Item 6: 2015 Methodology for Determining Minimum Ancillary Service Requirements

Dan Woodfin
Director, System Operations

Board of Directors Meeting
ERCOT Public
December 9, 2014

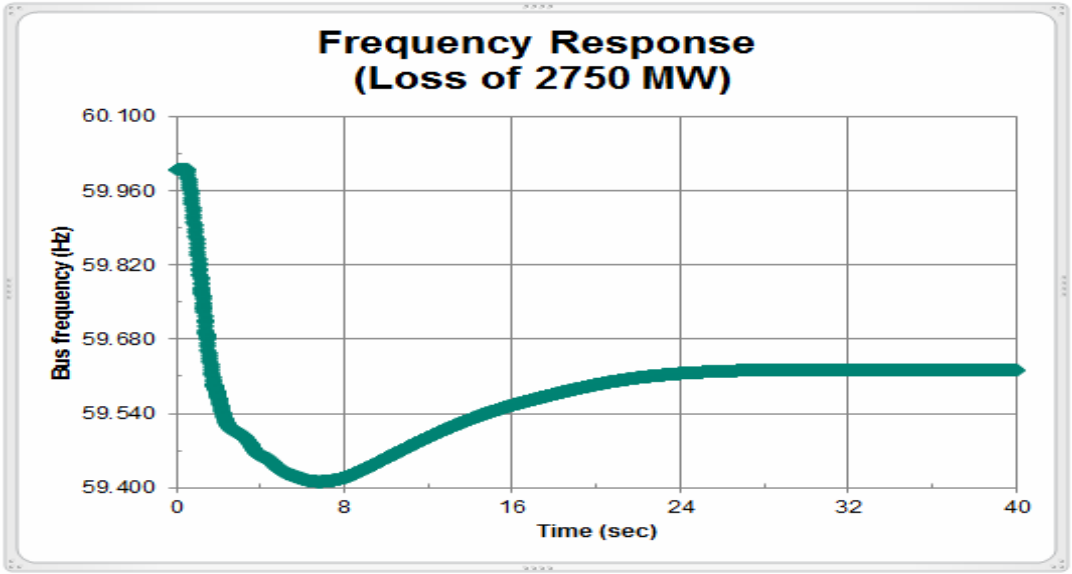
Annual AS Methodology Update

- 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

- Changes for 2015 to:
  - Responsive Reserve Service (RRS)
  - Non-Spin Reserve Service (NSRS)
  - Regulation Service

Background on RRS Requirements

- To meet new NERC BAL-003-1 requirements that are effective in early 2016, ERCOT will need to protect against underfrequency load shed (UFLS) for the simultaneous loss of two largest units (currently 2750 MW)
  - ERCOT would like to modify the A/S Methodology meet this standard in mid 2015 in order to get operating experience and resolve any issues before the standard becomes effective
- ERCOT has performed a set of simulations to study the level of RRS that is required to meet this standard under a range of potential system conditions



Summary of RRS Studies

- The amount of RRS that is needed changes depending on the amount of synchronous generation (inertia) that is committed
  - The amount of RRS needed during low inertia periods is higher than the amount currently procured but lower than the amount currently procured in high inertia periods
- During low inertia periods, RRS from Load Resources (LRs) is more effective per MW than from generation
  - "Equivalency Ratio" is 1:1 for higher inertia periods

To prepare to meet the BAL-003-1 standard, ERCOT proposed several options to implement a revised methodology for RRS based on these studies; these options were honed through QMWG, ROS, WMS and TAC to produce the TAC recommendation

RRS – Recommendation

- Once annually, ERCOT will calculate and post amounts of RRS to be procured for each hour of the year
- The calculated quantities of RRS to be procured are based on:
  - Historic system inertia conditions based on expected load and wind patterns
  - LRs providing 50% of RRS
  - Using the Equivalency Ratio between RRS from generation and load
  - Generating Resources providing capacity that is frequency-responsive
- No portion of the calculated NSRS requirement will be procured through RRS

Calculated RRS Quantities for Example Months

January - 2015

HE	Total RRS MW	Based on 20% HSL limit and:		
		PFRS	LRs	Equivalency Ratio
22-02	2808	1404	1404	1.40
03-06	3002	1501	1501	1.50
07-10	2808	1404	1404	1.40
11-14	2808	1404	1404	1.40
15-18	2808	1404	1404	1.40
19-22	2808	1404	1404	1.40

April - 2015

HE	Total RRS MW	Based on 20% HSL limit and:		
		PFRS	LRs	Equivalency Ratio
22-02	3002	1501	1501	1.50
03-06	3132	1566	1566	2.00
07-10	2808	1404	1404	1.40
11-14	2808	1404	1404	1.40
15-18	2808	1404	1404	1.40
19-22	2808	1404	1404	1.40

August - 2015

HE	Total RRS MW	Based on 20% HSL limit and:		
		PFRS	LRs	Equivalency Ratio
22-02	2702	1351	1351	1.25
03-06	2702	1351	1351	1.25
07-10	2702	1351	1351	1.25
11-14	2538	1269	1269	1.08
15-18	2300	1150	1150	1.00
19-22	2538	1269	1269	1.08

