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TESTIMONY OF

BARTHOLOMEW A. McMANUS and STEPHEN H. ENYEART

Witnesses for Bonneville Power Administration

SUBJECT: RESERVE CAPACITY FORECAST FOR WIND GENERATION WITHIN-HOUR BALANCING SERVICE

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Section 1: Introduction and Purpose of Testimony

Q. Please state your names and qualifications.

A. My name is Bartholomew A. McManus and my qualifications are stated at WI-09-Q-BPA-10.

A. My name is Stephen H. Enyeart and my qualifications are stated at WI-09-Q-BPA-04.

Q. What is the purpose of your testimony?

A. The purpose of this testimony is to describe and explain the Bonneville Power Administration (BPA) Transmission Services' (TS) methodology for calculating the reserve capacity needed for within-hour balancing for wind generation in BPA's Balancing Authority Area in Fiscal Year (FY) 2009.

Q. How is your testimony organized?

A. The testimony is organized in four sections. Section 1 is this introduction. Section 2 provides a background, including a description of BPA's reliability requirements for transmission system within-hour balancing. Section 3 describes the methodology for calculating the reserve capacity needed for within-hour balancing for wind generation in FY 2009. Section 4 quantifies the amount of reserve capacity BPA needs for within-hour balancing for wind in FY 2009.

Section 2: Background

Q. What are the reliability requirements for within-hour balancing?

A. BPA is a Balancing Authority, an entity that is required to comply with the North American Electric Reliability Corporation (NERC) transmission system reliability requirements. NERC Control Performance Standard 2 (CPS2) requires that at any given time, BPA must ensure that electrical power production of generators interconnected within its Balancing Authority Area equals load. Load in this context consists of the power consumed within the Balancing Authority Area plus generation transmitted outside of BPA's Balancing Authority Area.

Q. How does BPA provide within-hour balancing?

A. BPA provides within-hour balancing by instantaneously increasing generation or decreasing generation by calling upon reserve capacity that has been set aside to manage unanticipated variations between the generation and load within each hour. Reserve capacity is extra capacity set aside to meet unanticipated changes in demand for power or to meet other variations between load and generation.

Q. How does BPA use reserve capacity instantaneously for within-hour balancing?

A. BPA provides within-hour balancing service by using an Automatic Generator Control (AGC), a system that is on-line at all times to instantaneously balance load and generation. Within-hour balancing requirements are comprised of two different reserve requirement services that provide balancing for two different time periods within the hour: regulation service (which compensates for moment-to-moment variances between generation and load) and following (which compensates for larger variances that occur over longer time periods, between five and 60-minutes).

Q. Please elaborate on the difference between regulation and following.

A. Regulation compensates for the variations between load and generation that occur from one minute to the next. For example, if at 12:01 load exceeds generation by 4 megawatts (MW), AGC instantaneously calls on reserve capacity to increase generation by 4 MW to eliminate the variance. Following compensates for within-hour variances of load and generation that occur over a longer time period, between five and 60 minutes. For example, if from 12:05 to 12:15 the load steadily increases by 100 MW, following eliminates the variance by increasing generation 100 MW over the 10-minute period to match the load. See Attachment A.

Q. Why is the reserve requirement limited to the effects of wind generation, excluding other types of generation integrated into BPA's Balancing Authority Area?

A. Wind increases the demand for reserve capacity needed to meet within-hour balancing requirements because its unpredictability imposes greater operating challenges than traditional, more constant output generators. Wind resources generate only when the wind blows, and the wind can vary from moment-to-moment within the hour. Other types of resources predictably vary slightly within the hour, causing only trivial effects on BPA's within-hour balancing requirements. Attachment B demonstrates the actual generation variability of thermal generation versus the variability of wind generation in BPA's Balancing Authority Area. During the four day period, the thermal generator varied slightly when generating while the wind generation varied greatly, at some points not generating at all. Wind dramatically affects BPA's within-hour balancing requirements because of the significant minute-to-minute oscillation in the output at each generator as the wind velocity changes.

Q. What are the sudden decreases and increases in thermal generation shown in Attachment B?

A. The sudden decreases and increases in thermal generation correspond to changes in the generator's schedule. Therefore, they are not imbalances but instead reflect deliberate changes in output to meet the new schedule. As the chart demonstrates, the sudden up and down changes all occurred during the standard ramp period of ten minutes to until ten minutes after the hour.

Q. How does Attachment B show the output of wind generators changing to meet schedules?

A. Attachment B shows no sudden changes in output of wind during the standard ramp period. Therefore, if wind generators changed their schedules, their output did not change to meet the new schedules.

Section 3: Methodology to Forecast Reserve Capacity Needed For Within-Hour Balancing For Wind Generation In Fiscal Year 2009

A. Methodology Overview

Q. Please describe the general methodology you used to forecast the amount of reserve capacity needed for within-hour balancing for wind in FY 2009.

A. We first calculated the reserve requirements for regulation and for following. Adding these together gave us the total reserve requirement for BPA's Balancing Authority Area. We then calculated the regulation and following requirements for BPA's internal load; that is, load within the Balancing Authority Area, and added them together to derive the total reserve requirement for internal load. We then derived the reserve requirements for wind generation alone by subtracting the reserve requirement for the internal load from the reserve requirement for the entire Balancing Authority Area.

Q. Is there industry support for using this methodology?

A. Yes. This methodology is recognized by a technical team that we worked with as part of The Northwest Wind Integration Action Plan. The technical team consisted of representatives from other electric utilities, environmental organizations, and research institutions, all of which share the common purpose of determining how to quantify the within-hour balancing reserve requirements for wind generation. The technical team recognized that within-hour balancing requirements of wind generation include reserve capacity for the regulation and following timeframes, and that they can be estimated by subtracting the reserve requirements for the internal load from the reserve requirements for the entire Balancing Authority Area.

B. Forecast of FY 2009 Reserve Requirements for BPA's Balancing Authority Area

Q. Please describe the approach you used to forecast the reserve requirements for the Balancing Authority Area.

A. We separately calculated the reserve requirements for following and regulation for each minute of a sample of minute-to-minute data. We started by forecasting the FY 2009 internal load for each minute, as explained in detail in Section B(1). We then forecast the amount of wind generation that will be integrated into the Balancing Authority Area during FY 2009, including project location and installed capacity; that is, the amount of energy each generator is capable of producing at any one time. See Section B(2). Based on the FY 2009 forecast of installed capacity, we then forecast the FY 2009 minute-to-minute wind generation in the Balancing Authority Area. See Section B(3). We then used the forecasted minute-to-minute wind generation data and load data to calculate the amount of reserves needed for following and regulation, together referred to as the reserve requirements needed to balance the entire Balancing Authority Area in FY 2009.

(1) FY 2009 Internal Load Data

Q. How did you forecast FY 2009 minute-to-minute internal load?

A. We forecast the FY 2009 internal load by first downloading four months of historical minute-to-minute internal load data from BPA's Plant Information (PI) system. PI is a system in BPA's control center that electronically stores load and generation data.

Q. Why did you choose a four-month sample timeframe of load data to estimate future load data for FY 2009?

A. Ideally, I would estimate future FY 2009 load data by using an entire year of historical load data. However, a year of sample load data would amount to several thousand pages of data. Such a sample would be much too large to perform the necessary calculations to predict reserve requirements. BPA's total system load varies on a seasonal basis and is highest in the summer and winter (because of air conditioning and heating loads, respectively). Therefore, I used four months of historical load data to represent the variable load trends experienced during each of the four operating seasons: summer (August 2006), fall (November 2006), winter (February 2007), and spring (April 2007). This was the most recent data available for a full one-year period.

Q. Did you increase the load data from the sample timeframe to forecast the FY 2009 load data to account for load growth?

Yes. When forecasting load for system planning purposes, BPA transmission planners assume that total system load increases on average of 1.5% per year. To predict the minute-to-minute internal load in FY 2009 we increased the sample data by 1.5% per year. For example, we multiplied the August 2006 data by 1.5% to calculate the estimated minute-to-minute load for FY 2007, multiplied that data by 1.5% to estimate the minute-to-minute load in FY 2008, and multiplied the FY 2008 minute-to-minute load by 1.5% to finally forecast the FY 2009 minute-to-minute load.

