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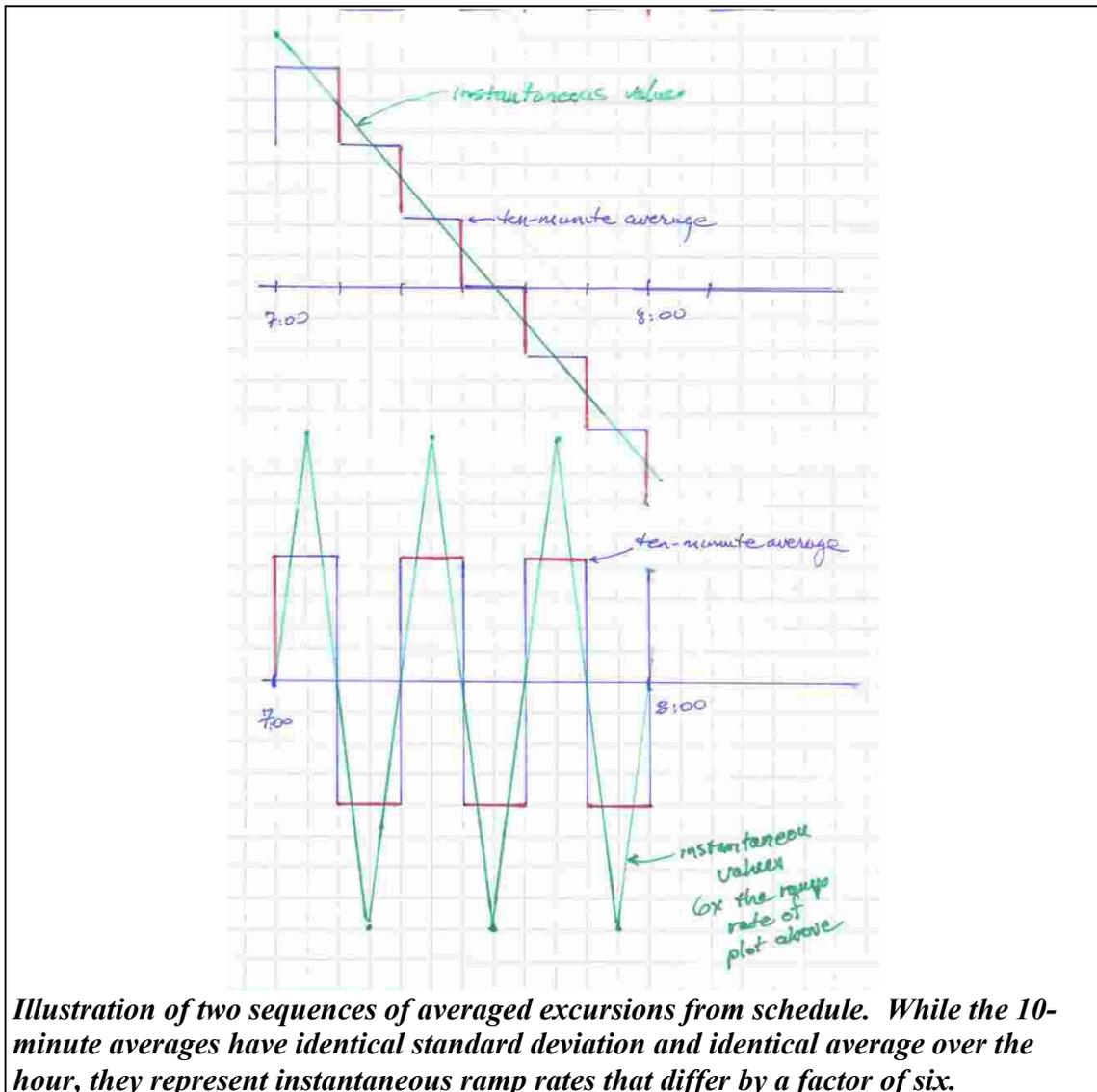
Pete Warnken  
PacifiCorp  
825 NE Multnomah  
Portland, OR 97232

Dear Mr. Warnken,

Thank you for the opportunity to comment on the PacifiCorp white paper, "Project Method for 2010 Wind Integration Cost Study," dated April 23, 2010. I commend PacifiCorp on its efforts to quantify the economic impact of incremental wind generation to its system. In particular, the approach outlined in the paper provides a road map for separating the regulation costs from the forecast error costs. To the extent that these requirements are independent, and given the significant potential for independent cost and performance changes in the future, this information will become even more valuable.