October - 2015

HE	Total RRS MW	Based on 20% HSL limit and:		
		PFRS	LRs	Equivalency Ratio
22-02	3002	1501	1501	1.50
03-06	3002	1501	1501	1.50
07-10	2808	1404	1404	1.40
11-14	2696	1348	1348	1.30
15-18	2696	1348	1348	1.30
19-22	2696	1348	1348	1.30

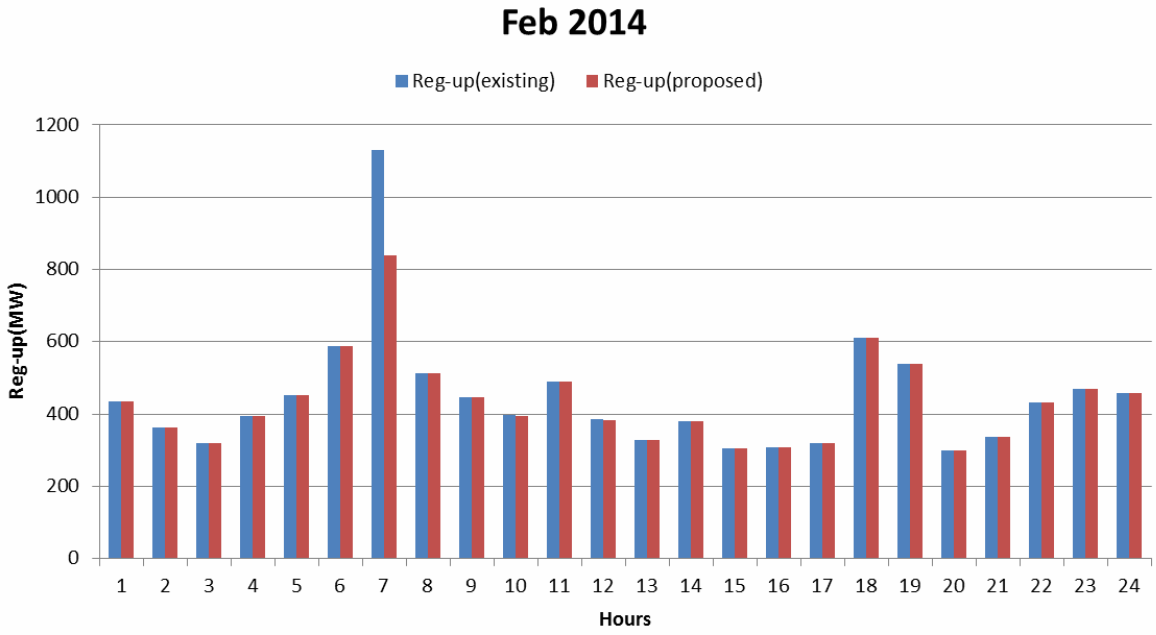
Non Spin Reserve Service - Recommended Changes

- Remove transfer of 500 MW of calculated NSRS requirement to RRS
  - Procure the calculated NSRS amount as NSRS

TAC also requested ERCOT to review the basis for determining NSRS requirement prior to 2016

Regulation – Recommended Changes

1. Annual update to the factors used to adjust the Regulation Service quantities for additional installed wind generation since June 2013
   - Added approximately 988 MW of Wind since last analyses
2. Reg-Up quantities calculated based on Reg-Up use only, excluding the use of other Ancillary Services during abnormal events, e.g., February 2014



Implementation Dates

- 2015 AS Methodology will be effective January 1, 2015
  - Regulation changes will be implemented January 1, 2015
  - RRS and Non-Spin changes will be implemented June 1, 2015

Date: December 2, 2014
To: Board of Directors
From: Dan Woodfin, ERCOT Director of System Operations
Subject: 2015 Methodology for Determining Minimum Ancillary Service Requirements

Issue for the ERCOT Board of Directors

ERCOT Board of Directors Meeting Date: December 9, 2014
Item No.: 6

Issue:
Whether the ERCOT Board of Directors (Board) should approve the proposed *ERCOT Methodologies for Determining Ancillary Service Requirements* (AS Methodology) as presented herein to be effective January 1, 2015.

Background/History:
Ancillary Services are necessary to maintain the reliability of the ERCOT system. The ERCOT Nodal 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 ERCOT Board of Directors to review and approve ERCOT's methodology.

ERCOT staff presented the 2014 AS Methodology to the Board on December 3, 2013, which the Board approved to be effective February 1, 2014 as requested.

