Q. Please state your name, occupation and business address.

A. My name is John A. Hanson. I am employed by Northwest Natural Gas Company (NW Natural or company), as Director of Integrated Resource Planning, at One Pacific Square, 220 NW Second Avenue, Portland, Oregon 97209-3991. I report to the Manager of Rates and Regulatory Affairs.

Q. Are you the same John A. Hanson who sponsored NW Natural (NW Natural or NWN) exhibits numbered 13 and 14 in this proceeding?

A Yes. My qualifications are at page 1 in Exhibit 13. In view of the subject matter addressed in this subsequent testimony, I want to add to my statement of qualifications by noting that I conducted a graduate seminar titled Urban Environmental Management for five consecutive years while I was a full time member of the Graduate Faculty of the Urban Studies Ph.D. program at Portland State University. The Seminar included a significant component focused on global warming, urban climatology, and the effects of urbanization on reported temperatures.

Q. What is the purpose of your rebuttal testimony?

A. The purpose of this testimony is to respond to the testimony of Staff witness Mariam about weather normalizing NW Natural's residential and commercial class sales. In the company's last two general rate case proceedings before the Washington Utilities and Transportation Commission (WUTC or Commission), NW Natural sponsored only brief descriptions of the weather normalization process, much as Mr. McVay did in this case. McVay, Exhibit 5, pp. 2-4 – Testimony. In this testimony, I will more fully document the methods and assumptions underlying pages 2-4 of Mr. McVay's testimony. I also briefly discuss the Washington benefits of Mist underground storage development.

Q. Why are you providing additional documentation on weather normalization methods in this proceeding?

A. NW Natural's weather normalization methods have always been documented and have been subjected to WUTC Staff (Staff) audits in each of NW Natural's past Washington general rate cases. However, there has never been a full hearing on the weather normalization issue in Washington. During all NW Natural rate case proceedings during the last two decades, settlement resolutions have incorporated the company's weather normalization methods and normal weather measurement. Subsequent parts of my rebuttal testimony detail the history of settlement outcomes.

Q. What findings and conclusions do you ask the Commission to approve regarding weather normalization?

A. I ask the Commission to find and conclude that the use of Department of Commerce, National Oceanic and Atmospheric Administration (NOAA) published normal degree days as recommended by Staff is fundamentally inferior to the use of calculated averages based on actual daily weather history for NW Natural's Washington service area. The NOAA published degree days are inferior measures of normal weather because NOAA uses an indirect statistical method and also because the NOAA 30-

year averages are so historically dated that they do not capture more contemporaneous weather trends.

Q. How is your rebuttal testimony organized?

A. Section I explains why weather normalization is required in the determination of revenue requirements for a regulated gas utility that supplies energy for heating.

Section II contains a chronological history of NW Natural's and Staff's positions on the normal weather issue. Section II also includes NW Natural's position on weather normalization issues and suggests reasons for Staff's current position on these issues.

Section III addresses the major issue in dispute between NW Natural and Staff: how should normal weather be measured?

Section IV highlights principal differences between NW Natural and Staff on the econometric specification of regression equations designed for prediction or restatement of temperature sensitive sales. Differences exist between NW Natural and Staff positions, but the differences are immaterial when compared to differences associated with the estimation of normal weather.

Section V expands on lessons the company learned from a weather normalization adjustment clause, the experimental (and now terminated) Temperature Sensitive Sales Adjustment (TSSA) provision in NW Natural's Oregon tariffs. In the company's opinion, if Staff is convinced that its measures of normal weather are correct, then Staff should also be willing to accept a weather normalization adjustment mechanism that assures that the company achieves its authorized rate of return regardless of actual weather conditions.

Section VI rebuts Public Counsel witness Lazar's recommendations regarding the rate treatment of the company's investment in Mist underground storage.

Section VII contains brief concluding remarks on weather normalization.

SECTION I: THE NECESSITY FOR WEATHER NORMALIZATION

Q. What are the consequences of not normalizing test year sales for the effects of weather in a gas distributor's general rate application?

A. Several undesirable consequences would result. If general rate reviews were undertaken each year, retail gas rates would fluctuate from year to year due to the variability of weather conditions. Basing rates on test year actual temperature sensitive sales would introduce essentially random changes in gas rates from year to year, but at the same time would not, on the average, lead to excess earnings for the gas distribution company involved. The resulting price signals to consumers would seem like nonsense.

Q. What are the basic elements involved in the weather normalization of temperature sensitive gas sales by class of service?

A. There are four basic elements to weather normalization. The first is the determination of base or non-temperature sensitive use by an examination of summer month consumption. The second is the separation of heating or temperature sensitive use for a month by subtracting base use from total use. The third relates heating use to weather conditions as measured by heating degree days using regression analysis. The final step can take the form of a direct forecast or "backcast" of heating use using normal (average) heating degree days and summing base and heating use to get normal total use. Alternatively, actual and normal heating degree days can each be used to backcast expected sales levels under both actual and normal weather with the difference applied to recorded monthly sales to obtain normalized gas use.

Q. What is a heating degree day and how does it relate to weather normalization of temperature-sensitive sales?

A. Pages 3 of NWN Exhibit 5 (KSM-Testimony) includes the definition of a heating degree day that both Staff and NW Natural have utilized in the past. Historically, Staff and the company have used the number of degrees measured in Fahrenheit that average temperature falls below on a day. The historical use of 65° Fahrenheit as a base for space heating degree day computations can be easily understood by assuming a desired "room temperature" of 68°. This is called the thermostat "set point." Heat from electrical lighting and appliances, and metabolic processes associated with human activity perhaps provide 3° worth of "heating" so that it is only when outdoor temperatures fall below 65° that supplemental heat is required. 65° F is the most commonly used "balance point" for residential energy use analysis.

