BEFORE THE NEW MEXICO PUBLIC REGULATION COMMISSION

IN THE MATTER OF SOUTHWESTERN)
PUBLIC SERVICE COMPANY'S)
APPLICATION REQUESTING:)
(1) ISSUANCE OF A CERTIFICATE OF)
PUBLIC CONVENIENCE AND NECESSITY)
AUTHORIZING CONSTRUCTION AND)
OPERATION OF WIND GENERATION AND)
ASSOCIATED FACILITIES, AND RELATED)
RATEMAKING PRINCIPALS INCLUDING) CASE NO. 17-00044-UT
AN ALLOWANCE FOR FUNDS USED)
DURING CONSTRUCTION FOR THE WIND)
GENERATION AND ASSOCIATED)
FACILITIES; AND (2) APPROVAL OF A)
PURCHASED POWER AGREEMENT TO)
OBTAIN WIND-GENERATED ENERGY.)
)
SOUTHWESTERN PUBLIC SERVICE)
COMPANY,)
)
APPLICANT.)
)

DIRECT TESTIMONY

of

WILLIAM A. GRANT

on behalf of

SOUTHWESTERN PUBLIC SERVICE COMPANY

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GLOSSARY OF ACRONYMS AND DEFINED TERMS

Acronym/Defined Term Meaning

Bonita PPA Bonita Wind Energy, LLC Power Purchase

Agreement

Commission New Mexico Public Regulation

Commission

FERC Federal Energy Regulatory Commission

GIA Generator Interconnection Agreement

IM Integrated Marketplace

MW Megawatt

Network Upgrades Facilities needed to physically and

electrically connect the generation to the

transmission system

PUCT Public Utility Commission of Texas

RegDown Regulation Down

RegUp Regulation Up

SPP Southwest Power Pool, Inc.

SPS Southwestern Public Service Company, a

New Mexico corporation

SPS Wind Projects Sagamore Wind Project and Hale Wind

Project

Tariff SPP Open Access Transmission Tariff

Xcel Energy Xcel Energy Inc.

LIST OF ATTACHMENTS

Attachment	<u>Description</u>
WAG-1	Calculating Regulating Reserve Requirements SPP Integrated Marketplace
	(non-native format)

1 I. WITNESS IDENTIFICATION AND QUALIFICATIONS 2 Q. Please state your name and business address. 3 A. My name is William A. Grant. My business address is 600 South Tyler Street, Suite 2900, Amarillo, Texas 79101. 4 5 Q. On whose behalf are you testifying in this proceeding? 6 A. I am filing testimony on behalf of Southwestern Public Service Company, a New 7 Mexico corporation ("SPS") and wholly-owned electric utility subsidiary of Xcel 8 Energy Inc. ("Xcel Energy"). 9 Q. By whom are you employed and in what position? 10 I am employed by SPS, as Regional Vice President of Regulatory and Strategic A. 11 Planning. 12 Please briefly outline your responsibilities as Regional Vice President of Q. 13 Regulatory and Strategic Planning. 14 A. My responsibilities include: 15 determining the appropriate planning strategy for SPS, including working 16 with generation and transmission planning and coordinating with the Southwest Power Pool, Inc. ("SPP") on regional policy and cost allocation 17 issues affecting SPS; 18 overseeing the activities of the SPS regulatory department to ensure that 19 SPS meets the regulatory requirements of the Texas and New Mexico

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1 2		commissions as well as the Federal Energy Regulatory Commission ("FERC"); and
3 4		 overseeing the relationships with the state and federal commissions and managing the relationships and policy decisions with the SPP.
5	Q.	Please describe your professional experience.
6	A.	I have over 30 years of experience in both power plant and system operations at
7		Xcel Energy or its predecessors. For seven years, I was Director, Power
8		Operations for Xcel Energy Services Inc., in which I was responsible for the
9		economic dispatch and analytical support for all of the Xcel Energy Operating
10		Companies, including SPS. For seven years, I was Manager, Transmission
11		Control Center and Wind Integration for SPS. In 2012, I was named Director,
12		Strategic Planning for SPS. In 2017, I was named Regional Vice President of
13		Regulatory and Strategic Planning.
14	Q.	Have you testified before any regulatory authorities?
15	A.	Yes. I testified before the New Mexico Public Regulation Commission
16		("Commission") in Case No. 12-00350-UT regarding the SPP, which was a SPS
17		rate case.
18		I have also submitted pre-filed testimony to the Commission on behalf of
19		SPS regarding the SPP in several proceedings. These include: Case Nos.
20		16-00269-UT and 15-00296-UT (SPS rate cases); and Case No. 13-00031-UT

