**BEFORE THE**
**WASHINGTON UTILITIES AND TRANSPORTATION COMMISSION**

WASHINGTON UTILITIES AND
TRANSPORTATION COMMISSION,

                **Complainant,**

    **v.**

PUGET SOUND ENERGY, INC.,

                **Respondent.**

**Docket No. UE-060266**
**Docket No. UG-060267**

**PREFILED REBUTTAL TESTIMONY (NONCONFIDENTIAL) OF
JEFFREY A. DUBIN
ON BEHALF OF PUGET SOUND ENERGY, INC.**

**AUGUST 26, 2006**

**PUGET SOUND ENERGY, INC.**

**PREFILED REBUTTAL TESTIMONY (NONCONFIDENTIAL) OF
JEFFREY A. DUBIN**

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# PUGET SOUND ENERGY, INC.

## PREFILED REBUTTAL TESTIMONY (NONCONFIDENTIAL) OF
## JEFFREY A. DUBIN

### I.  INTRODUCTION

**Q.  Are you the same Jeffrey A. Dubin who submitted prefiled direct testimony in this proceeding on February 15, 2006, on behalf of Puget Sound Energy, Inc. ("PSE" or "the Company")?**

A.  Yes.

**Q.  Please summarize the purpose of your rebuttal testimony.**

A.  My prefiled rebuttal testimony responds to the prefiled response testimony of Dr. Yohannes Mariam, Exhibit No. ___(YKGM-1T), filed on behalf of the Staff of the Washington Utilities and Transportation Commission ("Commission Staff") regarding electric and gas weather normalization.

My prefiled rebuttal testimony also responds briefly to the prefiled response testimony of Mr. James Russell, Exhibit No. ___(JMR-1T), regarding fees paid to my company by PSE for work performed for PSE's 2004 general rate case.

### II.  WEATHER NORMALIZATION

**Q.  Please summarize your direct testimony.**

A.  My prefiled direct testimony discusses several significant improvements to PSE's weather normalization models, which had previously assumed a linear relationship between load and temperature.  My work with PSE verified that the

1  relationship between load and temperature on PSE's system is non-linear.  The

2  primary change I proposed to account for this non-linearity in the load-

3  temperature relationship that is present on the PSE system was to introduce

4  additional heating and cooling degree day measures.  This change is important as

5  it allows the econometric models for electricity and natural gas to more accurately

6  reflect the relationship of load to temperature.

7  Additionally, PSE updated its models using the most recently available data.  This

8  ensured better consistency among PSE's electric, natural gas, and rate schedule

9  allocation models.

10  **Q.**    **Does Commission Staff accept PSE's proposed weather normalization rate**

11         **adjustment in this rate case?**

12  A.    Yes.  Dr. Mariam's prefiled response testimony states that Commission Staff

13        accepts PSE's proposed weather normalization rate adjustment, but only for

14        purposes of this rate case

15  **Q.**    **Why does Commission Staff accept the Company's weather normalization**

16         **adjustment for only this case?**

17  A.    Dr. Mariam states that the difference in energy load that would result if

18        Commission Staff used the same base temperature as in the last PSE rate case

19        rather than the method proposed by PSE in this rate case is only 3 percent.  Thus,

1      as the proposed change does not materially affect rates, Commission Staff accepts

2      the proposed change for purposes of this case.[1]

3  **Q.     Would you comment on Commission Staff's reasoning?**

4  A.     While the Company and I are pleased that Commission Staff accepts PSE's

5         proposed weather adjustment, Dr. Mariam's logic to limit its acceptance to just

6         this case is troubling.  PSE worked long and hard, both within and in addition to

7         the collaborative process with Commission Staff, to analyze and improve upon its

8         weather normalization methodology.  The Company also responded to

9         voluminous data requests and conducted additional analyses to address

10        Commission Staff's concerns and questions regarding its proposed methodology

11        in this case.  I provide a listing of Commission Staff's Data Requests regarding

12        weather normalization as Exhibit No. ___(JAD-6).

13        As I discussed in my prefiled direct testimony, PSE rigorously investigated

14        alternative specifications that systematically addressed concerns expressed by

15        Commission Staff.  PSE thoroughly and exhaustively investigated each issue

16        raised by Staff and presented the results of these investigations to Commission

17        Staff.  Moreover, PSE did not adopt a model that was the most financially

18        favorable to it, but instead put forth a tested, demonstrably accurate, and robust

19        methodology that has been subjected to expensive and exhaustive investigation by

20        both Commission Staff and PSE.