Modern housing construction and thermal performance standards now suggest the use of a lower balance point reference temperature for heating degree day computations. The company's energy efficiency and conservation program evaluations suggest balance points closer to 60º. For commercial establishments using natural gas for freeze protection purposes, a balance point far below 65° is called for. The company uses a 65º balance point assumption but is mindful its side effects on the heating use and degree day relationship, that is discussed later in my testimony.

Staff incorrectly refers to the 65° balance point assumption as the "international accepted mean daily temperature" [page 4, Exhibit (YKGM-T1)]. This mischaracterization of the balance point concept reveals a lack of familiarity with energy utilization analysis on the part of the witness.

Q Beyond the concept of heating degree days, what further issue is central to the weather normalization of residential and commercial class sales?

A. A variety of methods exist to express the relationship between heating degree days and energy consumption used for space heating for personal comfort. As will be shown in a Section IV of my testimony, the econometric methods (regression equations) used by Staff and NWN produce similar results when employed with the same measure of normal weather.

Q. What do you think is the principal issue on test year normal sales volumes?

A. The company and Staff have a few differences with respect to methodology of weather normalization. However, by far and away the largest single issue is the question of just what constitutes normal weather. It is sufficiently illustrative for this purpose to restate NW Natural's normal sales using Staff's measure of normal degree days and briefly remark on the differences that result.

Page 1 and 2 of Exhibit 28 (JAH-Exhibit/1 – 2) compare directly to page 1 of Staff Exhibit YKGM-1. The only change is that page 2 of my rebuttal exhibit uses Staff's degree days which are based on very old published weather averages or normals rather than the 20-year calculated averages that NW Natural customarily has used in Washington.

Q. Please compare these results.

A. A comparison of weather normalized residential and commercial class sales is summarized in the following table, with volumes shown in thousands of therms. The comparison in the first two columns uses the company's method as reflected in page 1 of my accompanying Exhibit 28. Consequently, all assumptions and methods in the first two columns are identical except for the source or method used in determining normal heating degree days. The differences between the second and third columns reflect the different methods used by the company and Staff.

	NWN Method & Weather	NWN Method & Staff Weather	Staff Method & Staff Weather	Difference Due to Weather Alone
Residential Sales	29,526	31,317	31,442	1,791
Commercial Sales	18,659	19,584	19,580	926

As can be seen, the choice of normal weather measurement explains virtually all of the differences between company and Staff. On the average, Staff sales will not materialize, nor will the related margin revenues. Since the residential and commercial classes of service involve the highest margins (approximately 32.6 cents per therm for the residential class and 24.7 cents for commercial, including demand increment), the choice of degree day normals has a significant effect on the restatement of normal revenues. For example, 1,791 thousand therms times 22.6 cents equals $404,766 for the residential class of service and 926 thousand therms times 24.7 cents equals $228,722 for the commercial class of service. This equates to a difference in the resulting adjustment to revenue requirements of $633,488.

Q. Please compare company and staff normal weather measures.

A. Pages 3 and 4 of my exhibit, JAH-Exhibit/3 – 4, compares actual degree days, Staff's NOAA 1961-90 average, a calculated 1961-90 average, and the company's 20-year calculated average. The chart at page 3 reveals that Staff's normal weather measure has been exceeded only four times out of the last 20 years. The company's measure has been exceeded five times. Observed weather has been equal to or below the company's measure in 13 of the last 20 years.

Q. What is important about these comparisons?

A. Neither Staff's nor the company's measure of normal weather gives the company any reasonable probability of earning its authorized return in most years. However, Staff's choice of the 10-year-old NOAA 30-year average of weather significantly reduces the company's revenue requirement, increasing the likelihood that the company cannot earn its authorized return.

SECTION II: BACKGROUND OF NWN AND STAFF POSITIONS

Has Staff changed its position respecting how to weather normalize temperature sensitive sales in this case?

Yes. As I previously stated, NW Natural has used the weather normalization approach included in its original filing in this docket for over twenty years with only minor modifications. NW Natural's approach has always used a 20-year rolling average of heating degree days in the company's Washington service territory.

Is this approach generally consistent with the approach the Washington Commission has taken with respect to other stand-alone gas utilities in Washington?

Yes. In the most recent general rate cases for Cascade Natural Gas Company and Washington Natural Gas Company [now part of Puget Sound Energy (PSE)], the companies filed for revenue requirements on the basis of a 20-year rolling average of weather in each company's service territory, with the coldest and warmest years in the 20-year rolling average excluded. As Staff explicitly acknowledges, rates for Cascade in UG-951415 were approved using the 20-year average (eliminating high and low year). Exhibit 28, page 5. Rates for Washington Natural Gas (now PSE) were approved in 1992 in Docket No. UG-920840 using the 20-year average method. The issue was not formally addressed by the Commission in WNG's 1993 rate case, as mentioned by Staff. Exhibit 28, page 6. However, the company has had discussions with representatives at PSE, and the PSE representatives stated that that company's 1993 rates were approved assuming the traditional approach of a 20-year average of weather with the highest and lowest years excluded. NW Natural's 20-year average approach to measuring normal weather is very consistent with the approaches used by the Commission for these other gas utilities.

Q Why do you think Staff is changing from essentially a 20-year average measure of weather to a 10-year-old 30-year average of weather now?

