Exhibit T-___ (YKGM-1T)
Docket No. UE-032065
Witness: Yohannes K.G. Mariam

BEFORE THE WASHINGTON UTILITIES AND TRANSPORTATION COMMISSION

WASHINGTON UTILITIES AND TRANSPORTATION COMMISSION, **Complainant,** **v.** **PACIFICORP, d/b/a PACIFIC POWER & LIGHT COMPANY** **Respondent.**	**DOCKET NO. UE-032065**

DIRECT TESTIMONY OF

YOHANNES K.G. MARIAM, PH.D.

STAFF OF
WASHINGTON UTILITIES AND
TRANSPORTATION COMMISSION

July 2, 2004

Q. Please state your name and business address.

A. My name is Yohannes K.G. Mariam. My business address is Chandler Plaza Building, 1300 South Evergreen Park Drive S.W., Olympia, Washington, 98504-7250.

Q. By whom are you employed and in what capacity?

A. I am employed by the Washington Utilities and Transportation Commission (Commission) as a Regulatory Analyst (Economist) in the Energy Section of the Regulatory Services Division.

Q. Please describe your educational background and professional employment experience?

A. I hold Masters of Science and Doctor of Philosophy (Ph.D) degrees from McGill University (Canada). My areas of specialization are quantitative economics (econometrics and operations research) and resource economics. I minored in applied cognitive psychology and anthropology. I was a fellow of the Natural Science and Engineering Research Council (NSERC) of Canada from 1993-1995. I worked as a regulatory and socio-economic consultant for Environment Canada from 1995 to 1997. In 1998 and 1999, I worked as a staff economist for the

Canadian Federal Department of the Environment (Environment Canada). In those positions I worked on a wide variety of projects and wrote several manuscripts dealing with economics, the environment, agriculture, development, and regulatory issues. I have served as an invited reviewer for the Journal of the Air and Waste Management, and as an invited lecturer at McGill University.

Since September 1999, I have been employed by the Commission as an economist in the Energy Section of the Regulatory Services Division. In that capacity, I have worked on purchased gas adjustments, incentive mechanisms, various tariff revisions, integrated resource planning, and general rate cases including Docket Nos. UE-031725 (PSE), UE-991832 (PacifiCorp), UG-031885 and UG-000073 (Northwest Natural), and UE-011595 (Avista). My analyses in those general rate cases concerned the prudence of new resources, rate spread, temperature normalization, and cost of service. I also contributed to the small business impact analysis of implementing railroad, telecommunication and energy related rules. I collaborate with other Staff members on issues relevant to economic disciplines and write technical papers dealing with regulated energy industries.

PURPOSE AND SUMMARY OF TESTIMONY

Q. What is the purpose of your testimony in this proceeding?

A. I present Staff's recommendation regarding PacifiCorp's proposed temperature normalization adjustment, including the impact on proforma revenue requirement.[1] I also testify regarding the Company's cost of service study.

Q. Please summarize Staff's temperature normalization adjustment.

A. Staff proposes changes to the Company's temperature normalization adjustment that will increase PacifiCorp's normalized test year electricity consumption by 55,930,371KWh. This results in an increase to PacifiCorp's proforma revenue by about $3,165,381. (Exhibit__ (YKGM-2), Tables 9a, 9b, 10a and 10b). Staff witness Thomas Schooley presents the overall revenue and rate impact of this adjustment.

Q. Are you sponsoring any exhibits?

A. Yes, I have prepared Exhibit ___ (YKGM-2) in support of Staff's proposed temperature normalization adjustment. The exhibit contains the following tables:

[1] Weather normalization is also called temperature normalization. In this testimony, both refer to the same issue: adjusting test year electricity usage based on the difference between normal and test year average temperature.

Table 1: Statistical Estimation Results of Weather Sensitivity Coefficients Using Autoregressive Procedure (Staff's Analytical Result);

Table 2: Monthly Weather Sensitive Electricity Adjustment By Rate Schedule for Walla Walla;

Table 3a: Summary of Unbilled Weather Sensitive Consumption for Walla Walla;

Table 3b: Test Year Unbilled Heating and Cooling Degree Days for Walla Walla;

Table 4: Monthly Weather Sensitive Electricity Adjustment by Rate Schedule for Sunnyside;

Table 5a: Summary of Unbilled Weather Sensitive Consumption for Sunnyside;

Table 5b: Test Year Unbilled Heating and Cooling Degree Days for Sunnyside;

