Exhibit No. ___ T (YKGM-1T)
Docket No. UG-060265
Witness: Yohannes K.G. Mariam

BEFORE THE WASHINGTON UTILITIES AND TRANSPORTATION COMMISSION

WASHINGTON UTILITIES AND TRANSPORTATION COMMISSION, **Complainant,** **v.** **CASCADE NATURAL GAS CORPORATION,** **Respondent.**	**DOCKET NO. UG-060265**

TESTIMONY OF

YOHANNES K.G. MARIAM, PH.D.

STAFF OF WASHINGTON UTILITIES AND TRANSPORTATION COMMISSION

August 15, 2006

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I. INTRODUCTION

Q. Please state your name and business address.

A. My name is Yohannes K.G. Mariam. My business address is 1300 S. Evergreen Park Drive S.W., P.O. Box 47250, Olympia, WA 98504.

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

A. I am employed by the Washington Utilities and Transportation Commission as a Regulatory Analyst (Economist).

Q. How long have you been employed by the Commission?

A. I have been employed by the Commission since September 1999.

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

A. I hold Masters of Science (M.S.) from McGill University in Montreal, Canada, and I was awarded a Doctor of Philosophy (Ph.D) degree from that school in 1993. My areas of specialization were quantitative economics (econometrics and operations research) and resource economics.

From 1993 to 1995, I was a fellow of the Natural Science and Engineering Research Council (NSERC) of Canada. From 1995 to 1997, I worked as a regulatory and socio-economic consultant for Environment Canada. 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 was invited to serve as a reviewer for the Journal of the Air and Waste Management, and as an occasional lecturer at McGill University.

Since September 1999, I have been employed by the Washington Utilities and Transportation Commission as an economist in the Energy Section of the Regulatory Services Division. In that capacity, I have analyzed purchased gas adjustments, incentive mechanisms, and integrated resource planning. In general rate cases and other rate proceedings, I have analyzed new resource prudence, power costs, rate spread, hydro and weather normalization, and cost of service: Docket Nos. UE-031725 and UE-040640/UG-040641 (Puget Sound Energy, Inc.); Docket Nos. UE-991832 and UE-050684 (PacifiCorp); Docket Nos. UG-031885 and UG-000073 (Northwest Natural Gas, Inc.); and Docket No. UE-011595 (Avista Corp.). I have contributed to the Commission's analysis of the impacts of proposed rules on small businesses in the railroad, telecommunication and energy industries. I also collaborate with other staff members on issues relevant to economic disciplines and write technical papers dealing with regulated energy industries.

II. SCOPE OF TESTIMONY

Q. What is the scope of your testimony?

A. I present staff's recommendation regarding Cascade's proposed temperature normalization adjustment, including the impact on the Company's proforma revenue requirement. I also present staff's recommendations with respect to Cascade's natural gas cost of service model.

III. SUMMARY OF TESTIMONY

Q. Please summarize staff's temperature normalization adjustment.

A. Staff proposes changes to the Company's temperature normalization adjustment that will increase Cascade's normalized test year natural gas consumption by 6,844,506 therms. This results in an increase in Cascade's proforma revenue of about $1.462 million. (Exhibit No. ___ (YKGM-2), Tables 1, 3, 4, 5, 6, 7, and 8). Mr. Parvinen's testimony presents the overall revenue and rate impact of this adjustment.

The Commission has consistently determined normal temperatures by using the most recent 30 years of actual temperature data published by the National Oceanographic and Atmospheric Administration (NOAA). Cascade proposes to replace this long-established methodology with one that uses data from a simple linear statistical model to estimate 55 years of data (1951 to 2005). Cascade contends that its proposal is intended to account for the effects of global warming. However, Cascade's

proposed methodology is both overly simplistic and statistically flawed, and for the reasons set forth in my testimony, should be rejected by the Commission.