A Several major influences are affecting NW Natural's Washington customers in this rate case. The company has made major investments in non-revenue producing plant to serve the additional capacity needs of a growing customer base. As well, this case will result in a more permanent shift in revenue responsibility for distribution system costs from Oregon to Washington. Finally, although gas costs are unrelated to a fair revenue requirement, all natural gas consumers are experiencing unprecedented (but temporary) increases in the wholesale cost of gas. These influences combined will have dramatic effects on the company's rates. NW Natural has been willing to work with Washington Staff about how to mitigate the effect of these increases on customers through phase-ins (addressed in the testimony of Bruce R. DeBolt). However, it appears to the company that Staff seeks to soften the impact of these events by departing from past precedents used in the development of weather normalization adjustments. Staff's departure, however, guarantees that in most years, the company will not be able to achieve its authorized return.

Q. The company experienced weather in the test year that was warmer than normal, and so the company has adjusted test year sales volumes to assume higher "normal" weather sales. How do you determine the dollar magnitude of the adjustment to revenues?

A. The appropriate approach is to use marginal energy rates because, had the weather been warmer, revenues would have been higher in the amount of the applicable energy rates on various rate schedules multiplied by the added energy consumed.

Q. Should average class prices be used for this adjustment?

A. Average class prices for the residential and commercial classes express total revenue for the class divided by total therm throughput. Consequently, average class prices include averaged-in monthly customer charges as well as the effects of higher priced energy blocks on declining block rate schedules. For these reasons, average class prices used by Staff overstate the effect of a change in sales volume on revenues and should not be used.

Q. Please compare average class prices and marginal energy rates for the residential and commercial classes.

A. Page 9 of my Exhibit shows the derivation of marginal energy rates for both classes. The key steps are identification of operative energy blocks for each rate schedule and the development of weights reflecting the rate schedule composition of each class.

Q. Were class prices or marginal energy rates used in adjusting revenues in the

resolution of the company's last (1997) general rate case?

A. The Settlement Agreement for UG-970932 employed marginal energy rates in the pricing of incremental therms due to weather normalization. Specifically, the tail block rate for Rate Schedule 24 was used for residential customers and the tail block rate for Rate Schedule 3 was used for commercial customers.

SECTION III: HOW IS NORMAL WEATHER MEASURED?

Q. What does NWN recommend that the Commission adopt as a policy on determination of normal heating degree days?

A. Selection of normal heating degree days for Vancouver and other reporting stations must allow for the highest degree of accuracy and current relevance possible. The following policy seems most reasonable: where the historical availability of daily data and the property of reporting station homogeneity permits the direct computation of mean heating degree days, regulated utilities may utilize computed averages instead of Department of Commerce (NOAA) estimates. Homogeneous station records are defined as not having experienced changes in the location or exposure of recording instruments. Auditing of averages computed by private utilities need only involve reconciliation with published monthly actuals over the relevant time period.

Q. Why does NOAA not simply calculate the arithmetic average of heating degree days by month based on daily observations?

A. For a reporting station with a homogeneous history at a single location, computed averages are, by definition, correct. The methodology underlying published normals is defensible only when temperature measurement instruments have been moved to different locations over time, or when records of multiple stations must be combined to create an artificial history for a nonexistent station. Statistical methods capable of normalizing the records of two or more stations to create an artificial history for the most recent or dominant surviving station are clearly required. A principal use of published averages is to make weather station comparisons, typically taking the form of national or micro-climate isopleth maps.

Understandably, for these purposes, the same statistical method must be applied to all weather stations throughout the nation even if their reporting history is completely homogeneous, as in the case of Portland, Salem, Corvallis, Eugene, Vancouver and others, as well.

A further reason involves the limitations of NOAA's computational equipment, particularly for the 1941-70 and 1951-80 published averages, which took place before the advent of inexpensive random access memory and data storage devices.

Q. What estimation method does NOAA use?

A. The NOAA or Thom "Universal Truncation" method develops heating or cooling degree day normals for any base temperature by reference to average temperature in the month under consideration and a calibrated frequency distribution to capture temperature variability within a month. *See*, Thom, H.C.S., 1966, "Normal degree days above any base by the universal truncation coefficient," Monthly Weather Review, 94, pp. 461-465.

Hence, in a month such as January, where observed average daily temperature can always be expected to fall below the base (say, 65° Fahrenheit), knowledge of the month's average temperature and number of days in the month leads to an equivalence of mean daily heating degree days and monthly mean HDD based solely on knowledge of the month's mean temperature. In other words, the frequency distribution is not truncated. In the summer months and in the shoulder months of a heating season, one must expect significant departures from arithmetic HDD means derived on a daily basis when compared to Thom method HDD normals. After all, one method is based on historical daily observations and the other is based on properties of a fitted frequency distribution.

Q. What is meant by truncation?

A. Truncation has two easily confused meanings in this context. The Thom universal truncation method uses *a truncated frequency distribution* describing the expected daily occurrences of heating or cooling requirements during a month. In Thom's use of the term, truncation refers to the fact that a frequency distribution describing the occurrence of HDDs in a month is bell-shaped with one end cut off at the base temperature.

Computational truncation, or rounding, of remaining decimals in the calculation of actual HDDs for a day is a common weather service practice. The

NOAA weather service convention is to recognize high and low temperature for a day using a twelve o'clock midnight demarcation of days with both high and low temperatures for the day taken as having been properly rounded to the nearest whole degree value. On a day with a high temperature of 55 degrees and a low of 40 degrees, the mean temperature is 47.5 degrees. However, when rounded the mean for the day becomes 48.0 degrees. When compared to a reference temperature (say 65 degrees) for purposes of establishing a heating degree day value, 17 degree days are reported when 17.5 HDDs are computationally correct.