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[1] PSE's proposed weather adjustment in this case is in fact less favorable to PSE than the revenue requirement that would have resulted if PSE had used the same model used in the 2004 general rate case for this proceeding.

1  **Q.  Does Dr. Mariam agree that PSE has improved its weather adjustment**

2     **model?**

3  A.  Yes.  Dr. Mariam states that PSE's current methodology is a "step in the right

4     direction because it attempts to capture the nonlinear relationship between energy

5     consumption and temperature."[2]  However, as stated above, it is troubling that

6     Commission Staff does not confirm the value of the new methodology on its

7     merits, given the effort that has been put into the weather normalization

8     collaborative and development of evidence to support the improved methodology

9     for this case.

10 **Q.  What appears to be the basis for Commission Staff's reservations about**

11    **PSE's proposed methodology?**

12 A.  As stated above, Dr. Mariam agrees that a non-linear relationship between

13    temperature and load exists on PSE's system.[3]  However, he apparently disagrees

14    about the data necessary to capture this non-linearity.  In particular, Dr. Mariam

15    argues that PSE has failed to fully substantiate its proposed change in the base

16    temperature used in its weather normalization models to capture the non-linear

17    relationship.[4]  Dr. Mariam argues that "a change in balance point temperature,

18    such as that proposed by the Company, requires a load research study based on

19    highly granular and detailed data that takes into account the impact of changes in

20    temperature and a number of other environmental factors that can influence

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[2] Exhibit No. ___(YKGM-1T) at page 7, lines 1-2.

[3] *See* Exhibit No. ___(YKGM-1T) at page 5, footnote 2

[4] *See id.* at page 3, lines 6-8.

1    ratepayer 'thermal comfort'[5] and, hence, ratepayer energy consumption."[6]  Dr.

2    Mariam asserts that PSE has failed to provide such an analysis.

3  **Q.     What is a balance point temperature?**

4  A.    The balance point[7] is the outside temperature at which no inside heating is

5       required.

6  **Q.     Generally what factors affect balance point temperatures?**

7  A.    Thermostat setting and the insulation properties of the residential shell determine

8       the balance point temperature.  Importantly, the heat gain from occupants and

9       appliances in a well insulated dwelling may lower the balance point temperature

10      significantly below the thermostat set point.  For example, assume that a customer

11      sets the thermostat in her residence at 65 degrees in the winter and is comfortable

12      at this temperature.  Depending on the characteristics of the dwelling and the

13      number of occupants, it is possible that no extra energy (electricity or natural gas,

14      etc.) will be required to achieve the 65 degree thermostat setting until the outside

15      temperatures drops below 45 degrees.  In this case, the "sensible" heat gain from

16      occupants and appliances is sufficient to keep the residence at a comfortable

17      temperature unless the outside temperature is extremely cold.  In this example, the

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[5] Thermal comfort depends on both humidity and temperature (ASHRAE, 1985 Fundamentals, Chapter 8, Physiological Principles for Comfort and Health).  Residential customers are assumed to control their comfort levels by setting their thermostats.  Thus, I do not draw a distinction between thermostat settings and comfort levels in my discussion.

[6] *See* Exhibit No. ___(YKGM-1T) at page 7, lines 7-11.

[7] The balance point always refers to the outside temperature.  Conversely, the indoor temperature is set using the thermostat to maintain a temperature inside the residence that is comfortable to the residents.

1    thermal comfort level is 65 degrees but the balance point temperature is 45

2    degrees.  The point is that heating is not triggered until the outside temperature

3    drops below 45 degrees.  This is the base or balance point temperature that is

4    relevant for measuring heat load, and thus the relevant base temperature for a

5    heating degree-day measurement.

6    **Q.    Do you agree with Dr. Mariam that PSE has not fully substantiated its**

7    **proposed "change" in balance point temperature?**

8    A.    No.  There are several reasons why I disagree with Dr. Mariam's assertion at

9    page 7, lines 22-24 of his prefiled response testimony.  First, PSE did not propose

10   to "change" the balance point temperature from 65 degrees, but instead adopted an

11   econometric specification of the load temperature relationship that *added to* its

12   weather adjustment model additional temperatures at bases other than 65 degrees

13   (specifically, at 45 degrees for heating months and 60 degrees for cooling

14   months).  PSE did so because its data regarding the relationship between

15   temperature and load on its system showed that this relationship is different

16   beginning at these different temperature "break points".

