and Net Load Forecast (i.e., include effects of solar in Net Load Forecast error & Net Load up-ramp risk calculation).
 2. Include an adjustment to account for additional over-forecast uncertainty from projected increase in installed wind capacity in 2018.
- The preliminary Non-Spin quantities for 2018 have been computed using the above changes to the current methodology (2015, 2016 and 2017 Net Load Forecast Error and risk of Net Load Ramp).

Adjustment to Non-Spin based on Wind Growth – 2018



Average hourly adjustment to Non-Spin Requirement = 121 MW

Hourly Avg. NSRS Comparison



Summary

- Following is a summary of the 2018 A/S Methodology,
 - ERCOT is not proposing any changes to the methodology for determining Regulation Service & Responsive Reserve quantities for 2018.
 - ERCOT is proposing two changes to the methodology for determining Non-Spinning Reserve Service for 2018.
- ERCOT is seeking ERCOT Board of Directors' (ERCOT Board's) approval of the 2018 Ancillary Service Methodology.



Date: December 5, 2017
To: Board of Directors
From: Nitika Mago, Supervisor of Operations Analysis
Subject: 2018 Methodology for Determining Minimum Ancillary Service Requirements

Issue for the ERCOT Board of Directors

ERCOT Board of Directors Meeting Date: December 12, 2017

Item No.: 9.2

Issue:

Whether the ERCOT Board of Directors (Board) should approve the proposed *Methodology for Determining the Minimum Ancillary Service Requirements* (2018 AS Methodology) as presented herein to be effective January 1, 2018.

Background/History:

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

ERCOT staff presented the 2017 Methodology for Determining Ancillary Services Requirements (2017 AS Methodology) to the Board on December 13, 2016, which the Board approved to be effective January 1, 2017 as requested.

The primary changes for the 2018 AS Methodology are related to the Non-Spinning Reserve Service (Non-Spin). No changes have been proposed for Regulation Service or Responsive Reserve Service (RRS). The changes 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 13, 2016.
 - Update Wind Adjustment tables that track incremental effect of actual increase in installed wind capacity in 2017 on Regulation Service quantities.
- Responsive Reserve Service:
 - No change, i.e., same methodology as approved on December 13, 2016.
 - Minimum RRS requirement in the AS Methodology ties to the minimum stated in the Operating Guides.
- Non-Spinning Reserve Service:
 - Update the net load and net load forecast error calculation to include solar generation and solar forecast, respectively.

- Include an adjustment to account for additional over-forecast uncertainty from projected increase in installed wind capacity.

The proposed 2018 AS Methodology will go into effect on January 1, 2018. Upon approval, the minimum AS quantities for 2018 will be determined using the 2018 AS Methodology and posted on the Market Information System (MIS) by December 20, 2017.

On November 30, 2017, the Technical Advisory Committee (TAC) unanimously endorsed the proposed 2018 AS Methodology, with an effective date of January 1, 2018.

In addition to the changes proposed in the 2018 AS Methodology as outlined above, the Board will also consider Nodal Protocol Revision Request (NPRR) 815, Revise the Limitation of Load Resources Providing Responsive Reserve (RRS) Service, at its meeting on December 12, 2017. If the Board approves NPRR815, additional changes to the AS Methodology will need to be made as outlined in the Board materials for Agenda Item 9.1.

Key Factors Influencing Issue:

The proposed changes to the Wind Adjustment tables used to add incremental amounts of Regulation Service quantities are based on actual wind generation data from 2017. This is a routine update that ERCOT makes annually based on the actual growth of installed wind generation.

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 and solar forecast in the net load and net load forecast calculations respectively will start capturing the impacts of these additional variable resources on the overall Non-Spinning Reserve Service requirements in 2018 and beyond.