It has been clear to my satisfaction that all database development engaged in by NW Natural should have at its foundation the use of unrounded recorded average temperature for a day (thus retaining the truncated or rounded 0.5 degrees when expressed as an average temperature). Such a foundation still permits calculating degree days for any base temperature.

Heating degree day monthly totals reported by some NWN district reporting stations (Corvallis, Hood River) carry the truncated decimal place of "inaccuracy" which typically exceeds NOAA's official records for a month by 8 HDDs. This discrepancy is attributable to one-half of the days being subject to a computational truncation error of 0.5 HDD (0.5 x 0.5 x 365/12 = 7.6). If arithmetic averages are used in the calibration of a model that associates gas consumption coincident with recorded HDDs, consistent treatment of truncation in both coincident weather observations and the arithmetic development of mean

HDDs is required. The Vancouver weather station carries the added decimal point of accuracy so that *published* actuals for a month coincide with *calculated* actuals.

Q. What is the impact of the Thom method on individual weather stations?

A. The Thom method as implemented by the NOAA serves broader agency purposes reasonably well. Unfortunately, considerable injustice can be done in weather stations with clean records. Variants of Thom's "universal truncation method" as well as the original method must involve statistical error for any reporting station. Statistical error must be expected and is most apparent in NW Natural's case when comparing NOAA estimates to computed actuals for NW Natural's more important weather reporting stations. For example, the current published annual normal for Vancouver is 5,196 heating degree days for the 1961-1990 period. Calculated normal degree days for the same period indicate 5,095 to be the correct figure. The Vancouver weather station has a perfectly homogeneous record, but only one figure is correct. The NOAA published figure is simply an estimate which, in the case of Vancouver, errs by 2.0 percent on the high side on an annual basis.

Q. Are you aware of any published research that focuses on methods potentially replacing the "Thom Method" of synthetically developing heating degree day normals from monthly average temperature data?

A. Yes. More than a decade ago, I received a phone call from Richard L. Lehman of the National Weather Service, Climatic Analysis Center, that was motivated by concerns unrelated to the normal weather issue. During the conversation, I learned that Dr. Lehman is likely to have a major influence on the methodology used in NOAA's next (1992) update of heating degree day normals. He pointed out that he had authored two articles that may be of interest when I mentioned NW Natural's concern with the NOAA's past published heating degree day normals. Dr. Lehman mailed reprints of several articles he has authored, two of which should be referenced in this proceeding: "Errors in Estimating Monthly Degree Day Normals by the Fast Method," Bulletin of the American Meteorological Society, Vol. 65, No. 1, January 1984, pp. 20-23, and; "Probability Distributions of Monthly Degree Day Variables at U.S. Stations. Part I: Estimating the Mean Value and Variance From Temperature Data," Journal of Climate and Applied Meteorology, Vol. 26, No. 3, March 1987, pp. 329-340. Ultimately, NOAA used the Thom method again in their 1992 update.

Q. What do you find noteworthy in these publications?

A. Both articles, while highly mathematical, provide a good technical description of the relative merits of alternate means of establishing synthetic heating degree day averages or normals. Clearly, the yard stick or measure of "goodness" by which synthetic methods are gauged here, is how well they duplicate calculated arithmetic averages based on daily observations at various weather stations where daily detail is available. The benchmark used in the evaluation of synthetic methods is nothing more or less than that which NW Natural requests from this commission. After all, why use a proxy or surrogate when the real thing is readily available for principal NW Natural weather stations?

Q. Staff states at page 6, lines 6 through 11, Exhibit YKGM-T1, "In contrast, the methodology used by NOAA accounts for the impact of factors that may influence normal temperature observed over several years. These included adjustments for missing data, time of observation bias, and other factors. The objective of making these adjustments is to ensure that the impacts of external factors on temperature are taken into account and that the data become homogeneous and representative." What factors need to be considered in the case of the Vancouver weather station?

A. The only factor discussed by Staff that applies is missing data. None of the other reasons discussed above for employing the Thom method apply to the Vancouver weather station.

A. Missing Data Issues

Q. Does the occurrence of missing data require the use of heating degree day averages based on the Thom or other synthetic methods?

A. No. Missing data presents the same problem for the direct computation of heating degree days as it does for the use of synthetic methods. For the Thom method, missing observations on average monthly temperature are needed. For the company's customary direct computation method, missing daily observations of daily average temperature must be developed.

Q. How does the company estimate missing data?

A. Departures from average temperature at the nearby Portland and Salem weather stations is used to estimate the departure from average for Vancouver on those days for which Vancouver has missing data. Page 10 of my Exhibit documents instances of missing data going back to July of 1961. There are only three instances in which an entire month of observations is missing in the last 20 years; other occurrences involve only a small number of days. For each instance, estimates replace missing observations using the following procedure: (1) minimum and maximum temperatures are identified for Portland and Salem in the following year for the same calendar month, (2) the percentage departure of Vancouver minimum and maximum temperatures from Portland and Salem is calculated for that month in the forward year, (3) the percentage departure is applied to Portland and Salem minimums and maximums for the day with a missing observation, and (4) the two results are averaged to obtain the estimate for Vancouver.

Q. How sensitive is the resulting calculated heating degree day average to possible estimation error on NW Natural's part?

A. Not very sensitive. Even if our estimates for missing data points were arbitrarily adjusted by a factor of 20 percent in the direction of colder weather for each missing observation, the resulting 20-year annual average would only increase by 16 heating degree days. Stated another way, intentional efforts to bias the resulting averages downward though the use of a non-objective estimation technique simply would not make much of a difference in the final result.