17   In so doing, PSE followed a standard empirical methodology to specify weather

18   effects in its weather adjustment models.  For example, in an article Dr. Mariam

19   identified and provided to PSE,[8] Kissock *et. al.* (2003)[9] illustrate the non-linear

20   load temperature relationship and several regression based techniques, including

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[8] E-mail from Yohannes Mariam to Villamor Gamponia, dated May 12, 2006.

[9] J. Kissock, *et al.*, "Inverse Modeling Toolkit: Numerical Algorithms", ASHRAE, KC-03-2-2 (RP-1050), Reprint.

1    "change-point" and "variable balance degree day" methods, to determine balance

2    points empirically.

3    Second, PSE conducted and provided to Commission Staff a rather extensive and

4    detailed study in response to a Commission Staff data request.[10]  This study was

5    specifically completed in response to Commission Staff's request that a "highly

6    granular and detailed" load research study be employed to determine balance

7    point temperatures (*see e.g*. Exhibit No. ___(JAD-7) and Exhibit No. ___(JAD-8),

8    requesting supporting documentation and non-statistical analysis to justify the use

9    of different base temperatures).

10   **Q.    Do you agree that a "highly granular and detailed" study is necessary to**

11   **determine balance point temperatures?**

12   A.    No.  While it might be interesting to investigate balance point temperatures for

13   different individual households in varying types of housing stock, etc., such

14   individualized information is not necessary for purposes of understanding the

15   relationship between temperature and load on a system-wide level.  Instead,

16   simple statistical techniques relying on system load aggregate data may be used to

17   empirically determine balance point temperatures.  My prefiled direct testimony

18   provided an empirical determination of balance point temperatures following

19   standard methodologies established in the published literature.  Subsequent to

20   filing my prefiled direct testimony and in response to specific data requests from

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[10] *See* PSE's Response to WUTC Staff Data Request No. 016 and PSE's First Supplemental
Response to WUTC Staff Data Request No. 016, provided as Exhibit No. ___(JAD-7) and Exhibit
No. ___(JAD-8), respectively.

1    Commission Staff, PSE went a step further and provided a detailed engineering

2    analysis as well as alternative econometric techniques to determine balance point

3    temperatures.

4  **Q.    What factors does Commission Staff assert affect balance point**

5  **temperatures?**

6  A.    Dr. Mariam argues at page 7, lines 12-19 of his prefiled response testimony that

7    balance point temperatures are affected by several environmental factors,

8    including the structure of the residence (windows, doors, square footage, etc.) and

9    year built.  Dr. Mariam also argues that the number and composition of household

10    members, weather factors (such as humidity, sunshine hours, precipitation, wind

11    speed, and radiant temperature), and the types of appliances can affect balance

12    point temperatures.

13  **Q.    Do you disagree?**

14  A.    Dr. Mariam is correct with respect to balance point temperatures for individual

15    households.  These factors and others are well known and were, for example,

16    discussed fully in Dubin (1985).[11]  In particular, Dubin (1985) developed a

17    detailed engineering thermal load model that relates environmental factors,

18    dwelling characteristics, and thermostat settings (related to thermal comfort and

19    the marginal cost of comfort) to balance point temperature.  Nonetheless, balance

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[11] Jeffrey A. Dubin, *Consumer Durable Choice and the Demand for Electricity* (1985).

1    points may also be determined by empirical methods as is discussed by Kissock

2    (2003),[12] among others.

