Exhibit No.:	_____
Issues:	Rate Design-Income/ Consumption Relationship
Witness:	Philip B. Thompson
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MISSOURI PUBLIC SERVICE COMMISSION

MISSOURI GAS ENERGY

CASE NO.

GR-2009-0355

REBUTTAL TESTIMONY OF

PHILIP B. THOMPSON

Jefferson City, Missouri

September 28, 2009

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CASE NO. GR-2009-0355

September 2009

Q. PLEASE STATE YOUR NAME AND BUSINESS ADDRESS.

A. Philip B. Thompson, 1993 N. Mahonia Pl., Bellingham, Washington. 98229

Q. ON WHOSE BEHALF ARE YOU APPEARING IN THIS PROCEEDING?

A. I have been retained by Missouri Gas Energy (MGE).

Q. PLEASE SUMMARIZE YOUR EDUCATIONAL AND EMPLOYMENT BACKGROUND.

A. I have a B.A. in Economics from Kent State University and a Ph.D. in Economics from the University of Arizona. From 1982-1984 I was an instructor at Texas A&M University. From 1984-1986 I was a Public Utility Economist with the Missouri Office of the Public Counsel, and from 1986-1994 served as Public Counsel's Chief Economist. From 1994-2000 I was an Assistant Professor of Economics at the University of Missouri-Rolla (now the Missouri University of Science and Technology), and from August 2000 through July 2009 I was a faculty member in the Economics Department at Central Michigan University. I recently began employment as Assistant Professor of Economics at Western Washington University.

Throughout my career I have made presentations at many conferences and published papers in peer-reviewed journals and in other publications, mostly on topics

related to utility and energy economics, including the influence of household income on residential natural gas consumption. My vita is attached to this testimony as Schedule PBT-1.

Q. HAVE YOU EVER TESTIFIED BEFORE THIS COMMISSION?

A. Yes. I filed written testimony in numerous cases while employed by the Office of the Public Counsel, and in other cases while working as a consultant. In many of these cases I also appeared for cross-examination at a hearing.

Q. WHAT IS THE PURPOSE OF YOUR TESTIMONY?

A. My purpose is to discuss the likely impact on low-income natural gas consumers of a shift away from a straight fixed-variable (SFV) rate design for MGE's residential customers. In doing so I will provide some basic historical data on average gas usage and income in approximately 180 zip codes in MGE's service territory; report the results of an econometric study I performed in an effort to ascertain the relationship between residential gas consumers' usage of natural gas in MGE's service territory and their income levels and other factors that affect household natural gas usage; and present an analysis of MGE customers who received low-income energy assistance in 2008. This is in response to the direct testimony of Public Counsel witness Barbara Meisenheimer insofar as she recommends that the Commission require MGE to revert to a residential rate structure that recovers a significant portion of the non-gas costs allocated to that class in a volumetric rate.

Q. WHY IS THE INCOME-CONSUMPTION RELATIONSHIP FOR NATURAL GAS CONSUMERS IMPORTANT?

A. Residential natural gas rate structures have typically consisted of a monthly fixed charge, known as the customer charge, and a rate applied to each volumetric unit of consumption, also sometimes called the commodity charge. In some rate structures the fixed charge includes a charge for the first units of usage each month, in which case the volumetric charge is not levied on that usage. Purchased gas costs are always collected through a volumetric rate, while the local distribution company's non-gas or margin costs have generally been collected through a combination of the fixed charge and the volumetric rate.

When rate design for the residential class is contemplated, a decision must be made concerning how to apportion the total margin revenue to be collected between the fixed and volumetric charges. As the proportion of the margin revenue target that is collected through the volumetric charge increases, bills for customers with above-average usage rise and those for below-average users fall.

In deciding how to apportion a class revenue increase between the rate components, this Commission has traditionally used cost-of-serve studies as a starting point, but has considered other factors in its final rate determinations. These factors include "*consumption characteristics (effect on low income customers)*, economic factors, current rate structures, value of service, *rate affordability*, customer service quality, historical rates, the concept of gradualism to avoid or minimize potentially

disruptive rate shifts or rate shock, and the magnitude of the required increases or the overall rate impact of the increase in the revenue requirement." (*Re: Missouri Gas Energy*, Report and Order, GR-96-285, issued February 1, 2001, Missouri Public Service Commission, pp. 40-41, emphasis added, footnotes deleted.)