ERCOT continues to see a steady growth in installed wind capacity from one year to the next. ERCOT has observed that increase in wind capacity also tends to increase the MW quantity of wind forecast error whose magnitude varies both by hour and by season. In the past, the Non-Spin methodology has solely relied on historical information to estimate Non-Spin quantities for future. This creates a possibility of under-estimating Non-Spinning Reserve Service quantities. To address the potential under-estimation of Non-Spin quantities, the 2018 AS Methodology proposes to create and use a Wind Forecast Adjustment table that tracks the incremental increase in Non-Spinning Reserve Service requirements needed due to projected increase in wind over-forecast error due to future growth in installed wind capacity.

These changes were proposed by ERCOT Staff and endorsed unanimously by the Reliability and Operations Subcommittee (ROS), Wholesale Market Subcommittee (WMS) and Technical Advisory Committee (TAC).

Conclusion/Recommendation:

ERCOT staff recommends that the Board approve the proposed *2018 Methodology for Determining the Minimum Ancillary Service Requirements*, attached as Attachment A, as endorsed by TAC, to be effective January 1, 2018.



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 2018 *ERCOT Methodologies for Determining Minimum Ancillary Service Requirements*, as set forth in Attachment A, as endorsed by the Technical Advisory Committee (TAC), to be effective on January 1, 2018;

THEREFORE, BE IT RESOLVED, that ERCOT is hereby authorized and approved to implement the 2018 *ERCOT Methodologies for Determining the Minimum Ancillary Service Requirements*, as set forth in Attachment A, as endorsed by TAC, to be effective on January 1, 2018.

CORPORATE SECRETARY'S CERTIFICATE

I, Vickie G. Leady, Assistant Corporate Secretary of ERCOT, do hereby certify that, at its December 12, 2017 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, 2017.

Vickie G. Leady
Assistant Corporate Secretary

ERCOT Methodologies for Determining Minimum Ancillary Service Requirements

ERCOT Board approved ~~TBD~~12/13/2016

Effective Date of 01/01/2018~~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 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 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 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 penetration, ERCOT will calculate the increase in installed wind generation capacity. Then, depending on the month of the year and the hour of the day, ERCOT will add incremental MWs to the maximum values determined above. The tables of incremental MWs for Reg-Up and Reg-Down come from the study ERCOT performs annually, using similar techniques as the 2008 GE wind study, but using actual wind data. The increase in wind capacity will be calculated by taking the total nameplate capacity of wind resources in the ERCOT network model at the time of the procurement study and subtracting out the total nameplate capacity of wind resources in the ERCOT model at the end of the month being studied from the previous year.