3  **Q.    Please summarize the first study that you and PSE conducted and provided**

4          **to Commission Staff after you filed your prefiled direct testimony.**

5  A.    The first study I conducted was a detailed granular study required by Commission

6         Staff.  I have provided a copy of this study as Exhibit No. ___(JAD-9).  The

7         analysis' purpose was to determine the likely range of balance point temperatures

8         in single-family residential structures in the PSE service area.  Recall that no

9         additional heating is required when outdoor temperatures are higher than the

10        balance point.  Thermostat setting and the insulation properties of the residential

11        shell all play a role in determining the balance point temperature.  To conduct this

12        study, I analyzed PSE's RAS 2004 survey.  RAS is an acronym for Residential

13        Appliance Saturation.  The RAS survey samples individual gas and electric

14        customers on the PSE system.  It contains detailed information on over 5,000

15        households.  I adapted an energy thermal model published in Dubin (1985)[13] to

16        work with the PSE survey.  I used information on single-family residence square

17        footage, the presence or absence of insulation, the types of storm or glazed

18        windows in the home, and other factors available in the survey as inputs to my

19        model.  These factors and matched weather information permitted me to make an

20        engineering prediction of the monthly space heating load that would likely occur

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[12] Kissock, *supra* note 9.

[13] Dubin, *supra* note 11, at chapter 2, a copy of which is included as part of Exhibit No. ___(JAD-8).  The thermal load model was co-developed (circa 1980) with Professor Daniel McFadden, winner of the 2000 Nobel Prize in economics.

1    for each household.  The energy load model quantifies the differences between

2    energy used for houses of different sizes and characteristics.  Given an assumed

3    indoor comfort level (thermostat setting) and household and building

4    characteristics, the thermal load model calculates the implied balance point

5    temperatures for each dwelling.

6    **Q.     Did you also analyze survey information on thermostat settings?**

7    A.     Yes.  I analyzed survey data taken from roughly 400 PSE customers during the

8          last twelve months.  This data provides detailed information on thermostat

9          settings.  This survey showed that over 40 percent of respondents have thermostat

10         settings lower than 65 degrees, while over 10 percent report thermostat setting

11         less than 55 degrees.

12   **Q.     What did you conclude from this study?**

13   A.     The engineering thermal modeling approach to electric loads in the PSE service

14         territory showed that balance point temperatures may be as low as 45 to 50

15         degrees for households.  This finding demonstrates that using base temperatures

16         of 65 degrees in weather normalization regression models are not likely to

17         adequately capture the load temperature relationship for a significant number of

18         dwellings in the PSE service territory.  Applied to the RAS data, the engineering

19         thermal load model yields practical implications and demonstrates that energy

20         load on the PSE system is not best measured solely by HDD base 65 degrees

21         because balance point temperatures are significantly lower than comfort levels for

22         a significant fraction of PSE customers.

1    **Q.**     **Does your model and analysis account for all of the factors mentioned by**

2           **Commission Staff?**

3    A.     Yes.

4    **Q.**     **Does your analysis rely on "highly granular and detailed" data to determine**

5           **balance point temperatures?**

6    A.     Yes.

7    **Q.**     **Did you present this study to Commission Staff?**

8    A.     Yes.  I met with Commission Staff and participated in a teleconference in which

9           this study was presented and explained to Staff.

10   **Q.**     **Did the econometric model you used in your prefiled direct testimony**

11          **account for all of the environmental factors listed by Commission Staff as**

12          **potential determinants of balance point temperature?**

13   A.     No.  Commission Staff requested that PSE assemble information on, *inter alia,*

14          humidity, sunshine hours, precipitation, and wind speed.[14]  PSE assembled this

15          data and provided it to Commission Staff.  However, Commission Staff did not

16          ask PSE to do anything with this data.

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[14] Commission Staff Data Request 163.

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1   **Q.   Would incorporating this data into your econometric model affect the**

2   **empirical results or degree of weather normalization for PSE?**

3   A.   No.  While some of these factors show statistical significance in PSE's weather

4   normalization model, they do not affect the overall explanatory power of the

5   model nor do they affect the degree of weather normalization.[15]

6   **Q.   Is it surprising that there is no affect?**

7   A.   No.  For instance, in another paper that was provided by Dr. Mariam[16], Hyde

8   (1997)[17] discussed such factors.  When Hyde (1977) analyzed the temperature

9   load relationship in Ireland, he included these additional factors (humidity, wind

10   speed, sunshine, etc) in his regression analysis, but did not find that they were

11   important determinants of the temperature load relationship.  Presumably this is

12   because these factors have low correlation to temperature.[18]  Such factors may be

13   more important in other areas of the United States, but their presence or absence

14   did not affect the degree of empirical weather normalization proposed by PSE for

15   its Washington service territory.