(2) Wind Project Forecast

Q. What was your forecast of wind generation in BPA's Balancing Authority Area in FY 2009?

A. We used a BPA wind project forecast maintained by BPA planning to determine the amount of wind that will be in FY 2009, as well as the projects' locations and estimated installation dates. The list includes 1,380 MW of installed wind generating capacity as of December 2007 from existing wind resources; 857 MW of proposed wind expected to be installed by the end of FY 2008; and 640 MW expected to be installed during the last two months of FY 2009. The forecast resulted in 2,237 MW of wind generation expected for the first ten months of FY 2009 and 2,877 MW during the last two months. The proposed projects are all projects that BPA is currently processing pursuant to the Federal Energy Regulatory Commission (FERC) Large Generation Interconnection Procedures

(LGIP). Attachment C shows a list every wind project installed and anticipated to be installed by the end of FY 2009.

Q. *How did you forecast these amounts?*

A. The wind project forecast estimates each project's installation date by taking into account the following factors: the wind project's progress in permitting, completion of engineering and environmental studies, and land acquisition issues. We also talked to each developer to determine a realistic installation date.

(3) FY 2009 Wind Generation Data

Q. *Please briefly describe the methodology used to forecast the minute-to-minute wind generation in FY 2009.*

A. Forecasting the minute-to-minute wind generation allows us to subtract these figures from each minute of load data to calculate the reserve requirement for each minute during the rate period. To forecast the FY 2009 minute-to-minute wind generation, ideally we would start by downloading a year's worth of actual wind generation data from each existing wind project. However, the sample size would be unwieldy and would not match the time frame of the internal load data we used. Instead, we used BPA's PI system to download minute-to-minute wind generation data from nine existing wind resources in BPA's Balancing Authority for the same four-month sample time frame. See Attachment D, Table 1D for a list of the existing wind projects used. The minute-to-minute generation data was derived from individual energy usage meters connected to each of the nine existing wind generators in BPA's Balancing Authority Area. We used the existing wind generation data to forecast how planned wind resources in FY 2009 that are not yet installed will generate during the sample time frame. The existing generation plus planned generation represents the forecasted FY 2009 wind generation data.

Q. *Were there any missing data?*

A. The data were missing for 0.1% of the wind generation data, including fewer than ten times with respect to periods of time more than five minutes. These errors were due to standard communication problems with individual meters. We identified and filled in the missing data.

Q. Please explain how you filled in missing data or periods lasting four minutes or less.

A. For missing data for periods of four minutes or less, we manually filled in numbers by plotting a straight line from the last minute before the missing data to the first minute reported after the missing data. This method was consistent with the how we observed the wind to oscillate based on the actual data downloaded. For example, if minute 1:03 reported 5 MW of wind generation, minutes 1:04 to 1:06 were missing, and minute 1:07 reported 10 MW of generation, we filled in minutes 1:04 through 1:06 by assuming a steady increase over the three minutes from 5 MW to 10 MW. Thus, we assumed 6.25 MW for minute 1:04; 7.5 MW for minute 1:05; and 8.75 MW for minute 1:06.

Q. Please explain how you filled in the missing data for periods lasting five minutes or more.

A. For missing data for periods of more than five minutes, we determined that plotting a straight line between the last minute reported before the missing data and the first minute reported after the missing data would not accurately predict the actual movement of wind generation. We observed that, over periods of five minutes or longer, wind generation is more random because of the random changes in wind speed over longer periods of time. In order to mimic actual generation patterns, we filled in the missing data with random numbers using the Microsoft Excel randomizing function. Under this program, the user sets an upper and lower bound and the program randomly generates a number between those bounds. When we plotted actual generation patterns on a graph, we observed that the amount generated rarely varied more than 3 MW from one minute to the next. Therefore, we set the upper and lower bounds so that the random number generated for the missing minute would be within 3 MW above or below the generation reported for the prior minute. For periods of more than five minutes, calculating values for each minute by plotting a straight line from the last to the next accurate number would incorrectly result in a steady increase or decrease in wind generation rather than the small minute-to-minute variations that reflect actual wind operation.

Q. How did you forecast the output from planned wind resources?

A. We forecast the output from planned wind resources using the downloaded minute-to-minute wind generation data from the nine existing wind resources as a baseline. Because wind generation depends on prevailing weather patterns, wind resources in locations with similar meteorological conditions have similar generation patterns. Therefore, when a prevailing weather pattern occurs, that is, when the wind speed is strong enough to cause wind resources to generate, each wind resource in locations with similar meteorological conditions responds to the weather pattern similarly. If an existing wind resource is generating, a planned resource in a similar meteorological location will generate around the same time period for the same length of time. The resource that is upwind will generate first; when the wind reaches the downwind resource, it will begin generating.

Q. How did you determine when the planned resource would begin generating?

A. We applied time delays between the existing and planned resources; that is, we determined the average amount of time it takes the wind from the predominate direction to travel between two resources and applied it to the generation data from existing resources to predict the minute-to-minute generation for each planned resource. See Attachment D, Table 2D for a list of the time delays applied between each planned and existing resource.

Q. How did you determine the average time delay between each existing and planned wind resource?

A. The average time delays were supplied by a company called 3Tier, a professional wind forecasting firm in Seattle. We chose 3Tier to supply the wind data because 3Tier had previously developed a wind pattern model of a large geographical area that included many of the installed wind projects in BPA's Balancing Authority Area as well as most of the planned wind projects. BPA provided 3Tier with the exact locations of each existing and expected wind resource in BPA's Balancing Authority Area in FY 2009. 3Tier supplied the average time delays between the resource locations using a meteorological model called the Mesoscale Model that models the weather patterns within a defined geographic area. The Mesoscale Model assumes that wind generation will change if the wind speed changes by at least 0.7 meters per second.

Q. Please explain how you applied the time delays between the existing and planned resources to forecast the minute-to-minute generation for planned resources.

A. We started with the forecasted minute-to minute generation data for the four months of FY 2009 for each existing wind resource. For each planned resource, we chose an existing wind generator, that, according to 3Tier's data, would change its generation output a given time before (lead) or after (lag) the planned resource changed its generation output. Based on the lead and lag time data supplied by 3Tier, we then calculated the time it would take for the wind to travel from the planned resource to the existing resource. This time delay is the time it would take for the second resource to change its generation output. Based on the time delay and the minute-to-minute data for the existing resource, we could estimate the timing and amount of generation at the planned resource.

For example, if Existing Resource A generates for 40 minutes starting at 1:00 p.m. and the time delay between Existing Resource A and Planned Resource B is 20 minutes, then Planned Resource B will begin generating at 1:20 p.m. and will generate until 2:00 p.m.

We separately forecasted the minute-to-minute wind generation data based on 2,237 MW and 2,877 MW of installed wind.

Q. *How did you account for the difference in installed capacity between each existing resource and the planned resource with which it was correlated?*

A. We compensated for this difference in calculating how much the planned resource would generate. For example, assume that Existing Resource A has a generating capacity of 100 MW, and generates 50 MW at 1:00 p.m. for 40 minutes. If there is a 20-minute time delay between Existing Resource A and Planned Resource B, Planned Resource B will begin generating at 1:20 p.m. and stop generating at 2:00 p.m. If Planned Resource B has a generating capacity of 150 MW, the expected generation of this resource for this period is 75 MW: (150 MW/100 MW) X 50 MW. We used this methodology to determine the forecasted minute-by-minute generation level at each planned wind resource for the sample time frame to create data sets estimating the output for 2,237 MW and 2,877 MW of installed wind generation. See Attachment D.

(4) FY 2009 Following and Regulation Reserves for the entire Balancing Authority Area

Q. *How did you use the forecasted minute-to-minute load data and wind generation data to calculate the following reserve requirement for the Balancing Authority Area?*

A. The two sources of variability in the Balancing Authority Area are wind generation and load. For each minute of data, we subtracted the wind generation from the load. In essence, we treat the wind generation as negative load. The difference in the results from each minute to the next is the change in "load" that the Balancing Authority must meet. Since the BPA forecast for installed wind generation in FY 2009 is in two phases, we actually did this twice, first subtracting the generation data for 2,237 MW of wind generation and then subtracting the generation data for 2,877 MW of wind generation.