1	(SPS interim report on SPP membership). I have also submitted pre-filed
2	testimony to the Public Utility Commission of Texas and the FERC regarding the
3	SPP. My testimony has covered, among other topics:
4	• SPP's operations and planning, and how those activities affect SPS;
5	• SPP fees and charges;
6	• SPP regional cost allocation for transmission facilities; and
7	 SPS generation dispatch and outages.

1 2		II. ASSIGNMENT AND SUMMARY OF TESTIMONY AND RECOMMENDATIONS
3	Q.	What is your assignment in this proceeding?
4	A.	In this proceeding, I discuss:
5 6 7 8		 the process to determine what type of transmission upgrades are needed to interconnect the Sagamore and Hale Wind Projects (collectively referred to herein as the "SPS Wind Projects") to the SPP transmission grid and what the current status is of those efforts;
9		 how the acquisition of the SPS Wind Projects is expected to impact the ancillary services SPS needs prospectively;
11 12 13 14		 how firm transmission service is not needed for the SPS Wind Projects, but SPS will submit requests for firm transmission service in the future and, if the costs are reasonable, acquire firm transmission service, which would qualify the SPS Wind Projects for capacity credit under the SPP's Open Access Transmission Tariff ("Tariff"); and
16 17 18		 SPS's responsibility under the Bonita Wind Energy LLC Power Purchase Agreement ("Bonita PPA") for arranging for any transmission service for deliveries of energy beyond the point of delivery, as defined in the PPA.
9	Q.	Please summarize the conclusions and recommendations in your testimony.
20	A.	The developers of the SPS Wind Projects (Invenergy, LLC for the Sagamore
21		Wind Project and NextEra Energy Resources, LLC for the Hale Wind Project)
22		have already begun the process for determining the transmission upgrades needed
23		to interconnect the Sagamore and Hale Wind Projects to the SPP transmission
24		grid. The process for the Hale Wind Project is complete. For the Sagamore Wind

Project, Invenergy has a Generator Interconnection Agreement ("GIA") request, which will be transferred to SPS upon closing of the transaction. The SPP is continuing to study the requested interconnection for the Sagamore Wind Project. SPS expects the acquisition of the SPS Wind Projects will increase its ancillary service requirements. In particular, SPS expects Regulating Reserves to increase as a result of acquiring the SPS Wind Projects. The increase will be determined by the SPP through a formula that is described further in my testimony. However, the costs of procuring the Regulating Reserves is expected to be low because: (1) the average price per Megawatt ("MW") is relatively low; and (2) SPS self-provides the vast majority of its required Regulating Reserve. The estimated fuel cost savings resulting from the SPS Wind Projects and the Bonita PPA are not dependent on firm transmission service. However, SPS will request the SPP to determine what transmission upgrades are necessary to obtain firm transmission service. If the required upgrades for firm transmission service are a reasonable cost, then SPS may agree to pay for the upgrades and receive a capacity credit as allowed under the SPP Tariff. Q. Is Attachment WAG-1 a true and correct copy of the document you have described in your testimony?

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1 III. INTERCONNECTION OF WIND FACILITIES TO THE SPP 2 TRANSMISSION SYSTEM 3 Q. What topic do you discuss in this section of your testimony? 4 A. I discuss how the developers for the SPS Wind Projects have already started the 5 process to determine what type of transmission upgrades are needed to 6 interconnect the SPS Wind Projects to the SPP transmission grid and what the 7 current status is of those efforts. 8 SPS witness Riley Hill discusses Generation Tie lines from the wind facilities Q. 9 to the interconnection tie breaker on the transmission grid. Is this all that is 10 needed for the wind facilities to be interconnected to the SPP transmission 11 system footprint? 12 No. A connection is still needed from the interconnection tie breaker to the SPP A. 13 transmission system. In addition, the SPP must: (1) analyze the impact to the 14 system to inject power equal to the generator nameplate at the interconnection point; and (2) determine the need for any possible network upgrades.¹ 15

¹ "Network upgrades" are the upgrades in addition to the direct interconnection lines and substations needed to physically and electrically connect the wind generating facilities to the transmission system.