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

If any incremental changes to the annually posted amounts are needed then the revised amounts for the following month will be posted to the MIS prior to the 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>5.65</u> - <u>6</u>	<u>2.12</u> - <u>14</u>	<u>4.34</u> - <u>3</u>	<u>5.75</u> - <u>73</u>	<u>4.43</u> - <u>4</u>	<u>2.42</u> - <u>4</u>	<u>-0.2</u> - <u>0.2</u>	<u>0.70</u> - <u>7</u>	<u>4.34</u> - <u>3</u>	<u>3.43</u> - <u>4</u>	<u>1.71</u> - <u>74</u>	<u>4.34</u> - <u>3</u>	<u>2.42</u> - <u>4</u>	<u>2.42</u> - <u>4</u>	<u>3.23</u> - <u>2</u>	<u>1.31</u> - <u>3</u>	<u>4.04</u> - <u>0</u>	<u>0.40</u> - <u>4</u>	<u>0.50</u> - <u>5</u>	<u>2.52</u> - <u>5</u>	<u>2.02</u> - <u>0</u>	<u>1.21</u> - <u>2</u>	<u>1.21</u> - <u>2</u>	<u>5.85</u> - <u>8</u>
Feb.	<u>3.33</u> - <u>3</u>	<u>3.32</u> - <u>9</u>	<u>3.83</u> - <u>0</u>	<u>3.83</u> - <u>1</u>	<u>2.22</u> - <u>0</u>	<u>0.8</u> - <u>0.3</u>	<u>0.2</u> - <u>0.3</u>	<u>4.94</u> - <u>89</u>	<u>9.11</u> - <u>2.7</u>	<u>6.66</u> - <u>5</u>	<u>3.83</u> - <u>8</u>	<u>3.43</u> - <u>1</u>	<u>3.23</u> - <u>5</u>	<u>3.42</u> - <u>5</u>	<u>3.43</u> - <u>0</u>	<u>2.31</u> - <u>5</u>	<u>4.34</u> - <u>4</u>	<u>4.25</u> - <u>8</u>	<u>1.71</u> - <u>5</u>	<u>0.3</u> - <u>1.0</u>	<u>0.60</u> - <u>3</u>	<u>0.1</u> - <u>0.3</u>	<u>0.90</u> - <u>5</u>	<u>3.23</u> - <u>2</u>
Mar.	<u>4.54</u> - <u>5</u>	<u>5.76</u> - <u>1</u>	<u>6.97</u> - <u>8</u>	<u>6.47</u> - <u>5</u>	<u>4.53</u> - <u>6</u>	<u>2.93</u> - <u>6</u>	<u>0.9</u> - <u>1.6</u>	<u>5.77</u> - <u>4</u>	<u>7.06</u> - <u>1</u>	<u>6.17</u> - <u>14</u>	<u>4.74</u> - <u>4</u>	<u>3.93</u> - <u>4</u>	<u>4.14</u> - <u>0</u>	<u>5.97</u> - <u>9</u>	<u>6.28</u> - <u>0</u>	<u>4.04</u> - <u>0</u>	<u>4.55</u> - <u>2</u>	<u>4.64</u> - <u>3</u>	<u>2.32</u> - <u>2</u>	<u>1.81</u> - <u>9</u>	<u>2.13</u> - <u>1</u>	<u>0.90</u> - <u>3</u>	<u>1.21</u> - <u>3</u>	<u>4.14</u> - <u>1</u>
Apr.	<u>4.94</u> - <u>9</u>	<u>6.25</u> - <u>8</u>	<u>7.16</u> - <u>9</u>	<u>7.06</u> - <u>4</u>	<u>7.58</u> - <u>5</u>	<u>5.66</u> - <u>9</u>	<u>3.82</u> - <u>8</u>	<u>6.17</u> - <u>1</u>	<u>4.54</u> - <u>3</u>	<u>4.73</u> - <u>6</u>	<u>5.25</u> - <u>4</u>	<u>5.26</u> - <u>3</u>	<u>3.12</u> - <u>2</u>	<u>2.71</u> - <u>2</u>	<u>3.12</u> - <u>9</u>	<u>1.61</u> - <u>2</u>	<u>2.82</u> - <u>0</u>	<u>4.35</u> - <u>9</u>	<u>2.91</u> - <u>6</u>	<u>2.92</u> - <u>6</u>	<u>2.21</u> - <u>6</u>	<u>1.32</u> - <u>1</u>	<u>1.1</u> - <u>0.8</u>	<u>5.45</u> - <u>4</u>