We then calculated a 60-minute rolling average for each minute. For example, the 60-minute rolling average at 1:30 is the average from 1:00 to 2:00; the 60-minute rolling average at 1:31 is the average from 1:01 to 2:01. We then subtracted each 60-minute rolling average from the 60-minute average for the next hour. For example, we subtracted the 60-minute average at 1:30 from the 60-minute average at 2:30. For each minute during the sample time frame, this gave us the change in load from the prior hour.

Q. How did you use this data to calculate the reserve requirement for following?

A. We now had over 40,000 data points for each month of the sample time frame showing the hourly changes in "load" at 2,237 MW and 2,877 MW of wind generation. We threw out the highest one half of one percent of the data points for each month to eliminate the effects of extreme outlying figures. The top number left for each month was the amount of following reserves needed 99.5 percent of the time during the month. We averaged the figures for the four months at 2,237 MW of wind and 2,877 MW of wind generation. The reserve requirement at 2,877 MW of wind generation was unreasonably high and therefore we added a fifth month, October 2006, to the 2,877 MW case and scaled up the load and wind generation to FY 2009. The result determined that we need 829.9 MW of following for 2,237 MW of wind and 926.8 MW of following for 2,877 MW of wind. See Attachments E and F.

Q. Why did you use 99.5%?

A. We used the percentile distribution function in Microsoft Excel to calculate the amount of reserves that would be sufficient 99.5% of the time. The percentile distribution function is a common statistical method used when a simple average would be misleading. BPA engineers have traditionally used the mean plus three standard deviations to calculate reserve requirements in the BPA Balancing Authority, which results in the amount of reserve requirement needed 99.7% of the minutes in the sample time frame. Here, the data did not form a normal bell curve because of the larger amounts of load and generation distributed toward each end of the curve. We used the 99.5 percentile, that is the amount of reserve requirement needed 99.5% of the minutes in the sample time period, because it eliminates the larger number of outlying numbers.

Q. *How did you use the forecasted minute-to-minute load data and wind generation data to calculate the regulation reserve requirement for the Balancing Authority Area?*

A. We calculated the regulation reserve requirement for the Balancing Authority Area by subtracting the load for each minute from the 60-minute rolling average for that minute. For example, we subtracted the load at 1:30 from the rolling average from 1:00 to 2:00. This gave us the difference between the load for each minute and the average load for that hour. This difference is the amount of regulation required for that minute. We calculated the reserve requirement for regulation separately for 2,237 MW and 2,877 MW of installed wind. Using the same methodology we used for following, we calculated the amount of regulating reserves required 99.5% of the time. This resulted in 154 MW of regulation reserves needed for 2,237 MW of wind generation and 157 MW of regulation for 2,877 MW of wind generation.

Q. *What is the total reserve requirement for the Balancing Authority Area?*

A. The total reserve requirement for the entire Balancing Authority Area is the following plus the regulation: 983.8 MW for 2,237 MW of wind generation and 1,083.8 MW for 2,877 MW of wind generation. See Attachments E and F.

C. Forecast of FY 2009 Reserves Requirement for Internal Load

Q. *How did you calculate the reserve requirements for following and regulation for internal load?*

A. We performed the identical calculations used for the entire Balancing Authority Area, except that we used load data for each minute instead of load minus wind generation data. We used two sets of load data, one set for the beginning of FY 2009 and one set for the end of FY 2009, to correspond to the two time periods we used for wind generation. We determined that we needed 669.4 MW of following reserves at the beginning of FY 2009 and 688.6 MW for the end of FY 2009. We determined that we needed 124 MW of regulation reserves at the beginning of FY 2009 and 127.2 MW of regulation reserves at the end of FY 2009. The total reserve requirements for the internal load were 793.4 MW at the beginning of FY 2009 and 815.8 MW at the end of FY 2009. See Attachments E and F.

Section 4: Study Results – Reserve Capacity Needed For Within-Hour Balancing For Wind Generation

Q. *What are the forecasted reserve requirements for within-hour balancing for wind generation in FY 2009?*

A. For the FY 2009 cases, we subtracted the regulation and following requirements for the internal load from the regulation and following requirements for the entire Balancing Authority Area. This resulted in 30 MW of regulation (154 MW – 124 MW) and 160.5 MW of following (829.9 MW – 669.4 MW) for 2,237 MW of wind generation, and 29.8 MW of regulation (157 MW – 127.2 MW) and 238.2 MW of following (926.8 MW – 688.6 MW) for 2,877 MW of wind generation. We determined that the total reserve requirement is 190 MW for 2,237 MW of wind generation and 268 MW for 2,877 MW of wind generation. See Attachments E and F.

Q. *How did you calculate the average amount of reserves needed for the entire FY 2009?*

A. In order to estimate the average reserves needed throughout FY 2009, we used the weighted average of the forecasted reserves for the first ten months (October through July) and the last two months (August through September) of the fiscal year. We calculated the weighted average for the reserve requirements as 203 MW ((190 MW x 10 months) + (268 MW x 2 months))/12 months = 203 MW).

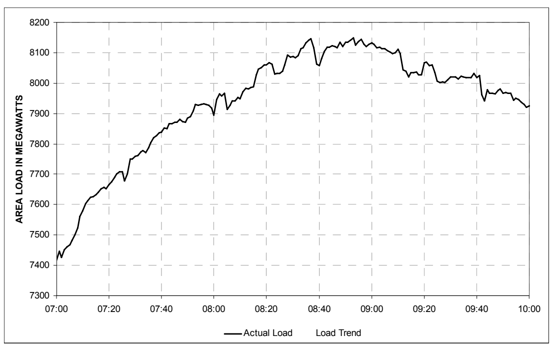
Q. *Does this conclude your testimony?*

A. Yes.

Attachment A, Table 1A

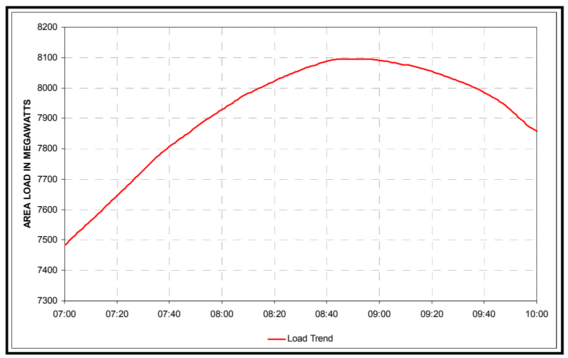
Regulation versus Following

- Regulation is the minute-to-minute difference between actual generation and load signal (AGC).
- Following is defined as the change in the general trend over a specific time interval – 5, 10, 15 or even 20 minutes.