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[15] The limited affect of these factors is similar to that found for the price and income factors explored at the suggestion of Commission Staff during the collaborative process (see Exhibit No. ___(JAD-1T) at page 30).  It remains very difficult to improve upon a model that already explains over 97 percent of the variation in system load.

[16] E-mail from Yohannes Mariam to Villamor Gamponia, dated May 12, 2006.

[17] O. Hyde & P.F. Hodnett, "Modeling the Effect of Weather in Short-Term Electricity Load Forecasting." *Mathematics Engineering Industry,* Vol. 6, No. 2, pp. 155-169 (1997).

[18] The effect of omitting variables in an empirical load temperature study was explained in footnote 5, on page 37 of my prefiled direct testimony.  As I discuss further below, Dr. Mariam apparently believes that these factors are determinants of temperature.  But Dr. Mariam is factually incorrect.  The simple correlation between precipitation and heating degree days is roughly 0.1, the correlation between relative humidity and heating degree days is roughly 0.4 and the correlation between wind speed and heating degree days is roughly 0.2.  These levels do not indicate that temperature is highly correlated with these ancillary factors.

1    **Q.    Please describe the other study that you completed and presented to**

2    **Commission Staff with respect to balance point temperature determination?**

3    A.    At page 9, lines 16-20, of his prefiled response testimony, Dr. Mariam suggests

4         that PSE acquire a non-linear modeling software such as Multivariate Adaptive

5         Regression Splines ("MARS") to determine balance point temperature.  However,

6         PSE has already completed a MARS analysis of the load temperature relationship,

7         which has also been provided to Commission Staff.[19]

8    **Q.    What is the MARS approach?**

9    A.    MARS is a semi-parametric statistical technique that determines the "best"

10        relationship between a dependent variable and independent explanatory variables

11        by locating "cut-points" in the explanatory variables and generating new

12        explanatory factors based on these cut-points.  For instance, when temperature is

13        the explanatory variable, a MARS analysis will determine a cut-point and

14        generate an explanatory variable called a "basis" function that measures the

15        difference between temperature and the cut-point for instances where the

16        temperature is lower than the cut-point.  If temperature is higher than the cut-

17        point, the generated variable is set to zero.  MARS uses the explanatory factors to

18        create basis functions based on the cut-points that it determines have the greatest

19        empirical relevance.  These cut-points are determined by the MARS technique,

20        not by the user.  I presented the MARS methodology to Commission Staff in our

21        joint meeting and explained that MARS had the ability to determine heating

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[19] E-mail from Villamor Gamponia to Yohannes Mariam, dated June 16, 2006, a copy of which is provided as Exhibit No. ___(JAD-10).

1  degree-day type measures without assuming a base temperature *a priori.* I also

2  explained that there was likely to be little gain in using MARS techniques over

3  the empirical model proffered in my prefiled direct testimony.

4  **Q.  Why did you expect little gain from using MARS methods?**

5  A.  I expected little gain because I had already performed an exhaustive analysis of

6  alternative empirical models with various base temperatures.  Moreover, the final

7  econometric model adopted by PSE and proposed in this proceeding explained

8  over 97 percent of the variation in daily system load.  Consequently, there was

9  very little room to improve this specification.

10  **Q.  Did you perform a MARS analysis as part of your prefiled direct testimony?**

11  A.  No.  I implemented the MARS approach to determine the load temperature

12  relationship on the PSE system in response to inquiries made by Commission

13  Staff and in preparation for a presentation to Staff on additional research

14  conducted to substantiate PSE's models and base temperatures.  MARS is a

15  reasonable statistical approach for analyzing load temperature relationships.  It is

16  my understanding that this method was also suggested to Commission Staff by

17  PacificCorp.[20]

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[20] My prefiled direct testimony did not use a MARS approach but instead adopted a MARS-like
econometric specification.  Again, there is little difference between the MARS formulation and that
provided by PSE.  Dr. Mariam, however, misunderstands the definitions of the variables used in my study.
Specifically, footnote 3, on page 6 of Dr. Mariam's prefiled response testimony incorrectly defines the
heating degree day (base 65) factor used in my study.

**Q.** **What were the results of this analysis?**

**A.** The results of the MARS analysis substantiated balance point temperatures much lower than 65 degrees. Additionally, I performed a full weather normalization analysis using the model resulting from the MARS approach. This analysis resulted in a trivial change to the weather normalization proposed in my prefiled direct testimony and accepted by Commission Staff in this proceeding.