Q. Please summarize staff's recommendations regarding Cascade's cost of service study.

A. Staff recommends that Cascade should follow the allocation of mains costs, and administrative and general expenses, based on the Commission-approved cost of service study in Docket Nos. UG-940034 and UG-940814. Staff's recommended changes to the company's cost of service study result in a fairer allocation of costs, by narrowing the gap between system average return and that of the various classes of customers, compared to the company's results. Further, staff's recommendation better reflects the amount of revenue that each rate schedule should contribute in order to recover the cost of receiving natural gas service. Ms. Steward's testimony presents the impact of the results of the cost of service study on rate spread.

Q. Are you sponsoring any exhibits?

A. Yes, I present Exhibit No. ___ (YKGM-2) and Exhibit No. ___ (YKGM-3) in support of staff's proposed temperature normalization adjustment. Exhibit No. ___ (YKGM-2) contains eight tables. The descriptions are as follows:

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

Table 2: Average Difference Between Estimated & Actual Use per Customer (2000-2005);

Table 3: Test Year and Normal Heating Degree Days
for Bellingham, Bremerton, Walla Walla, and Yakima;

Table 4: Monthly Weather Sensitive Natural Gas Adjustment
by Rate Schedule for Bellingham;

Table 5: Monthly Weather Sensitive Natural Gas Adjustment
by Rate Schedule for Bremerton;

Table 6: Monthly Weather Sensitive Natural Gas Adjustment
by Rate Schedule for Walla Walla;

Table 7: Monthly Weather Sensitive Natural Gas Adjustment
by Rate Schedule for Yakima;

Table 8: Comparison of Staff and Cascade's Method of Weather
Normalization on Proforma Revenue and Energy.

Exhibit No. ___ (YKGM-3) contains two tables. The descriptions are:

Table 1: Results of Descriptive Statistics;

Table 2a: Results of Unit Root Test (Bellingham and Bremerton);

Table 2b: Results of Unit Root Test (Walla Walla and Yakima).

IV. WEATHER NORMALIZATION ADJUSTMENT

A. General Purpose and Implementation of a Weather Normalization Adjustment

Q. Why is a temperature normalization adjustment necessary?

A. Cascade's customers use natural gas for space heating. Consequently, temperature greatly affects usage of natural gas by the residential and commercial customers. This effect is reflected in the Company's total revenues.

A temperature normalization adjustment allows the Commission to estimate gas loads, and resulting revenue, as if weather had been "normal" during the test year. This ensures that rates are not set too high, if the test year was warmer than normal, or too low, if the test year was colder than normal.

Q. What parameters are required to compute temperature normalized natural gas consumption for the test year?

A. Four parameters are required to compute temperature-normalized natural gas consumption for the test year. They are: 1) deviations of monthly mean temperatures from 65^0F, called degree days; 2) variations or differences between normal and test-year temperature; 3) temperature sensitivity coefficients; and (4) test-year number of customers.

Q. How is normal temperature determined?

A. Normal temperature is determined from data published by the National Oceanographic and Atmospheric Administration. NOAA computes normal heating degree-days (HDD) at various locations, including locations in Cascade's service area in Washington. HDD is a quantitative index that reflects demand for energy to heat houses. HDDs are calculated using a "balance" or "base point" outside temperature that is assumed to trigger the need for heating energy.[1] When the outside temperature is below the base point, the indoor temperature needs to be increased by space heating. The most commonly used balance point temperature in determining HDD is 65^0F.

Q. How are variations from normal calculated?

A. Variations from normal temperature and heating requirements are computed using HDD. In normalizing test year natural gas consumption, the temperature for each month of the test year is compared to the normal temperature for that month. The difference, or variation, between normal and actual test year temperatures is referred to as "heating degree days." This variation in temperature is used to calculate the weather normalization adjustment for the test year natural gas consumption as if the temperature was normal.

[1] HDD is measure in degree Fahrenheit and given as HDD=65^0F-Average temperature, for average temperature ≤65^0F.

Q. How are temperature sensitivity coefficients and test year customers used in the calculation of a weather normalization adjustment?