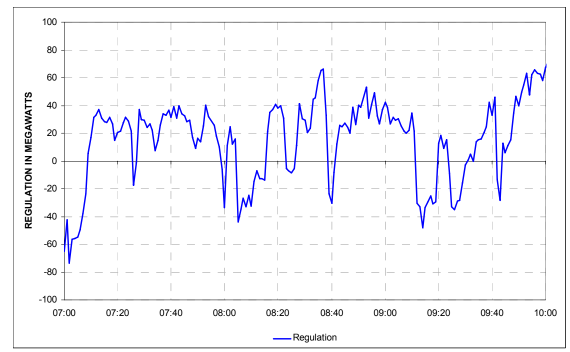
Actual Load

=



Following Curve

+



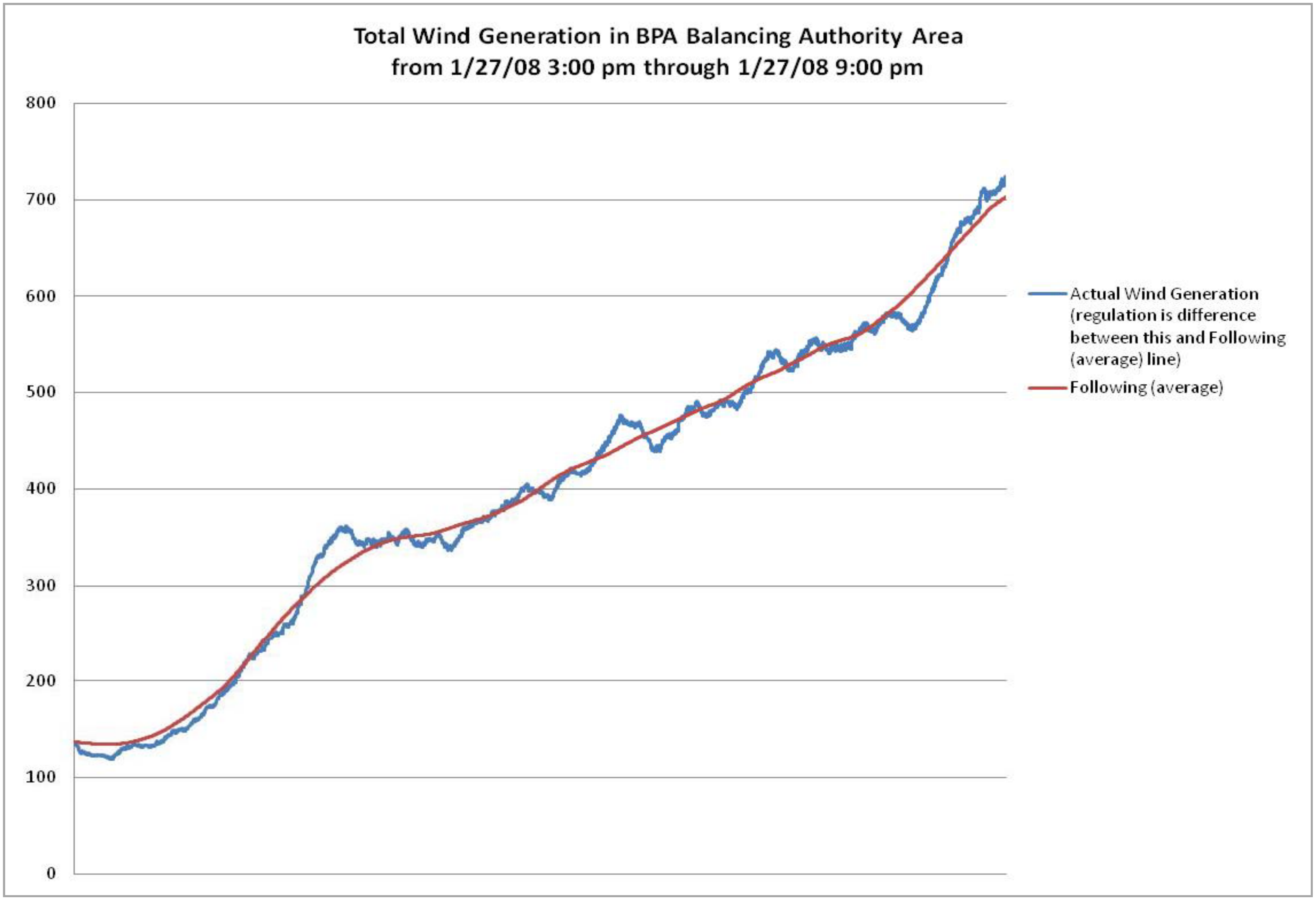
Regulation

Balancing is the within-hour adjustments for variances of Load and Generation:

