BEFORE THE WASHINGTON UTILITIES AND TRANSPORTATION COMMISSION

DOCKET NO. UE-15______

DOCKET NO. UG-15______

DIRECT TESTIMONY OF

DR. GRANT D. FORSYTH

REPRESENTING AVISTA CORPORATION

I. INTRODUCTION

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

A. My name is Dr. Grant D. Forsyth. I am employed by Avista Corporation as its Chief Economist. My business address is 1411 E. Mission Avenue, Spokane, Washington.

Q. Dr. Forsyth, please provide information pertaining to your educational background and professional experience.

A. I am a graduate of Central Washington University with a Bachelor of Arts Degree in Economics, the University of Oregon with an MBA in Finance, and Washington State University with a Ph.D. in Economics. Before joining Avista in April 2012, I was a tenured faculty member in the Department of Economics at Eastern Washington University. In my 13-year career at EWU, beginning in 1999, I specialized in money and banking, macroeconomics, international finance, and regional economic analysis. The majority of my academic research used applied econometrics. Prior to EWU, I worked in the Czech Republic as an academic economist (1996-1997) and private sector economist (1997-1999) in the Czech financial industry. My financial industry position was the Director of Research for a diversified Czech financial holding company. In this position I oversaw a staff doing both equity and macroeconomic research.

My primary job duties at Avista include (1) generating the customer and load forecasts for electric and natural gas operations;[1] (2) generating the peak load forecast for electric operations; and (3) participating in external policy groups. Current examples of

[1] My forecasts are used in the Company's revenue model and are frequently used as modeling inputs by the Company's Power Supply and Gas Supply departments.

external policy groups include the Washington Governor's Council of Economic Advisors and Washington's Citizen Commission for Performance Measurement of Tax Preferences.

Q. What is the scope of your testimony?

A. My testimony will describe the methodology used to determine the annual growth rates and historical trends for Avista's expense and net plant-related expenditure categories. For purposes of my testimony, the use of the term "expenditures" will refer to both expense cost categories as well as net plant investment-related cost categories. These historical growth rates were used by Ms. Andrews as the starting point in developing appropriate growth rates for her attrition analysis.

My testimony will describe, in a step-by-step fashion, the rationale for the following: (1) the historical time period of the analysis; (2) the use of a compound growth formula versus alternative methods; and (3) the use of the geometric average rate of growth versus other methods to determine annual growth rates.

A table of contents for my testimony is as follows:

Q. Are you sponsoring any exhibits in this proceeding?

A. No. Additional information can be found within my workpapers submitted with the Company's filed case.

II. TESTIMONY SUMMARY

Q. Please summarize the historical data period being reviewed by you for your trend analysis.

A. The historical data used for the trend analysis is from 2001-2013. The period used for the trend analysis should reflect, as closely as possible, the Company's recent and planned expenditures. Regardless of the methodology for determining expenditure growth rates, using time periods that no longer represent recent and planned expenditures can lead to inaccurate representations of future growth. Annual capital investment for the 2001-2013 period clearly shows a significant shift in the expenditure trend starting in 2007. This is the case for both electric and natural gas operations. Specifically, in 2007, capital investment started increasing at a significantly faster pace compared to the 2001-2006 period.

Given current and planned expenditures by the Company, we do not foresee a return to the expenditure trend of the 2001-2006 period in the near-term. In fact, the expectation is that expenditures will experience accelerated, non-linear growth during the 2014-2016 period from that experienced during 2007-2013. Company witness Mr. Thies, in his testimony, explains why Avista has increased its capital spending in recent years, and why it plans to continue a higher level of spending for the near-term. Company witness Ms. Andrews has made an adjustment to the capital investment-related growth rates to better reflect the 2016 rate year, which she explains in her testimony.

Q. What is the basic analytical approach underlying the trend analysis?

A. The Company's trend analysis uses traditional compounding growth theory to arrive at base-line growth rates for certain expenditure categories, including net plant. In particular, the trend analysis uses the ***compound growth rate formula*** (CGF). The CGF has wide applications in finance and economics for modeling values that are not expected to accumulate in a linear fashion over time. Examples where the CGF is used include the modeling of investment dollars, population, and capital accumulation.

The CGF can be directly applied to any historical expenditure series to generate a single growth rate that represents a mathematically consistent average annual growth rate for that historical period. This growth rate can serve as the initial, base-line rate for each relevant expenditure category.