B. The Importance Of Moving Averages

Q. Why does NW Natural advocate the use of a moving average of weather?

A. Clearly, man's effect on temperature, whether on a global or microclimate basis, is to raise reported temperatures. The phenomenon is most pronounced in urban areas where reduced vegetation, increased paving, convective dust domes, and reject heat from metabolic and energy-using activities raise daily peak temperatures and reduce recorded night time lows. Studies have shown that urbanization alone reduces heating degree days by one to two degrees per day on those days for which positive degree days would be reported.

The Portland/Vancouver Metropolitan Area has undergone both intensive and extensive development since the 1960's. The NOAA Vancouver weather station has been enveloped by urbanization. Paving has its own effect on average temperatures and heating degree days for all reporting stations. Pavement stores heat during the day and releases heat during the night, thus raising reported night-time lows. Rejected heat from heated buildings and vehicular traffic also increases reported temperatures as urbanization proceeds.

Simultaneously, heating requirements for residential and commercial structures are reduced by urbanization to varying degrees depending on the density of nearby development and location within the metropolitan area. Some structures benefit from the rejected heat of other land uses. Of course, there is no reason to expect the effect of urbanization to be the same at the Vancouver weather station as it is at any arbitrarily chosen point of gas use within NW Natural's Washington service area. We must simply assume that the impact of urbanization on heating degree days is the same for the average customers' location as it is for the Vancouver weather station, or any other weather reporting station. Recognizing this phenomenon, the necessity of using moving averages for heating degree days becomes apparent -- this is the only means of capturing the effects of urbanization on temperature when normalizing energy sales for space heating purposes. Moving averages simply keep calculated weather norms apace with the simultaneous experience at the point of fuel use.

Q. Why does NW Natural specifically advocate the use of a 20-year moving average?

A. If average daily temperature were a purely random variable with a constant expected value, it would make little conceptual difference whether one used a 10-, 20-, or 30-year moving average. A trade-off exists between the variability of a moving average based on a short period of time and the stability of an average based on a long period of observation. Very current, or contemporaneous, measures of average produce a volatile moving average. NW Natural has for many years used a 20-year average for internal corporate planning, Integrated Resource Planning and, for rate case purposes, has used the 20-year rolling average since 1964.

The most recent (1980-99) 20-year average for Vancouver indicates a normal of 4,923 annual degree days -- 273 degree days below NOAA's most recent published 30-year average 5,196 (January 1992). This amounts to a 5.5 percent difference. To the extent that urbanization has an effect on recorded degree days, it must be recognized that the Vancouver metropolitan area during the 1980s and 1990s is quite different from the city of Vancouver that existed during the 1960s and 1970s. Logic supports the use of a more contemporary 20-year average. To varying degrees, other reporting stations in NW Natural's service area are subject to this same phenomenon.

Weather observed during a recent month is most subject to the effects of urbanization while a 20-year average is centered at a point in time 10 years ago.

The 10-year average lag implicit in a 20-year average is perhaps the shortest lag one can utilize without introducing excessive fluctuation in a moving average. Without speculating on the magnitude of global warming trends or the effect of urbanization on reported heating degree days, it should be clear that even the 10-year lag inherent in a 20-year moving average results in a regulated energy distributor not earning an allowed rate-of-return, on the average, during a warming trend. Of course, the company's use of contemporary, 20-year weather averages for ratemaking purposes is independent of the direction of weather trends. A contemporary 20-year moving average also captures the effects of a cooling trend more rapidly than a 30-year average that is updated once each decade.

Q. If published weather normals must be used, what options exist to correct the test year for differences between calculated and published averages?

A. Regulated utilities can be expected to earn their allowed rate of return, on the average, when test period sales are correctly normalized for the effects of weather (other rate case factors permitting). Booked test period sales (or requirements) are observed coincident with the actual weather of the test period. Econometric models (regression equations) calibrated using currently observed weather can only be used for weather normalization of gas sales when using contemporary normals calculated using actual weather.

If NOAA heating degree day normals must be used, then degree days recorded during rate case test periods (or the period during which a regression equation is calibrated) must be inflated or deflated by the margin of error manifest in published norms. Again, for Vancouver this amounts to 5.5 percent when the most recent 20-year average is compared to published annual normals.

SECTION IV: ECONOMETRIC SPECIFICATION ISSUES

Q. Has staff criticized the company's specification of its regression equation used to relate temperature sensitive sales to weather variations?

A. Yes. For this reason, I think it is appropriate to fully explore the characteristics of alternative model specifications. Matching weather observations to observations on gas utilization is the foremost concern, followed by the choice of functional form, whether to use direct forecasts or an adjustment to recorded actual sales approach, period of observation, and concerns about serial correlation.

Q. Please distinguish between monthly gas sales and monthly gas sendout.

A. Sales are the therms billed to customers during a month. Sendout refers to the amount of gas physically delivered to customers during a month. Due to cycle billing of small volume customers, recorded sales for a month includes gas physically delivered to customers in the previous month and current month. Consequently, during late winter months, recorded sales typically depend more on the weather in the preceding month than in the month for which sales are recorded. If all gas meters were read at the same instant of time at the end of each month, sales and sendout would be theoretically equal.