The primary changes for the 2015 AS Methodology are related to the Responsive Reserve Service (RRS), but changes are also proposed to Regulation Service and Non-Spinning Reserve Service (NSRS). The changes are shown in red-line in Attachment A and can be summarized as follows:

- Responsive Reserve Service:
  - Rather than procuring a constant amount of RRS for every hour of the year, ERCOT will calculate and post varying amounts of RRS to be procured for each hour of the year.
    - Quantities will be determined for six 4-hour blocks for each month and are the fixed minimum values that will be procured in the day-ahead market for each hour of the next day.
    - These quantities will be posted annually for 2015 as illustrated in Attachment B.
  - The quantities of RRS included in Attachment B were determined based on:
    - Covering 70% of historic system inertia conditions based on expected diurnal load and wind patterns for the month for those hours;
    - An assumption that 50% of RRS requirement will be met by Load Resources and the appropriate Equivalency Ratio for the expected conditions for that hour will be used; and,
    - Generating Resources will be limited to providing no more than 20% of their High Sustained Limit (HSL) into RRS (pursuant to Nodal Protocol Revision Request (NPRR) 669, Maintaining Frequency Responsiveness

from Generation Resources Providing RRS, which is pending stakeholder consideration).
    - Load Resources remain limited to providing a maximum of 50% of RRS.
    - The portion (500 MW) of the calculated NSRS requirement that was being procured through RRS will no longer be procured through RRS, but will remain in NSRS.
- Non Spinning Reserve Service:
    - The portion (500 MW) of the calculated NSRS requirement that was being procured through RRS will no longer be procured through RRS, but will remain in NSRS.
- Regulation Service:
    - Update the factors used to adjust the Regulation Service quantities for additional installed wind generation.
    - Remove RRS schedule release as an input to the Regulation Up Service (Reg-Up) procurement.

Under the proposed 2015 AS Methodology, the proposed changes for Regulation Service would go into effect on January 1, 2015, but the proposed changes to RRS and NSRS would not go into effect until June 1, 2015. For January through May of 2015, the required quantities of RRS and NSRS would be calculated in the same manner as in the 2014 AS Methodology.

On October 23, 2014, the Technical Advisory Committee (TAC) unanimously endorsed the proposed 2015 AS Methodology, as modified by TAC, with an effective date of January 1, 2015. TAC also requested that ERCOT review the basis used for determining the NSRS requirements prior to approval of the 2016 AS Methodology.

Key Factors Influencing Issue:

On January 16, 2014, FERC approved NERC Reliability Standard BAL-003-1, Frequency Response and Frequency Bias Setting. Requirement R1 of this standard obligates ERCOT to maintain an Interconnection Frequency Response that is based on maintaining system frequency above the level that would not cause under-frequency load-shed due to the two largest units (a total of 2750 MW) tripping offline simultaneously. ERCOT performed multiple simulations to determine the level of frequency-responsive Resources that would be necessary to meet this performance obligation under a variety of system conditions. ERCOT proposed several options to implement a revised methodology for determining RRS requirements based on these simulations and recommended that the revised methodology be implemented during 2015 in order to provide sufficient operating experience prior to 2016 when the relevant BAL-003-1 standard requirement becomes effective. These options were honed through a series of stakeholder meetings, including an October 6, 2014 joint meeting of the Wholesale Market Subcommittee (WMS) and the Reliability and Operations Subcommittee (ROS) and the October 23, 2014 TAC meeting, to produce the provisions of the proposed 2015 AS Methodology related to RRS, as well as the proposed change to NSRS.

The proposed changes to the factors used to adjust the Regulation Service procurement amounts are based on actual wind generation data. The removal of the deployment of RRS as an input to the Regulation Service methodology is intended to avoid the procurement of large quantities of

Regulation Service after prolonged deployment of RRS due to an outlier event. These changes were proposed by ERCOT staff and endorsed by ROS, WMS and TAC.
Conclusion/Recommendation: ERCOT staff recommends that the Board approve the proposed 2015 *ERCOT Methodologies for Determining Ancillary Service Requirements*, attached as Attachment A, as unanimously endorsed by the TAC, to be effective January 1, 2015.

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 2015 *Methodologies for Determining Ancillary Service Requirements*, as unanimously endorsed by the Technical Advisory Committee (TAC), to be effective on January 1, 2015.

THEREFORE, BE IT RESOLVED, that ERCOT is hereby authorized and approved to implement the 2015 *Methodologies for Determining Ancillary Service Requirements*, as unanimously endorsed by TAC, to be effective on January 1, 2015.

CORPORATE SECRETARY'S CERTIFICATE

I, Vickie G. Leady, Assistant Corporate Secretary of ERCOT, do hereby certify that, at its December 9, 2014 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, 2014.

_____
Vickie G. Leady
Assistant Corporate Secretary

Attachment A

ERCOT Methodologies for Determining Ancillary Service Requirements

ERCOT Board approved XX~~12~~/~~10~~XX/~~2013~~20XX

Effective Date of XX~~02~~/XX~~01~~/20XX~~14~~

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Executive Summary

Introduction

ERCOT Protocol 3.16(2) requires that methodologies for determining the amounts of Ancillary Services to be required by ERCOT must be developed at least annually. Protocol 3.16(3) 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.

The approach taken is to provide the individual procedures that ERCOT will use for those services whose quantity requirements are not determined within the operations systems.

Overview of ERCOT AS Methodology

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

These procedures are only intended for determining AS requirements for the upcoming month and will be performed prior to the 20th of each month. RRS requirements are determined annually and will be posted to MIS by December 20 for the upcoming year. For any additional months in which ERCOT is required to provide an AS requirement forecast, the forecasted requirement will be set to the historical requirement for the same month of the previous year.