A. Temperature sensitivity coefficients are computed from a regression analysis between temperature (HDD) and natural gas consumption. These coefficients are multiplied by the variation of test year temperature from normal temperature and the number of customers. The result is temperature normalized natural gas consumption for the test year.

B. Cascade's Proposed Method of Weather Normalization

Q. Does Cascade propose to implement the temperature normalization procedure used in the settlement of the Company's last general rate case?

A. No. Cascade's last rate case, Docket No. UG-951415, was settled. Therefore, the Commission did not formally approve the method of weather normalization used in that rate case.

Q. Does staff agree with the temperature normalization method Cascade proposes in this proceeding?

A. No.

Q. Please describe the temperature normalization method proposed by Cascade.

A. Cascade proposed the following approach to temperature normalization:

1) First, use per customer was regressed on heating degree-days and natural gas rates to obtain weather sensitivity coefficients. Cascade used approximately five years (October 2000 to September 2005) of monthly usage data for residential and commercial customers;

2) The estimated coefficients were multiplied by the number of customers and then by the difference between test years HDD and "estimated" normal HDD;

3) Finally, the estimated normalized test year natural gas usage levels for residential and commercial customers were used in the determination of the proforma revenue requirement.

Q. Please describe how Cascade calculated variations in test year HDD from normal HDD.

A. Cascade calculated variations in test year HDD from normal HDD as the difference between actual test year HDD and normal HDD derived as the average of statistically estimated HDDs for the period 1951 to 2005. However, Cascade used "estimated" normal HDDs rather than NOAA's 30-year normal.

Q. Please explain the data and statistical estimation method used by Cascade in its temperature normalization analysis.

A. Cascade used data from 2000 to 2005 to estimate the impact of weather on consumption of natural gas by residential and commercial customers. It implemented a linear statistical model to estimate the impact of temperature on consumption of natural gas (also called weather sensitivity coefficients).

Q. Please explain how Cascade derived normal temperatures (HDD) in this proceeding.

A. Assuming a linear temperature trend in past observations, Cascade implemented a linear statistical model to estimate HDDs. In other words, rather than using actual HDDs developed by the NOAA (1971 to 2000), Cascade estimated HDDs for the period 1951 to 2005 to compute normal HDDs. This approach was based on the assumption that increases in global surface temperature is positively correlated with local or regional temperature. In order to capture this correlation, Cascade proposes to use data from a longer time period. NOAA revises the 30-year normals every 10 years. Cascade used a statistical model to derive an "estimate" of normals from a longer time period (1951 to 2005). Cascade referred to the average of estimated HDDs for the period 1951 to 2005 as "normal HDD". Cascade argues that the derivation of HDD using this kind of simple statistical analysis is superior to the manner in which NOAA derives its normal.

Q. Please explain how NOAA's method of deriving normal temperature differs from the method proposed by Cascade.

A. NOAA uses 30-year data to derive normal temperature. The most recent normal temperature derived by NOAA is for the period 1971 to 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 other factors, in order to derive normal temperature. Thus, NOAA uses 30 years of actual temperature data to develop normals, while Cascade proposes to use a statistically estimated 55 years to compute normal temperature (HDD).

Q. What are the reasons for staff's objections to Cascade's weather normalization methodology?

A. Staff believes that there are both statistical and non-statistical reasons that make Cascade's weather normalization procedure less accurate than the method used by NOAA and, therefore, inappropriate and biased. First, Cascade implemented a simple regression model to estimate HDD for each month over the period 1951 to 2005. Then, Cascade computed a simple average of the "estimated" HDDs to replace NOAA's normals. From a statistical viewpoint, however, an average value can be considered "normal" only if it is demonstrated that the data are normally distributed and have a finite variance. It must be demonstrated that the forecast value of a variable continues to be closer to the long run trend. The variable must be trendless. The difference between forecasted value and long-term trend has to decline. Cascade

did not demonstrate that the HDD data are normally distributed and trendless. Thus, Cascade's normal HDDs are not appropriate for weather normalization purposes.