May	<u>11.81</u> - <u>18</u>	<u>8.48</u> - <u>9</u>	<u>7.88</u> - <u>9</u>	<u>7.57</u> - <u>9</u>	<u>7.48</u> - <u>8</u>	<u>4.32</u> - <u>2</u>	<u>5.56</u> - <u>3</u>	<u>5.86</u> - <u>1</u>	<u>3.41</u> - <u>8</u>	<u>5.56</u> - <u>6</u>	<u>5.55</u> - <u>6</u>	<u>5.05</u> - <u>0</u>	<u>3.74</u> - <u>6</u>	<u>2.93</u> - <u>6</u>	<u>2.22</u> - <u>9</u>	<u>0.6</u> - <u>1.0</u>	<u>1.72</u> - <u>0</u>	<u>3.42</u> - <u>4</u>	<u>4.85</u> - <u>8</u>	<u>5.47</u> - <u>1</u>	<u>2.73</u> - <u>1</u>	<u>1.40</u> - <u>7</u>	<u>2.73</u> - <u>2</u>	<u>8.58</u> - <u>5</u>
Jun.	<u>2.22</u> - <u>2</u>	<u>4.65</u> - <u>14</u>	<u>4.33</u> - <u>5</u>	<u>4.74</u> - <u>6</u>	<u>5.15</u> - <u>14</u>	<u>4.13</u> - <u>9</u>	<u>7.37</u> - <u>6</u>	<u>6.76</u> - <u>9</u>	<u>4.03</u> - <u>3</u>	<u>5.56</u> - <u>4</u>	<u>5.04</u> - <u>8</u>	<u>3.73</u> - <u>6</u>	<u>1.60</u> - <u>5</u>	<u>0.80</u> - <u>2</u>	<u>0.60</u> - <u>3</u>	<u>1.62</u> - <u>6</u>	<u>2.32</u> - <u>1</u>	<u>3.34</u> - <u>1</u>	<u>3.63</u> - <u>8</u>	<u>3.12</u> - <u>8</u>	<u>0.90</u> - <u>3</u>	<u>0.0</u> - <u>0.4</u>	<u>1.80</u> - <u>9</u>	<u>6.26</u> - <u>2</u>
Jul.	<u>1.81</u> - <u>8</u>	<u>2.52</u> - <u>1</u>	<u>2.72</u> - <u>4</u>	<u>3.02</u> - <u>7</u>	<u>3.43</u> - <u>2</u>	<u>3.92</u> - <u>0</u>	<u>8.61</u> - <u>0.8</u>	<u>7.98</u> - <u>9</u>	<u>4.13</u> - <u>8</u>	<u>4.23</u> - <u>44</u>	<u>4.75</u> - <u>04</u>	<u>4.14</u> - <u>7</u>	<u>1.92</u> - <u>10</u>	<u>2.08</u> - <u>2.2</u>	<u>-0.8</u> - <u>2.2</u>	<u>0.80</u> - <u>7</u>	<u>1.31</u> - <u>6</u>	<u>1.71</u> - <u>5</u>	<u>1.81</u> - <u>1</u>	<u>1.72</u> - <u>10</u>	<u>0.60</u> - <u>5</u>	<u>0.20</u> - <u>0</u>	<u>1.11</u> - <u>7</u>	<u>1.21</u> - <u>2</u>
Aug.	<u>3.43</u> - <u>4</u>	<u>2.52</u> - <u>5</u>	<u>3.23</u> - <u>6</u>	<u>2.92</u> - <u>8</u>	<u>4.24</u> - <u>8</u>	<u>4.24</u> - <u>8</u>	<u>6.56</u> - <u>9</u>	<u>6.46</u> - <u>3</u>	<u>3.62</u> - <u>1</u>	<u>4.35</u> - <u>14</u>	<u>4.44</u> - <u>3</u>	<u>3.43</u> - <u>5</u>	<u>1.50</u> - <u>9</u>	<u>0.0</u> - <u>1.4</u>	<u>0.30</u> - <u>8</u>	<u>1.01</u> - <u>9</u>	<u>0.70</u> - <u>0</u>	<u>1.10</u> - <u>6</u>	<u>1.52</u> - <u>4</u>	<u>1.40</u> - <u>8</u>	<u>0.60</u> - <u>1</u>	<u>0.1</u> - <u>0.1</u>	<u>0.60</u> - <u>5</u>	<u>0.50</u> - <u>5</u>