In order to consider the impact of a particular fixed/volumetric charge apportionment on low income customers, we must first have information about the income-consumption relationship. For example, if low income consumers use less than the average amount of gas (within the residential class), a larger fixed charge will increase the burden of such customers relative to other customers. On the other hand, if low income customers use *above*-average quantities, bills for such customers would be reduced by collecting a greater portion of the margin revenue target through the fixed charge and a smaller portion from the volumetric charge.

The Commission has in a number of cases considered both possibilities. In Case No. GR-2000-512 the Commission approved a Stipulation and Agreement settling the case, which included an increase in AmerenUE's monthly fixed charge for residential customers from $8 to $9. But three Commissioners expressed concern that an increase in the customer charge is regressive, meaning that it results in larger bill increases for low income customers.

The Commission has also recognized the alternative possibility in its Report and Order in Case No. GR-96-285 (February 1, 2001, p. 41, footnote 12), stating that

"frequently lower income customers use more gas for heating because the homes they heat are often older and more poorly insulated, thereby causing those people who can least afford it, to consume more gas to achieve the same degree of heating as newer, better insulated homes." Finally, advocacy agencies for low income customers often argue that such customers are below-average users who would be harmed disproportionately by a revenue increase apportionment weighted heavily toward the fixed charge.

Which view is correct? Both arguments have theoretically sound underpinnings. The question therefore becomes an empirical one: What is the income-consumption relationship?

Q. YOU SEEM TO BE SUGGESTING THAT THERE ARE TWO POSSIBILITIES: CONSUMPTION IS LOW AT LOW INCOME LEVELS AND INCREASES WITH INCOME, OR THAT USAGE STARTS HIGH AT LOW INCOMES AND DECLINES WITH INCOME. IS THAT CORRECT?

A. Those are two possibilities, but there is a third. In a sense, both sides of the argument may be correct. That is, usage may be high at low income levels and fall as income increases, but then reaches a minimum and begins to climb again after a certain income level. If we imagine a graph with income on the horizontal axis and monthly usage per customer on the vertical, the relationship I have just described would have "U"-shape.

Q. HOW MIGHT THE "COMBINATION" RELATIONSHIP YOU REFER TO BE EXPLAINED?

A. Simply as a combination of the two most likely explanations for the individual relationships. At the lowest income levels, families live in homes that are inefficient in their gas use, as explained in the previous answer. Their homes are older, not well insulated, and lacking energy-efficient doors and windows. Their furnaces may be older and not well maintained, especially if the home is rented.

As incomes rise above the very lowest levels, families obtain the wherewithal to improve the thermal integrity of their residences and the efficiency of their furnaces, either because they live in newer homes or have the wherewithal to retrofit efficiency measures, and usage declines. But at some income level usage begin to rise once again as the household gas bill becomes a smaller factor in the family budget and as more gas appliances (e.g., swimming pool heaters) are added. In addition, households with higher incomes tend to occupy larger homes.

Q. PLEASE DESCRIBE SCHEDULE PBT-2.

Schedule PBT-2 contains a series of four graphs that plot relationships among average household gas usage, household income, average dwelling age, and average dwelling size. Its purpose is to illustrate some of the one-on-one relationships between these variables, which can give us some idea of how these variables move together.

Q. WHERE DID YOU GET THE DATA YOU USED?

A. The raw data and the variables derived from it are described in Schedule PBT-3, which is discussed at greater length in a later portion of my rebuttal testimony, but it is useful to give a short answer to this question here. Data provided by MGE consisted of customer usage and the number of bills by zip code for each of the months (October 1998 through September 2000) in the study period, along with data on the weather and on the Company's prices over the period. Data on population and housing variables were taken from the 2000 U.S. Census. Questions in the 2000 Census ask about the respondent's demographic, economic, and housing characteristics in 1999, which is in the middle of the two-year period covered by the study.