Regulation Service (RGS) Requirement

ERCOT has developed a procedure for determination of the base requirement for Regulation Service. The base requirement will be calculated as follows:

Calculate the 98.8 percentile of the 5 minute net load (load and wind) changes during the 30 days prior to the time of the study and for the same month of the previous year by hour. Also, calculate the 98.8 percentile of the up and down Regulation Service deployed during the 30 days prior to the time of study and for the same month of the previous year by hour. These results will be used to calculate the amount of Regulation Service required by hour to provide an adequate supply of Regulation Service capability 98.8% of the time.

ERCOT will calculate the increased amount of wind penetration each month and utilize updated tables based on actual historical wind data in the computation of Regulation Service requirements. The initial table was provided by GE in their final report to ERCOT. The tables indicate additional MWs to add to the regulation requirements per 1000 MWs of increase in wind generation.

If it is determined that during the course of the 30 days prior to the time of the study that the ERCOT average CPS1 score was less than 100%, additional Regulation Up and Down will be procured for hours in which the CPS1 score was less than 100%.

Each month ERCOT will perform a back-cast of last month's actual exhaustion rate. If the exhaustion rate exceeded 1.2% in any given hour, ERCOT will determine the amount of increase necessary to achieve an exhaustion rate of 1.2 % for that hour.

Non-Spinning Reserve Service (NSRS) Requirements

The GE final report to ERCOT indicated that wind generation could be treated as negative load. The report went on to describe Load minus wind generation as Net Load. The impact of Net Load on the system was the basis for the analysis performed by GE. Net Load cannot be forecasted but Load and wind generation can be forecasted independently and then combined. The combination of Load forecast uncertainty and Wind forecast uncertainty on the system, creates operational risks that have to be mitigated through ancillary services and/or manual instructions taken by the ERCOT operators. ERCOT will calculate the historical Net Load by subtracting the actual wind from the actual Load. The historical Net Load will then be compared to the Load and wind generation forecasts to determine the historical accuracy observed in forecasting.

Through May 31, 2015, ERCOT will ~~then~~ compute the amount of NSRS that is required to ensure that the combination of NSRS procured plus 500 MW of Responsive Reserve Service (RRS) plus the average amount of Regulation Up procured will result in a total capacity that is larger than or equal to 95 percent of the uncertainties observed in the Net Load accuracy evaluation. In the determination of the requirements, ERCOT will also consider the size of the largest unit. This is intended to cover exposure to the loss of the largest unit during periods of higher risk.

After May 31 2015, ERCOT will compute the amount of NSRS that is required to ensure that the combination of NSRS procured plus the average amount of Regulation Up procured will result in a total capacity that is larger than or equal to 95 percent of the uncertainties observed in the Net Load accuracy evaluation. In the determination of the requirements, ERCOT will also consider the size of the largest unit. This is intended to cover exposure to the loss of the largest unit during periods of higher risk.

Responsive Reserve (RRS) Requirement

Responsive Reserves are resources ERCOT maintains to restore the frequency of the ERCOT System within the first few minutes of an event that causes a significant deviation from the standard frequency. The ERCOT Operating Guides set the minimum RRS requirement at 2300 MW for all hours under normal conditions. However, as a result of 500 MW of RRS being included in the Net Load analysis for NSRS, an additional 500 MW will be added to the 2300 MW minimum~~.~~ until May 31 2015.

After May 31 2015, the additional 500 MW from NSRS will not be added to the RRS. On June 1 2015 the ERCOT RRS requirement will be based on expected diurnal load and wind patterns for

the month and covering 70% of historic system inertia conditions for the each month.

Regulation Service (RGS) 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 Regulation Service – Up (regulation up) and Regulation Service – Down (regulation down) on an annual basis. It is ERCOT's intent to use historical rates of Regulation Service usage to perform this evaluation. Regulation Service is deployed in order to correct actual frequency to scheduled frequency. This normal Regulation Service requirement may be increased by a multiple of two (2) during projected severe stress conditions such as forecasted extreme weather days.

Summary

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. This data is used to calculate the Regulation Service requirements with the mathematical expectation that sufficient Regulation Service will be available 98.8% of all periods. This implies that 1.2% of every month ERCOT expects to exhaust available Regulation Service and will perform a back-cast of last month's actual exhaustion rate to determine if this expectation is being met. If the exhaustion rate exceeded 1.2% in any given hour, ERCOT will determine the amount of increase necessary to achieve an exhaustion rate of 1.2% for that hour.

Procedure

Using archived data, ERCOT will calculate the 98.8 percentile of actual Regulation Up and Down Service deployed hourly for the 30 days prior to the time of the study and the same month of the previous year. Additionally, the 98.8 percentile of positive and negative 5 minute net load changes will be calculated for the 30 days prior to the time of the study and the same month of the previous year. In order to consider the increased amount of penetration, ERCOT will calculate the increase in installed generation capacity and then, depending on the month of the year and the hour of the day, will add incremental MWs to the values determined using data from the previous year. The tables of Incremental MWs for Regulation Up and Down come from the study ERCOT performed during the summer of 2013, using similar techniques as GE but with actual wind data The increase in wind capacity will be calculated by taken 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.