Table 6: Monthly Weather Sensitive Electricity Adjustment by rate schedule for Yakima;

Table 7a: Summary of Unbilled Weather Sensitive Consumption for Yakima;

Table 7b: Test Year Unbilled Heating and Cooling Degree Days for Yakima;

Table 8: Summary of Test Year Electricity Adjustment;

Table 9a: Staff's Volume and Revenue Impacts of Temperature Normalization Adjustment

Table 9b: PacifiCorp's Volume and Revenue Impacts of Temperature Normalization Adjustment

Table 10a: Comparison Between Staff's and PacifiCorp's Adjustment

Table 10b: Summary of Adjustment by Class of Customers

Q. Please explain the need for a temperature normalization adjustment.

A. Several factors influence electricity consumption. These factors are changes in temperature, household size, income, price of competing fuels, and efficiency of energy using appliances, among others. In regions such as the Northwest, where customers use electricity for space heating, temperature greatly impacts total usage. Major normalization adjustments in the electricity industry reflect the impact of temperature. Without this normalization adjustment, a company's revenue requirement, as depicted in the proforma results of operations, may not produce a reasonable level of rates.

Q. Please explain how NOAA develops normal temperature.

A. The World Metrological Organization (WMO), of which the United States is a member, develops weather normals based on 30 years of observations because it is believed that 30 years are necessary to provide an adequate number of observations to compute a normal temperature. The WMO has set the end of a decade as the desirable term for a 30-year period from which to calculate climatic conditions. The average value of a meteorological element over the 30 years is

defined as a climatological normal.[2] Thus, the National Oceanographic and Atmospheric Administration (NOAA) computes 30-year climate normals every ten years.

The most recent normal temperature derived by NOAA is for the period 1971-2000. NOAA implements a relatively robust method to remove or minimize the effects of missing data, errors in recording data, changes in instrumentation, observation practices, observation time, temperature abnormalities, and so on, in order to derive normal temperature.

Q. Please explain how a temperature normalization adjustment is calculated.

A. In order to implement a temperature normalization procedure, the impacts of heating degree-days ("HDD") and cooling degree days ("CDD") on consumption of electricity (also called, "the weather sensitivity factor" or "coefficient") are estimated using an appropriate statistical method.[3] Normalized electricity usage for the test year is calculated using the statistically estimated temperature

[2] World Meteorological Organization, 1984: Technical Regulations, Vol. I. WMO Publication No. 49. Geneva, Switzerland.

[3] HDD refers to non-zero difference between average temperature and 65 degree Fahrenheit (HDD={65^0F - average temperature} ≥0), where 65^0F is the internationally accepted mean daily temperature). However, PacifiCorp has replaced 65^0F with its own version of mean or base temperature (see testimony on pages 8-9).

65^0F is an internationally accepted average outside temperature that would result in an indoor bodily comfortable temperature. When the outside temperature is below 65^0, the indoor temperature needs to be increased by space heating.

sensitivity factor, the number of customers, HDD, CDD, and actual electricity consumed.

Q. Do you agree with PacifiCorp's proposal to implement the temperature normalization procedure used in the settlement of the Company's last general rate case?

A. No. Because the Commission did not adopt PacifiCorp's normalization method from the settlement in its last rate case for use in future rate cases, it should not be used in this case.

Q. Do you agree with normal temperature data used by PacifiCorp?

A. No. PacifiCorp used normals for the period 1961-90. NOAA's most recent release of normal temperature data is for the period 1971-2000. PacifiCorp should have used the most recent data available.

Q. Please describe how PacifiCorp calculated HDD and CDD.

A. PacifiCorp, similar to other electricity utilities, operates under the assumption of normal weather. Accordingly, the Company calculated HDD and CDD as the

difference between actual test year temperature and PacifiCorp's choice of balance point temperature.

Q. Please describe your concerns with PacifiCorp's temperature normalization adjustment procedure.

A. PacifiCorp's weather normalization adjustment uses four different temperature ranges as its cut-off or base temperature.[4] And, the Company measures departures from these ranges to determine heating and cooling degree-days. However, utilities regulated by the WUTC as well as several utilities across the country use the universally accepted base temperature of 65^0F.

Q. Do you agree with PacifiCorp's choice of ranges of temperature for a base or cut-off point?

A. No. I will discuss the reasons in the following pages.

[4] In this testimony, base, cut-off and balancing point temperature are used interchangeably. They refer to the choice of temperature value(s) from which departures are calculated to determine HDD and CDD.

