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MEMORANDUM

To: Utah Public Service Commission
From: Division of Public Utilities
Philip Powlick, Director
Artie Powell, Manager, Energy Section
Thomas Brill, Technical Consultant
Joni Zenger, Technical Consultant
Subject: In the Matter of the Acknowledgement of PacifiCorp's Integrated Resource Plan,
Docket No. 09-2035-01.
Date: March 11, 2010

ISSUE

PacifiCorp (Company) presented a Draft Study Design for its 2010 Wind Integration Study on February 26, 2010. The Division of Public Utilities will submit the following Wind Integration Study comments to both the Company and the Utah Public Service Commission (Commission). These comments are based on a PacifiCorp PowerPoint slideshow: "2011 Integrated Resource Plan: 2010 Wind Integration Study, Draft Study Design, February 26, 2010."

BACKGROUND

Previous to the February 26, 2010 presentation of the Draft Study Design, the Company held a 2010 Wind Integration Study Public Input Meeting, which described the Company's Wind Integration Study process and outlined its schedule. At the Public Input Meeting held on February 16, 2010, which the Division attended by phone conference, the Company indicated that it would provide a "Draft Study Design" to the parties by February 26, 2010. Based on the technical nature of the issues and discussion that occurred at the phone conference, the Division

had anticipated that the Company would provide a document, complete with algebraic expressions, where necessary, detailing each step of the study. The PowerPoint slideshow sent by PacifiCorp falls far short of the Division's expectations. Furthermore, the schedule outlined on page 4 of the Presentation Deck leaves little time for comments on the draft or final study design. For example, the schedule provides only seven working days for the first round of comments. For these reasons, the Division is only able to provide cursory comments at this time. The Division's final comments on the overall design and results will be filed with the Commission when PacifiCorp files a Wind Integration Study in Utah.

COMMENTS ON THE DRAFT STUDY DESIGN

Given the limited nature of the Company's Draft Study Design, the Division makes the following specific comments.

Control Performance Standard II

On page nine, the Company indicates that it will "Apply a CPSII performance-based reliability metric" to establish the appropriate level of reserves. The Control Performance Standard II ("CPSII") uses a 90% (or 90th percentile) criterion to measure performance reliability. However, the Company's Draft Design does not explain or demonstrate that this is an appropriate level of confidence. Indeed, the Division's recollection of the February 26th discussion left this issue open for further research. The Final Study Design needs to provide empirical justification for the level of confidence used to determine reserve requirements. Additionally, the Final Study Design should explain in detail, including algebraic and numeric examples, of how the CPSII metric is applied to determine the reserve requirements. The last bulleted item on page 9 is a good example of where the Draft Study Design should include a mathematical formula, in addition to the narrative description, demonstrating the basis for their calculations.

Hour Ahead Forecast Rules

On page 11, the Company presents the "Hour Ahead Forecast 'Rules.'" On pages 11-12, the Company presents various parameters for the forecast "rules." In order to evaluate intra-hour variability, actual load and wind data are compared to some type of forecast. The Company does

this by looking at the percentage change in load between the forecast hour and two hours prior to the forecast hour in the prior like day and applying the actual observed load from two hours prior to the forecast hour on the forecast day in order to evaluate intra-hour variability. It is unclear why two hours was selected in this forecast rule. For the “wind persistence forecast rule” the Company bases the forecast on a measurement 40 minutes prior to the forecast period; why is 40 minutes selected? The fact that Saturday is considered to be like a weekday is also unexplained. The Division’s observation is that while Saturday load is typically greater than a Sunday or a holiday, it is noticeably less than a typical weekday. This contributes to the under-forecast in the example on page 12. In the graphical example on page 13 it appears that the 40-minute prior observation is used to fix the forecast for the entire forecast hour. If the 40-minute prior is such a good estimator, why not update the forecast every 10 minutes with the next newly observed 40-minute prior? In the example at least, this would have improved the forecast. It is unclear whether the Company has examined some other simple forecasting techniques, such as exponential smoothing, or moving averages, that could improve the forecast. The Company should provide this documentation.