1	Q.	How did the developers start the process for the SPP to evaluate the need for
2		possible transmission upgrades?
3	A.	The developers initiated the process by submitting a generator interconnection
4		request to the SPP. In Order No. 2003, the FERC established standardized
5		procedures and agreements for the interconnection of large generators. ²
6	Q.	How will the SPP determine what transmission upgrades are necessary?
7	A.	The SPP will perform analyses that will specify and estimate the cost of network
8		upgrades. The types of analyses performed are dictated by the type of
9		interconnection queue a generator chooses.
10		The three interconnection study queues are:
11 12 13		(1) the feasibility study queue (Feasibility Queue), which results in an optional feasibility study completed within 90 days of the close of a cluster window;
14 15		(2) the preliminary interconnection system impact study queue (Preliminary Queue), which results in an optional system impact

² Standardization of Generator Interconnection Agreements and Procedures, Order No. 2003, FERC Stats. & Regs. ¶ 31,146 (2003) (Order No. 2003), order on reh'g, Order No. 2003-A, FERC Stats. & Regs. ¶ 31,160, order on reh'g, Order No. 2003-B, FERC Stats. & Regs. ¶ 31,171 (2004), order on reh'g, Order No. 2003-C, FERC Stats. & Regs. ¶ 31,190 (2005), aff'd sub nom. Nat'l Ass'n of Regulatory Util. Comm'rs v. FERC, 475 F.3d 1277, (D.C. Cir. 2007), cert. denied, 552 U.S. 1230, 128 S. Ct. 1468, 170 L. Ed. 2d 275 (2008)). See also Midwest Indep. Transmission Sys. Operator, Inc., 124 FERC ¶ 61,183, at P 31 (2008), order on reh'g, 127 FERC ¶ 61,294 (2009); Interconnection Queuing Practices, 122 FERC ¶ 61,252 (2008).

1 2		study completed within 180 days of the close of a cluster window; and
3 4 5 6 7		(3) the definitive interconnection system impact study queue (Definitive Queue), which is the first required stage within the interconnection process and results in a system impact study completed within 120 days of the close of a cluster window and an Interconnection Facilities Study completed in 90 days, thereafter.
8	Q.	Is Invenergy in the Definitive Queue for the Sagamore Wind Project?
9	A.	Yes. Invenergy is in the Definitive Queue. Invenergy will continue the process
10		until it gets a GIA in place. At the closing of the transaction between SPS and
11		Invenergy, the GIA will transfer to SPS.
12	Q.	Does SPS know if there are any costs for network upgrades for
13		interconnection of the Sagamore Wind Project?
14	A.	Not currently; however, the purchase sale agreement with Invenergy allows SPS
15		to terminate if the costs of the network upgrades exceed \$44.4 million.
16	Q.	Have any of the steps outlined above been undertaken for the Hale Wind
17		Project?
18	A.	Yes. NextEra already has a GIA in place. The cost of the network upgrades were
19		\$1.5 million and is a part of the purchase price to be paid by SPS. The
20		interconnection is already physically built.

IV. ANCILLARY SERVICES RELATED TO THE WIND FACILITIES

- 2 Q. What topic do you discuss in this section of your testimony?
- A. I provide background regarding ancillary services, why ancillary services are needed, the types of ancillary services that are available to SPS, and how the acquisition of the SPS Wind Projects and the Bonita PPA is expected to affect the
- 6 ancillary services SPS needs prospectively.

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- 7 Q. Please briefly describe ancillary services.
 - A. Ancillary services help balance the transmission system as it moves electricity from generating sources to ultimate consumers. Specifically, at any given point in time, the amount of electricity produced must correspond precisely to the amount of electricity being consumed to ensure secure operation of the electricity grid at a constant frequency. Unforeseen fluctuations between electricity being added to and withdrawn from the electrical grid must be balanced on short notice, which is generally accomplished through directing power plant operators to increase or reduce power plant output. All but one of the ancillary services involves generating units. The amount of resources needed to meet ancillary services requirements have always been spread over multiple units in the footprint rather than carried on just a few units to ensure adequate response to system imbalances.