**Q.** **After accepting your recommended level of weather normalization, did Dr. Mariam recommend in his prefiled response testimony that additional analysis be performed?**

**A.** Yes. Dr. Mariam apparently views the PSE analysis as deficient and recommends that PSE be ordered to complete a micro-level study of customers.[21] Specifically, Dr. Mariam suggests that PSE be ordered to: (i) develop a research plan for selecting study customers by rate schedule and county;[22] (ii) collect hourly data for three years for these electric customers, and five years of daily natural gas data

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[21] Exhibit No. ___(YKGM-1T) at page 8, line 3, through page 9, line 3,

[22] Dr. Mariam points to temperature and socio-economic differences across the PSE service territory. He avers that differences in socio-economic characteristics <u>may</u> affect weather sensitivity coefficients (Exhibit No. ___(YKGM-1T) at page 8, footnote 5). However, Dr. Mariam eschews any econometric test of this hypothesis using the data provided to him through a myriad of data requests. Dr. Mariam also ignores that this issue has been investigated by PSE. As stated in my prefiled direct testimony (page 31), PSE found that, with minor exception, weather normalization coefficients do not vary significantly by county. Additionally, as I discussed in my prefiled direct testimony, there is a high degree of temperature correlation in the PSE territory (Exhibit No. ___(JAD-1T) at page 31). PSE did not collect SeaTac data under the <u>assumption</u> that this would proxy for all temperatures in the service territory (Exhibit No. ___(YKGM-1T) at page 8, footnote 5). Instead, PSE examined this issue empirically during the weather normalization collaborative and found it did not matter (see e-mail from Villamor Gamponia to Yohannes Mariam dated March 9, 2005, a copy of which is provided as Exhibit No. ___(JAD-11)). Similarly, in a study provided by Dr. Mariam, Hyde (1997) used four weather stations for the entire country of Ireland but ultimately concluded that only one weather reading was required for temperature normalization. While Ireland is smaller than the State of Washington, the fact remains that PSE service territory temperatures are well represented by the temperature measurements at SeaTac.

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1      for study customer; (iii) collect weather data on variables that affect temperature;

2      (iv) collect non-weather data on housing characteristics; and (v) acquire full

3      featured (MARS) software to determine the load temperature relationship.

4 **Q.**     **Do you agree with this proposal?**

5 A     No. PSE has fully substantiated its weather normalization methodology and has

6      presented a full explanation of its model in my prefiled direct testimony.

7      Additionally, as I have explained, in response to Commission Staff critiques, PSE

8      conducted several new analyses that further substantiated its results. These

9      studies were presented to Commission Staff and Dr. Mariam has summarily

10      ignored them in his prefiled direct testimony. Moreover, Dr. Mariam now

11      requests additional data collection to improve a weather normalization that is

12      already over 97 percent accurate.

13 **Q.**     **Would you comment on Staff's proposal in detail?**

14 A.     Yes. First, Staff does not articulate a plan or a theory explaining why it believes

15      collection of this additional data is relevant for anything, especially weather

16      normalization. Dr. Mariam states that better data produces better estimates.[23]

17      However, he fails to explain why the data he proposes that PSE be ordered to

18      collect is better than the data PSE has already collected for the purpose at hand.

19      Second, Dr. Mariam has no basis to conclude that such data, if collected, would

20      lead to better results. Dr. Mariam has not pointed to any published study,

21      methodology, or theory that would imply that hourly level data captured for

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[23] Exhibit No. ___(YKGM-1T) at page 9, lines 7-9.

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1  individual customers would produce an improvement in PSE's weather

2  normalization, which already explains 97 percent of the variation in the data.

3  Third, it is well known that micro-level or individual level information is, at

4  times, an inferior choice to achieve certain types of econometric results.

5  During the 1960s, individual level data was becoming more popular for

6  econometric analysis due primarily to the increases in available computing power.

