Transmission Services Customer Workshop

presented by

Wind Integration Team (WIT)

July 1, 2008

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Agenda

- Objective Statement
- Overview of Wind Reserves Forecasting Method
- Specific Approaches and Examples of Techniques
- Next Steps: Open for Questions and Comments

Objective

- Today’s presentation responds to customer requests, made at the June 9, 2008 Customer Workshop, for additional description and possible examples of the two different techniques for how to allocate the total reserve requirement to the different segments.

- The WIT is continuing to develop the with-in hour reserve requirement methodology to yield a reserves amount that will be an input into the FY10-11 Transmission Rate Case.

- Customers are invited to input on the approach toward developing the reserves requirement methodology. Our goal is to complete the study by July 30, 2008.

Overview

- The within-hour reserve requirement is driven by the impact of wind integration on the overall reserve requirement that TS needs to reliably operate the transmission electrical system.
- The reserves utilized at any given time is defined by the difference between the scheduled (estimated) generation[1] and load as ramped in hour by hour, and the actual measured generation and load.
- The reserves are provided by generators which are under automatic control (AGC).

[1]other than under control

Overview

- The reserve amount needed by TS has three time horizons that potentially could translate into different products:
  - Regulation describes the dynamic energy swings minute by minute (changes smaller than a minute tend to be filtered out by the AGC algorithms).
  - Following (either load or generation) describes the within hour shifts of average energy.
  - Imbalance describes the hourly difference between the scheduled energy and the actual hourly average (or perfect schedule).

Overview

- The goal of the reserves forecast methodology is to consistently and equitably determine the relative impacts to the three reserve components of these 5 segments (including load).
  - The generation (not under control) in BPA's Balancing Area (BA) can be categorized into 4 segments:
    - Federal generation
    - Small Hydro
    - Wind
    - Thermal
  - Load in BPA's Balancing Authority

Data Analysis

- Our approach has been to look at the historical data we have available in order to establish a baseline for the future. Thus far we have captured (one minute averages):
  1. Total Actual Load in the BA (generation minus net interchange)
  2. Total Actual Wind in the BA
  3. Total Thermal Generation in the BA
  4. Total Small Hydro (Willamette) Generation in the BA
  5. Total Wind Station Control Error (SCE)
  6. Total Thermal SCE
  7. Total Small Hydro SCE

Data Analysis

- We have also captured available hourly data which has been converted to a one minute time series fully ramped in over 20 minutes (w/ramp):

8. Load Forecast for the BA (estimate computed before the hour)
9. Estimated Wind in the BA (sum of the individual wind estimates)

- From the historical time series we have computed hourly averages (perfect schedules) which also have been ramped in:

10. Load perfect schedule basepoint w/ramp
11. Total Wind perfect schedule basepoint w/ramp

Data Analysis

- The following time series have also been calculated:

12. Load only full reserve requirement
    (series 1 minus series 8)
13. Load only perfect schedule reserve requirement
    (series 1 minus series 10)
14. Total Wind only full reserve requirement
    (series 2 minus series 9)
15. Total Wind only perfect schedule reserve requirement
    (series 2 minus series 11)

Approaches to Reserves Forecast

- At the June 9th workshop we introduced two techniques to determine how to allocate the total reserve requirement to the different segments:
  - One technique uses a proportional allocation (simple math).
    - Allocates the total reserves based on the proportional amount of the reserves each segment would need independently. This allocation is done on a 10-minute basis, creating a proportional reserve requirement time series for each segment. An appropriate percentile of each time series is then used to determine the monthly reserve requirement.
  - The second uses a correlation matrix allocation (statistics).
    - Uses statistical methods to determine the amount each segment reserve need impacts the aggregate standard deviation of reserve need. This proportion is then used to allocate the total reserve need, which is calculated as an appropriate percentile of the sum of the segment error.

Proportional Reserves Allocation

(Method #1: Simple Math, bottom up approach)

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Proportional Reserves Allocation

- The Proportional Reserves Allocation technique as presented separates each of the error terms (one-minute series)
  - the load error (series 13)
  - the wind error (series 15)
  - and the load-wind error (series 13 minus series 15)

  into the following 10-minute series:
  - Inc Following (10-minute average of positive error)
  - Inc Regulation (10-minute max positive error minus Inc Following)
  - Dec Following (10-minute average of negative error)
  - Dec Regulation (10-minute min negative error minus Dec Following)
- For each of these four results, the load-wind value is allocated proportionally to load and wind based on the proportion of the separate load and wind values.

Correlation Matrix Reserves Allocation

(Method #2: Statistical Approach, top down approach)

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Same as Kirby-Hirst?

- At the June 9th workshop the question was asked if the separation/allocation method #2 is similar to or the same as the Kirby-Hirst disaggregation method?
  - The methods appear to be the same.
  - This was explored quickly and anecdotally by working through some of the examples contained in the Kirby-Hirst paper, “Customer-Specific Metrics for the Regulation and Load-Following Ancillary Services.”
  - Using the provided spreadsheet, ReserveAllocationExample.V061008.xls, the examples on pages 17 and 40 can easily be replicated.
    - Note: the example on page 40 uses a correlation of -0.67276, a value not directly provided in the paper.

The Spreadsheet

- At this point, switch over to the spreadsheet and work through the examples.
- Use the spreadsheet to replicate the examples previously referenced.
- Work through the larger 7 x 7 matrix example.
- Work through the Kirby-Hirst example on page 21. Note: although not provided in the paper, the example implies the following matrix which we can use to further demonstrate consistency of approach:

IMPLIED CORRELATION MATRIX

	A	B	C	D
A	1.000	-0.158	-0.147	-0.032
B	-0.158	1.000	-0.097	-0.052
C	-0.147	-0.097	1.000	-0.013
D	-0.032	-0.052	-0.013	1.000

The Timeseries

- The appropriate timeseries that yields the relevant reserve categories needs to be determined.

- In an effort to test the causes of reserve need by resource type, the following equations are being used to develop the timeseries:

  - for each resource type, x;
  - $Reserve_x = SCE_x = GI_x + Bal_x$
  - Bal_x = Actual Gen_x - Perfect $Schedule_x$
  - $GI_x = SCE_x – Bal_x$
  - $Bal_x = Following_x + Regulation_x$
  - Total Reserve = $Reserve_{x1} + Reserve_{x2} + ... + Reserve_{xN}$

The Timeseries

- The timeseries was developed in this manner because it was an easy way of getting at the contribution of each resource type to control error.
- Additionally, the approximation approach is reasonable since the controller projects respond to the net control error.
- Any relevant timeseries may be used.

Next Steps

- Validate the results of the two techniques.
- Decide on a single approach by July 30, 2008.
- Open for customer questions and comments.