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August 19, 2010

Via Electronic and US Mail

Public Utility Commission
Attn: Filing Center
550 Capitol St. NE #215
P.O. Box 2148
Salem OR 97308-2148

> Re: In the Matter of PUBLIC UTILITY COMMISSION OF OREGON Investigation
> into Forecasting Forced Outage Rates for Electric Generating Units
> **Docket No. UM 1355**

Dear Filing Center:

      Enclosed please find an original and five (5) copies of the Errata Reply Testimony of Randall J. Falkenberg, along with clean and redlined replacement pages, on behalf of the Industrial Customers of Northwest Utilities ("ICNU") in the above-referenced docket.

      Thank you for your assistance.

Sincerely yours,

/s/ Martin H. Patail
Martin H. Patail

Enclosures
cc: Service List

CERTIFICATE OF SERVICE

I HEREBY CERTIFY that I have this day served the foregoing Errata Reply Testimony and Exhibits of Randall J. Falkenberg on behalf of the Industrial Customers of Northwest Utilities upon the parties, on the official service list shown below for UM 1355, via U.S. mail to parties which have not waived paper service, and via electronic mail to the entire service list.

Dated at Portland, Oregon, this 19th day of August, 2010.

/s/ Martin H. Patail
Martin H. Patail

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(W) = Waive Paper Service

BEFORE THE PUBLIC UTILITY COMMISSION

OF OREGON

UM 1355

In the Matter of   )
)
The Public Utility Commission of Oregon   )
Investigation into Forecasting Forced Outage   )
Rates For Electric Generating Units.   )
)

REPLY TESTIMONY OF

RANDALL J. FALKENBERG

ON BEHALF OF

THE INDUSTRIAL CUSTOMERS OF NORTHWEST UTILITIES

ERRATA

August 19, 2010

REPLY TESTIMONY OF RANDALL J. FALKENBERG - ERRATA

Page 3, line 11.

Remove the sentence: "Use of a four-year moving average model <u>implies</u> a stationary (mean reverting) rather than non-stationary series."

Page 4, line 14. The word "ex-ante" should read "ex-post." The correct sentence is:

"PGE presents 'data to date' analyses, based on use of only ex-post data."

Page 6, line 20. The word "ex-ante" should read "ex-post." The correct sentence is:

"None of my original conclusions would be changed if ex-post data alone was used."

Page 13, line 12-13.

Remove the sentence: "The four-year rolling average model is nothing more than a special case of the above equation: N = 4, and $\square$ (k) = ¼ for all k."

Remove the referenced footnote "26."

Page 14, line 7-8.

Remove the sentence: "This shows PGE now admits that a fundamental premise of its criticism of the ICNU collar is incorrect."

1   3. PGE further contends that even accepting the results of my analysis, they fail
2   to approach statistical significance. PGE presents a series of "permutation
3   tests" in support of this argument.[7]

4   4. PGE contends that use of Root Mean Square Error ("RMSE") is not the best
5   metric for deciding between forecast methods. PGE suggests this overstated
6   forecast accuracy gains presented in my supplemental testimony.[8] PGE
7   proposes use of the Relative Geometric Root Mean Square Error ("RGRMSE")
8   because it is allegedly less sensitive to outliers.

9   **Q.**   **IS THE PGE TESTIMONY CORRECT?**

10 **A.**   No. PGE's criticisms above are wrong, exaggerated and irrelevant:

11   **1. Time series analysis provides evidence the FOR series are stationary**
12   **and mean reverting.**

13   **2. At the very most, use of ex-ante data implies it would be inappropriate**
14   **to characterize the analysis in my supplemental reply testimony as a**
15   **"backcast."[9] However, it is still a very useful empirical analysis**
16   **explaining the actual behavior of outage rates in the years following**
17   **extreme outage rate occurrences. These analyses showed that extreme**
18   **outage rates are more likely to be followed by "closer to normal"**
19   **rather than "slightly less extreme" outage rates.**
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21   **3. The forecast accuracy comparisons in my supplemental testimony are**
22   **quite reasonable, and even conservative. When possible impacts**
23   **stemming from use of ex-ante data was removed, the ICNU collar still**
24   **provides substantial accuracy gains relative to the 90/10 replacement**
25   **strategy PGE favors.**

26   **4. Even if the OPUC were convinced the FOR series are not mean**
27   **reverting, simply excluding the outliers or replacing them with the**
28   **prior year's four-year moving average provides a better forecast than**
29   **the 90/10 replacement strategy.**

30   **5. PGE's permutation tests contain a basic error that invalidates their**
31   **results. Corrected permutation tests (and conventional statistical tests)**
32   **demonstrate a very high likelihood the ICNU method will improve**
33   **forecast accuracy, and very low likelihood that the results obtained**
34   **were due to random chance.**

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[7]   Id. at 2.
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[9]   A hypothetical recreation of a forecast prepared at some time in the past.