1	Q.	From whom does SPS procure ancillary services?
2	A.	SPS procures ancillary services through the Ancillary Services Market, which is a
3		component of the SPP Integrated Marketplace ("IM"). SPS also sells ancillary
4		services through the SPP IM, as well.
5	Q.	How does SPS procure ancillary services from the SPP?
6	A.	SPS procures ancillary services under the following six ancillary service
7		schedules:
8		• Schedule 1 – Scheduling, System Control and Dispatch Service
9 10		 Schedule 2 – Reactive Supply and Voltage Control from Generation or Other Sources Service
11		• Schedule 3 – Regulation and Frequency Response Service
12		• Schedule 4 – Energy Imbalance Service
13		• Schedule 5 – Operating Reserve – Spinning Reserve Service
14		• Schedule 6 – Operating Reserve – Supplemental Reserve Service
15	Q.	How does the acquisition of wind generation affect the need for ancillary
16		services?
17	A.	Due to its variability, wind generation increases the requirement for Regulation
18		and Frequency Response Services (Schedule 3).

1 A. Schedule 3 – Regulation and Frequency Response Service

- 2 Q. Please describe Schedule 3 Regulation and Frequency Response Service.
- 3 A. Schedule 3, Regulation and Frequency Response Service, is necessary to provide 4 for the continuous balancing of resources (generation and interchange) with load 5 and for maintaining normal operating frequency (i.e., 60 Hertz). Regulation and 6 Frequency Response Service is accomplished by committing on-line generation 7 whose output is raised or lowered (predominantly through the use of automatic 8 generating control equipment) and by other non-generation resources capable of 9 providing this service as necessary to follow the moment-by-moment changes in 10 load. All load within the SPP balancing area purchases Schedule 3 service 11 through the SPP IM.
- 12 Q. How will the change in the level of Regulation and Frequency Response 13 Service (i.e., Schedule 3) be determined?
- 14 A. The SPP uses a formula to determine the levels of required Regulating Reserves.

 15 The formula is attached to my testimony as Attachment WAG-1.
- 16 Q. Please explain how the formula operates.
- 17 A. In essence, Regulating Reserves in the SPP IM are based on both the total market
 18 area load forecast and the total market area intermittent resource output forecast.
 19 The Regulation Up ("RegUp") and Regulation Down ("RegDown") MW value

1		for each operating hour consist of the sum of four components. These
2		components are: (1) a load magnitude component; (2) a load variability
3		component; (3) an intermittent resource magnitude component; and (4) an
4		intermittent resource variability component. All of these components are
5		calculated each day for each operating hour on a rolling seven day-ahead basis for
6		both RegUp and RegDown.
7	Q.	Please describe the effect of that intermittent resources, such as wind, has on
8		the formula.
9	A.	As seen on Attachment WAG-1, both the RegUp and RegDown calculations have
10		variables specifically for intermittent resources such as wind. An increase in the
11		amount of wind on the system leads to an increase in both RegUp and RegDown
12		requirements.
13	Q.	Has the SPP evaluated the effect of wind integration on Reserve Regulation
14		Service?
15	A.	Yes. The SPP has regularly studied the impact, with the most recent study
16		released on January 5, 2016. It can be viewed at:
17 18		https://www.spp.org/documents/34200/2016%20wind%20integration%20study%20(wis)%20final.pdf
19		Some key take-aways are presented under Section 1.3 "Major Findings."
20		In particular, SPP performed a Ramping Analysis, which:

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examined the impact of wind on system ramping requirements and the ability of the system to meet the ramping needs. By studying one year of data (March 2014-Feb 2015), it was shown that wind does have an impact on overall system ramping, albeit at a relatively small level. Ramp lengths from 5 minutes up to 12 hours were all shown to increase due to wind, with longer intervals seeing a larger impact. While the largest ramps show a minor increase, the time periods during which large ramping occurs becomes less predictable, and the net load (load minus wind) has become slightly more variable due to the presence of wind. Studying the actual hourly dispatch of the system, SPP appears to have sufficient ramping capability for the near term. However, ramping issues should be monitored – the study here provides a useful base against which future changes can be measured. As wind increases, the system may require new operational capabilities, either by developing new ancillary service products to manage within-hour ramping, or new situational awareness tools for inter-hour ramping. It was also shown that the ability to dispatch variable energy resources can reduce the largest short term net load ramps, particularly in the case of over-generation issues. [emphasis added]