For determining the base Regulation Up Service requirements, ERCOT will take the largest of the 98.8 percentile of the Regulation Up Service deployments over the last 30 days, the 98.8 percentile of the Regulation Up Service deployments for the same month of the previous year, the 98.8 percentile of the positive net load changes over the last 30 days, and the 98.8 percentile of the positive net load changes for the same month of the previous year. For determining the

base Regulation Down Service requirements, ERCOT will take the largest of the 98.8 percentile of the Regulation Down Service deployments over the last 30 days, the 98.8 percentile of the Regulation Down Service deployments for the same month of the previous year, the 98.8 percentile of the negative net load changes over the last 30 days, and the 98.8 percentile of the negative net load changes for the same month of the previous year. These Regulation Service requirements may be increased for hours in which the desired 1.2% exhaustion rate is exceeded.

During the 0600 & 2200 time periods, large schedule changes typically occur, related to 16 hour block energy sale products. Because of these large energy swings, ERCOT often finds its maximum deployment rate of Regulation Service insufficient to control frequency[1]. During these times, ERCOT may see the need for extra Regulation Service to be available to cover the amount needed to respond to such large schedule changes~~. ERCOT may also include historic deployment of Responsive Reserve as a part of Regulation Service deployment in this analysis.~~.

Additionally, if it is determined that during the course of the 30 days prior to the time of the study that the ERCOT average CPS1 score was less than 100%, ERCOT will procure an extra 10% of both Regulation Up and Down for hours of the day during the upcoming month in which the CPS1 score was less than 100%. This value will increase to 20% if the CPS1 score for the previous month falls below 90%. These additional reserves will assist ERCOT in ensuring that NERC requirements are met.

ERCOT will post these requirements as required by the Protocols.

[1] The restrictions are specified in protocol section 8.1.1.4.1(1) which states "ERCOT shall limit the deployment of Regulation Service of each QSE for each LFC cycle equal to 125% of the total amount of Regulation Service in the ERCOT System divided by the number of control cycles in five minutes."

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

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	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.	4.12.5	3.90.1	2.6-1	2.83.0	4.41.3	2.2-0.9	2.80.1	4.2.5	3.1.5	86.1	2.4.7	6.04.4	4.31.2	5.2.8	5.13.9	4.10.2	3.12.7	-1.07.6	-1.27	2.51	0.8-2.4	2.5-0.1	1.72.0	1.40.5
Feb.	4.71.1	6.92.5	3.15.0	9.27.0	4.5.8	4.02.1	0.70	4.02	53.0	4.0-1.5	3.50.7	3.42.7	0.61.1	5.71	4.0.8	1.82	4.86	313.3	0.64.4	-0.92	-1.51	5.30.4	4.2.0	5.31.2
Mar.	1.91	24.3	2.93.0	2.24.1	4.0.5	7.-0.1	0.1.5	5.06.2	5.16.9	8.15.5	5.67.2	3.710.5	5.17.8	4.51.9	3.1.9	4.7-0.3	6.51.7	8.54.9	6.514.2	2.0.3	-1.5.4	4.21.6	8.84.9	2.23.7
Apr.	53.6	5.54.8	4.97.7	6.13.3	7.32.8	-0.1.6	4.52	89.2	3.61.2	8.2.1	6.8.4	4.23.9	3.4.6	2.23.3	1.15	1.50	2.26.9	7.02.9	3.14.7	1.83.2	4.30.5	2.10.7	3.54.6	5.07.8
May	43.9	7.14.9	4.91.3	6.98.4	35.5	2.20.5	4.50	5.4.6	2.5.3	73.2	3.75	4.05.2	3.54	4.69	6.1.9	6.2.7	-0.2.1	5.07.3	8.57.7	1.96.0	1.54.3	0.12.3	5.42.2	0.4.7
Jun.	3.1.9	8.89.1	4.813.3	6.78	8.93.5	2.03.9	5.27.1	3.01.9	5.78.4	5.95	3.24.5	3.31.1	3.95	1.20.4	1.89	2.6-0.5	-0.65	-0.17	3.3-1.0	14.3	0.59	1.9-0.7	1.2-0.9	5.01.4
Jul.	2.16	1.2.4	4.3.5	2.71.5	1.90.5	31.0	36.9	3.04.1	2.3.5	6.31	3.14.0	1.84	0.91.5	0.74.3	1.2-0.7	-1.7	1.20.3	1.54	2.1.5	2.71.9	0.53	-1.12	-0.10	0.61.3
Aug.	1.8-0.4	1.40.9	1.82.0	2.68	1.82.4	1.13.5	4.68.9	3.76.8	4.30.9	3.18	2.3.9	31.1	-0.84	-0.68	1.10.8	3.10.4	-0.03	0.6-1.1	2.43.7	1.54	0.1	0.01.2	-0.26	1.10.0
Sep.	1.20.9	1.59	1.2.3	1.72.8	2.21	2.6-1.5	32.2	46.9	2.20.8	2.30.5	2.1-0.6	2.0	3.80.0	1.8-0.2	1.53.7	2.06	1.47	0.61.7	2.27.3	1.94	-0.85	-0.30	0.51	1.20
Oct.	2.03.4	3.14.5	2.86.3	2.94.4	3.05.8	2.63.9	2.85.4	4.82.3	7.31.9	20.6	6.21	5.53.2	25.2	4.16	-0.81.1	1.02.3	2.85.4	1.20.8	-15.3	-1.2.0	2.7-0.8	1.67	2.30	2.50.7
Nov.	0.42.8	2.64.5	2.95.7	5.23	4.23.7	3.52.8	2.23.5	4.63.1	38.7	4.3.1	5.94.7	25.7	3.410.7	4.1.7	2.63.8	3.70.8	5.62.2	0.26.5	2.8-3.5	1.60	2.6-3.1	1.24	3.1.5	1.0.7