Q. Why does the Company use four temperature ranges and what are they?

A. PacifiCorp contends that the traditional definition of degree-days does not necessarily match with consumers' use of electric heating and cooling equipment. The Company's argument also implies that the impact of temperature on retail sales varies for different ranges of temperature. Thus, the Company decided to use four temperature ranges based on an assessment of graphical representation of usage per customer and temperature. PacifiCorp's four ranges of degree-days are:

(1) Heating degree days-winter (HDD)=55-average daily temperature, if Temp≤55;

(2) Heating degree days-shoulder (HDDSH)= 65-average daily temperature, if 55<Temp≤65;

(3) Cooling degree days-Shoulder (CDDSH)= 68-Average daily temperature, if 65<Temp<68; and

(4 Cooling degree days summer (CDD)= Average daily temperature - 68, if Temp≥68.

Q. How did PacifiCorp arrive at the different base or cut-off temperature ranges?

A. In the 1980's, PacifiCorp hired RTI consultants to develop the weather normalization adjustment procedure. The RTI study plotted electricity usage per customer against average daily temperature. Based on the shape of the curve, the study identified four ranges of temperature. In the study, RTI argued that the transition from heating to

cooling points is not linear. RTI proposed a transition period between cooling and heating degree-days, called shoulder months. Therefore, in addition to the conventional heating and cooling degree-days, RTI developed cut-off points for the shoulder months.

Q. Please summarize PacifiCorp's normalization method.

A. PacifiCorp used the following approach to implement the weather normalization adjustment procedure:

(1) Obtained "normal" temperature data from NOAA for the period 1961-1990;

(2) Computed degree days using the four ranges of temperature as its base or cut-off temperature;

(3) Calculated test year unbilled degree days as the difference between test year actual temperature and normal temperature;

(4) Calculated use per customer by rate schedule from retail sales data;

(5) Multiplied the coefficients obtained from RTI's study of the 1980's by the test year unbilled degree days and number of customers in each rate schedule to calculate unbilled electricity usage;

(6) Multiplied the unbilled electric usage result in (5) by the energy rate to arrive at unbilled sales revenue, which PacifiCorp used in its the determination of the proforma revenue requirement.

Q. Please discuss the statistical estimation results that PacifiCorp used in its temperature normalization adjustment.

A. In discovery, Staff requested copies of the outputs of the statistical analyses performed by RTI consultants that show how good or robust the estimates were. In response to the data request, the Company informed Staff that it did not retain the outputs from the statistical runs. Consequently, Staff has no way of evaluating either the details of the estimation method or the validity of the estimates.

Q. How did PacifiCorp estimate the weather sensitivity coefficients for electricity usage in the most recent years?

A. PacifiCorp used the estimates that RTI derived in the 1980's and assumed that the coefficients would not change. That is, the Company assumed that the coefficients estimated in the 1980's would apply to the most recent electricity usage and weather data.

Q. Does Staff agree with the temperature normalization method used by PacifiCorp?

A. No.

Q. Do you agree with PacifiCorp's justification for the choice of four-base or balance point temperature ranges?

A. No. I disagree with PacifiCorp's choice of base temperature ranges because (1) the study was conducted in the Utah region and then applied to Washington, (2) the relationship between temperature and electricity consumption varies by location, time period, and customer characteristics, so the results from a study completed in the 1980's may not apply to a 2003 test year, and (3) the study disregarded the scientific basis for the choice of base or cut-off temperature usually set at 65^0F. The determination of balance point temperature requires a detailed study that takes into account the following factors:

(1) Characteristics of the structure (e.g., windows, doors, square footage, etc.) and year built;

(2) Number and composition of household members (by age group);

(3) Humidity, radiant temperature, cloud cover, and wind observations; and

(4) Types or kinds of electric appliances and magnitude of reject heat.

Data on these and related factors have to be collected over a period of at least three years to determine a household's comfort level.[5] The findings from these kinds of detailed studies may be aggregated to a class of customers, provided the study sample represents that class of customers. Without the availability of such a study, Staff cannot accept PacifiCorp's reasoning as a basis to change the base temperature. Until PacifiCorp provides the Commission with empirical proof that is sufficient to establish a different balancing point temperature or range of temperatures, Staff objects to changing the universally accepted 65°F balance point.[6]

Q. Do you agree with the method PacifiCorp adopted to choose the statistical model(s) used in the weather normalization procedure.