Sep.	<u>1.84</u> - <u>4</u>	<u>1.52</u> - <u>9</u>	<u>2.62</u> - <u>3</u>	<u>2.33</u> - <u>8</u>	<u>3.43</u> - <u>8</u>	<u>2.34</u> - <u>3</u>	<u>3.75</u> - <u>4</u>	<u>6.95</u> - <u>9</u>	<u>5.30</u> - <u>0</u>	<u>4.15</u> - <u>8</u>	<u>3.95</u> - <u>2</u>	<u>3.52</u> - <u>7</u>	<u>3.00</u> - <u>6</u>	<u>1.80</u> - <u>1</u>	<u>0.91</u> - <u>0</u>	<u>0.30</u> - <u>3</u>	<u>1.11</u> - <u>7</u>	<u>1.60</u> - <u>6</u>	<u>1.0</u> - <u>4.8</u>	<u>1.8</u> - <u>1.5</u>	<u>1.90</u> - <u>3</u>	<u>0.80</u> - <u>3</u>	<u>0.61</u> - <u>0</u>	<u>1.61</u> - <u>8</u>
Oct.	<u>2.32</u> - <u>6</u>	<u>0.85</u> - <u>7</u>	<u>2.45</u> - <u>7</u>	<u>3.16</u> - <u>3</u>	<u>3.75</u> - <u>9</u>	<u>2.31</u> - <u>9</u>	<u>2.13</u> - <u>9</u>	<u>6.27</u> - <u>4</u>	<u>6.26</u> - <u>8</u>	<u>3.6</u> - <u>2.4</u>	<u>3.62</u> - <u>2</u>	<u>3.7</u> - <u>0.1</u>	<u>2.21</u> - <u>0</u>	<u>1.1</u> - <u>1.8</u>	<u>1.3</u> - <u>0.4</u>	<u>1.40</u> - <u>2</u>	<u>1.21</u> - <u>9</u>	<u>0.52</u> - <u>7</u>	<u>0.50</u> - <u>8</u>	<u>0.71</u> - <u>10</u>	<u>0.00</u> - <u>1</u>	<u>0.5</u> - <u>0.2</u>	<u>0.41</u> - <u>0</u>	<u>2.91</u> - <u>0</u>
Nov.	<u>3.41</u> - <u>9</u>	<u>2.45</u> - <u>6</u>	<u>3.61</u> - <u>3</u>	<u>3.40</u> - <u>9</u>	<u>3.33</u> - <u>1</u>	<u>2.81</u> - <u>1</u>	<u>0.8</u> - <u>0.6</u>	<u>4.72</u> - <u>8</u>	<u>5.54</u> - <u>5</u>	<u>4.14</u> - <u>23</u>	<u>3.95</u> - <u>5</u>	<u>4.13</u> - <u>7</u>	<u>2.22</u> - <u>7</u>	<u>1.23</u> - <u>4</u>	<u>2.14</u> - <u>4</u>	<u>2.92</u> - <u>6</u>	<u>3.26</u> - <u>6</u>	<u>1.14</u> - <u>2</u>	<u>0.11</u> - <u>5</u>	<u>0.11</u> - <u>3</u>	<u>0.01</u> - <u>7</u>	<u>0.70</u> - <u>8</u>	<u>0.43</u> - <u>8</u>	<u>2.61</u> - <u>2</u>
Dec.	<u>3.04</u> - <u>4</u>	<u>3.15</u> - <u>23</u>	<u>3.63</u> - <u>24</u>	<u>4.82</u> - <u>9</u>	<u>2.61</u> - <u>3</u>	<u>2.63</u> - <u>6</u>	<u>0.10</u> - <u>0</u>	<u>5.62</u> - <u>3</u>	<u>2.14</u> - <u>8</u>	<u>6.55</u> - <u>84</u>	<u>4.35</u> - <u>9</u>	<u>4.6</u> - <u>1.9</u>	<u>7.53</u> - <u>24</u>	<u>4.53</u> - <u>6</u>	<u>4.34</u> - <u>11</u>	<u>1.62</u> - <u>5</u>	<u>1.25</u> - <u>8</u>	<u>1.61</u> - <u>2</u>	<u>0.43</u> - <u>3</u>	<u>0.42</u> - <u>4</u>	<u>0.41</u> - <u>7</u>	<u>2.60</u> - <u>6</u>	<u>1.00</u> - <u>8</u>	<u>0.21</u> - <u>4</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.	3.73 3.73	3.33 3	1.51 1.51	-0.8 0.8	0.90 0.9	1.91 1.9	-0.3 0.3	-2.0 2.0	-3.5 3.5	-3.3 3.3	1.21 1.2	2.12 2.1	0.50 5	-0.8 0.8	-0.4 0.4	-0.3 0.3	0.50 5	1.81 8	5.85 8	4.54 5	4.64 6	3.03 0	0.50 .5	4.24 2
