PacifiCorp Response to Additional Comments on the 2010 Wind Integration Study Methodology June 21, 2010

This document is PacifiCorp's response to additional comments from Renewable Northwest Project (RNP) received on June 1, 2010 on the 2010 Wind Integration Study methodology paper dated May 19, 2010.

RNP Comment 1:

Page 1, paragraph 1: calling wind "non-dispatchable" is not at all accurate in the NW -- BPA dispatches wind on a regular basis. PacifiCorp may choose not to model the dispatchability of wind, but "less-dispatchable" is probably a better designation. This does bring up the question of whether [PacifiCorp] will entertain limiting generation to reduce the need to hold sufficient down regulation either in this study or in a future one. It may be a moot point if the wind integration costs out of this study are reasonable (i.e., around $5/MWh or so) as I expect they will.

PacifiCorp Response to RNP 1:

Dispatchable power is defined as capable of responding to system needs by moving resource output up or down as requested or in some cases by automatic control. Additionally these plants are capable of coming on line when asked to provide system support as needed. Wind generation plants do not have this ability. Wind plants can be curtailed, but they cannot be dispatched as a thermal resource can – this is a Boolean matter, in terms of modeling.

Down regulation demand is a function of the variability of wind generation and load levels. The generation applied to meet the net load would be "limited" within the production cost model through an hourly optimization. Wind curtailment is not contemplated in this study. As the goal of this study is not to hit a target rate, but to include the current externalities we can model as variables in our rate-making framework, PacifiCorp does not see the pre-consideration of a target cost as reasonable or unreasonable, since this number did not come from a study performed on our system with our generation fleet and load obligations.

RNP Comment 2:

On page 2, second bullet and throughout: there is an emphasis on day-ahead balancing costs. I doubt this will amount to anything much-- buying and selling day ahead to reduce the purchases and sales in the hourly markets makes sense, but I don't see how it entails large costs-- in fact, the point of balancing day-ahead is to reduce the costs of transacting in hourly markets. The idea of day-ahead balancing "costs" as a component of wind integration costs is troubling-- gas plants need to make day-ahead gas nominations based on spark-spread forecasts. If wind has day-ahead balancing integration costs, then so do gas plants. I doubt that the costs calculated here will be significant, but if they are you can bet that we will argue for gas generation integration costs in the next IRP.

PacifiCorp Response to RNP 2:

PacifiCorp eliminated day-ahead balancing transaction costs—referred to in the 2008 IRP wind integration study as the "transactional costs associated with balancing the hourly long-term expected wind generation to the hourly day-ahead wind schedule"—as a component of wind integration costs for the current study. The references to "day-ahead" in the method paper pertain to the rebalancing cost associated with day-ahead forecast errors.

RNP Comment 3:

The second to last paragraph on page 5: Not clear what parameters the "stochastic noise" will be added to-- is this an error term added to a regression forecast made from the estimated regression parameters, or are we talking about adding noise to the regressions parameters themselves? I am still not fully following the suggested algorithm and would very much appreciate a worked (perhaps simplified) example. Also, the predicted values (wind generation in ten-minute increments) should maintain certain statistical relationships in time. For example, the time-period-to-time-period differences should follow some kind of distribution and the stochastic error from one time period may be correlated with the previous and successive time periods. These relationships in observed data should be maintained in the manufactured wind generation data.

PacifiCorp Response to RNP 3:

The wind data development is ongoing. The noise mentioned is the addition of the regression residual back to the dependent variable.

RNP Comment 4:

Middle two paragraphs on page 6: The second of the two paragraphs is an encouraging change from the previous version. NREL data might provide correlations needed for work described in the first of these two paragraphs-- it doesn't seem to get mentioned there, so it's a little unclear how the NREL data is anticipated to be used.

PacifiCorp Response to RNP 4:

The wind data development is ongoing. The NREL data is being used to "seed" development of wind distributions which do not have any generation in the 2007-09 timeframe.

RNP Comment 5:

"Regulation" paragraph on page 7, fourth sentence: Not clear what "persistence forecast of the rolling prior 60 minutes" means, or what significance a rolling 60 minute average wind generation has here (persistence forecasts are elsewhere described as the generation level 40 minutes prior to the start of the operating hour). Without intra-hour markets, the relevant quantities for determining reserves would seem to be the differences between observed ten-minute load-net-wind and the load-net-wind schedule for the hour. Those differences ("schedule errors") might be decomposed into components representing the average difference over the hour, and the interval-to-interval variability. There would not seem to be room here for a rolling average. The wind schedule should be made from a persistence forecast, not a rolling average.

It may have made sense for EWITS to look at rolling 60 minute averages precisely because they DID have a "sub-hourly clearing market" that PacifiCorp does not have.

PacifiCorp Response to RNP 5:

There is a need to address variability for reserves intended to manage hourly deviations from an intended schedule (called load following in this study) and reserves intended to manage ten-minute variability (called regulation in this study). The rolling average for wind provides a reasonable assessment of variability. Whether these resources are balanced through open sub-hourly cleared markets or maintenance of flexible generation online does not eliminate the need to plan for these sources of variation in actual operations, and as such the need is modeled here.