III. HISTORICAL TIME PERIOD OF THE ANALYSIS

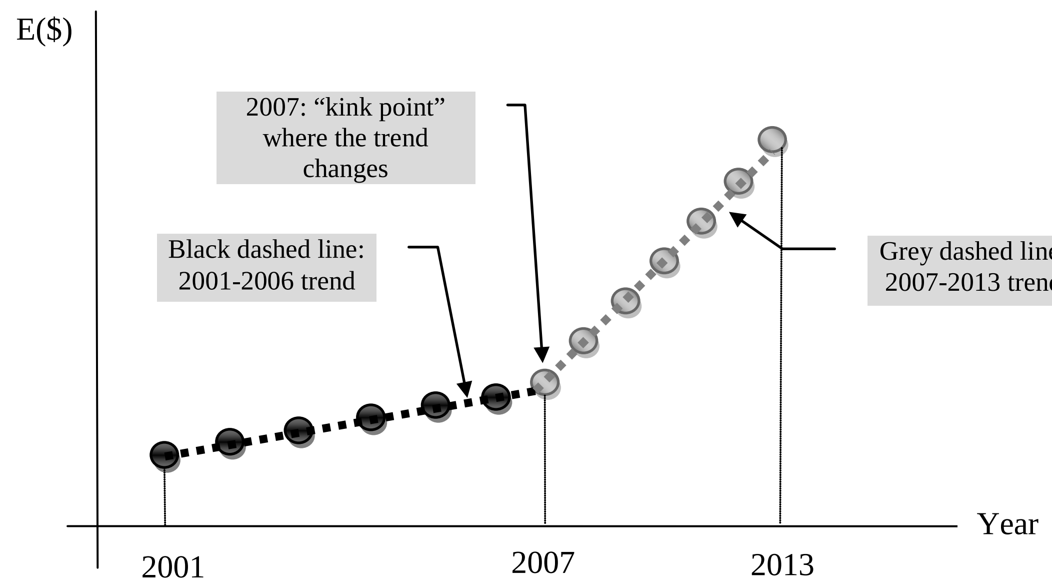
Q. Why is the time period for the analysis of historical trends important?

A. The historical data used should reflect, as closely as possible, the Company's recent and planned expenditures. Regardless of the methodology for determining expenditure growth rates, using time periods that do not represent recent and planned expenditures can lead to inaccurate representations of future growth.

Q. How has Avista's annual capital investment changed over time?

A. Annual capital investment for the 2001-2013 period clearly shows a significant shift in the expenditure trend starting in 2007. This is the case for both electric and natural gas operations. Specifically, in 2007, capital investment started increasing at a significantly faster pace compared to the 2001-2006 period. Figure 1 below illustrates the observed shift that started in 2007. In Figure 1, E($) is the annual expenditure level in dollars, the black dots are annual expenditures for the 2001-2006 period highlighted by a black dashed trend line. The grey dots are expenditures for the 2007-2013 period highlighted by a grey dashed trend line. The year 2007 represents a transition or "kink point" in the previous historical trend, where the trend is steeper following the kink point. If the Company's plans call for expenditures to continue at the higher level on an annual basis, then the expenditure trend for the 2001-2006 period is not a valid reference period, because it is no longer representative of the Company's expenditure trend.

Figure 1



Q. Is there reason to believe the 2007-2013 expenditure trend will revert to the 2001-2006 period trend in the near future?

A. No. Given current and planned expenditures by the Company, we do not foresee a return to the expenditure trend of the 2001-2006 period in the near-term. In fact, the expectation is that expenditures will experience accelerated, non-linear growth during the 2014-2016 period. Mr. Thies, in his testimony, explains why Avista has increased its capital spending in recent years, and why it plans to continue a higher level of spending for the near-term. Ms. Andrews has made an adjustment to the capital investment-related growth rates to better reflect the rate year, which she explains in her testimony.

IV. THE COMPOUND GROWTH FORMULA

Q. What is the compound growth formula, and why is appropriate for the trend analysis?

A. The ***compound growth rate formula*** (CGF) has wide applications in finance and economics. The CGF is appropriate when a given variable—for example, a dollar value—is expected to increase in a non-linear fashion over time, starting from a given base period. The basic CGF is given as $V_t = V_0(1+r)^t$. Here, V_0 is the starting base period value from which compounding starts; r is the assumed annual growth rate of V starting from V_0; t is the number of years over which r is to be applied; and V_t is the amount of V after t years of growth at rate r. The entire term $(1+r)^t$ is called the ***compound factor***.

Q. Can this formula be demonstrated with a simple example?

A. Yes. Let V_0 = $100 for the base period value; r = 0.10; and t = 3. At the end of year 3, V_0 will have grown to $\$100(1 + 0.10)^3 = \$100(1.10)^3 = \$100(1.331) = \$133.10$. That is, at the end of year 3, V_3 = $133.10. Note that the compound factor for t = 3 is 1.331. On a year-to-year basis, V_0 will grow as follows:

[1] For t = 1: $V_1 = \$100*(1 + 0.10)^1 = \$100*(1.10)^1 = \$100*(1.10) = \$110.00$