Feb.	4.34 4	2.11 4	1.70 7	4.27 1	3.43 9	3.32 9	2.94 4	1.01 4	-0.7 3.2	3.06 2	3.54 5	2.01 0	3.34 3	2.63 6	2.32 8	2.33 3	1.92 4	1.80 1	5.98 3	6.66 7	7.18 5	6.06 6	5.36 .5	4.14 1
Mar.	3.33 3	2.42 7	1.51 0	2.21 7	2.20 7	3.24 5	2.41 5	2.73 4	1.52 9	2.31 4	1.41 3	1.41 1	3.24 5	1.20 5	0.80 6	1.30 6	2.31 3	1.91 9	2.81 0	4.94 4	5.45 0	4.73 2	4.55 .2	1.71 7
Apr.	4.04 0	3.02 6	2.32 5	2.72 0	3.45 0	2.82 8	1.40 7	1.71 9	0.3 1.5	1.12 3	0.2 1.2	0.40 1	1.21 5	-0.2 1.4	0.90 1	3.02 5	5.97 8	4.95 4	4.43 9	7.59 3	7.27 2	6.97 8	5.23 .8	8.88 8
May	4.44 4	4.04 9	2.93 1	2.94 2	2.31 9	1.81 5	2.12 5	2.33 1	1.11 5	1.41 0	1.62 9	1.31 5	1.00 8	2.22 2	4.45 2	5.25 8	6.26 5	4.13 9	4.13 6	6.57 3	7.26 5	8.09 4	5.14 .9	5.25 2
Jun.	1.51 5	2.72 4	0.2 0.4	0.2 0.3	0.40 4	0.70 9	1.01 3	0.4 0.2	0.40 1	0.30 5	0.50 0	0.50 7	0.5 0.6	3.54 3	5.06 2	5.04 7	5.35 8	3.12 1	3.23 0	4.53 7	7.08 0	7.17 1	3.52 .9	0.50 5
Jul.	2.42 4	3.66 1	-0.8 2.2	-1.4 1.6	-1.1 1.2	-1.1 1.5	-0.1 0.7	- 0.10	0.30 6	-0.3 0.7	-0.2 0.2	-0.2 0.2	0.60 6	2.32 5	2.51 2	3.73 8	5.56 2	3.73 8	3.74 4	3.83 0	6.56 8	7.38 2	4.14 .3	3.83 8
Aug.	-0.4 0.4	1.52 2	-1.0 1.6	-1.0 1.3	-1.2 1.5	-1.1 1.8	- 0.62	-0.1 0.3	0.40 6	-0.2 0.6	- 0.00	-0.9 1.8	0.30 4	2.32 4	2.62 7	2.81 8	4.96 0	3.01 4	2.52 1	3.93 5	5.95 6	6.27 8	3.90 .9	8.68 6
Sep.	0.7 0.1	0.10 6	0.1 1.3	1.3 1.8	0.7 0.9	- 0.33	-0.3 0.5	-1.3 0.8	0.20 9	- 0.7	-0.8 0.3	0.6 0.4	0.03 0	2.2 2.0	3.13 7	3.13 9	5.33 8	4.63 2	4.5 0.3	6.07 3	6.26 2	5.01 2	4.2 0.9	- 0.31
Oct.	2.60 9	1.20 8	0.62 8	1.02 7	0.50 5	0.00 0	0.86 1	1.32 2	- 1.11	- 0.71	- 0.7	0.6 0.11	- 0.31	- 0.71	0.93 0	2.24 2	2.92 2	2.5 1.7	7.46 6	7.41 0.5	6.05 6	3.01 3	2.80 .9	2.9 0.1
Nov.	2.61 4	1.64 2	0.43 5	0.54 7	1.11 9	1.52 3	0.41 3	0.51 3	-1.9 2.7	-0.80 2	- 0.15	- 0.15	0.00 7	0.70 7	0.54 2	1.02 4	1.10 7	1.1 0.9	7.06 9	6.87 9	5.5 1.5	2.83 7	3.24 .6	2.7 0.1
Dec.	1.08 4	- 0.72	1.71 8	0.81 9	2.02 3	5.02 8	0.51 3	0.11 4	-2.1 3.5	-2.2 0.3	- 0.45	- 1.03	2.74 1	- 1.54	- 0.12	1.1 3.1	0.00 6	2.23 9	3.98 9	6.26 8	5.74 0	3.23 9	4.43 .1	0.35 4