Q. WHY DO YOU BELIEVE THAT DATA FROM TEN YEARS AGO ALLOW US TO MAKE REASONABLE CONCLUSIONS FOR PURPOSES OF THIS CASE?

While it is always best to use recent data, Census data on the variables of interest at the zip code level are only produced during the decennial "major" Census surveys, and the next such Census will not take place until next year. But the sorts of relationships investigated in my analyses are relatively slow to change. For example, the stock of housing turns over slowly, and it is highly likely that lower income gas consumers continue to live in the oldest dwellings in the housing stock (see below for a discussion of the relationship between income levels and dwelling age). Thus, while it is unlikely that data from the 2010 Census will look exactly like that of the 2000

Census, the older data presents a reasonably accurate picture of the relationships that are in place today.

An exception to this is that nominal (dollar value) incomes have changed over the ten year period. According to the Consumer Price Index for Midwestern urban wage earners and clerical workers, prices increased by 25% between September 1999 and August 2009. At the same time, per capita real (inflation adjusted) GDP in the U.S. increased by about 11.33% over the same period. The two facts taken together imply that average incomes in the U.S. increased by roughly 36% over the period (although those at the lower end of the income scale have seen smaller percentage increases on average). Thus, the dollar amounts seen on the graphs in Schedule PBT-2 as well as income figures reported in other parts of my rebuttal testimony and schedules should be increased by approximately 35% to arrive at dollar figures we would likely see today. This means that a stated figure of, say, $50,000 from 1999 would be the equivalent to roughly $67,500 today.

Q. PLEASE CONTINUE WITH YOUR DESCRIPTION OF SCHEDULE PBT-2.

The first graph, appearing at the top of Schedule PBT-2-1, plots the relationship between average household income in a zip code and the average monthly usage of MGE's customers in that zip code, with each point representing one zip code within MGE's service territory. Although the points in that graph do not lie perfectly along either a straight or curved line, the overall impression is that the relationship is in fact U-shaped, with many of the low income zip codes exhibiting average monthly usage

well in excess of the overall average. On that same page, I have divided the 180-plus zip codes into income-based deciles, so that the points represent average income and usage within the 10% of zip codes with the lowest incomes, the 10% of zip codes with the second-lowest incomes, and so forth. This graph illustrates the idea of the U-shaped relationship more clearly. Indeed, that graph shows that the 10% of zip codes with the very lowest incomes has the highest use of any decile, with average usage approximately 15 ccf, or about 20%, higher than the overall average usage.

One of the main factors driving high usage in low income zip codes is the age of the associated housing stock. Housing age serves as a reasonable proxy for the "tightness" of the building shell: the extent of insulation, the presence of double-paned glass, and, to some extent, the age of the heating equipment in use. The graph at the top of Page 2 of Schedule PBT-2 displays a graph of the relationship between the average household income in a zip code and the associated age of the housing stock therein. This graph demonstrates a generally negative relationship: that lower income households reside, on average, in older dwellings. This is what one would expect to see based on the casual observation that, all else equal, older homes are more affordable for low-income households. Indeed, to the extent that greater energy efficiency increases the market value of a home, we should expect older, less energy efficient homes to cost less, making it more likely that low-income homeowners live in such older homes.

Home size also has an impact on gas usage; the graph at the bottom of Schedule PBT-2-2 shows the relationship between household income and house size, as measured by the median number of rooms per house by zip code. Again, the result is not surprising--larger homes belong, on average, to households with higher incomes.

Q. DR. THOMPSON, THE TWO GRAPHS ON SCHEDULE PBT-2-2 SEEM TO INDICATE THAT TWO FORCES AFFECT THE INCOME-USAGE RELATIONSHIP IN TWO DIFFERENT DIRECTIONS. WHICH OF THESE EFFECTS DOMINATES THE INCOME-GAS USAGE RELATIONSHIP?

This tends to confirm the existence of a U-shaped income-gas usage relationship. That is, at lower income levels we see the negative income-dwelling age relationship dominate, but at higher levels of income, increasing dwelling size becomes more important. Of course, this can be seen in the income-usage graph at the top of Schedule PBT-2-1.

Q. PLEASE DESCRIBE THE GRAPH ON SCHEDULE PBT-2-3.

This final graph of the series presents another way to pair up these variables. It shows that as dwelling ages increase, so does gas consumption. This is not a surprising result, since dwelling age is a proxy for housing energy efficiency: older homes are less efficient because they have less insulation, older furnaces, etc.