In addition, under Section 7.4, "Main Insights and Conclusions," the study found that the "hourly-averaged data showed that one hour load ramping was seen to increase by an amount equivalent to approximately 3% of installed wind capacity, when wind was netted from load." Thus, when the load profile is considered in comparison to the variability of the load profile and diversity of the wind resources, only 3% more Regulating Reserve would have to be provided by the market for an increase of wind generation. To illustrate this conclusion

1		further, if you connected 100 MW of wind generation, then 3 MW of additional
2		Regulating Reserve would be required.
3	Q.	Is the ratio of 3 MW of additional Regulating Reserve per 100 MW of wind
4		generation addressed in the January 5, 2016 study consistent with the SPP
5		formula you addressed above?
6	A.	Yes. The 3 MW per 100 MW of wind generation is a computation from the
7		formula.
8	В.	Cost Affect Due to Increases in Regulating Reserve Service
9	Q.	How does the SPP charge for the Regulating Reserve requirement?
10	A.	It is cleared by the load in the real time market.
11	Q.	What are the components of charges that SPS pays?
12	A.	The charges that are assessed are: (1) an energy component; and (2) a
13		procurement component. The procurement component is a charge for an entity
14		procuring the Regulation Reserve Service.
15	Q.	Has SPS considered any component of the charges for Regulating Reserve as
16		a part of its cost savings estimates presented by SPS witness Jonathan
17		Adelman?
18	A.	Yes. The energy component of the charges for Regulating Reserve is captured by
19		the Promod IV modeling discussed by Mr. Adelman. The procurement

1		component was not included in the savings analysis. The procurement
2		component, however, was not included because the charges will be insignificant.
3	Q.	Why do you think the increase in costs for the procurement component of
4		Regulating Reserve will be insignificant?
5	A.	This cost increase will be insignificant for two reasons. First, the amount of
6		additional Regulating Reserve to be purchased by SPS will be low. Second, SPS
7		self-provides the majority of Regulating Reserve service that is required.
8	Q.	Can you estimate the additional costs of the procurement component of
9		Regulating Reserve associated with the new wind generation?
10	A.	Yes. As noted above, the SPP has found that for every 100 MW of wind
11		
		generation added, 3 MW of Regulating Reserve is required. In total, the wind
12		generation added, 3 MW of Regulating Reserve is required. In total, the wind acquisition will be 1,230 MW (522 MW for the Sagamore Wind Project, 478 MW
12 13		
		acquisition will be 1,230 MW (522 MW for the Sagamore Wind Project, 478 MW
13		acquisition will be 1,230 MW (522 MW for the Sagamore Wind Project, 478 MW for the Hale Wind Project, and 230 MW for the Bonita PPA). Applying the 100:3
13 14		acquisition will be 1,230 MW (522 MW for the Sagamore Wind Project, 478 MW for the Hale Wind Project, and 230 MW for the Bonita PPA). Applying the 100:3 ratio to 1,230 MW equals 36.90 MW. SPS's load ratio share is approximately

1	Q.	How can you determine the costs for procuring the additional 4.06 MW of
2		Regulating Reserve?
3	A.	Using the actual settled regulation purchases from the SPP in 2016, SPS procured
4		560,105 MW of regulation at a cost of \$3,152,765 or an average price of
5		\$5.63/MW. This price can be used to approximate the impacts of any additional
6		Regulating Reserve service SPS may need to purchase as a result of the addition
7		of the wind.
8	Q.	What are the additional costs of procuring the 4.06 MW of Regulating
9		Reserve?
10	A.	Using \$5.63/MW and 4.06 MW of additional reserves results in a maximum
11		annual cost of approximately \$200,234 (4.06 MW x \$5.63/MW x 8,760
12		hours/year).
13	Q.	What is the SPS retail customers' share of the \$200,234?
14	A.	It is approximately 65% or \$130,152 annually (combined for SPS's New Mexico
15		and Texas retail jurisdictions). However, as I will explain, the net dollar effect is
16		even less than this amount.