A. Not necessarily. Staff was not provided with documentation on how RTI selected the statistical model used in the weather normalization adjustment. Therefore, Staff is unable to agree or disagree with the method of statistical model selection.

[5] This suggestion that data need to be gathered for at least three years is intended to make sure that the minimum number of observations would be obtained to establish a benchmark for a parameter that may exhibit or show a trend over time.

[6] The American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) sets the standard for comfort levels. Determination of comfort levels require analysis of room temperature, mean radiant temperature (MRT), air velocity, relative humidity, activity, clothing, and so on.

Consequently, there is no justification to accept the Company's weather normalization results.

Q. Do you have other concerns with PacifiCorp's choice of different base or cut-off temperature ranges?

A. Yes. Although it is possible to assess the relationship between temperature ranges and electricity usage through statistical analysis, this can be justified only if there are accurate hourly or daily usage data. PacifiCorp has not presented accurate hourly or daily usage data in this case. The Company does not have an automatic meter reader, so it must use retail sales (load) and billing data to calculate electricity usage per customer.

The problem is that PacifiCorp produces its data through a process in which hourly system-wide load is allocated to each state, and then to each rate schedule. This approach simply is not a substitute for actual hourly usage data obtained from automatic meter readings. Consequently, it is difficult to ascertain whether or not electricity usage levels behave differently at the four temperature ranges that PacifiCorp adopted in its weather normalization procedure. Furthermore, in order to account for hour-to-hour variability in usage, the impact of non-weather related variables (e.g., income and prices) should also be

included in the analysis. PacifiCorp did not incorporate these variables into its analyses. PacifiCorp's method of developing cut-off temperature ranges based on graphical analyses of temperature and usage data is not the most reliable approach, especially where it affects the rates paid by customers whose consumption is weather sensitive.

Q. Do you agree with PacifiCorp's approach to apply the temperature sensitivity coefficients derived in the 1980s to adjust electricity usage in the 2002-2003 test year?

A. No. Usage patterns, customer's characteristics, temperature and other relevant factors change over time. Using estimated coefficients derived from data in the 1980's might not reflect the true sensitivity of electricity usage to changes in temperature in the test year.

Q. Please comment on the credibility of PacifiCorp's use of per customer data.

A. In discovery, Staff requested PacifiCorp to provide retail sales data used in its computation of weather normalization procedure. The Company's response was missing records and negative usage data. Although the Company supplied a corrected version of usage data, Staff is concerned about the accuracy and reliability

of the Company's sales data. Furthermore, customers from different districts were grouped together. Due to the time constraints of the procedural schedule in this docket, Staff was unable to evaluate the reasons for the consolidation and whether or not it was prudent for the Company to do so for purposes of the weather normalization adjustment.

Q. Please describe the changes that Staff proposes to PacifiCorp's normalization method.

A. Staff would modify PacifiCorp's weather normalization adjustment procedure as follows:

(1) Use temperature and retail sales data for the period 1997-2003;

(2) Use 65^0F as the base or cut-off temperature from which degree days were measured;

(3) Acquire test year heating and cooling degree days, and 1971-2000 normal temperature data from NOAA;

(4) Implement an autoregressive or an autoregressive moving average estimation method; and

(5) Incorporate variables to capture the impacts of holidays, seasons, price, month, and year.

Q. Why should the Commission adopt Staff's proposed changes to PacifiCorp's temperature normalization method?

A. Unlike PacifiCorp, Staff used the most recent weather sensitivity coefficients. Thus, the coefficients derived by Staff will reveal a better estimate of the sensitivity of test year usage to changes in temperature. Further, Staff's estimation method removes the impacts of serial correlation in the data. Staff's analysis also properly compared the non-weather sensitive (base load) usage with the historical average. Staff's statistical analysis produced base or non-weather sensitive use per customer that was within ±10% historical average. Staff was unable to evaluate PacifiCorp's results because the Company no longer retains those estimates.