Q. IS THERE SOME WAY TO SORT OUT THE EFFECTS OF EACH OF THESE VARIABLES ON RESIDENTIAL GAS USAGE?

Yes. A statistical technique known as multiple regression analysis allows us to do so. Schedule PBT-3 includes the results of an econometric (multiple regression analysis) study I performed of residential natural gas consumption determinants in MGE's service territory. The results of that study also demonstrate that the relationship between income and consumption in MGE's service territory is U-shaped. This more detailed study allows for the inclusion of a variety of factors that might influence household gas usage, such as the size of a home (in this case, the average number of rooms per house), the unemployment rate (which is a proxy for the likely presence of individuals in the home during "standard" working hours), and whether homes are owner-occupied or rented.

Q. PLEASE DESCRIBE THE CONTENTS OF SCHEDULE PBT-3.

A. Schedule PBT-3 contains a report to MGE that I authored to present and explain the results of my econometric study. It includes a general overview section and a technical section. The remainder of this testimony will provide the highlights of the study results, but a more complete description of the results appears in the report.

Q. PLEASE PROVIDE A BASIC DESCRIPTION OF THE STUDY YOU CONDUCTED.

A. The study explains the way in which average monthly usage in MGE's residential customer class varies across geographic units and over time. The geographic units

employed are zip codes. The time periods are the entire two-year period under examination (October 1998 through September 2000), referred to as "annual" models, and each individual month during that period, the "monthly" models. (Note: A "model" is simply a single regression equation containing a specific set of explanatory variables.)

The annual models take average monthly usage in a zip code over the entire two-year period as the *dependent* variable, or the variable whose behavior we wish to explain. Various combinations of *independent* or *explanatory* variables are used to determine the causes of variations in usage across zip codes and the contribution of each explanatory variable. These included weather, income, housing characteristics (e.g., age), and household characteristics (e.g., employment history). Data for a total of 181 zip codes in MGE's service territory were used.

The monthly models have average monthly usage *for each month in the period* as the dependent variable. Thus, instead of only 181 observations (one for each zip code), there are 4,344 (24 for each zip code). A very similar set of explanatory variables is examined, with the addition of a price variable.

Q. PLEASE SUMMARIZE THE RESULTS.

A. I will first present the results of some simple calculations indicating that low income customers use above-average amounts of natural gas. The sum of total usage over the period over all 181 zip codes divided by the total number of bills, also summed across

months and zip codes, yields an average usage per bill of 72.01 Ccf (hundred cubic feet). The same calculation performed using only the 23 zip codes with the lowest average household income (covering approximately one-tenth of the total number of bills, or the lowest income decile) yields an average usage per bill of 86.69 Ccf, 20% higher than the overall average.

Regression analysis allows us to more closely examine whether it is income or other factors that drive these differences in consumption, and whether the income-consumption relationship is "U"-shaped. As I suggested earlier, the results of my econometric study strongly suggest that the income-consumption relationship in MGE's service territory does indeed have a "U"-shape, so that average monthly consumption at first declines as income rises, then turns upward with further increases in income. There is no evidence that consumption increases steadily from lowest incomes to highest incomes. Schedule PBT-3 contains detailed support for these conclusions.

For the annual models presented in Schedule PBT-3, depending on which model is examined, the bottom of the "U" occurs at annual income levels ranging from $45,650 to $73,945 (1999 dollars; multiply by roughly 1.35 to estimate comparable 2009 dollar amounts). In addition, the low-income section of the "U" crosses the average usage level at incomes ranging from $32,203 to $47,005 when the estimated relationship is evaluated at the means of the other explanatory variables.

This means that consumers with incomes below these levels consume above-average amounts of gas.

For the monthly models, the bottom of the "U" occurs at annual income levels ranging from $58,857 to $66,108 (1999 dollars). The low-income section of the "U" crosses the average usage level at incomes ranging from $35,624 to $42,656, again when the estimated relationship is evaluated at the means of the other explanatory variables.

Q. YOU STATED EARLIER THAT YOU EXAMINED OTHER VARIABLES IN ADDITION TO INCOME AS DETERMINANTS OF RESIDENTIAL USAGE. PLEASE EXPLAIN THE RESULTS OF YOUR STUDY IN THIS REGARD.