For the Hourly Like-day Rule, the percentage change between two hours on the like-day is used to estimate or forecast the next hour load on the forecast day. For example, based on the graph on page 12, the percentage difference in load from hour 6 and hour 8 on the like-day is added to the actual load during hour 6 on the forecast day to forecast hour 8. Algebraically, this can be expressed as

$$\hat{L}_{i,fd} = \% \Delta L_{i,ld} + L_{i-2,fd} = \frac{L_{i,ld} - L_{i-2,ld}}{L_{i-2,ld}} + L_{i-2,fd}$$

Where “L” is the actual load, “ \hat{L} ” is the load forecast, and the subscripts represent the hour (“i”), the forecast day (“fd”), and the like-day (“ld”). The hourly load forecast variance is then,

$$S_L^2 = \frac{1}{n-1} \sum_{i=1}^n (L_{i,fd} - \hat{L}_{i,fd})^2$$

1. The Draft Study Design does not explain how the hourly load (“L”) is being measured: is it an average, peak or some other measure?

2. There is no justification of why this forecast method is better than other methods. For example, in the previous study filed in Utah’s rate case, the hour ahead wind forecast used the average wind as the forecast of the next hour. What other rules might be possible? The Final Study Design needs to address this issue.
3. The like-day needs to be justified. For example, in the graph from page 12, the like-day used to forecast Monday is Saturday. Intuitively, Friday seems a more appropriate “like-day” or maybe even the previous Monday.

The Hourly Persistence Wind Forecast Rule is also defined on page 11: “The observed generation from 40-minutes prior to the forecast hour will be used to establish the hour-head forecast. Algebraically, this can be expressed as,

$$\hat{W}_i = W_{i-1,-40}$$

The hourly wind forecast variance is then,

$$S_w^2 = \frac{1}{n-1} \sum_{i=1}^n (W_i - \hat{W}_i)^2$$

1. The method for forecasting the persistence of wind is different here than that used in the previous wind integration study filed in Utah. In the previous case, the Company used the average of the previous hour as the forecast. The Company needs to justify empirically this change.
2. The Company also needs to justify empirically the 40-minute choice. Why not 10, or 20, or 30 etc.?

A final variance is identified on page 14 as “the hourly variance between load forecast net of wind and actual load net of wind”:

$$\begin{aligned}
S_Q^2 &= \frac{1}{n-1} \sum_{i=1}^n (Q_i - \hat{Q}_i)^2 \\
&= \frac{1}{n-1} \sum_{i=1}^n [(L_i - W_i) - (\hat{L}_i - \hat{W}_i)]^2 \\
&= S_L^2 + S_W^2 - 2S_{LW}
\end{aligned}$$

where S_{LW} is the covariance of load and wind. The Final Study Design will need to define:

1. How the distributions are constructed. (The Draft Design on page 14 says “distributions of hourly variance.” Is this the distribution of the hourly forecast error?)
2. The exact steps to “statistically estimate the amount of load following reserves.”

In general, various calculations and statistical analyses are referred to throughout the PowerPoint slideshow of February 26, 2010. The Company should provide the mathematical formulae and numerical examples to go along with the narrative.

Estimation of Regulation Reserves

On page 15 of the Draft Study Design, the Company talks about the 10-minute variance from forecast. However, the description is not clear. In the previous study filed in Utah, the Company defined “regulate-up” and “regulate-down.” Is this what is meant in the Draft Study Design? Additionally, the Final Study Design will need to define:

1. How the distributions are constructed.
2. The exact steps to “statistically estimate the amount of load following reserves.”

Sampling and Statistical Methodology

In drafting the design for the study, the Division believes that the Company should consider using wind anemometer data that should be readily available, as well as alternative sampling design such as bootstrapping. The Company should also consider other forecasting techniques, i.e., exponential smoothing or moving averages, in order to improve the forecasts in the study. In addition, the Company needs to justify its selection of the confidence intervals that are used in the study design.