Q. Please explain the importance of correcting for serial correlation in the weather normalization adjustment.

A. Serial correlation, or autocorrelation, refers to the relatively higher degree of association between components of two observations (often adjacent or consecutive time periods) that cannot be explained by variables included in the analysis (also called error or residual terms). The statistical measure that determines the existence of serial correlation is called the "Durbin-Watson" or

"D-W" statistic. In general, if the value of the D-W statistic is close to 2.00, then there is no problem with serial correlation.[7] The impact of serial correlation is that it leads to a conclusion that the statistical estimates are more precise than they really are. It will result in consistently under- or over-estimation of future values of the same variables. For example, it may show significantly higher or lower usage of electricity for the next one, two, three, or five years that is substantially different from the results of a model that makes correction for these kinds of correlations. Therefore, in order to improve the reliability of estimates of weather sensitive electricity usage, it is necessary to correct correlations between residuals of adjacent observations. Staff's recommendation does so.

Q. Does Staff propose to use the same data and method for all temperature normalization procedures?

A. No. Staff's proposed changes to PacifiCorp's method are applicable only to this rate proceeding. For future rate cases, the Commission should order the Company to implement the following changes to its temperature normalization procedure for use in future general rate case filings:

[7] For a sample size ≥100, a D-W statistic that lies between 1.57 and 2.20 implies that there is no problem of serial correlation.

(1) PacifiCorp should develop accurate daily electricity usage data by rate schedule for about 10 years including the test year. Because the Company used billing cycle data to develop calendar-month usage that matches temperature records, it would not be difficult to develop daily usage data.

(2) PacifiCorp should use 65^0F base temperature and 30-year data, which is the balance point temperature and years of observation adopted by NOAA, WMO, and other national and international organizations. The methodology used by NOAA accounts for the impact of factors that may influence normal temperature observed over several years. These include adjustments for missing data, for time of observation bias, instruments used, abnormal temperature, and so on. The objective of these adjustments is to ensure that the impacts of external factors on temperature are taken into account, and that the data become homogenous and representative. Therefore, this methodology produces a better gauge of temperature norms. PacifiCorp should continue to use 65-degree base temperature and normal temperature from the most recent 30-year data until NOAA, WMO, and other national and international organizations agree to change them.

(3) PacifiCorp should collect data on variables, such as income, price, family size, and attributes of housing that may affect use per customer; and

(4) PacifiCorp should document, update and retain all statistical estimation procedures that it uses to develop the weather normalization adjustments. Further, the Company should justify the choice empirical models and estimation procedures.

The implementation of Staff's suggested changes would improve the accuracy of estimates of temperature sensitive heating loads by rate schedule. And, it will permit PacifiCorp to seek revenue requirements and pricing of electricity usage that properly reflect the impact of changes in temperature.

COST OF SERVICE

Q. Please describe PacifiCorp's proposed cost of service study.

A. PacifiCorp proposes an embedded cost of service study similar to the study it submitted to the Commission in Docket No. UE-991832. PacifiCorp's methodology is based on the HB 2831 in Docket No. UE-980181. David Taylor presents the results of the PacifiCorp's cost of service study.

Q. What is Staff's conclusion regarding PacifiCorp's cost of service study?

A. Staff does not have a major objection with the methodology employed in the embedded cost of service study.

Q. Please explain the purpose of a cost of service study in utility rate making.

A. A cost of service study is a detailed and comprehensive economic, engineering, and accounting study that allocates the total cost of providing service to various classes of customers. It measures the utility's costs incurred to serve each class of customer, including a reasonable return on investment for a specified period of time.

Q. Please describe how an embedded cost of service study is performed.

A. The implementation of a fully allocated or embedded cost of service study involves a three-step approach: functionalization, classification and allocation. In the first step, total costs (rate base, or investment, and expense items) of a utility, as maintained in accordance with the FERC's Uniform Systems of Accounts, are assigned to four cost functions with which they are closely associated: production, transmission, distribution, retail service and miscellaneous functions.

In the second step of the cost of service study, classification, each functional cost is further divided using principles of cost-causation. There are three categories or classes that are related to measurable cost-defining characteristics of providing electric service: demand (capacity), energy (commodity), and customer-related.

Once the functionalized costs are classified into cost-causing categories, the final step of the cost of service study, allocation, develops factors that are used to allocate costs to classes of customers or rate schedules. Often, the development of allocation factors is based on usage and customer information associated with the test period results of operations.

The cost of service study enables the analyst to determine whether or not the revenue provided by a class of customers recovers the cost to serve those customers. The results of the cost of service study are used in assessing the appropriateness of rate spreads across classes of customers.

Q. Do you agree with the method of functionalization, classification and allocation of costs employed by PacifiCorp in its cost of service study?

A. Yes.

Q. Does this conclude your direct testimony of the cost of service study?

A. Yes.