Q. How is the time pattern in which weather is experienced best matched to resulting sales or sendout?

A. A variety of methods can be utilized involving different degrees of sophistication. For integrated resource planning purposes, the company uses a method that weights the heating degree days impacting each individual billing cycle by the number of customers in that billing cycle. We have called this approach “cycle-ized” degree days. When used in a direct forecast or backcast mode applied to test-year temperature sensitive sales, this model specification is superior to other less statistically efficient approaches. Its superiority stems from fully utilizing the detailed information on weather patterns for each of the 21 billing cycles per month. For a detailed description see pages A-25 and A-26 of the company's 2000 Integrated Resource Plan, July 2000 printing.

At the opposite extreme lies an approach we have called "calendar-ized" sendout. Here, sales for each billing cycle are spread to the months spanned by each billing cycle by recognizing a base use component and temperature sensitive component. Base use is spread in proportion to days in each month and temperature sensitive use is spread in proportion to billing cycle heating degree days falling in each month. Consequently, calendar month degree days can then be matched to calendar month sendout. While calendar-izing sendout seems like a logical approach to the weather/sales matching problem, it is less efficient than the cycle-ized degree days approach. It assumes that temperature sensitive use is proportional to degree days when it is known that use per degree day rises with degree days, when using a base of 65°. It also assumes in advance the properties of the relationship it is trying to estimate. Consequently, the method throws away information by allocating temperature sensitive use incorrectly.

Q. What method was used in the company's direct case [McVay, Revised Exhibits 5 (KSM-Testimony) and 6 (KSM-Exhibit)]?

A. Neither of the methods mentioned above were used. Following precedents of prior rate cases, the method employed simple averages of the heating degree days in the current month and previous month when matching weather to the current month. In terms of efficiency, it throws away the most information because it completely ignores billing-cycle-based detailed information.

Q. Why has the company sponsored this method?

A. The company has sponsored this method due to past negotiations in which Staff requested literal duplication of weather normalization methods included in our last general rate case. Consequently, the method the company sponsored here dates back to company rate cases filed in the early 1980s.

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Q. Was the weather adjustment method changed in the course of Docket No. U-86-41?

A. No. Equations calibrated by averaging previous and current month weather were used directly to "backcast" test year sales under normal weather.

Q. Was the weather adjustment method changed in Docket No. UG-970932?

A. At Staff's request, the method of applying the weather adjustment changed, but the method of calibrating usage equations did not change. In that docket, the "adjustment-to-actuals" approach was first used. Usage equations are used to "backcast" test year sales under both actual and normal weather conditions with the resulting difference applied to recorded actuals. A month that was warmer than normal will have a positive adjustment and vice versa for a colder than normal month.

Q. Does the company endorse the adjustment-to-actuals approach?

A. No. It was used in the current case because of the precedent in UG-970932 and the fact that one of its most undesirable features did not pose major problems for the test-year in this docket. We wished to expedite a resolution of revenue requirement issues in the case by not raising new issues, and thus did not challenge the adjustment-to-actuals approach.

Q. What is the undesirable feature of the adjustment-to-actuals approach?

A. The adjustment-to-actuals method is unable to remove the effects of a major cold snap on test-year sales. This is because when using a base of 65°, use per customer per heating degree day rises as degree days rise. A sequence of very cold days raises gas use proportionally more than the degree day departure from normal. Recorded actual sales in the month are greater than the average weather impacting the month would suggest. Cold snaps are of course surrounded by less severe weather so that when the adjustment is developed using actual and normal weather, the forecast value for actual weather is systematically below recorded sales and fails to remove the effect of the cold snap.

Q. Please compare weather normalization results using the cycle-ized degree day approach and the adjustment-to-actuals approach that uses a simple averaging of previous and current month degree days.

A. Page 11 of my Exhibit shows the cycle-ized results by month and in total for the residential and commercial classes of service using 20-year average weather. The following table summarizes the resulting reduction from our as-filed levels of sales, in thousands of therms.

	NWN Cycle-ized Method	As-Filed NWN Method & Weather	Reduction From As-Filed Case
Residential Sales	28,864	29,526	662
Commercial Sales	17,852	18,659	807

Q. What conclusions do you draw from this comparison?

A. Weather-normalized residential and commercial sales using the cycle-ized degree days method with a direct forecast/backcast of test year sales provide the litmus test by which other methods should be judged. The approach fully utilizes billing cycle detail about weather patterns affecting cycle sales for a month and by directly backcasting test year sales it avoids the bias caused by periodic cold weather spikes. While producing a higher level of normalized sales, the company's as filed case reflects previous concessions to Staff. In this instance, the concession of using the adjustment-to-actuals approach adds approximately 1.5 million therms to normalized sales beyond the superior cycle-ized method. In this instance, the as-filed approach benefits ratepayers through a lower resulting revenue requirement.

Q. Staff states at page 7, Exhibit YKGM-T1, lines 5 through 7, "The company seems to consider the magnitude of R-square as a sole criterion for the choice

of a statistical functional form or representation." Do you agree with this statement?

A. No. The company's choice of functional form stems from the past need to simultaneously estimate time trends in the dependent variable "therms per customer per heating degree day". By using a log-log transformation, a time index can be included directly in the regression (thus its coefficient can be interpreted as a compound rate of change) and provide efficient estimates of trends in space heating gas use. In addition, the log-log transformation allows the capture of curvilinearity (the non-linear relationship) between use per customer per heating degree day and heating degree days. As mentioned earlier in my testimony, use per customer per degree day rises as degree days rise, but not necessarily in a linear fashion. The resulting value of R-square is somewhat incidental since it is no mystery that outdoor temperatures drive space heating gas use.

Q. What is the value of the Durbin-Watson statistic for NW Natural's weather sensitivity coefficient?

A. The calculated value for residential is 1.98, and 2.04 for commercial. Both values exceed 1.45, suggesting that serial correlation is not present. The calculation was performed on the company's as-filed predicted and actual temperature-sensitive heating use, rather than on the log transform values of use per customer per heating degree day.