Q. Please discuss the impact of Cascade's use of the most recent five-year usage per customer and temperature to calculate weather sensitivity coefficients.

A. By shortening the study period to the most recent five years, Cascade's weather normalization results are biased in favor of warmer temperature. As indicated earlier, NOAA updates normal temperature every ten years to smooth fluctuation and capture sustained change in temperature. The weather normalization adjustment is expected to produce consumption that would prevail in a normal year. Test year temperature would be compared with normal temperature, and the weather sensitivity coefficients should be based on data that captures these variabilities in temperature. Cascade's results would have better reflected use per customer under normal temperature if the most recent ten years of monthly use per customer had been used in its weather normalization adjustment.

Q. Now that you have explained the statistical analyses that are relevant to calculate averages or normals, please explain how these statistical properties are applicable to Cascade's weather normalization procedure.

A. Cascade performed a simple regression analysis to compute the estimated average or normal HDDs for the period 1951 to 2005. This regression analysis should have been preceded by a demonstration of normality and absence of a trend. Staff conducted: 1) a test of normality; and 2) a time series analysis to detect trends and test for unit-

root (random-walk) and stationarity. Staff's findings indicate that the temperature data exhibited unit root or random-walk characteristics and are not normally distributed (Exhibit No. ___ (YKGM-3, Tables 1, 2a and 2b). These results imply that it is statistically improper to calculate an average of any variable to represent the "normal" value because the data are not normally distributed, and are not trendless.

Q. Does NOAA develop 30-year normals only for the temperature variable?

A. No. NOAA and other agencies such as the World Meteorological Organization (WMO) use 30 years to calculate normals for temperature, precipitation, rainfall, and snowfall.

Q. Why does NOAA develop temperature normals every ten years?

A. Climatic changes are observed gradually over time. It is necessary to use an adequate number of time series observations in order to capture the variability present in a series that exhibits small changes. Thus, computation of normals every ten years allows the resulting normal to capture sustained changes in temperature.

Q. Please discuss why NOAA calculates temperature normals based on 30 years of data.

A. The WMO and its member countries decided that it is appropriate to use three decades of data.[2] The 30-year interval is sufficiently long to filter out many of the

[2] At the International Meteorological Conference in Warsaw, Poland in 1935, the years 1901 to 1930 were selected as the international standard period for normals. NOAA adopted this 30-year standard

short-term interannual fluctuations and anomalies, as well as reflect longer term climatic trends.

The WMO, national U.S. agencies such the Department of Energy, NOAA, and many energy regulatory bodies continue to use NOAA's 30-year normal (see http://www.publicaffairs.noaa.gov/back.html, & http://www.nws.noaa.gov/iao/index.php). A recent article published by the American Meteorological Society argues that the use of 30 years for computing normal is adequate. Furthermore, the article suggested, "presenting the public with a 30-yr normal range of temperatures gives a more accurate and representative idea of what the temperatures usually are like at any particular time of the year".[3] Moreover, assessments of normal climatological variables such as precipitation, temperature, rainfall and snowfall are based on normals computed from 30-year time periods. Abnormalities in climate such as El Niña and El Niño are predicted from 30 years normal data.[4] Therefore, until the national and international scientific community and agencies agree to change the manner in which normals for a climatological variable are determined, staff recommends that the Commission approve the use of NOAA's 30-year normal for the purpose of weather normalization.

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to recalculate "normals" at the end of each decade. (see http://www.wrh.noaa.gov/tfx/pdfs/NORMALS.pdf).

[3] See http://ams.allenpress.com/pdfserv/10.1175%2FBAMS-87-6-769

[4] See http://www.wmo.ch/web/catalogue/New%20HTML/frame/engfil/wcn/wcn24.pdf

Q. Do you recall weather normalization adjustments in which the WUTC approved a methodology of deriving normal temperature different from that used by NOAA?

A. No. Staff does not know of any rate case in which the Commission-approved normal temperatures by a method other that developed by NOAA.