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

Introduction

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

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

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

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

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

Summary

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

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

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

Procedure

ERCOT will determine the Non-Spin~~ning-reserve~~ requirement using the 70th 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 ~~WGR-IRR~~ High Sustained Limits (HSLs) in the Current Operating Plans (COPs) from the Mid-Term Load Forecast (MTLF). The COPs and MTLF used are the updated values as of three hours prior to each Operating Hour. The net load uncertainty is then defined as the difference between the net load and the forecasted net load.

The risk of net load ramp is determined based on the change in net load over an hour divided by highest observed net load for the season. The fixed value of percentile ranging between 70th 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 compared to 70th percentile for periods with lowest risks.

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

To address this, ERCOT will include the impact of increase in over-forecast error from the expected growth in wind generation installed capacity into the future Non-Spin requirement. The net impact is calculated by a multiplication of the projected wind capacity growth between the same month of current year and the next year, and incremental MW adjustment to Non-Spin value per 1000 MW of incremental wind generation capacity. The incremental MW adjustment to the Non-Spin value per 1000 MW is calculated as the change in 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 table below reflects the additional Non-Spin adjustments per 1000 MW of installed wind capacity.

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

Incremental MW Adjustment to Non-Spinning Reserve Service, per 1000 MW of Incremental Wind Generation Capacity