RNP Comment 6:

Formulas and definitions, pages 8 and 9: It does not make sense to separately calculate the "Regulation" quantities on page 8 and feed them into the equation on page 9. The 10-min regulation on page 9 would be (only if the two variables are both uncorrelated **AND** normally distributed) the [square root of the sum of the squares of the load and wind percentile value] minus the L10 level. What is written is incorrect even for normally distributed and uncorrelated variables. I am OK with assuming zero correlation, but the distribution of errors is not normal, and in every case I am aware of, had important asymmetry-- BPA holds about 20% more dec reserves than inc reserves for the same exceedence probability. **The math here is plain WRONG.** It may even result in underestimating the needed reserve level. Even the concept of separate wind and load regulation requirements from which L10 can be subtracted has little meaning. This whole line of reasoning is also unnecessary, the percentile levels of the load net wind error distribution can be observed directly from the data without using a special equation.

PacifiCorp Response to RNP 6:

PacifiCorp can see the utility of placing the L10 value outside the combination of the Regulation and applying it afterward. L10 can be subtracted from estimated reserve requirements, and the observation that short-term deviations in load and wind generation are uncorrelated is directly in line with the NREL Western Wind and Solar Integration Study. PacifiCorp has noticed asymmetry in the reserves calculated for load following to date (and the potential for this is clear in the method described in the draft), and is working to model these reserve demands appropriately in the PaR model. As for general issues pertaining to “the math”, this question does not explicitly indicate where there is an error. Additionally, PacifiCorp is not, through this method, treating the errors as normally distributed.

RNP Comment 7:

Paragraph above "Analysis" heading on page 12, first and second sentences: In first sentence, not sure what is being "trended" and should be sure it isn't the wind. Not clear in second sentence what "gaps" refers to there-- don't know what this clause means.

PacifiCorp Response to RNP 7:

The load estimation is compared to a trend. The gaps are the difference between the anticipated generation output and what is required to maintain service.

RNP Comment 8:

1st sentence in paragraph at top of page 13: the clause "averaging the volumetric position over the study period will be a simple matter of integration" is confusing-- not clear what the substance of the referred-to "volumetric position" is. We pointed this sentence out before for clarification.

PacifiCorp Response to RNP 8:

Volumetric position is the volume of megawatts per hour of reserves necessary through the study period. Integration in this case refers to taking a definite integral of the volumetric positions occurring over time through the study period in question. For example, the system spends a certain amount of time at a 6,000MW load state in the month of May. The reserves estimated to be necessary to maintain balance for that load state (both positive and negative) are noted, and the reserves demands are time weighted for each load state throughout all the May months (2007-09) in the study. This is a definite integral.

RNP Comment 9:

Equation on page 14: This equation is also wrong and unnecessary. This really should not stand-- it's bad math and not even a reasonable approximation under any stated conditions (e.g., L10 would have to be zero in addition to uncorrelated, normally distributed schedule errors).

PacifiCorp Response to RNP 9:

This equation is the combination of two uncorrelated, coincident quantities. It is correct in that sense. We may apply L10 after this point, as discussed above.

RNP Comment 10:

Table 2, page 15: The Regulation row in the table is incorrect as defined by the equations previously cited.

PacifiCorp Response to RNP 10:

PacifiCorp is moving to up and down regulation reserves, which will alter this table.

RNP Comment 11:

Table 4, page 17: Somewhat odd that the calculation of the integration costs are relegated to small print at the base of a table-- As we previously pointed out, holding "incremental" reserves for the hour-to-hour schedule error in the model ends up being a double count in the Operating Reserve Integration Cost Calculation (PaR Simulations 1 and 2). One way to fix that would be to use the "Perfect Shape" in both simulation runs, or conversely, only holding "regulation" reserves in Simulation 2. As written, this likely double counts some of the reserve costs unless "load following" reserves can be released by the model as needed to cover rapid wind ramp events. In the System Balancing Integration Costs calculation, I note that these costs are the joint wind and load balancing costs, and that there needs to be a plan for teasing out the wind portion.

PacifiCorp Response to RNP 11:

In fact, the integration cost necessary is best represented serving the system with and without wind's variable shape, as a flat delivery would require virtually no extra reserves and maintain as similar a resource stack setup as the variable wind shape would allow. Deadening the wind generation shape for the second run shows no merit, as it neither represents what happened on the systems for the study period nor does it allow the production cost model to assess what reserves would be necessary to manage the great variability of wind generation. Additionally, the reoptimization of the production stack each time an economic calculation is made renders the release of reserves issue moot on an hourly basis. If out of merit resources were dispatched intra-hour, which does not happen in this model, your issue would have merit. Again, wind generation's inherent variability and the inability to dispatch it and the resulting cost of maintaining reserves adequate to maintain system integrity is driving this calculation. These reserves are required due to difficulties and inefficiencies wrought by shifting resource allocations due to forecast errors, running plants in less efficient states than full operation to provide flexibility for up and down reserves, and keeping units on standby whether they ultimately operate or not.