Q. Please identify rate case filings in which NOAA's 30-year normal temperature was proposed by regulated utilities in Washington State for weather normalization of revenue.

A. PacifiCorp, Avista, Puget Sound Energy (PSE), and Cascade all used NOAA's 30-year normal. However, Cascade (in the current proceeding) now proposes to derive normals based on longer time periods than what was used by NOAA. Staff proposed the use of NOAA's 30-year normal in rate case filings by Avista (Docket Nos. UE-991606 and UE-050482), PacifiCorp (Docket Nos. UE-991832, UE-032065 and UE-050684), and PSE (Docket Nos. UE-031725 and UE-040640/UG-040641). The Commission approved staff's recommendation to use NOAA's 30-year normal in the PSE cases for weather normalization purposes. This methodology was also used in the Avista and PacifiCorp cases, under settlements approved by the Commission. Staff continues to propose similar treatment in Docket Nos. UE-060266/UG-060267 and UG-060265. The current 30-year normal of 1971 to 2000 will be replaced by another normal that covers the period 1981 to 2010 in about three years.

Q. Please discuss the problem of using more than 30 years to compute normal temperature.

A. There are many reasons that make the use of time periods of more than 30 years inappropriate for developing normal temperatures. First, the Commission has consistently approved the use of the 30-year normal for normalizing revenue. Second, one of the bases for the conclusion that global temperature is rising is the 30-year normal. Changing a base normal temperature that has been used for more than seven decades requires more than a simple linear regression analysis implemented by Cascade. Conclusions about global and regional climatic abnormalities need to be modified since they are assessed based on deviation from a 30-year normal. Third, the use of a longer time period to compute normals has to be based on statistical evidence that the trend is stationary. Cascade has not provided such evidence. Fourth, most integrated or least cost resource plans submitted by regulated utilities to the commission are based on the assumption of 30-year normal temperatures. These resource plans are the basis for acquisition of resources by regulated utilities.

Q. Are there other non-statistical reasons that invalidate Cascade's calculation of normal temperature?

A. Yes. Staff opposes Cascade's method of using simple statistical estimation of temperature or its derivative such as HDDs because changes in local or regional climate are non-linear and not stationary. They are influenced by a complex set of factors that cannot be accurately depicted using simple linear regression models. In fact, if predicting temperature (HDDs) was as easy as employing a simple linear statistical model, there would not be a need for sophisticated, complex and sometimes controversial global climate change models such as the Global Circulation Models (GCMs).[5] Staff objects to Cascade's proposal to change the calculation of normal temperature from NOAA's use of 30 years actual data to 55 years of estimated data.

Q. Please describe the changes that staff proposes regarding Cascade's weather normalization methodology.

A. Staff proposes that the company 1) use an autoregressive statistical model rather than a linear statistical model, and 2) continue to use NOAA's 30-year normal HDD, rather than the "estimated" 55-year normal HDD (Exhibit No. ___ (YKGM-2), Tables 1 and 2).

[5] The Intergovernmental Panel on Climate Change (IPCC) reports also indicate uncertainties and the need to develop local or regional models, not simple regression models, in order capture the temperature and on-temperature related factors that affect local climatological variables. For example, see US Climate Change Science Program, 2003 at: http://www.climatescience.gov/Library/stratplan2003/final/ccspstratplan2003-chap4.htm; and The IPCC (2001) at http://www.ipcc.ch/pub/taroldest/syr/011.htm

Q. Please explain the benefits of the changes staff proposes to Cascade's weather normalization method.

A. Staff's proposed changes in the statistical model and estimation technique provide better estimates of the probability with which to accept or reject the impact of changes in temperature on natural gas consumption. This is because most time series data suffer from a statistical problem called autocorrelation. Autocorrelation refers to the correlation of a variable with itself over successive time intervals. Sometimes, it is called serial correlation. Correcting for autocorrelation improves the reliability of estimated weather sensitivity coefficients without violating the properties of the statistical model. The regression model with no autoregressive terms used by the Company does not correct for the presence of serially correlated errors. 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 consistent under- or over-estimation of future values of the same variables. Therefore, in order to improve the reliability of estimates of weather sensitive natural gas usage, it is necessary to correct correlations between residuals of adjacent observations. Staff's recommendation does so.