Within-Hour Balancing = Following + Regulation

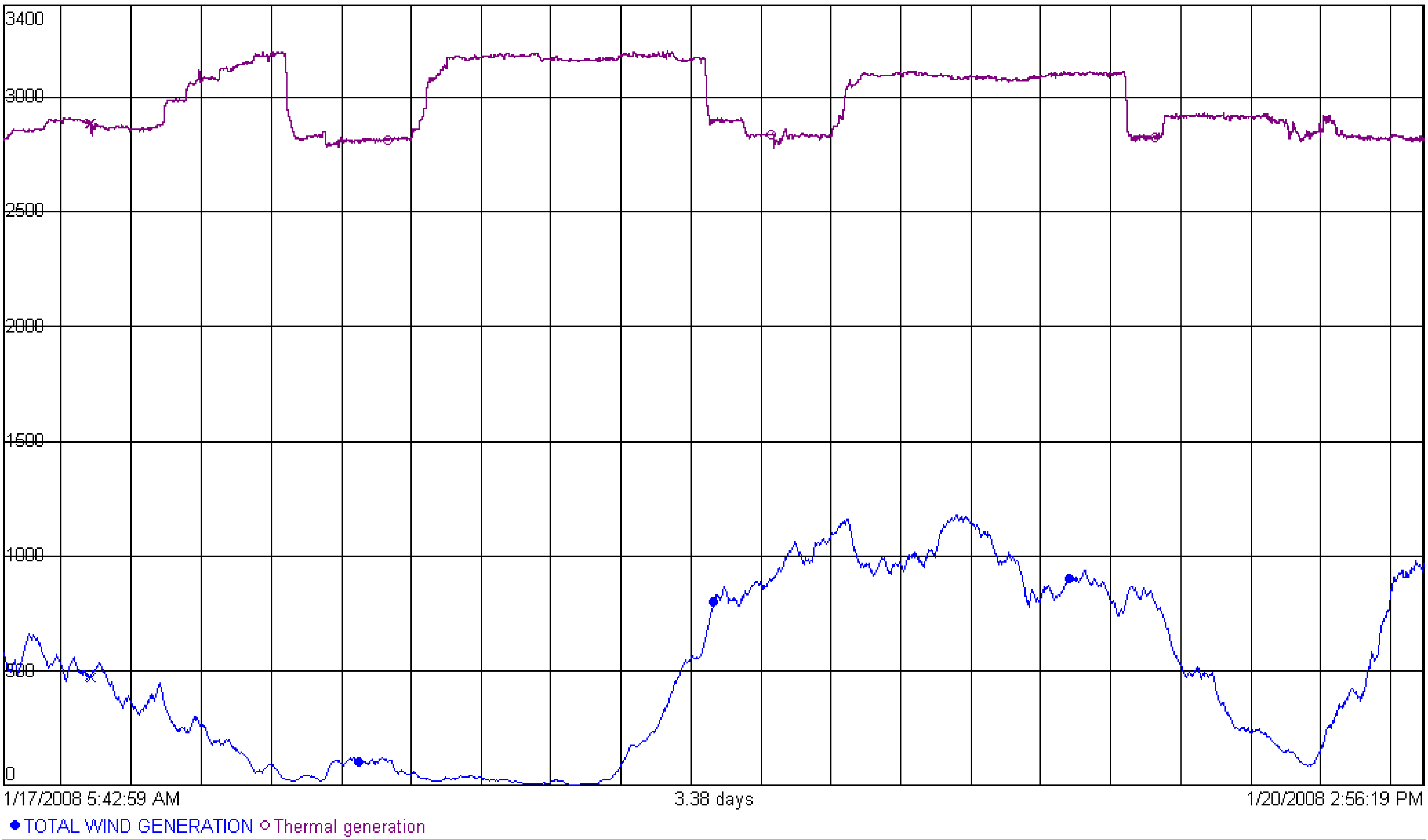
Attachment A, Table 2A

Regulation versus Following



Attachment B

Thermal Generator Within-Hour Variance Compared to Wind Generation



Attachment C
FY 2009 Wind Project Forecast

	A	B	C	D	E	F	G
	PROJECT NAME **S. Enyeart - As of: 10/2007 (Note 1)**	**GI Installed MW**	**In BPA Control Area**	**Year in Service**	**Reasons for Proposed In Service Date**	**Request Date in Service**	**LOCATION**
1	Vansycle Wind Project	25	25	1996	OnLine	N/A	South of Walla Walla WA
2	Stateline Wind Project	90	90	2000	OnLine	N/A	South of Pasco WA (Nine Mile substation)
3	Condon Wind Project	50	50	2000	OnLine	N/A	near Condon OR
4	Klondike Phase I	24	24	2000	OnLine	N/A	East of Wasco OR
5	Nine Canyon I/Ia	63	18	2001	OnLine	N/A	Near Kennewick WA
6	Klondike Phase II	76	76	6/2005	OnLine	9/2003	East of Wasco OR
7	Blue Sky/Hopkins Ridge	150	150	12/2005	OnLine	12/2003	East of Dayton WA
8	Big Horn Wind Project	200	200	6/2006	OnLine	1/2004	East of Goldendale WA
9	Leaning Juniper Phase 1	100	100	10/2006	OnLine	1/2004	South of Arlington OR
10	White Creek Wind	200	200	8/1/07	Interconnection complete 8/1/2007.	9/2006	SW of Bickleton WA - Rock Creek Substation
11	Goodnoe Hills - Phase	96	96	11/2007	Interconnection in progress for 11/1/2007.	6/2006	SE of Goldendale WA -Rock Creek Substation
12	Biglow Canyon Wind Phase 1	126	126	10/2007	Interconnection complete 10/1/2007.	12/2003	NE of Wasco OR, connect to John Day
13	Klondike III part 1 and 2	225	225	10/2007	Interconnection complete 8/1/2007.	1/2006	East of Wasco OR, connect to John Day
14	**Additions 2007:**	**647**	**647**				
15	**Total as of 12/2007:**	**1425**	**1380**				
	Scheduled for 2008:						
16	Nine Canyon III Addition	32	32	10/2008	Interconnection in progress for 1/10/2008.	6/2003	Near Kennewick, Add'n to existing wind farm
17	Pebble Springs (Leaning Juniper II)	100	100	9/2008	Permits done/LGIA signed, date per PPM	1/2004	South of Arlington - Jones Canyon Substation
18	Klondike III part 3	75	75	5/2008	Permits done/LGIA ned, date per PPM	1/2006	East of Wasco OR - John Day substation
19	Arlington Wind	200	200	9/2008	Permits done/LGIA signed, date per Horizon	1/2005	Southwest of Arlington - Jones Canyon Subst
20	Miller Ranch (Sand Ridge I)	100	100	10/2008	E&P signed, funded, CX only required	10/2008	South of Bickleton Wa - Rock Creek Substation
21	Hay Canyon (Locust Grove)	100	100	9/2008	E&P signed, funded, CX only required	12/2008	East of Wasco OR, connection to PPM Klondike
22	Windy Point Wind PH I and II	100	100	10/2008	Permits done/LGIA signed, date per Cannon	10/2005	Southeast of Goldendale - Rock Creek Substation
23	Willow Creek Wind	100	100	10/2008	NEPA, E&P funded, date per Invenergy	10/2005	Southeast of Arlington OR
24	Big Horn Wind Project Phase 3	50	50	10/2008	Permits done/LGIA signed, date per PPM	6/2007	East of Goldendale WA
25	**Additions 2008:**	**857**	**857**				
26	**Potential Total as of 10/2008:**	**2282**	**2237**				

Attachment C
FY 2009 Wind Project Forecast

	A	B	C	D	E	F	G
	PROJECT NAME **S. Enyeart - As of: 10/2007 (Note 1)**	**GI Installed MW**	**In BPA Control Area**	**Year in Service**	**Reasons for Proposed In Service Date**	**Request Date in Service**	**LOCATION**
	Listed for 2009:						
27	Biglow Canyon Wind Phase 2 (John Day 230kV Substation)	150	150	8/2009	LGIA signed, phase II, date per PGE request	10/2003	Add phase 2 to existing site
28	Golden Hills (BP South Wind) (John Day 230kV Substation)	200	80	8/2009	NEPA underway, Studies complete, date estimated per BPAE plans	10/2004	East of Moro OR
29	White Creek III (Roosevelt site)	100	100	8/2009	NEPA underway, Studies complete, date per White Creek request	12/2003	Addition to White Creek (nearer Roosevelt area)
30	Willow Creek	50	50	8/2009	Remainder of 2008 project	10/2005	Southeast of Arlington OR
31	Big Horn Wind Project Phase 2 (Rock Creek Substation)	150	0	10/2009	NEPA underway, Studies complete, date per PPM Energy request	10/2007	South of Bickleton WA
32	Kittitas Valley Wind Project	110	110	8/2009	NEPA underway, Studies complete, date per Horizon request	6/2003	North of Ellensburg WA,
33	Goodnoe Hills (Rock Creek Substation)	54	0	10/2009	Remainder of 2007 project	6/2006	South of Rock Creek substation
34	Saddleback Wind Project	70	0	10/2009	NEPA delayed, Studies complete, date estimated based on earlier discussions	3/2004	West of White Salmon WA.
35	Reardon - Twin Buttes	75	0	10/2009	NEPA delayed, Studies complete, date estimated based on earlier discussions	11/2006	SW of Grand Coulee
36	Windy Point Wind PH I and II (Rock Creek Substation)	150	150	8/2009	Permits done/LGIA signed, date per Cannon, continuation of WTG delivery in 2009	10/2007	South of Goldendale WA
37	Windy Flats 1 & 2 (Windy Point Wind PH III)	90	0	12/2009	Permits underway, studies complete, date per Cannon, continuation of WTG delivery in 2009	12/2008	South - SW of Goldendale
38	Combine Hills Phase II	65	0	2009	NEPA underway, Studies complete, date per White Creek request	1/2005	Southwest of Walla Walla WA,
39	Cascade Wind	50	0	2009	NEPA underway, Studies complete, date per White Creek request	10/2008	West of The Dalles
40	**Additions 2009:**	**1314**	**640**	**by 8/1/2009**		**by 8/1/2009**	
41	**Potential Total as of 12/2009:**	**3481**	**2877**				

Notes:
1. Table is basis for Integration Rate analysis. Based on forecast as of 10/2007. Changes in expected generation MW / date of interconnection due to more recent information not included.
2. GI installed capacity is amount of request, may be split between years.
3. In BPA Control Area column includes amount estimated to be on-line by 8/1/2009
4. Labels: LGIA - Large Generation Interconnection Agreement
   E&P - Engineering and Procurement Agreement used to fund project initially before LGIA signed
   CX - Categorical Exclusion used under NEPA guidelines

Attachment D

Table 1D: Planned Resource Wind Generation Data Forecasting Methodology

Table 1: Existing Wind Projects Used to Forecast Wind Generation Data for Planned Resources	
Existing Wind Projects**	Capacity (MW)
Condon	50
Klondike I	24
Klondike II	76
Nine Canyon	18
Stateline	90
Vansycle	25
Hopkins Ridge	150
Leaning Juniper	100
Big Horn	200
Total	**733**

**Wild Horse, a 240 MW capacity wind project, was used to forecast the output for the planned Kittitas Valley Wind Project. Wind generation data for Wild Horse was obtained from Puget Sound Energy to estimate the output of the Kittitas Valley Wind Project.

	Attachment D Table 2D: Time Delays Between Planned and Existing Wind Resources Used to Forecast Generation Data				
	A	B	C	D	E
	2007 Planned Resources	**Capacity (MW)**	**Existing Resource Correlated to Estimate Generation Data for Planned Resources**	**Time Delay between Planned Resource Leads or Lags the Existing Resource**	**Time Delay**
1	White Creek I	100	Big Horn	Leads	10 minutes
2	White Creek II	100	Big Horn	Leads	20 minutes
3	Klondike III Parts 1 and 2	225	Klondike I and II	Lags	20 minutes
4	Goodnoe Hills	96	Big Horn	Leads	30 minutes
5	Biglow Canyon I	126	Leaning Juniper	Leads	10 minutes
6	**Forecast wind added in 2007**	**647**			
7	**Forecast Total Wind Installed by 2007**	**1380**			
	2008 Planned Resources	**Capacity (MW)**	**Existing Resource Correlated to Estimate Generation Data for Planned Resources**	**Time Delay between Planned Resource Leads or Lags the Existing Resource**	**Time Delay**
8	Nine Canyon III	32	Nine Canyon	Same time	0
9	Windy Point I	100	Big Horn	Leads	50 minutes
10	Leaning Juniper II	100	Leaning Juniper	Same time	0
11	Klondike III Part 3	75	Klondike I and II	Lags	20 minutes
12	Arlington	200	Leaning Juniper	Leads	10 minutes
13	Sand Ridge	100	Big Horn	Lags	20 minutes
14	Locust Grove	100	Leaning Juniper	Same time	0
15	Willow Creek	100	Leaning Juniper	Lags	30 minutes
16	Big Horn III	50	Big Horn	Same Time	0
17	**Forecast wind added in 2008**	**857**			
18	**Forecast Total Wind Installed by 2008**	**2237**			
	2009 Planned Resources	**Capacity (MW)**	**Existing Resource Correlated to Estimate Generation Data for Planned Resources**	**Time Delay between Planned Resource Leads or Lags the Existing Resource**	**Time Delay**
19	Biglow Canyon 2	150	Leaning Juniper	Leads	10 Minutes
20	Golden Hills	80	Klondike I and II	Lags	30 Minutes
21	White Creek 2	100	Big Horn	Leads	30 Minutes
22	Willow Creek	50	Leaning Juniper	Lags	30 Minutes
23	Kittitas Valley	110	Wild Horse	Leads	120 Minutes
24	Windy Point 1 & 2	150	Big Horn	Leads	60 Minutes
25	**Forecast wind added in 2009**	**640**			
26	**Forecast Total Wind Installed by 2009**	**2877**			