Hour Ending																								
Month	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>	<u>8</u>	<u>9</u>	<u>10</u>	<u>11</u>	<u>12</u>	<u>13</u>	<u>14</u>	<u>15</u>	<u>16</u>	<u>17</u>	<u>18</u>	<u>19</u>	<u>20</u>	<u>21</u>	<u>22</u>	<u>23</u>	<u>24</u>
<u>Jan.</u>	<u>41</u>	<u>41</u>	<u>45</u>	<u>45</u>	<u>45</u>	<u>45</u>	<u>50</u>	<u>50</u>	<u>50</u>	<u>50</u>	<u>42</u>	<u>42</u>	<u>42</u>	<u>42</u>	<u>37</u>	<u>37</u>	<u>37</u>	<u>37</u>	<u>46</u>	<u>46</u>	<u>46</u>	<u>46</u>	<u>41</u>	<u>41</u>
<u>Feb.</u>	<u>41</u>	<u>41</u>	<u>45</u>	<u>45</u>	<u>45</u>	<u>45</u>	<u>50</u>	<u>50</u>	<u>50</u>	<u>50</u>	<u>42</u>	<u>42</u>	<u>42</u>	<u>42</u>	<u>37</u>	<u>37</u>	<u>37</u>	<u>37</u>	<u>46</u>	<u>46</u>	<u>46</u>	<u>46</u>	<u>41</u>	<u>41</u>
<u>Mar.</u>	<u>54</u>	<u>54</u>	<u>54</u>	<u>54</u>	<u>54</u>	<u>54</u>	<u>58</u>	<u>58</u>	<u>58</u>	<u>58</u>	<u>40</u>	<u>40</u>	<u>40</u>	<u>40</u>	<u>41</u>	<u>41</u>	<u>41</u>	<u>41</u>	<u>50</u>	<u>50</u>	<u>50</u>	<u>50</u>	<u>54</u>	<u>54</u>
<u>Apr.</u>	<u>54</u>	<u>54</u>	<u>54</u>	<u>54</u>	<u>54</u>	<u>54</u>	<u>58</u>	<u>58</u>	<u>58</u>	<u>58</u>	<u>40</u>	<u>40</u>	<u>40</u>	<u>40</u>	<u>41</u>	<u>41</u>	<u>41</u>	<u>41</u>	<u>50</u>	<u>50</u>	<u>50</u>	<u>50</u>	<u>54</u>	<u>54</u>
<u>May</u>	<u>54</u>	<u>54</u>	<u>54</u>	<u>54</u>	<u>54</u>	<u>54</u>	<u>58</u>	<u>58</u>	<u>58</u>	<u>58</u>	<u>40</u>	<u>40</u>	<u>40</u>	<u>40</u>	<u>41</u>	<u>41</u>	<u>41</u>	<u>41</u>	<u>50</u>	<u>50</u>	<u>50</u>	<u>50</u>	<u>54</u>	<u>54</u>
<u>Jun.</u>	<u>51</u>	<u>51</u>	<u>50</u>	<u>50</u>	<u>50</u>	<u>50</u>	<u>46</u>	<u>46</u>	<u>46</u>	<u>46</u>	<u>34</u>	<u>34</u>	<u>34</u>	<u>34</u>	<u>28</u>	<u>28</u>	<u>28</u>	<u>28</u>	<u>35</u>	<u>35</u>	<u>35</u>	<u>35</u>	<u>51</u>	<u>51</u>
<u>Jul.</u>	<u>51</u>	<u>51</u>	<u>50</u>	<u>50</u>	<u>50</u>	<u>50</u>	<u>46</u>	<u>46</u>	<u>46</u>	<u>46</u>	<u>34</u>	<u>34</u>	<u>34</u>	<u>34</u>	<u>28</u>	<u>28</u>	<u>28</u>	<u>28</u>	<u>35</u>	<u>35</u>	<u>35</u>	<u>35</u>	<u>51</u>	<u>51</u>
<u>Aug.</u>	<u>51</u>	<u>51</u>	<u>50</u>	<u>50</u>	<u>50</u>	<u>50</u>	<u>46</u>	<u>46</u>	<u>46</u>	<u>46</u>	<u>34</u>	<u>34</u>	<u>34</u>	<u>34</u>	<u>28</u>	<u>28</u>	<u>28</u>	<u>28</u>	<u>35</u>	<u>35</u>	<u>35</u>	<u>35</u>	<u>51</u>	<u>51</u>
<u>Sep.</u>	<u>46</u>	<u>46</u>	<u>49</u>	<u>49</u>	<u>49</u>	<u>49</u>	<u>50</u>	<u>50</u>	<u>50</u>	<u>50</u>	<u>35</u>	<u>35</u>	<u>35</u>	<u>35</u>	<u>33</u>	<u>33</u>	<u>33</u>	<u>33</u>	<u>42</u>	<u>42</u>	<u>42</u>	<u>42</u>	<u>46</u>	<u>46</u>
<u>Oct.</u>	<u>46</u>	<u>46</u>	<u>49</u>	<u>49</u>	<u>49</u>	<u>49</u>	<u>50</u>	<u>50</u>	<u>50</u>	<u>50</u>	<u>35</u>	<u>35</u>	<u>35</u>	<u>35</u>	<u>33</u>	<u>33</u>	<u>33</u>	<u>33</u>	<u>42</u>	<u>42</u>	<u>42</u>	<u>42</u>	<u>46</u>	<u>46</u>
<u>Nov.</u>																								
<u>Dec.</u>																								

Responsive Reserve ~~Service~~ (RRS) Requirement Details

Operating Guide Section 2.3.1.1, Obligation, ~~The ERCOT Operating Guides~~ sets 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 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 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.