1 Q. Does SPS self-supply Regulating Reserve?

A. Effectively, yes. SPS sells Regulating Reserve into the SPP IM from its generators and separately purchases Regulating Reserves from the SPP IM for its load. SPS supplies approximately 97% of the Regulating Reserve ancillary services it requires to serve its load.

6 Q. How does self-supply affect the charges SPS will pay for the Regulating

7 **Reserve?**

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Since SPS assets sell Regulating Reserves to the SPP IM while SPS load simultaneously purchases regulation, this situation results in no additional costs from SPP to SPS for 97% of the required volumes. Thus, on a net basis, the costs to SPS would be approximately 3% of the annual \$200,234 for the increase in Regulating Reserve Service, or approximately \$6,000. As I mentioned earlier, approximately 65% of this net dollar amount would be assigned to SPS's two retail jurisdictions combined, or approximately \$3,900 annually.

Also, since SPS is supplying the incremental regulation, any deployed regulation further benefits SPS customers by selling deployed energy during RegUp events to the SPP or the repurchase of lower-priced energy during RegDown deployment events. Additionally SPP's make whole payment market

- 1 mechanisms assure no losses should circumstances result in a negative economic
- 2 outcome.

1 2		V. TRANSMISSION SERVICE FOR THE SPS WIND PROJECTS AND THE BONITA PPA
3	Q.	What topic do you discuss in this section of your testimony?
4	A.	I discuss how firm transmission service is not needed for the SPS Wind Projects
5		and Bonita PPA, but SPS will submit requests for firm transmission service in the
6		future. If the network upgrades necessary for firm transmission service fall within
7		a reasonable range of costs, then SPS may agree to pay for the upgrades, after
8		which the SPS Wind Projects and Bonita PPA would qualify for capacity credit
9		under the SPP Tariff for a portion of their nameplate capacity.
10	Q.	Is firm transmission service required for SPS to integrate the SPS Wind
11		Projects or Bonita PPA?
12	A.	No.
13	Q.	Even though firm transmission service is not required for either the SPS
14		Wind Projects or the Bonita PPA, has SPS submitted requests for firm
15		transmission service?
16	A.	No, not at this time.
17	Q.	Will SPS request firm transmission service for either the SPS Wind Projects
18		or the Bonita PPA?
19	A.	Yes, for both the SPS Wind Projects and the Bonita PPA.

I	Q.	Why would SPS request firm transmission service if it is not necessary?
2	A.	Acquiring firm transmission service could allow the SPS Wind Projects and
3		Bonita PPA to qualify for capacity credit. In particular, under SPP Criteria
4		12.1.5.3(g), if SPS obtains firm transmission service, then it could receive
5		approximately 185 MW of capacity credit (15% of the nameplate capacity)
6		towards SPS's planning reserve margin. Additionally, firm transmission service
7		provides transmission congestion rights.
8	Q.	Because SPS has not requested firm transmissions service, does it know what
9		the transmission cost impacts might be to secure firm network transmission
10		service for the SPS Wind Projects?
11	A.	No, not at this time.
12	Q.	Please describe the process by which SPS will request the SPP to study firm
13		transmission service for the SPS Wind Projects and the Bonita PPA.
14	A.	SPS will submit Transmission Service Requests to be entered into SPP's
15		Aggregate Study process. SPP will perform transmission service studies to
16		identify what network upgrades, if any, are necessary for the SPS Wind Projects
17		and Bonita PPA to receive firm transmission service. SPS will receive
18		preliminary results from the transmission service study no later than three months

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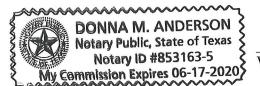
after the initial requests are submitted. Under the current Aggregate Study process, the final results will be known within six months of study commencement. SPS expects one of the following two end results and resulting actions: (1) if the transmission upgrades are significant, then SPS likely will not accept firm transmission service; (2) if the transmission upgrades are minimal, i.e., cost less than the benefits received from the firm service, then SPS would move forward with firm transmission service. The benefits to be evaluated would be the value of the capacity credit and an evaluation of the amount and potential value of the transmission congestion rights. Q. If SPS does not obtain firm transmission service, will that substantially affect the avoided energy savings SPS estimates for the SPS Wind Projects? No. The benefits described by Mr. Adelman are not dependent on receiving firm A. transmission service. Q. Does this conclude your pre-filed direct testimony? Α. Yes.