Attachment E, Table 1E
Reserve Capacity Requirements for 2237 MW of Installed Wind Generation
Average of February, April, August and November Values

	A	B	C	D	E	F	G	H	I
	Percentage	Percentile	Regulation	Total BAA Regulation	Following	Total BAA Following	Wind Regulation Requirement	Wind Following Requirement	Wind Within-Hour Balancing Requirement
1	0.1	0.001	0.0	0.1	0.3	0.3	0.0	0.0	0.0
2	0.25	0.0025	0.1	0.1	0.7	0.8	0.0	0.1	0.1
3	0.5	0.005	0.2	0.2	1.4	1.6	0.0	0.2	0.3
4	1	0.01	0.4	0.5	2.9	3.4	0.1	0.6	0.6
5	2.5	0.025	1.0	1.2	7.3	8.3	0.2	1.0	1.2
6	10	0.1	4.2	4.9	28.4	34.4	0.8	5.9	6.7
7	20	0.2	8.5	10.0	56.0	66.6	1.5	10.6	12.1
8	30	0.3	12.8	15.0	85.2	100.5	2.2	15.3	17.5
9	40	0.4	17.4	20.3	113.9	137.6	2.9	23.7	26.6
10	50	0.5	22.2	26.0	149.6	177.4	3.8	27.8	31.6
11	60	0.6	27.6	32.3	191.3	224.2	4.7	32.8	37.5
12	70	0.7	34.1	39.8	239.7	282.4	5.6	42.7	48.4
13	80	0.8	42.2	49.4	310.2	354.9	7.2	44.8	51.9
14	95	0.95	65.4	81.6	480.9	578.7	16.2	97.7	113.9
15	97.5	0.975	79.5	100.8	566.9	670.3	21.4	103.4	124.7
16	99	0.99	104.1	129.7	632.4	765.9	25.6	133.5	159.1
17	99.5	0.995	124.0	154.0	669.4	829.9	30.0	160.5	190.5
18	99.75	0.9975	145.9	187.4	705.7	895.9	41.5	190.2	231.8
19	99.9	0.999	183.9	236.8	733.7	968.6	52.8	234.9	287.7

Attachment E, Table 2E
Reserve Capacity Requirements for 2237 MW of Installed Wind Generation
August 2006 Values

	A	B	C	D	E	F	G	H	I
	Percentage	Percentile	Regulation	Total BAA Regulation	Following	Total BAA Following	Wind Regulation Requirement	Wind Following Requirement	Wind Within-Hour Balancing Requirement
1	0.1	0.001	0.0	0.1	0.2	0.3	0.0	0.1	0.1
2	0.25	0.0025	0.1	0.1	0.5	0.9	0.0	0.4	0.4
3	0.5	0.005	0.2	0.3	1.0	1.6	0.1	0.6	0.6
4	1	0.01	0.4	0.5	2.2	3.2	0.0	1.0	1.0
5	2.5	0.025	1.1	1.2	5.3	7.9	0.1	2.6	2.8
6	10	0.1	4.3	4.8	19.6	29.4	0.5	9.8	10.3
7	20	0.2	8.7	9.8	39.2	54.4	1.1	15.2	16.3
8	30	0.3	13.3	14.9	60.4	80.5	1.7	20.1	21.8
9	40	0.4	18.1	20.3	84.0	109.6	2.2	25.6	27.8
10	50	0.5	23.2	26.3	109.5	141.8	3.1	32.4	35.5
11	60	0.6	29.0	32.7	142.4	181.3	3.8	38.9	42.6
12	70	0.7	35.7	40.3	179.8	222.9	4.6	43.1	47.7
13	80	0.8	44.2	50.1	233.1	278.1	5.9	45.0	50.9
14	95	0.95	73.6	87.1	375.2	459.4	13.5	84.3	97.7
15	97.5	0.975	96.3	113.5	415.2	538.7	17.2	123.5	140.7
16	99	0.99	134.6	150.9	454.6	621.0	16.4	166.4	182.8
17	99.5	0.995	160.3	173.2	487.6	681.5	12.9	193.8	206.8
18	99.75	0.9975	182.5	193.7	520.3	754.4	11.2	234.1	245.3
19	99.9	0.999	215.9	243.4	550.6	860.1	27.4	309.4	336.9

Attachment E, Table 3E
Reserve Capacity Requirements for 2237 MW of Installed Wind Generation
November 2006 Values

	A	B	C	D	E	F	G	H	I
	Percentage	Percentile	Regulation	Total BAA Regulation	Following	Total BAA Following	Wind Regulation Requirement	Wind Following Requirement	Wind Within-Hour Balancing Requirement
1	0.1	0.001	0.0	0.0	0.2	0.2	0.0	0.0	0.0
2	0.25	0.0025	0.1	0.1	0.6	0.7	0.0	0.1	0.0
3	0.5	0.005	0.2	0.2	1.4	1.5	0.0	0.1	0.1
4	1	0.01	0.4	0.4	2.7	3.3	0.0	0.6	0.6
5	2.5	0.025	0.8	1.1	7.3	8.4	0.3	1.0	1.3
6	10	0.1	3.6	4.5	28.5	35.2	0.9	6.8	7.7
7	20	0.2	7.6	9.4	54.1	70.4	1.8	16.3	18.1
8	30	0.3	11.7	14.4	85.3	106.8	2.6	21.5	24.1
9	40	0.4	16.1	19.5	119.5	147.3	3.5	27.8	31.2
10	50	0.5	20.7	25.4	165.4	193.7	4.8	28.2	33.0
11	60	0.6	25.8	32.0	215.5	247.1	6.1	31.6	37.7
12	70	0.7	32.2	39.9	267.1	315.0	7.7	47.8	55.5
13	80	0.8	40.2	50.1	341.1	395.8	9.9	54.7	64.6
14	95	0.95	60.2	80.9	524.4	621.9	20.7	97.5	118.2
15	97.5	0.975	69.7	97.5	622.5	731.5	27.8	109.0	136.9
16	99	0.99	83.9	123.0	711.5	867.7	39.0	156.1	195.2
17	99.5	0.995	96.6	147.8	753.3	965.4	51.2	212.0	263.2
18	99.75	0.9975	109.9	201.8	768.7	1062.5	91.9	293.8	385.6
19	99.9	0.999	133.2	277.5	800.9	1202.8	144.2	401.9	546.1

Attachment E, Table 4E
Reserve Capacity Requirements for 2237 MW of Installed Wind Generation
February 2007 Values