A. Most of these other variables contributed to gas usage in the anticipated direction. Colder weather, measured as an increase in Heating Degree-Days (HDD), increases usage. An increase in the median age of homes in a zip code increases average usage in that area, all else equal, as does an increase in the size of a home (measured as the average number of rooms).

A variable measuring the unemployment rate for each zip code also has a positive effect on gas usage. That is, the higher the unemployment rate in a zip code, the higher the gas consumption. A possible interpretation of this result is that not working is associated with a greater proportion of the time in which at least one family member is at home, which is likely to result in higher average thermostat

settings. That is, many consumers turn down the thermostat during the day if nobody is home, but not if someone is home.

A variable measuring the proportion of homes that are owner-occupied is positively related to usage in some model specifications and has no impact on usage in other models. The reason for this result is unclear since it is the opposite of what one would expect, but it may be due to the fact that the home ownership percentage is highly correlated (correlation coefficient = .71) with home size as measured by the median number of rooms. Such high correlation between two independent variables can make it difficult to sort out the relative contributions of the correlated variables, and can even change the direction of the estimated effect.

Some interesting results with respect to price variables were obtained: a positive relationship between price and usage. At first this would appear to run counter to the so-called law of demand, which holds that, all else equal, higher prices cause lower consumption. But a possible explanation for this result may be simply that higher prices tend to coincide with colder weather, which is the case for this dataset, and colder weather causes higher consumption. Consumers generally are unaware of the price of natural gas at the time of consumption, at least in the same sense that they are aware of the price of a gallon of gasoline or milk. In any event this result does not affect the overall performance of the models with respect to the other variables; a model that does not include a price performs very much like those that do with respect to the other explanatory variables.

In some model specifications I included the lagged (i.e., previous period's) value of the dependent variable CCF as an independent variable. Its estimated coefficient was positive, meaning that consumption in a given month was higher if preceded by a high usage month than if preceded by a low usage month.

Q. DO THE RESULTS OF YOUR STUDY INDICATE THAT INCREASING THE MONTHLY VOLUMETRIC CHARGE FOR MGE, AS PROPOSED BY MS. MEISENHEIMER, WOULD HAVE A REGRESSIVE IMPACT ON LOW INCOME CUSTOMERS?

A. Yes. The results of my study indicate that increasing the volumetric charge would be likely to have a regressive impact on low income consumers because low income customers in MGE's service territory consume higher than average volumes.

Q. OTHER THAN THE STUDIES AND GRAPHS YOU HAVE DISCUSSED SO FAR, IS THERE ANY ADDITIONAL SUPPORT FOR THE CONCLUSION THAT LOW INCOME CONSUMERS ARE LIKELY TO BE HARMED BY HAVING MGE RETURN TO ITS PRE-2007 RATE STRUCTURE, IN WHICH THE COMPANY COLLECTED A PORTION OF ITS NON-GAS MARGIN COSTS THROUGH A RESIDENTIAL VOLUMETRIC RATE?

A. Yes. MGE keeps extensive billing records on all of its customers and can identify those of its customers who receive low-income energy assistance. According to information provided by MGE, approximately 82% (or 10,246) of the customers who

received energy assistance would experience higher winter bills under the "Traditional Charges" shown in Public Counsel witness Meisenheimer's direct testimony (see Table 4 on page 12 of that testimony) than they would under the current "SFV charge" shown thereon.

For these customers, the average total bill for the five winter months (November through March) would be $60.63 higher under the so-called traditional rate design, and 1,700 of them (16.59% of the 10,246, or 13.68% of all EA customers) would experience bills at least $100 higher in total over the five-month period.

Q. PLEASE STATE YOUR OVERALL CONCLUSIONS.

A. In my opinion, there is no evidence that increases in the monthly customer charge (proportionally larger than increases in the volumetric charge) are regressive. The results of my study indicate that the income-consumption relationship for residential natural gas usage in MGE's service territory is mildly "U"-shaped: above-average at the lowest income levels, declining through middle incomes, and then rising again to above the average at higher income levels. This result can be seen from a simple visual inspection of the data as well as from more detailed statistical analyses.

Q. DOES THIS CONCLUDE YOUR REBUTTAL TESTIMONY?

A. Yes.