Q. Would you be concerned if the Durbin-Watson statistic indicated the presence of serial correlation in the company's regression equations for temperature sensitivity?

A. No, for two reasons. First, the simplified method of matching weather to billing-cycle sales used by company and staff (an average of weather in the previous and current month) may be the culprit. Improving the model specification by using "cycle-ized" degree days is a superior method of dealing with the problem. Second, the problem would not be a problem insofar as we are not testing a hypothesis regarding the significance of heating degree days as an independent variable, nor does the presence of serial correlation bias the estimated value of regression coefficients in a particular direction. If present, its expected impact is neutral.

Q. Why has the company used a three-year period of observation on temperature sensitive gas use?

A. The company has used a three-year period of observation on temperature sensitive use in integrated resource planning and weather normalization for rate case purposes for many years. We have used longer periods of observation when pronounced trends were present (that is, the time variable referred to above was statistically significant). Three years tends to keep the period of observation apace with the period of time rates will be in effect and captures the gas-usage attributes of recent customer additions. Base use, on the other hand, tends to be more stable over time.

Q. If Staff and company statistical methods tend to produce similar weather adjustments when using the same normal weather measures, why is the company concerned with Staff's approach?

A. We do not want the Commission to adopt Staff's particular method in this proceeding as the only appropriate method for future rate proceedings. In large part, we have continued with the company's current method to avoid suggestions that the company might have "gamed" various methods to achieve the most beneficial outcomes and also to minimize controversy over this issue.

SECTION V: LESSONS LEARNED FROM THE TSSA EXPERIMENT

Q. What is the purpose of weather normalization adjustment clauses adopted by public utility commissions in other states?

A. The purpose of such weather adjustment mechanisms is to reduce earnings variability due to fluctuations in weather. Weather normalization adjustments tend to take two general forms. In some jurisdictions customers' monthly bills are restated to reflect gas use assuming normal weather conditions occurred rather than actual weather. In other jurisdictions, deferred accounting is used with balancing accounts to recover unrealized revenue when the weather is warmer than normal and to refund over-earning amounts when the weather is colder than normal. These mechanisms can also be used to eliminate controversy about the appropriate measure of normal weather. If the utility is made whole -- allowed to earn its authorized return regardless of what weather actually materializes -- then the measure of normal weather adopted by a Commission can be more readily accepted by all parties in a case.

Q. Has NW Natural ever had a weather normalization mechanism?

A. Yes. During the early 1980s, NWN had a Temperature Sensitive Sales Adjustment (TSSA) in its Oregon tariffs. The TSSA was intended as a guard against earnings variability due to fluctuations in heating requirements. However, it also provided some degree of earnings protection to the company's stockholders due to incorrect measurement of normal weather by the OPUC Staff.

Q. How did the TSSA mechanism affect earnings variability?

A. Earnings variability was reduced.

Q. Please evaluate the TSSA mechanism as a "safety net" with respect to normal weather issues.

A. As a safety net on the issue of what constitutes normal weather, TSSA had approximately 80 percent of its webbing missing. When the Oregon Staff’s weather normalized residential and commercial volumes were used in setting rates, NW Natural could be made totally indifferent only if:

(1) Interest was earned (paid) on TSSA account balances;

(2) Commercial class sales were included;

(3) The five percent weather deviation "trigger" was eliminated, and;

(4) TSSA account postings reflected the full impact of weather deviations (not

just 80 percent of the effect beyond five percent weather deviation trigger).

Under these circumstances, NW Natural would have been protected even if OPUC Staff imposed an artificial degree day norm 1,000 degree days greater than the level that was typically in their case. Commercial class sales were not covered by TSSA. As TSSA was structured, only occasional and incomplete redress could be expected from TSSA when incorrect degree day normals are imposed in setting rates and in the specification of normal degree days.

Q. Could NW Natural accept the WUTC Staff's proposal to use 1961-90 NOAA heating degree day normals if it had a weather normalization adjustment mechanism?

A. The company could accept Staff's 30-year NOAA <u>only</u> if it is accompanied by a weather normalization adjustment. Weather normalization adjustments create additional administrative costs and they can be politically unpopular because customer bills do not reflect the weather customers know they experienced. Those issues aside, however, a weather normalization adjustment mechanism would eliminate the penalty on company earnings that Staff's NOAA-based normal weather creates.

Q. How would this work?

A. Using NOAA weather, normal sales volumes for rate case purposes would be overstated and resulting rates would be set lower than if the company's 20-year moving average were used. Surprisingly in this case, from the company's perspective we would want a temperature-sensitive sales-adjustment mechanism that was <u>also</u> based on NOAA weather normals. In the *expected value* sense, we expect to experience weather warmer than the NOAA normals; hence, we would also expect that postings to a TSSA balancing account would typically put us in a collect position, rather than a refund position. The question remains as to whether the company would view the additional administrative cost and potential customer "ill will" as less costly than the benefits of nearly complete earnings stability with respect to residential and commercial sales volatility.

Q. How would the mechanism for TSSA postings work?

A. Many approaches are possible. Within the realm of balancing account mechanisms, comparison of billing-cycle sales revenues per customer in a month to rate-case billing-cycle sales revenues per customer for the same month is the most straight forward. Alternatively, a posting based on usage-equation-predicted sales volumes with actual weather compared to usage-equation-predicted sales volumes using NOAA normal weather is another possibility.