VERIFICATION

STATE OF TEXAS)
) ss
COUNTY OF POTTER)

WILLIAM A. GRANT, first being sworn on his oath, states:

I am the witness identified in the preceding testimony. I have read the direct testimony and the accompanying attachment and am familiar with their contents. Based upon my personal knowledge, the facts stated in the testimony are true. In addition, in my judgment and based upon my professional experience, the opinions and conclusions stated in the testimony are true, valid, and accurate.

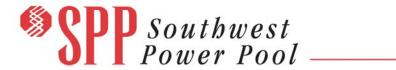


WILLIAM A. GRANT

SUBSCRIBED AND SWORN TO before me this ______ day of March, 2017.

Notary Public, State of Texas

My Commission Expires:



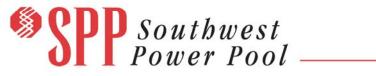
Calculating Regulating Reserve Requirements SPP Integrated Marketplace

SPP Operations 2/7/2017

Overview

Regulating Reserves in the SPP Integrated Marketplace are based on both the total market area load forecast and the total market area intermittent resource output forecast. Load forecast data is provided by SPP's Mid-term Load Forecast "MTLF", a component of SPP's GE EMS system. Intermittent resource forecast data, abbreviated to "IRF" below, is provided by Energy & Meteo.

The Regulation Up (RegUp) and Regulation Down (RegDown) MW value for each operating hour consist of the sum of four components. These components are a load magnitude component, a load variability component, an intermittent resource magnitude component, and an intermittent resource variability component. Magnitude components are simply just carrying a percentage of forecasted values as regulation. Variability components are intended to increase the amount of regulation carried in a given hour due to certain forecasted conditions. The variability components cannot be negative and, therefore, will not reduce the amount or regulation requirement derived from the magnitude components. All components are calculated each day for each operating hour on a rolling seven day ahead basis for both Regulation Up and Regulation Down.



Example Data

	Load Forecast	Intermittent Resource Forecast	
	(MTLF)	(IRF)	
Hour Ending	28975	3824	
7			
Hour Ending	32542	3161	
8	32312	3101	

Load Magnitude Coefficient (RegUp and RegDown)	0.005
Load Variability Coefficient (RegUp and RegDown)	0.02
Intermittent Magnitude Coefficient (RegUp and	0.01
RegDown)	
Intermittent Variability Coefficient (RegUp and	0.03
RegDown)	

The data above is intended for example purposes only and does not represent production environment conditions.

<u>Load Magnitude Component – Regulation Up and Regulation Down</u>

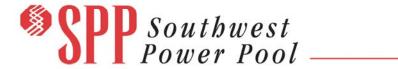
The load magnitude component will be calculated using the most recent MTLF data for the hour being calculated multiplied by the Load Magnitude Coefficient. RegUp and RegDown calculations can use different coefficients if needed. The load magnitude components of RegUp and RegDown are what many Balancing Authorities would consider to be the "standard" method of calculating a regulation reserve requirement.

Hour Ending X RegUp Load Magnitude Component

= (Hour Ending X MTLF) * (RegUp Load Magnitude Coefficient)

Example 1

Hour Ending 7 RegUp Load Mag. Comp. = (28975~MW)*(.005) =~144.875~MW



Hour Ending X RegDown Load Magnitude Component

 $= (Hour\ Ending\ X\ MTLF)$

* (RegDown Load Magnitude Coefficient)

Example 2

Hour Ending 7 REG Down Load Comp = (28975 MW) * (.005) = 144.875 MW

<u>Load Variability Component – Regulation Up and Regulation Down</u>

A load variability component is used in both RegUp and RegDown calculations. These components are intended to increase the total amount of RegUp or RegDown when a large change is occurring in the load forecast from one hour to the next. For RegUp, this variability component is only valid when the load forecast is increasing from the current hour to the next hour. For RegDown, the load forecast must be decreasing for the variability component to be valid. When a component is invalid due to these rules, a value of zero is used.