RECOMMENDATION

As previously stated, the Division believes that the proposed time line (to complete the study by August 2), leaves little time for stakeholder review and input, or for the Company to implement any input that is provided before moving to the next phase of the schedule. Going forward the Company must provide all mathematical formulae intact wherever calculations and statistical analyses are referred to, along with a narrative and some numerical examples. Information should be distributed at least three days prior to meetings; otherwise on-the-spot Power point presentations result in a process lacking in stakeholder input. Finally, the Division recognizes the Commission direction for the Company on wind integration cost found in the 2009 rate case Report and Order.¹ In particular, the Commission directed the Company to address all related issues in the next proceeding appropriate for addressing wind integration cost issues and we expect the Company to adhere to this directive as it designs and works to complete the study. The Division has outlined each issue below:

Office of Consumer Services

- The Company needs to revisit and justify the weighting factors its uses to calculate its west side and east side system wind integration costs.
- The Company's current method overstates the amount of wind energy on the west side.
- The Company's GRID output does not model reserves on coal and gas units that provide wind integration services, but the costs included in the test period accounts for those costs. The Company needs to correct the fact the GRID output reports do not match historical data.

UAE

- The Company needs to revisit the weighted average method its uses to calculate its west side and east side system wind integration costs.
- The Company must justify why the Company's self-supplied wind integration costs increased nearly six-fold.
- The Company's method for estimating the inter-hour integration costs needs to be reviewed and substantiated.

¹ Docket No. 09-035-23, Report on Revenue Requirement, Cost of Service, and Spread of Rates, February 18, 2010, p. 50.

- The Company needs to take into account the proper amount of wind resources integrated into BPA area and with BPA's current wind integration charges.
- The Company needs to justify and explain its assumptions regarding Company-owned reserves in its analysis of wind integration costs.
- The Company needs to justify and explain why all inter-hour wind integration occurs through market sales and purchases rather than from its own resources.
- The Company needs to justify the assumption that the Company loses financially on each and every transaction.
- The Company needs to take into account Company-owned reserves in its analysis of wind integration costs and justify why massive amounts of Company-owned generation must be held in reserves for intra-hour deviations in wind generation.
- The Company needs to justify why costs should be incurred for regulating down. Including such costs would mean over-recovery of wind integration costs.

Division

- The method for calculating intra-hour charges is flawed and needs to be revised due to several flaws in the analysis.
- The Company assumes that intra-hour variations, both regulate up and regulate down, follow a normal distribution, when in fact the distribution more closely approximates a Gumbel distribution.
- The Company has not justified its use of a 2 standard deviation in determining the proper level of reserves.
- The Company needs to substantiate the reliability of its estimation of wind integration costs.
- The Company does not evaluate the actual level of reserves that would be carried without the wind resources, but assumes that additional reserves must be added to accommodate wind resources.
- The Company incorrectly assumes that wind resources will always require additional reserves. The Company must substantiate this claim.
- The Company needs to include in its analysis whether reserves carried to cover other uncertainties are sufficient to cover the added uncertainty of wind.

- In its analysis of intra-hour energy deviation, the Company has not taken into account the net impact of all potential variations, such as hydro, customer demand, and fossil generation. The Company's analysis ignores all other sources of intra-hour variability.
- The Company needs to justify its claim that other generation resources must compensate for all changes in wind generation.
- The Company's analysis is based on 10-minute wind data from September 2008 through April 2009, not taking into account any summer data.
- The Company needs to take into account all wind facilities that are expected to begin commercial operations in making its analysis and in its basic assumptions used in the analysis.

The Division appreciates this opportunity to provide some initial comments at this time and hopes that the Company constructively applies our feedback to the study. The Division's final comments on the overall design and results of the study will be filed with the Commission when PacifiCorp files a Wind Integration Study in Utah.

cc: PacifiCorp IRP Mailbox
Dave Taylor, Rocky Mountain Power
Michele Beck, Office of Consumer Services