Dec.	5.42.9	5.42.0	3.30.0	5.32	4.3.4	4.03.1	1.93.8	4.21.9	4.53.3	4.3.8	2.6.1	5.35	3.84.6	5.13	4.02.5	30.1	6.20	-0.49	-0.14.3	3.70.0	4.05.6	3-0.1	3.41.8	3.91.5

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

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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.	-3.10.2	-2.10.7	-1.40.3	-1.7	-0.4.1	-0.61.5	-0.14.7	-0.21.5	5.2.0	-0.21.9	-1.82	-1.70.0	-2.29	-5.68	-1.20.7	-1.69	-2.61.8	-1.39	-8.85.2	-5.28.4	-5.87.7	-4.37	-3.42.9	-5.81.3
Feb.	-5.2.1	-1.50.6	-1.29	-2.80.7	-3.10.7	-1.40.3	-0.12.3	-0.12.9	-1.83.0	-4.72.9	-2.70.6	-1.0.8	-21.0	-1.64.5	-0.78	-1.82.5	-1.50.9	-0.43.5	-5.4.8	-64.2	-3.74.9	-3.67	-4.8.4	-3.4.1
Mar.	-6.63.9	-1.70.6	-2.61.0	-0.5.7	-2.38	-1.43	-0.32	-1.81	-5.0.9	-5.94	-3.51.6	-1.6.0	-3.82.2	-4.3.6	-4.15.2	-3.32.7	-4.43.1	-7.10.9	-1.3.8	-8.76.6	-5.410.1	-8.3.0	-8.75	-2.73.0
Apr.	-6.73.9	-6.34.4	-5.90.7	-1.52.7	-1.02.5	-1.52.6	-5.71.2	-1.0.2	-51.5	-60.1	-4.20.6	-21.5	-5.61.9	-63.4	-3.61.2	-4.2.6	-4.31	-3.6.9	-3.96.1	-7.812.2	-7.81	-65.3	-4.76	-3.72.0
May	-3.16.2	-1.56.7	-2.03.6	-3.50.0	-3.30.5	-2.80.6	-1.94	-1.2.7	-3.34.8	-1.43.6	-2.03.3	-1.2.0	-4.42.9	-3.4.8	-2.53	-3.84.9	-4.91	-5.52.4	-4.36.5	-5.4.1	-8.69.5	-9.58.4	-4.32.9	-6.37.1
Jun.	-3.8.4	-5.63.9	-3.61.7	-12.5	-0.58.6	-0.84.9	-0.2-3.1	-3.51.6	-1.3.1	-0.68	-1.58	-0.19	-0.2.5	-3.61.5	-3.69.1	-3.42	-6.31.0	-9.16.7	-511.6	-4.1.6	-78.0	-7.14.2	-7.36.6	-4.97.6
Jul.	-4.21.8	-3.40.9	-1.10.4	0.24	-1.15	-1.12	-01.9	-0.69	-0.0-1.5	-0.42.7	-0.40	-1.60.3	-24.0	-1.40.5	-2.1.6	-5.43.9	-4.49	-4.83.7	-4.1.5	-2.41.5	-5.85	-5.90.1	-5.62.9	-4.32.7

Aug.	-1.52.8	-0.65	-0.57	-0.12.9	1.5_0.2	0.7_1.1	0.4_2.5	0._1.8	0.01.1	0_2.1	01.1	0.01.9	0.91.5	2.10.7	4.13.8	2.84.7	2.84.0	4.30.8	-4.7.9	-11.2.7	-5.07.1	3.41.9	-60.0	6.51.0
Sep.	0.01.5	-1.80.2	-0.93.1	-1.15	-0.2	-0.41.2	-1.2.6	0.52.2	-2.0.4	-1.10	1.30.2	-0.27	1.10.0	0._4.3	3.37.6	-3.28	-2.70	3.12.0	-0.83	-5.28	-3.7.6	5.14.0	4.30.9	3.80.6
Oct.	-1.50.6	-1.0	-2.03	-1.92.8	-0.43	-1.72.4	0.62.8	-1.0.4	-01.7	2.23.6	-1.20	-01.4	0.42.7	-0.31	-02.4	2.03.5	-1.68.8	1.1_2.9	-9.36.8	-7.38.6	-3.86.5	-4.45.1	-3.75	4.31.5
Nov.	-2.23.8	-3.86.1	-1.43	0.01.5	-1.50.4	-2.61.0	-2.50.6	-1.30.7	0.2_3.9	-1.0.4	-2.50.3	-2.1.2	-2.41.0	-10.1	-1.32.4	-0.1.3	-0.95	0.40	-8.27.0	-5.23.0	-3.0.2	-73.3	-3.72.4	-5.53.3
Dec.	-6.85.2	-4.70.8	-3.85	-4.2.5	-3.10.9	-01.5	-4.0.5	-2.0.6	4.30.7	-1.0.6	-6.71	-1.79	-13.6	-2.81.0	-3.60.4	-1.30.5	-2.0.6	1.3_0.4	-5.07.4	-6.03.7	-5.76.3	-3.4.1	-1.5.2	-3.34