Hour Ending X RegUp Load Varability Component

$$= [(Hour\ Ending\ X + 1\ MTLF) - (Hour\ Ending\ X\ MTLF)]$$

 $*(RegUp\ Load\ Var.\ Coefficient)$

 $(Hour\ Ending\ X+1\ MTLF)-(Hour\ Ending\ X\ MTLF)\ must\ be$

>0 for the RegUp Load Varability Component to be valid

Example 3

Hour Ending 7 RegUp Load Var. Comp. =
$$(32542 - 28975) * 0.02$$

= 71.34 MW

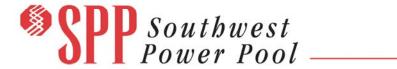
 $Hour\ Ending\ X\ RegDown\ Load\ Varability\ Component$

 $= [(Hour\ Ending\ X + 1\ MTLF) - (Hour\ Ending\ X\ MTLF)]$

 $*(RegUp\ Load\ Var.\ Coefficient)*(-1)$

 $(Hour\ Ending\ X+1\ MTLF)-(Hour\ Ending\ X\ MTLF)\ must\ be$

 $< 0 \ for \ the \ Reg Down \ Load \ Varability \ Component \ to \ be \ valid$



Example 4

Hour Ending 7 RegDown Load Var. Comp. =
$$(32542 - 28975) * 0.02 * -1$$

= 0

Since the load forecast is increasing from Hour Ending 7 to Hour Ending 8, the Load Variability Component for RegDown is not valid for Hour Ending 7.

<u>Intermittent Resource Magnitude Component – Regulation Up and Regulation Down</u>

The Intermittent Resource Magnitude Component will be calculated using the most recent IRF multiplied by the Intermittent Resource Magnitude Coefficient. RegUp and RegDown calculations can use different coefficients if needed.

Hour Ending X RegUp Intermittent Resource Magnitude Component

- $= (Hour\ Ending\ X\ IRF)$
- * (RegUp Intermittent Resource Magnitude Coefficient)

Example 5

Hour Ending X RegDown Intermittent Resource Magnitude Component

- $= (Hour\ Ending\ X\ IRF)$
- * (RegDown Intermittent Resource Magnitude Coefficient)

Example 6

Intermittent Resource Variability Component – Regulation Up and Regulation Down

An intermittent resource variability component is used in both RegUp and RegDown
calculations. These components are intended to increase the total amount of RegUp or
RegDown when a large change is forecasted to occur in the intermittent resource output
from one hour to the next. For RegUp, this variability component is only valid when the



intermittent resource forecast is decreasing from the current hour to the next hour. For RegDown, the intermittent resource forecast must be increasing for the variability component to be valid. When a component is invalid due to these rules, a value of zero is used.

Hour Ending X RegUp Intermittent Resource Varability Component $= \left[(Hour\ Ending\ X + 1\ IRF) - (Hour\ Ending\ X\ IRF) \right] \\ * (RegUp\ Load\ Var.\ Coefficient) * (-1)$ (Hour Ending X + 1 IRF) - (Hour\ Ending\ X\ IRF) must be $< 0\ for\ the\ RegUp\ Intermittent\ Resource\ Varability\ Component\ to\ be\ valid$

Example 7

Hour Ending 7 RegUp I.R. Var. Comp. = (3161 - 3824) * 0.03 * (-1) = 19.89 MW

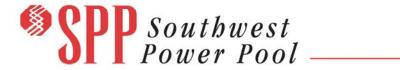
Hour Ending X RegDown Intermittent Resource Varability Component

= $[(Hour\ Ending\ X + 1\ IRF) - (Hour\ Ending\ X\ IRF)]$ * $(RegUp\ Intermittent\ Resource\ Var.\ Coefficient)$ (Hour Ending X + 1 IRF) - $(Hour\ Ending\ X\ IRF)$ must be

> 0 for the RegDown Load Varability Component to be valid

Example 8

Hour Ending 7 RegDown I. R. Var. Comp. = (3161 - 3824) * 0.03 = 0Since the intermittent resource forecast is decreasing from Hour Ending 7 to Hour Ending 8, the Intermittent Resource Variability Component for RegDown is not valid for Hour Ending 7.



Summing the Four Components – Regulation Up and Regulation Down

The sum of the four components for RegUp and RegDown will give the hourly MW requirement for each. Values are rounded to the nearest whole MW.

Example 9

Hour Ending 7 RegUp Requirement = 145 + 71 + 38 + 20 = 274 MW

Example 10

Hour Ending 7 RegDown Requirement = 145 + 0 + 38 + 0 = 183 MW