1   **6. Large, but unpredictable outliers included in my supplemental**
2   **testimony comparisons, understated, rather than overstated the**
3   **advantage of the ICNU collar. Consequently, PGE's primary**
4   **argument for RGRMSE is invalid.**

5   **7. PGE's criticism of the ICNU collar's accuracy comparisons are also**
6   **irrelevant because even based on RGRMSE, the ICNU collar method**
7   **improves forecast accuracy.**

8   **Q.**   **DO YOU HAVE ANY OTHER COMMENTS?**

9   **A.**   Yes. There are several other important points I would like to make:

10   1. PGE relies on two unique and novel statistical methods in this case (the
11   RGRMSE and permutation tests). The Company has never applied either
12   technique in any previous OPUC proceeding. It applied both techniques
13   incorrectly, and produced misleading results.

14   2. PGE presents "data to date" analyses, based on use of only ex-post data.
15   PGE contends these analyses show the ICNU collar fails to provide
16   forecast accuracy improvements. However, PGE's analysis contains a
17   mathematical error and uses such a limited data sample (as few as one data
18   point to compute the replacement mean FOR value) that the PGE results
19   are meaningless. Instead of providing "data to date" the information used
20   was often several years out of date.

21   3. Putting all other issues aside, analysis of the PacifiCorp data shows that the
22   year following an extreme outage rate is much more likely to be "closer to
23   normal" than just "slightly less extreme." As a result, mean replacement is
24   a much better strategy than PGE's preferred 90/10 replacement strategy.

25   4. PGE presents other analyses intended to address the favorability of the
26   90/10 collar using NERC data as a replacement strategy.[10] These results
27   do not provide any insights into the forecast gains arising from a NERC
28   based collar due to lack of data, and the other infirmities in PGE's analysis.

29   5. Even accepting PGE's major claims, they provide no basis for preferring
30   the alternatives to the ICNU collar. They merely imply that a statistical
31   analysis can't decide which alternative is best, not which is better. Even
32   so, there are other logical or policy grounds favoring acceptance of the
33   ICNU or OPUC collar proposals that have not been addressed by PGE.

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[10]   To avoid confusion, I will refer to PGE's recommended collar (90/10 NERC data range, 90/10 replacement strategy) as the "PGE Collar." PGE refers to this as the "Staff" collar, though it is not clear the Staff still supports this method. I will refer to the collar proposed by the Commission in its Order of October 6, 2009 as the "OPUC Collar."

1   best forecasting method from this time forward. This is the <u>ordinary</u> process used

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4   explains the historical data, not by a series of "backcasting" experiments.

5 **Q. HAVE PGE AND PACIFICORP BEEN CONSISTANT IN AVOIDING USE**
6 **OF EX-ANTE DATA?**

7 A.   No. Both PGE and PacifiCorp used ex-ante data in the analyses they presented of

8   the collar mechanisms to establish the collar ranges (two sigma for PacifiCorp and

9   90/10 for PGE). PGE acknowledged its own use of ex-ante data, but asserts that

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12   of the distribution are constant, even though there is no permanent mean. Under

13   PGE's logic, the mean could actually move outside of the collar, yet the ranges

14   would remain constant – a clearly illogical assumption.

15 **Q. DO YOU AGREE WITH PGE THAT THE RESULTS SHOW YOUR USE**
16 **OF EX-ANTE DATA INTERJECTS UNREASONABLE BIAS INTO YOUR**
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18 **A.**   No. In the following, I will show that because the FOR series is mean reverting, in

19   principle, no bias was introduced, and further, that the use of ex-ante data had a

20   limited effect. None of my original conclusions would be changed if ex-post data

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3   **A.**   No. In conventional time series analysis, a Moving Average process of order N

4   can be represented by a model expressed as:

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8   coefficient of the residual lagged k times.   In such a model the forecast of the

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[26/] ~~Y(t) = µ+1/4(ε(t-1)+ ε(t-2)+ ε(t-3)+ ε(t-4)) ; Y(t) = ¼((µ + ε(t-1))+(µ + ε(t-2))+(µ + ε(t-3))+ (µ + ε(t-4))). Based on the definition of Y(k), and ε(k): (ε(k) = Y(k)- µ). Y(t) = ¼(Y(t-1)+Y(t-2)+Y(t-3)+Y(t-4) which is the conventional formulation.~~

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