- The introduction of the section ***Calculating Incremental Operating Reserve Requirements***, especially the bottom of page 4 up to the subsection ***Regulation and Load Following*** on page 6, outlines how the Brattle Group proposes to create synthetic wind generation data for sites with incomplete and missing records. The description of statistical methods is not helpful. Creating synthetic wind data is a complex task, and there undoubtedly have been many different statistical approaches taken to problem. If it is important that the reader understand these details, specific examples and more explanation will be necessary. More important than the details of the method used to create the data, however, is that the resulting data appear reasonable. This leads to the next observation.
- PacifiCorp should independently validate the Brattle Group's synthetic wind data. PacifiCorp can prepare simple comparisons of real and synthetic data for sites with incomplete data without significant effort. For example, PacifiCorp could plot histograms of wind generation levels and of changes in generation levels (ramp rates) from each source. Distinct plots, for each month or time of day, would also be informative. I would expect the plots from the synthetic data at a given site to resemble those from the actual data. I would expect data from sites in close physical proximity of each other to resemble each other. While not as complete as they could be, these tests might identify issues early on that would make the data unsuitable for PacifiCorp's specific purposes.

- PacifiCorp should avail itself of regional experience in constructing synthetic wind data. Bonneville Power Administration is well down the path of developing synthetic wind data. On April 27, BPA's Ben Kujala presented his work on wind data synthesis, "Creating Synthetic Wind Power Records for LOLP studies," to the NERC LOLE Work Group meeting at the Council's Portland office. NERC also has a "Integration Variable Generation" Task Force with experts from the Pacific Northwest. The Northwest Wind Integration Forum and the Regional Adequacy Forum is another resource.
- It is not clear that standard deviations of ten-minute average excursions from schedule will provide sufficient information to select least-cost resources to meet ancillary service requirements. For example, the illustration below shows two sequences of deviation that have the same standard deviation over the hour. The implied decremental ramp-rate requirement (megawatts per minute) of the second plot, however, is six times that of the first plot. A set of operating reserves that can respond quickly enough for the first plot may not be able to respond quickly enough for the second plot.



PacifiCorp may want to consider data about the frequency of changes in generation levels or of load-net-wind requirements when evaluating its future ancillary service requirements. In the absence of any discrimination, the default action would be serve all requirements with the most flexible and expensive equipment.

- Steps appear to be missing in the description of the chain of logic that takes the reader from standard deviations in wind and load to the economics of ancillary services. For example, will the costs for sub-hourly variation in load-net-wind be a function of the wind generation level, as they are in the referenced NREL paper?
- The section *Analysis*, pages 10 to 12, is confusing. It is missing a stated objective and links of the chain of logic. The NREL paper (pages 137 to 155) has a reasonably careful development of its calculations and approach. It appears that Figure 5 of the PacifiCorp white paper is intended to be analogous to Figure 5-10, page 147, of the NREL paper, expressing standard deviation, hence reserve requirement, hence CPS2 requirement as a function of load. I would guess that there is also an unstated assumption that this CPS2 requirement is proportional to cost, which might motivate the "averaging of volumetric position over the study period." Is this the intent? I am at a loss to understand this section, otherwise.

Figure 5 of the PacifiCorp white paper appears to suggest that forecast error decreases above 8,210 megawatts, reaching a minimum around 10,440 megawatts. This is certainly contrary to the NREL assumption of negligible or increasing forecast error with size of load. I wonder if the variations in PacifiCorp's requirements in Figure 5 could instead be related to high ramp rates at moderate load levels. If this is the case, time of day or anticipated ramp rate might be better predictors for forecast error.

NREL's use of the hourly production level for wind as the basis of wind regulation and wind forecast error is based on the physical situation for wind generation, as they explain on page 146. If PacifiCorp needs an estimate of load forecast error as a function of the state of the system – as input to its production cost model, for example – other explanatory variables are probably more appropriate.

- As NREL points out, the assumption that it can use the day-ahead market price for 10-minute adjustments relies on the availability organized markets for this energy, and even then is a tenuous assumption (page 155). PacifiCorp may want to reconsider use of market energy prices as prices for these ancillary services.
- The final sections of the PacifiCorp white paper, *Calculating Operating Reserve Wind Integration Costs* and *Calculating System Balancing Wind Integration Cost* appear to be essentially sound. The accuracy of the results will turn on how the costs are represented and accrued in the PaR, however, which is unclear.

One issue to consider, however, is that the *order* in which reserve costs and balancing

costs are estimated can affect their relative size. That is, if reserve cost is estimated *with* forecasting error in both the base case and the change case, the results may differ from those *without* that error in both cases. I have no reason to believe that will be the case, but I would not be surprised if it is. I will simply note that PacifiCorp has chosen a particular path.

I hope you find these comments useful. I look forward to seeing the results of the study.

Sincerely,  
Michael J. Schilmoeller  
NWPPCC staff