7  Researchers, however, took notice of initially poor or unstable results that came

8  from this line of research.  For instance, Kuh (1975)[24] notes that "many cross-

9  sectional studies based on micro data (firms, families, or individuals) have proven

10  so disappointing that many researchers prefer to avoid this data source."  The

11  divergence between micro and macro level econometric analysis was addressed in

12  the literature by Grunfeld and Griliches (1960),[25] Kuh (1975),[26] and Welsh and

13  Kuh (1976).[27]  This research concluded that micro level analysis is not always

14  better.  For instance, Welsh and Kuh state that in "some cases it is plausible that

15  aggregate data rather than limited micro data be used for estimation" (Welsh and

16  Kuh (1976, p. 353)).[28]  Using micro data may result in less efficient (*i.e.* higher

17  variance) estimates when sampling variability is accounted for.  Thus, micro data

18  may not necessarily improve accuracy.

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[24] E. Kuh, "An Essay on Aggregation Theory and Practices." *Essays in Honor of Jan Tinbergen* (1975).

[25] Yehuda Grunfield & Zvi Griliches, "Is Aggregation Necessarily Bad?" *Review of Economics and Statistics* (1960).

[26] Kuh, *supra* note 24.

[27] Roy Welsh & E. Kuh, "The Variances of Regression Coefficient Estimates Using Aggregate Data." *Econometrica*, Vol. 44, pp. 353-363 (1976).

[28] *Id.*

1    In the case of weather normalization, the goal is to understand how the PSE

2    system responds (by rate class) to changes in weather.  The goal is not to

3    understand how a specific household changes its load when the outside

4    temperature changes.  Even if that were known, that relationship for that

5    household would necessarily be averaged or aggregated with other households to

6    produce a system wide adjustment.  Beyond these facets, I have explored hourly

7    load temperature information on the PSE system and my limited explorations

8    suggest that it will take a tremendous research effort to find an empirical

9    specification that achieves anywhere near the accuracy already achieved by PSE's

10   current models.[29]

11   **Q.   Do you object to any other facets of Dr. Mariam's proposal?**

12   A.   Yes.  First, PSE has estimated that implementing the type of study requested by

13        Dr. Mariam will cost roughly $3,500,000, as described in the prefiled response

14        testimony of Mr. David Hoff, Exhibit No. ___(DWH-6T).  These costs include

15        reprogramming meters, data collection, data processing, data validation, surveys

16        of households, and so forth.

17        Second, PSE has already collected the weather information that Dr. Mariam

18        requests in his prefiled response testimony (humidity, sunshine hours,

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[29] Another publication by Kissock similarly argues that daily rather than hourly data is appropriate for weather normalization. Kissock et. al. (1988, p.170) state: "Because internal heat gain and solar loads tend to cycle on a daily basis, their effect on energy consumption can be minimized by selecting data time scale equal to or longer than the 24-hour-cycle.  Thus, average daily energy consumption and temperature data represent the shortest time scale that can remove the effect of the diurnal variation of internal heat gains and solar loads from the energy consumption data." Kissock, J.R., Reddy, T.A., and Claridge, D.E., "Ambient-Temperature Regression Analysis for Estimating Retrofit Savings in Commercial Buildings", Transaction of the ASME, Vol. 120, August 1988.

1  precipitation, etc).  As I explained above, in PSE's service territory these factors

2  are more likely to be uncorrelated with temperature than to affect temperature as

3  Dr. Mariam suggests at page 8, lines 11-12, of his prefiled response testimony.

4  Consequently, these factors are irrelevant for weather normalization in the PSE

5  service territory.

6  Third, PSE already collects housing characteristic data in its RAS surveys, and as

7  I explained above, this data has been analyzed to fully substantiate the base

8  temperatures used in PSE's weather normalization models.

9  Finally, PSE already has access to MARS software to do non-linear analysis and

10  indeed has completed such an analysis.

11  **Q.  Are you opposed to micro-economic individual level analyses?**

12  A.  No.  Indeed, my early research and Ph.D. dissertation pioneered the methods of

13  micro-econometric modeling in the energy demand area.  However, it is neither

14  reasonable nor cost effective to order PSE to perform such an analysis and adopt

15  these methods and results (whatever they might be) as the basis for future weather

16  normalization studies.  Given the accuracy of PSE's current models, it makes little

17  sense to order PSE to conduct studies and develop new methodologies for which

18  data collection alone would cost approximately $2,700,000 (excluding analysis

19  costs) to achieve an unknown benefit.