While other LDCs have such mechanisms, the company would prefer to avoid adjusting each customer's monthly bill to a normal weather bill. While capable of keeping the company whole with respect to rate case revenue requirements, this latter approach is less precise, confusing to customers and also tends to disassociate customer behavior from their monthly bills. Adjusting customer bills is administratively more expensive than a balancing account approach.

Q. Is the company interested in a weather adjustment mechanism?

A. We have strong interest, but only if it is structured to create indifference with respect to the determination of normal weather. Given the choice between Staff's recommended normal weather and the company's, I am of the strong opinion that the company's normal weather would result in less balancing account activity and avoid the accumulation of excessive collection balances in the account. The company would be interested in pursuing a weather normalization adjustment for earning stabilization purposes, but would rather do so using a contemporary 20-year moving-average measure of normal weather. It is important to recognize that customers are also unharmed when the same normal weather measure is used for both ratemaking and weather normalization adjustments (earnings stabilization); the company simply earns the agreed upon revenue requirement regardless of the weather measure used to set rates.

SECTION VI: CONCLUDING REMARKS ON WEATHERIZATION NORMALIZATION

Q. What can we expect when new NOAA heating Degree Day Normals are published in 2002?

A. One would hope to see improvements over the existing (and ancient) Thom method with significant refinements in methodology that lead to a better (even though synthetic) approximation of arithmetic averages. However, in my opinion, it is unfair to NW Natural to be held hostage to the uncertain prospect of improvements in NOAA's methodology.

Furthermore, even if NOAA published heating degree day normals that exactly matched those arithmetically calculated for the 1971-2000 time period in 2002, NW Natural would have two remaining concerns.

First, this static, 30-year average would not fully capture the demonstrable downward trend in heating degree days during the 1980s and 1990s to the extent that NW Natural's advocated 20-year average would. Second, NOAA's normals would not be updated until the year 2012, thus failing to capture any continuation of a warming trend and leave rate reviews conducted in the 2000 to 2012 time frame dependent on a normal weather "snapshot" centered on the year 1985. By the year 2012, this imposes an implicit 27-year lag which is scientifically untenable given the increasing widespread recognition of global warming and the effects of further urbanization near the Vancouver weather station. Adopting NOAA normals instead of the well-established Commission precedent of using 20-year averages for gas utilities is punitive to NW Natural's shareholders and creates a situation where the recovery of revenue requirements deemed to be fair, just and reasonable is highly unlikely.

Q. What if the WUTC adopted all of the principles set forth in your testimony?

A. NW Natural's revenue requirement is largely recovered through volumetric rates applicable to the most temperature sensitive residential and small commercial classes of service. Because of this, earnings variability is increased by virtue of higher energy rates resulting from this proceeding. This variability can not be reduced through a more refined approach to weather normalization of temperature sensitive sales. However, the opportunity for NW Natural to earn its allowed rate of return, on average, would be significantly enhanced. In the unlikely event of a cooling trend, continued use of NW Natural's 20-year moving average would rapidly capture the trend, and NWN would have no dispute with the WUTC Staff even if the 20-year average moved above the level in Staff's proposed use of 1961-90 NOAA published normals.

Q. Does this conclude your rebuttal testimony on weather normalized temperature sales?

A Yes, it does.

SECTION VII: WASHINGTON BENEFITS RESULTING FROM MIST STORAGE

Q. What is your final area of rebuttal testimony?

A. I respond to Public Counsel witness Jim Lazar's testimony on the prudence and reasonableness of Mist underground storage investments. [page 7, lines 4 through 16, Exhibit __ (JL-T)]

Q. Has the company's Integrated Resource Planning process quantified system benefits associated with Mist underground storage development?

A. Yes. The company is just now completing its fourth integrated resource plan (the

2000 plan). Each of these plans have identified Mist underground storage as the least cost means of supporting growth in Washington and Oregon, and quantified the benefits of storage to customers, including those Mist increments placed in service in 1998 and 1999 for which the company is requesting rate treatment in this case. These plans are on file with the Commission, and the Commission may take official notice of them.

Q. Mr. Jim Lazar takes the company to task for not quantifying the benefits of Mist additions, page 7, Exhibit __ (JL-T). Are these criticisms justified?

A. Not at all. Washington picks up a share of Mist-related costs though a two-state allocation based on firm gas throughput in Oregon and Washington. For example, in the current plan, Mist produces net benefits exceeding costs by $253 million in NPV terms. These benefits flow to the two states roughly in proportion to firm throughput. Viewed another way, over the Plan's 30-year time horizon system peak-day demand grows by approximately 6.0 million therms in the Medium-High Base Case growth scenario. 1.1 million therms of this growth occurs in the company's Washington service area. Consequently, approximately 18 percent of Mist benefits will accrue to Washington customers.

Q. What is Mr. Lazar's specific suggestions on rate treatment?

A. Mr. Lazar recommendations that "Any increase associated with Mist should be deferred and offset with the corresponding benefits." [page 7, lines 12 and 13, Exhibit __ (JL-T)]

Q. What is the operational significance of Mr. Lazar's suggestion?

A. He seems to suggest that the company should follow a long-term planning course of action involving Mist development with its attendant development costs, but only be allowed rate recovery as benefits come into place. He fails to recognize that while some of the benefits of Mist development are immediate (lower commodity costs), most of the low cost benefits occur over time as the company is able to avoid paying year-round pipeline demand charges. If the company were not relying on Mist storage, it would be required to rely on interstate pipeline capacity, and the company's capacity costs would jump accordingly and immediately.

Q. Does this conclude your rebuttal testimony?

A. Yes.