Q. Please summarize the impact of staff's proposed changes to Cascade's weather normalization method.

A. Staff's proposed changes to the Company's temperature normalization adjustment produce statistically robust estimates (Exhibit No. ___ (YKGM-2), Table 1). The proposed changes increase Cascade's normalized test-year natural gas consumption by 6,844,506 therms ((Exhibit No. ___ (YKGM-2), Tables 3, 4, 5, 6, 7, and 8). This results in an increase in Cascade's proforma revenue of about $1.462 million.

Q. Please explain the robustness of staff's proposed temperature normalization method.

A. Staff's analysis shows that the actual versus estimated use per customer (UPC) was 112 and 115 therms per month for residential, and 281 and 287 for commercial customers, respectively. These results show a variation between actual and estimated UPC of about two percent to four percent (Exhibit No. ___ (YKGM-2, Table 2). This level of accuracy can be considered robust given that the data is monthly and not daily, and the time period used is only five years.

Q. Please summarize the weather normalization methodology that staff recommends Cascade should use.

A. Staff recommends that Cascade submit to the Commission the results of a weather normalization study based on at least five years of daily or 10 years of monthly rate schedule data by service territory. Cascade should implement a robust statistical model and estimation techniques, and should use NOAA's 30-year normals. Furthermore, Staff

recommends that Cascade should include data on variables, such as income, price, family size and attributes of housing and their impact on the consumption of natural gas, in its weather normalization methodology.

V. COST OF SERVICE STUDY

Q. Please explain the meaning of a cost of service study.

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 a cost of service study is implemented and its purpose in a general rate case filing by a utility company.

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, storage, transmission, and distribution.

In the second step of the cost of service study, classification, each functional cost item is further divided by cost-causation. There are four categories or classes

that are related to measurable cost-defining characteristics of providing gas service: demand (capacity), commodity (energy), customer, and revenue.

Once the functionalized costs are classified into cost-causing categories, the allocation step develops factors that are used to allocate costs to classes of customers or rate schedules through the allocation process. 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.

Q. Do you agree with the cost service model employed by the company in this proceeding?

A. No. Staff does not agree with the classification of mains and main-related items and administrative and general costs.

Q. Please discuss the changes staff proposes regarding Cascade's cost of service study.

A. In previous fully litigated rate cases such as Docket Nos. UG-940034 and UG-940814, the Commission approved a natural gas cost of service study that has become known as a Commission basis cost of service study (the "Commission Basis" methodology). PSE, Avista and Northwest Natural Gas Company generally follow the gas cost of service study approved in the above dockets. Staff believes that Cascade's cost of service model must change so that it reflects the Commission Basis methodology. Cascade's model did not allocate all distribution mains and

administrative and general expenses using the method in the Commission Basis study.

Staff proposes that: 1) the peak-and-average method be used to allocate distribution main costs, and 2) administrative and general expenses should be allocated on the basis of 50 percent O&M and 50 percent throughput.

Q. What are the results of your cost of service study?

A. The cost of service study results using the commission basis approach are shown below (excluding gas cost) compared to Cascade's result (see Table 1).

Table 1. Results of Cost of Service Study

	Revenue to Cost Ratio (excl. Gas Cost)	
Rate Schedules	Cascade	Staff
503	0.866	0.884
502	1.216	1.217
541	0.855	0.879
504	0.959	0.961
512	3.225	2.81
511	1.472	1.343
505	0.922	0.923
570	1.135	1.372
577	1.28	1.571
663	2.246	3.271
664	0.93	1.224
901	1.512	0.782

Q. Does this conclude your direct testimony?

A. Yes.