**Q. Is it possible that Dr. Mariam's recommendation would lead to better models for weather normalization?**

A.    In this instance, while I believe additional research could be academically interesting, there is no reason to believe that micro-level studies will improve significantly on the methodology that PSE has fully substantiated and demonstrated in this rate case. Micro-level modeling might be useful for load analysis or long-run planning but seems completely inappropriate in the context of a rate case.

**Q. Please summarize your rebuttal testimony regarding weather normalization.**

A.    Commission Staff has accepted PSE's proposed weather normalization for the purposes of this rate case. Yet, Dr. Mariam argues that PSE has not fully substantiated its changes to balance point temperatures and that such changes should be developed using non-linear software and "granular" data. Dr. Mariam recommends that PSE be ordered to collect (at great expense) micro (individual-level) data that might be used to perform such studies. Dr. Mariam fails to mention in his testimony that PSE has already conducted a micro-level study and presented it to Staff. Nor does Dr. Mariam acknowledge that non-linear (MARS) analysis and PSE's micro-level engineering analysis both substantiate PSE's selected balance point temperatures in the revised weather normalization methodology presented by PSE in this case. Dr. Mariam fails to explain any benefit to the costly data collection he proposes instead or how such data would be used to improve the models that PSE has already developed. I believe the

1  Commission should explicitly approve the weather normalization methodology

2  that PSE has presented in this case.

3  **III.    FEES FROM PSE'S LAST GENERAL RATE PROCEEDING**

4  **Q.    Have you also reviewed the prefiled response testimony of Commission Staff**

5  **member James Russell?**

6  A.    Yes.  I specifically reviewed the section of Mr. Russell's prefiled response

7  testimony that discusses his proposal that one-half of the fees paid to Pacific

8  Economics Group, L.L.C. (PEG) in the 2004 general rate case, Docket Nos. UG-

9  040640 and UE-040641 be removed from revenue requirements.  I focus on Mr.

10  Russell's statements regarding my fees for that case, while Mr. Karzmar addresses

11  his statements regarding Dr. Cicchetti's fees.

12  **Q.    Do you agree with Mr. Russell's characterization of your work in that case?**

13  A.    No.  Mr. Russell claims at page 14, footnote 1, of his prefiled response testimony

14  that the Commission adopted Dr. Mariam's use of 50-year hydro because of "his

15  superior screening of the available hydro data."  This assertion is incorrect and

16  misleading as it fails to recognize the contribution made by PEG in that

17  proceeding.  In that proceeding, I pre-filed a lengthy and detailed time-series

18  econometric analysis of water flows in the Pacific Northwest.  I concluded that

19  PSE's hydro generation is best characterized by a trendless random process and

20  that there was no basis to exclude hydro flow information from the 1928 through

21  1947 period (low water flow years) as being somehow abherent.  I concluded,

1    therefore, that using sixty years of water flow information was the optimal

2    manner in which to forecast future water flows and generation.

3    Dr. Mariam reviewed my analysis and agreed with its conclusions. As in the

4    present case, he could not find a single defect in the analysis. Dr. Mariam did,

5    however, recommend that a fifty-year period of information be used because

6    "rule-curves" were not available for the full sixty-year period. Presumably, when

7    and if such "rule-curves" are updated by the government, Dr. Mariam will accept

8    a sixty-year or longer basis for establishing future generation and water flows.

9    **Q.    Did not the Commission adopt a fifty-year water period?**

10   A.    It is true that a fifty-year water period was adopted by the Commission and

11   ultimately accepted by PSE. However, this was a matter of compromise. It is

12   incorrect for Mr. Russell to suggest that the Commission's decision relied soley on

13   Dr. Mariam's suggested compromise. PEG performed all the labor and executed

14   all the technical analysis underlying the fundamental shift from prior Commission

15   proceedings, which had excluded the low water years.

16   Further, a significant portion of PEG's fees in the 2004 general rate case were

17   devoted to the issue of natural gas forecasting and presented in rebuttal testimony

18   by me to specifically rebut assertions made by Dr. Mariam in his analysis of

19   natural gas price forecasting.

1   **Q.**   **Have you changed any of your opinions as result of reviewing WUTC's**

2          **Staff's testimony?**

3   A.   No.

4                   **IV.**   **CONCLUSION**

5   **Q.**   **Does that conclude your prefiled rebuttal testimony?**

6   A.   Yes.

Prefiled Rebuttal Testimony                        Exhibit No. ___(JAD-5T)
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Jeffrey A. Dubin