Non-Spinning Reserve Service (NSRS) Requirement Details

Introduction

Non-Spinning Reserve Service (NSRS) consists of Generation Resources capable of being ramped to a specified output level within thirty (30) minutes or Load Resources that are capable of being interrupted within thirty (30) minutes and that are capable of running (or being interrupted) at a specified output level for at least one (1) hour. NSRS 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 or when there is a limited amount of capacity available for Security-Constrained Economic Dispatch (SCED).

Summary

ERCOT will determine the 95th percentile of the observed hourly Net Load uncertainty from the previous 30 days from when the study is performed and from the same month of the previous year. Net Load is defined as the ERCOT load minus the estimated total output from WGRs. The estimated total output from WGRs considers what the total WGR output most likely would have been if the QSEs had not been given deployments to move their resources down. 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 6 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.

Through May 31, 2015:

ERCOT will subtract 500 MW and the Regulation Up requirement from the calculated 95th percentile value to determine the amount NSRS to purchase during each hour of the day for the upcoming month. This 500 MW corresponds to 500 MW of the RRS requirement. ~~6 hours~~ ERCOT will purchase NSRS such that the combination of NSRS, 500 MW of RRS, and Regulation Up Services cover 95% of the calculated uncertainties from the Net Load performance analysis. For on-peak hours (hours ending 7 through 22), ERCOT will also set a floor on the NSRS requirement equal to the largest unit minus 500 MW.

After May 31 2015:

ERCOT will purchase NSRS such that the combination of NSRS and Regulation Up Services cover 95% of the calculated uncertainties from the Net Load performance analysis. For on-peak hours (hours ending 7 through 22), ERCOT will also set a floor on the NSRS requirement equal to the largest unit.

Procedure

Through May 31, 2015:

The days that are used for analysis are the last 30 days prior to the study and the days from the same month in the previous year. For the purpose of determining the amount of NSRS to purchase for each hour of the day during the upcoming month, hours will be placed into four (4) hour blocks. The 95th percentile of the Net Load uncertainty for the analyzed days for all hours which are considered to be part of a four (4) hour block will be calculated. The same calculation will be done separately for each block. ERCOT will then calculate the average Regulation Up requirement for each four (4) block, separately, for the upcoming month. The NSRS requirement for the upcoming month for each block is calculated as the 95th percentile calculation for that block minus 500 MW and minus the average Regulation Up requirement during the same block of hours.

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Additionally, the average uncertainty in the Net Load forecast will be calculated using the same days of study and four (4) hour blocks. If it is determined that the Net Load forecast on average over-forecasted the observed Net Load for a four (4) hour block, then the average uncertainty will be added back to the NSRS requirement value calculated using just the percentile method described in the paragraph above. The calculated average uncertainty value for each block will be adjusted such that the sum of the two values does not exceed 1500 and ERCOT will place a cap of 1500 MW on the NSRS requirement. The adjusted average uncertainty value will not be set to a value less than 0. The adjusted average uncertainty value shall not be used by the ERCOT Operator to select a load forecast, and shall not be included in ERCOT-published Load Forecasts.

After this analysis has been completed, ERCOT will apply a floor on the final NSRS requirement equal to the largest unit minus 500 MW. This floor will only be applied to on-peak hours, which are hour ending 7 through 22.

After May 31 2015:

The days that are used for analysis are the last 30 days prior to the study and the days from the same month in the previous year. For the purpose of determining the amount of NSRS to purchase for each hour of the day during the upcoming month, hours will be placed into four (4) hour blocks. The 95th percentile of the Net Load uncertainty for the analyzed days for all hours which are considered to be part of a four (4) hour block will be calculated. The same calculation will be done separately for each block. ERCOT will then calculate the average Regulation Up requirement for each four (4) block, separately, for the upcoming month. The NSRS requirement for the upcoming month for each block is calculated as the 95th percentile calculation for that block ~~minus 500 MW and~~ minus the average Regulation Up requirement during the same block of hours.

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Additionally, the average uncertainty in the Net Load forecast will be calculated using the same days of study and four (4) hour blocks. If it is determined that the Net Load forecast on average over-forecasted the observed Net Load for a four (4) hour block, then the average uncertainty will be added back to the NSRS requirement value calculated using just the percentile method

described in the paragraph above. The calculated average uncertainty value for each block will be adjusted such that the sum of the two values does not exceed ~~15~~2000 and ERCOT will place a cap of ~~15~~2000 MW on the NSRS requirement. The adjusted average uncertainty value will not be set to a value less than 0. The adjusted average uncertainty value shall not be used by the ERCOT Operator to select a load forecast, and shall not be included in ERCOT-published Load Forecasts.