	A	B	C	D	E	F	G	H	I
	Percentage	Percentile	Regulation	Total BAA Regulation	Following	Total BAA Following	Wind Regulation Requirement	Wind Following Requirement	Wind Within-Hour Balancing Requirement
1	0.1	0.001	0.0	0.1	0.4	0.4	0.0	-0.1	0.0
2	0.25	0.0025	0.1	0.1	0.9	1.0	0.0	0.0	0.1
3	0.5	0.005	0.2	0.3	1.8	1.9	0.0	0.2	0.2
4	1	0.01	0.5	0.5	3.5	4.1	0.1	0.6	0.7
5	2.5	0.025	1.2	1.3	8.9	9.8	0.1	0.9	1.1
6	10	0.1	4.5	5.2	34.9	41.2	0.7	6.3	6.9
7	20	0.2	8.9	10.3	71.3	79.7	1.5	8.4	9.9
8	30	0.3	13.1	15.4	107.4	122.6	2.2	15.2	17.4
9	40	0.4	17.7	20.5	141.6	165.3	2.9	23.7	26.6
10	50	0.5	22.4	25.9	185.6	211.0	3.6	25.4	29.0
11	60	0.6	27.5	32.0	234.8	261.4	4.4	26.6	31.0
12	70	0.7	34.0	39.0	291.9	326.1	5.1	34.2	39.3
13	80	0.8	41.5	48.0	370.5	404.3	6.4	33.8	40.2
14	95	0.95	62.7	77.2	557.6	651.1	14.4	93.5	107.9
15	97.5	0.975	74.0	93.0	694.0	749.4	18.9	55.4	74.3
16	99	0.99	93.6	117.9	771.7	819.3	24.2	47.6	71.8
17	99.5	0.995	110.0	144.0	801.9	869.1	34.0	67.2	101.2
18	99.75	0.9975	138.5	170.4	824.3	924.9	31.9	100.7	132.6
19	99.9	0.999	182.4	196.7	840.3	935.2	14.3	95.0	109.3

Attachment E, Table 5E
Reserve Capacity Requirements for 2237 MW of Installed Wind Generation
April 2007 Values

	A	B	C	D	E	F	G	H	I
	Percentage	Percentile	Regulation	Total BAA Regulation	Following	Total BAA Following	Wind Regulation Requirement	Wind Following Requirement	Wind Within-Hour Balancing Requirement
1	0.1	0.001	0.0	0.1	0.3	0.3	0.0	0.1	0.1
2	0.25	0.0025	0.1	0.1	0.7	0.8	0.0	0.0	0.1
3	0.5	0.005	0.2	0.3	1.5	1.6	0.1	0.1	0.2
4	1	0.01	0.4	0.5	3.0	3.1	0.1	0.1	0.2
5	2.5	0.025	1.1	1.3	7.9	7.3	0.2	-0.6	-0.4
6	10	0.1	4.3	5.2	30.8	31.8	1.0	1.0	1.9
7	20	0.2	8.6	10.4	59.5	61.8	1.7	2.3	4.1
8	30	0.3	13.1	15.5	87.5	92.0	2.4	4.4	6.9
9	40	0.4	17.7	20.8	110.4	128.2	3.1	17.8	20.9
10	50	0.5	22.6	26.4	137.8	163.0	3.8	25.1	28.9
11	60	0.6	28.2	32.5	172.7	207.0	4.3	34.3	38.6
12	70	0.7	34.8	39.9	219.9	265.7	5.1	45.8	50.9
13	80	0.8	42.9	49.3	295.9	341.6	6.4	45.7	52.1
14	95	0.95	65.0	81.2	466.6	582.2	16.2	115.7	131.9
15	97.5	0.975	77.9	99.4	535.9	661.5	21.5	125.6	147.1
16	99	0.99	104.0	126.9	591.8	755.8	22.8	164.0	186.8
17	99.5	0.995	129.1	151.0	634.8	803.7	21.9	168.9	190.8
18	99.75	0.9975	152.7	183.8	709.4	841.8	31.1	132.4	163.5
19	99.9	0.999	204.2	229.5	743.0	876.4	25.3	133.4	158.7

Attachment F, Table 1F
Reserve Capacity Requirements for 2877 MW of Installed Wind Generation
Average of February, April, August, October and November Values

	A	B	C	D	E	F	G	H	I
	Percentage	Percentile	Regulation	Total BAA Regulation	Following	Total BAA Following	Wind Regulation Requirement	Wind Following Requirement	Wind Within-Hour Balancing Requirement
1	0.1	0.001	0.0	0.1	0.3	0.3	0.0	0.1	0.1
2	0.25	0.0025	0.1	0.1	0.7	0.8	0.0	0.1	0.2
3	0.5	0.005	0.2	0.3	1.4	1.6	0.0	0.2	0.3
4	1	0.01	0.4	0.5	2.8	3.3	0.1	0.5	0.6
5	2.5	0.025	1.1	1.3	7.0	8.4	0.2	1.4	1.6
6	10	0.1	4.3	5.0	28.1	32.7	0.7	4.6	5.3
7	20	0.2	8.7	10.2	55.1	64.1	1.4	9.1	10.5
8	30	0.3	13.2	15.4	82.6	99.9	2.2	17.3	19.5
9	40	0.4	17.8	20.7	109.8	137.3	2.9	27.5	30.4
10	50	0.5	22.6	26.4	144.3	177.0	3.8	32.6	36.5
11	60	0.6	28.0	32.9	184.6	224.8	4.8	40.2	45.1
12	70	0.7	34.5	40.4	233.7	287.2	6.0	53.5	59.5
13	80	0.8	42.6	50.2	304.5	365.9	7.6	61.4	69.0
14	95	0.95	65.3	83.0	473.1	592.9	17.7	119.8	137.5
15	97.5	0.975	81.1	102.3	568.7	690.2	21.1	121.6	142.7
16	99	0.99	107.0	131.7	647.4	813.5	24.7	166.1	190.8
17	99.5	0.995	127.2	157.0	688.6	926.8	29.7	238.2	268.0
18	99.75	0.9975	151.0	193.4	724.7	1017.0	42.4	292.3	334.7
19	99.9	0.999	185.4	236.2	750.4	1078.7	50.8	328.3	379.1

Attachment F, Table 2F
Reserve Capacity Requirements for 2877 MW of Installed Wind Generation
August 2006 Values

	A	B	C	D	E	F	G	H	I
	Percentage	Percentile	Regulation	Total BAA Regulation	Following	Total BAA Following	Wind Regulation Requirement	Wind Following Requirement	Wind Within-Hour Balancing Requirement
1	0.1	0.001	0.1	0.1	0.1	0.2	0.0	0.1	0.1
2	0.25	0.0025	0.1	0.2	0.4	0.7	0.0	0.3	0.3
3	0.5	0.005	0.2	0.3	0.7	1.2	0.0	0.5	0.6
4	1	0.01	0.5	0.5	1.6	2.6	0.0	1.0	1.1
5	2.5	0.025	1.3	1.3	3.9	6.5	0.1	2.6	2.7
6	10	0.1	4.9	5.2	15.6	22.2	0.3	6.6	6.8
7	20	0.2	9.7	10.3	32.2	44.3	0.6	12.1	12.7
8	30	0.3	14.4	15.6	49.2	69.0	1.1	19.8	20.9
9	40	0.4	19.1	20.9	67.5	95.7	1.8	28.2	30.1
10	50	0.5	24.1	26.6	89.0	126.6	2.5	37.5	40.0
11	60	0.6	29.8	32.8	115.9	164.5	3.0	48.7	51.7
12	70	0.7	36.3	40.1	150.6	219.5	3.8	68.8	72.6
13	80	0.8	45.0	49.5	206.0	284.7	4.5	78.7	83.2
14	95	0.95	72.0	83.4	341.3	444.0	11.4	102.6	114.0
15	97.5	0.975	101.5	108.1	384.3	518.8	6.6	134.5	141.0
16	99	0.99	143.6	144.3	425.3	702.2	0.7	276.9	277.6
17	99.5	0.995	166.6	172.0	454.2	826.7	5.4	372.5	377.9
18	99.75	0.9975	190.1	196.4	465.5	980.5	6.3	514.9	521.3
19	99.9	0.999	217.2	221.5	476.2	1064.4	4.3	588.1	592.5