After this analysis has been completed, ERCOT will apply a floor on the final NSRS requirement equal to the largest unit ~~minus 500 MW~~. This floor will only be applied to on-peak hours, which are hour ending 7 through 22. ERCOT will also place a cap of 2000 MW on the NSRS requirement. ERCOT will post these requirements as required by the Protocols.

Discussion

Historically, the need for NSRS has occurred during hot weather, during cold weather, during unexpected changes in weather, or during large unit trips when large amounts of spinning reserve have not been on line (spinning reserve in this document represents un-deployed online generation capacity). The increasing level of wind penetration has resulted in an increased level of operational risk. Wind output tends to be higher during off-peak hours when the system load is less and introduces a risk of decreasing output while the load demand is increasing. 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 increase. The risk of Net Load increases that are not forecasted exists for all hours of the day.

While Net Load analysis may cover reserves required for forecast uncertainty, it may not necessarily cover exposure to the loss of generation. Due to this risk, it may be necessary for ERCOT to have reserves available during high risk hours even if the forecast analysis does not indicate a need for NSRS to protect against forecast uncertainty.

Examples of circumstances when NSRS 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 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.

Responsive Reserve Service (RRS) Requirement Details

The ERCOT Operating Guides set the minimum RRS requirement at 2300 MW for all hours under normal conditions. However, as a result of 500 MW of RRS being included in the Net

Load analysis for NSRS, an additional 500 MW will be added to the 2300 MW minimum. This results in a total RRS minimum requirement of 2800 MW~~.~~ until May 31 2015.

After May 31 2015, ERCOT will procure amounts of RRS that vary~~ies~~ by hour of the day and by month. These RRS amounts will be published by month in 6 separate blocks covering 4 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 will use a 1 to 1 equivalency ratio and a 50% limit for Load Resources when procuring the RRS. This RRS amount will be published as a monthly requirement along with the equivalency ratio for each 4 hour block. ERCOT will post these monthly amounts for the upcoming year. These annually published amounts are the minimum quantity that will be procured in in the DAM for each hour of the year. After May 31 2015 the additional 500 MW of NSRS will not be added to the amount to RRS.

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 limit therefore will be 1400 MW.~~ 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.

Attachment B

Minimum RRS Quantities for each month by six 4-hour blocks for 2015

June - 2015

HE	Total RRS MW (**Based on 20% HSL Limit**)	PFRS	LRs	Equivalency Ratio
22-02	2696	1348	1348	1.30
03-06	2808	1404	1404	1.40
07-10	2696	1348	1348	1.30
11-14	2480	1240	1240	1.13
15-18	2538	1269	1269	1.08
19-22	2480	1240	1240	1.13

July- 2015

HE	Total RRS MW (**Based on 20% HSL Limit**)	PFRS	LRs	Equivalency Ratio
22-02	2480	1240	1240	1.13
03-06	2696	1348	1348	1.30
07-10	2696	1348	1348	1.30
11-14	2702	1351	1351	1.25
15-18	2538	1269	1269	1.08
19-22	2538	1269	1269	1.08

August - 2015

HE	Total RRS MW (**Based on 20% HSL Limit**)	PFRS	LRs	Equivalency Ratio
22-02	2702	1351	1351	1.25
03-06	2702	1351	1351	1.25
07-10	2702	1351	1351	1.25
11-14	2538	1269	1269	1.08
15-18	2300	1150	1150	1.00
19-22	2538	1269	1269	1.08

September - 2015

HE	Total RRS MW (**Based on 20% HSL Limit**)	PFRS	LRs	Equivalency Ratio
22-02	2696	1348	1348	1.30
03-06	2808	1404	1404	1.40
07-10	2696	1348	1348	1.30
11-14	2480	1240	1240	1.13
15-18	2480	1240	1240	1.13
19-22	2480	1240	1240	1.13

October - 2015

HE	Total RRS MW (**Based on 20% HSL Limit**)	PFRS	LRs	Equivalency Ratio
22-02	3002	1501	1501	1.50
03-06	3002	1501	1501	1.50
07-10	2808	1404	1404	1.40
11-14	2696	1348	1348	1.30
15-18	2696	1348	1348	1.30
19-22	2696	1348	1348	1.30

November - 2015

HE	Total RRS MW (**Based on 20% HSL Limit**)	PFRS	LRs	Equivalency Ratio
22-02	3002	1501	1501	1.50
03-06	3132	1566	1566	2.00
07-10	3002	1501	1501	1.50
11-14	2808	1404	1404	1.40
15-18	2808	1404	1404	1.40
19-22	2808	1404	1404	1.40

December - 2015

HE	Total RRS MW (**Based on 20% HSL Limit**)	PFRS	LRs	Equivalency Ratio
22-02	2808	1404	1404	1.40
03-06	3002	1501	1501	1.50
07-10	2808	1404	1404	1.40
11-14	2808	1404	1404	1.40
15-18	2808	1404	1404	1.40
19-22	2808	1404	1404	1.40