	Attachment F, Table 3F Reserve Capacity Requirements for 2877 MW of Installed Wind Generation October 2006 Values								
	A	B	C	D	E	F	G	H	I
	Percentage	Percentile	Regulation	Total BAA Regulation	Following	Total BAA Following	Wind Regulation Requirement	Wind Following Requirement	Wind Within-Hour Balancing Requirement
1	0.1	0.001	0.0	0.0	0.3	0.3	0.0	0.0	0.0
2	0.25	0.0025	0.1	0.1	0.8	0.7	0.0	-0.1	-0.1
3	0.5	0.005	0.2	0.2	1.5	1.4	0.0	-0.1	-0.1
4	1	0.01	0.4	0.4	3.0	2.7	0.1	-0.3	-0.2
5	2.5	0.025	0.9	1.1	6.7	6.7	0.2	0.0	0.2
6	10	0.1	4.0	4.4	28.6	29.1	0.4	0.4	0.8
7	20	0.2	8.2	9.2	54.7	56.5	1.0	1.9	2.9
8	30	0.3	12.6	14.2	79.1	85.7	1.6	6.7	8.3
9	40	0.4	17.3	19.3	105.5	116.8	2.0	11.3	13.3
10	50	0.5	22.0	24.6	139.1	153.3	2.6	14.3	16.9
11	60	0.6	27.3	30.8	178.7	197.2	3.4	18.4	21.8
12	70	0.7	33.4	37.8	231.0	255.3	4.3	24.3	28.7
13	80	0.8	41.5	46.6	297.6	327.3	5.1	29.8	34.9
14	95	0.95	64.1	75.6	468.2	521.4	11.5	53.2	64.7
15	97.5	0.975	79.7	91.4	587.1	613.7	11.6	26.6	38.2
16	99	0.99	106.3	118.4	705.4	715.1	12.2	9.7	21.8
17	99.5	0.995	131.0	139.5	767.9	806.7	8.5	38.9	47.4
18	99.75	0.9975	155.0	159.9	823.5	859.3	5.0	35.8	40.7
19	99.9	0.999	185.6	199.0	877.7	939.2	13.5	61.6	75.0

Attachment F, Table 4F
Reserve Capacity Requirements for 2877 MW of Installed Wind Generation
November 2006 Values

	A	B	C	D	E	F	G	H	I
	Percentage	Percentile	Regulation	Total BAA Regulation	Following	Total BAA Following	Wind Regulation Requirement	Wind Following Requirement	Wind Within-Hour Balancing Requirement
1	0.1	0.001	0.0	0.0	0.2	0.4	0.0	0.2	0.2
2	0.25	0.0025	0.1	0.1	0.6	1.1	0.0	0.5	0.5
3	0.5	0.005	0.2	0.2	1.4	2.0	0.0	0.6	0.7
4	1	0.01	0.4	0.5	2.7	4.2	0.1	1.4	1.5
5	2.5	0.025	0.8	1.2	7.4	10.5	0.4	3.1	3.5
6	10	0.1	3.6	4.9	29.0	37.8	1.2	8.8	10.1
7	20	0.2	7.7	9.9	54.9	75.2	2.2	20.3	22.5
8	30	0.3	11.9	15.1	86.3	118.3	3.2	32.0	35.2
9	40	0.4	16.2	20.4	120.8	163.2	4.2	42.4	46.6
10	50	0.5	20.9	26.6	166.7	210.6	5.7	43.9	49.6
11	60	0.6	26.1	33.5	216.9	266.9	7.4	50.0	57.3
12	70	0.7	32.6	42.0	268.0	336.9	9.4	68.9	78.3
13	80	0.8	40.7	52.9	342.7	424.1	12.2	81.4	93.6
14	95	0.95	61.0	87.4	526.5	680.1	26.3	153.6	179.9
15	97.5	0.975	70.7	105.0	625.9	780.6	34.3	154.7	189.0
16	99	0.99	85.5	133.9	717.5	925.5	48.4	208.0	256.4
17	99.5	0.995	98.7	161.2	754.1	1115.7	62.5	361.6	424.1
18	99.75	0.9975	116.6	230.5	775.6	1244.2	113.9	468.6	582.5
19	99.9	0.999	141.8	303.2	789.8	1305.6	161.4	515.9	677.3

Attachment F, Table 5F
Reserve Capacity Requirements for 2877 MW of Installed Wind Generation
February 2007 Values

	A	B	C	D	E	F	G	H	I
	Percentage	Percentile	Regulation	Total BAA Regulation	Following	Total BAA Following	Wind Regulation Requirement	Wind Following Requirement	Wind Within-Hour Balancing Requirement
1	0.1	0.001	0.0	0.0	0.4	0.3	0.0	-0.1	-0.1
2	0.25	0.0025	0.1	0.1	0.9	0.8	0.0	-0.1	-0.1
3	0.5	0.005	0.2	0.3	1.8	1.8	0.0	0.0	0.1
4	1	0.01	0.5	0.5	3.5	3.8	0.0	0.2	0.3
5	2.5	0.025	1.2	1.3	8.9	10.3	0.1	1.4	1.5
6	10	0.1	4.6	5.3	35.3	42.0	0.7	6.7	7.4
7	20	0.2	9.1	10.5	72.4	80.7	1.4	8.3	9.8
8	30	0.3	13.4	15.8	108.8	126.7	2.4	17.9	20.3
9	40	0.4	18.0	21.0	142.8	172.7	3.0	29.9	32.9
10	50	0.5	22.8	26.7	187.0	218.1	4.0	31.1	35.1
11	60	0.6	28.0	33.2	235.7	270.3	5.2	34.6	39.7
12	70	0.7	34.5	40.6	295.1	333.6	6.1	38.5	44.6
13	80	0.8	42.2	50.0	373.9	418.4	7.9	44.6	52.4
14	95	0.95	63.5	82.5	558.1	690.1	19.0	132.0	150.9
15	97.5	0.975	74.9	99.9	704.5	795.0	25.0	90.4	115.5
16	99	0.99	94.3	128.4	785.9	890.0	34.1	104.1	138.3
17	99.5	0.995	109.8	156.3	816.1	975.5	46.5	159.4	205.9
18	99.75	0.9975	140.5	189.3	837.9	1020.0	48.8	182.1	230.9
19	99.9	0.999	184.8	222.0	853.5	1073.0	37.1	219.5	256.7

Attachment F, Table 6F
Reserve Capacity Requirements for 2877 MW of Installed Wind Generation
April 2007 Values

	A	B	C	D	E	F	G	H	I
	Percentage	Percentile	Regulation	Total BAA Regulation	Following	Total BAA Following	Wind Regulation Requirement	Wind Following Requirement	Wind Within-Hour Balancing Requirement
1	0.1	0.001	0.0	0.1	0.3	0.4	0.0	0.1	0.1
2	0.25	0.0025	0.1	0.1	0.8	0.9	0.0	0.1	0.1
3	0.5	0.005	0.2	0.2	1.5	1.7	0.0	0.1	0.2
4	1	0.01	0.4	0.5	3.1	3.3	0.1	0.2	0.3
5	2.5	0.025	1.1	1.4	8.2	8.1	0.2	0.0	0.2
6	10	0.1	4.5	5.4	31.9	32.4	1.0	0.5	1.5
7	20	0.2	9.0	10.9	61.1	63.9	1.9	2.8	4.7
8	30	0.3	13.5	16.2	89.6	99.5	2.7	10.0	12.7
9	40	0.4	18.2	21.8	112.3	138.0	3.5	25.7	29.2
10	50	0.5	23.2	27.6	139.8	176.2	4.5	36.3	40.8
11	60	0.6	28.8	34.0	175.7	225.3	5.3	49.6	54.9
12	70	0.7	35.5	41.7	223.8	291.0	6.2	67.2	73.4
13	80	0.8	43.7	52.0	302.4	374.9	8.2	72.4	80.7
14	95	0.95	65.9	86.2	471.4	629.2	20.4	157.8	178.1
15	97.5	0.975	78.9	107.1	541.4	743.2	28.2	201.7	229.9
16	99	0.99	105.5	133.5	603.0	834.5	28.1	231.5	259.6
17	99.5	0.995	130.1	155.9	650.8	909.4	25.8	258.6	284.4
18	99.75	0.9975	152.8	190.9	721.1	981.0	38.1	259.9	298.0
19	99.9	0.999	197.7	235.2	755.0	1011.5	37.5	256.5	293.9