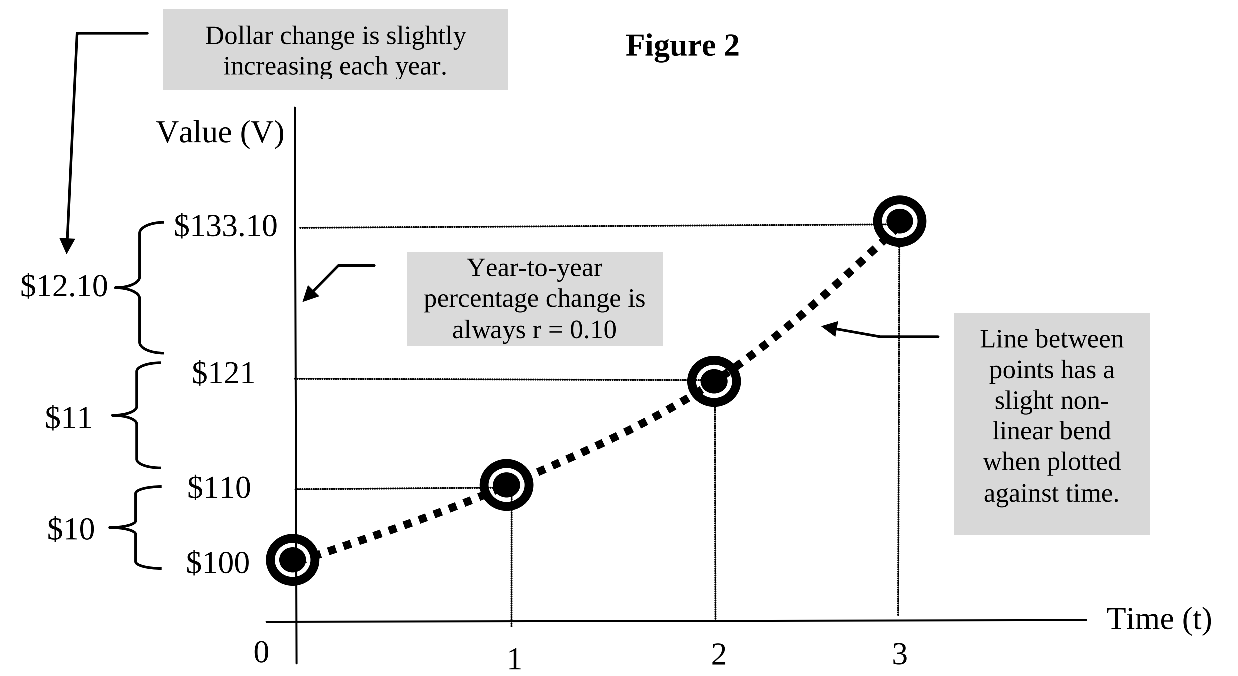
[2] For t = 2: $V_2 = \$100*(1 + 0.10)^2 = \$100*(1.10)^2 = \$100*(1.21) = \$121.00$

[3] For t = 3: $V_3 = \$100*(1 + 0.10)^3 = \$100*(1.10)^3 = \$100*(1.331) = \$133.10$

For t = 1 the compound factor is 1.10 and for t = 2 the compound factor is 1.21.

It is important to note that the year-to-year percentage change in V is equal to r—that is, r = (110 – 100)/100 = (121 – 110)/110 = (133.10 – 121)/121 = <u>0.10</u>. Regardless of how r is chosen, r will always equal the year-to-year percentage change in V. Thus, it is V, and not r, that increases non-linearly over time. This can be seen by the fact that the annual dollar change in V is slightly higher each year, even though the annual percentage change in V is constant. This is because time, t, appears as an exponent in the CGF; as a result, the dollar change in V will not be constant over time. Figure 2 demonstrates these issues graphically.

Figure 2



Q. What are the cumulative one-year, two-year, and three-year growth rates using CGF?

A. The cumulative growth rate over t years, R_t, can be easily calculated by subtracting one from the compound growth factors:

[1] For t = 1: $R_1 = (1+ r)^1 - 1$

[2] For t = 2: $R_2 = (1+ r)^2 - 1$

[3] For t = 3: $R_3 = (1+ r)^3 - 1$

Using the example from above with r = 0.10, the following cumulative growth rates would result: $R_1 = 0.10$; $R_2 = 0.21$; and $R_3 = 0.331$. This means V will have grown 10% after 1 year, 21% after 2 years, and 33.1% after 3 years.

Q. Is the above calculation just the same as simply taking the growth rate, r, and multiplying by the years in the future—that is R_1 = r*1, R_2 = r*2, and R_3 = r*3?

A. No. Multiplying the growth rate, r, by the number of future years is a linear approximation of the cumulative growth rate for a value growing in non-linear fashion. The cumulative growth rate r*t is only appropriate if future growth is linear with respect to time. In this case, the liner growth rate formula (LGF) becomes $Vt = V_0*(1 + r*t)$. As before, let V_0 = $100 and r = 0.10. On a year-to-year basis, V_t is calculated as follows:

[1] For t = 1: V_1 = $100*(1 + 0.10*1) = $100*(1.10) = $110

[2] For t = 2: V_2 = $100*(1 + 0.10*2) = $100*(1.20) = $120

[3] For t = 3: V_3 = $100*(1 + 0.10*3) = $100*(1.30) = $130

Only in the first year is the LGF is equal to the CGF. The above values are imposed on Figure 2 to create Figure 3.

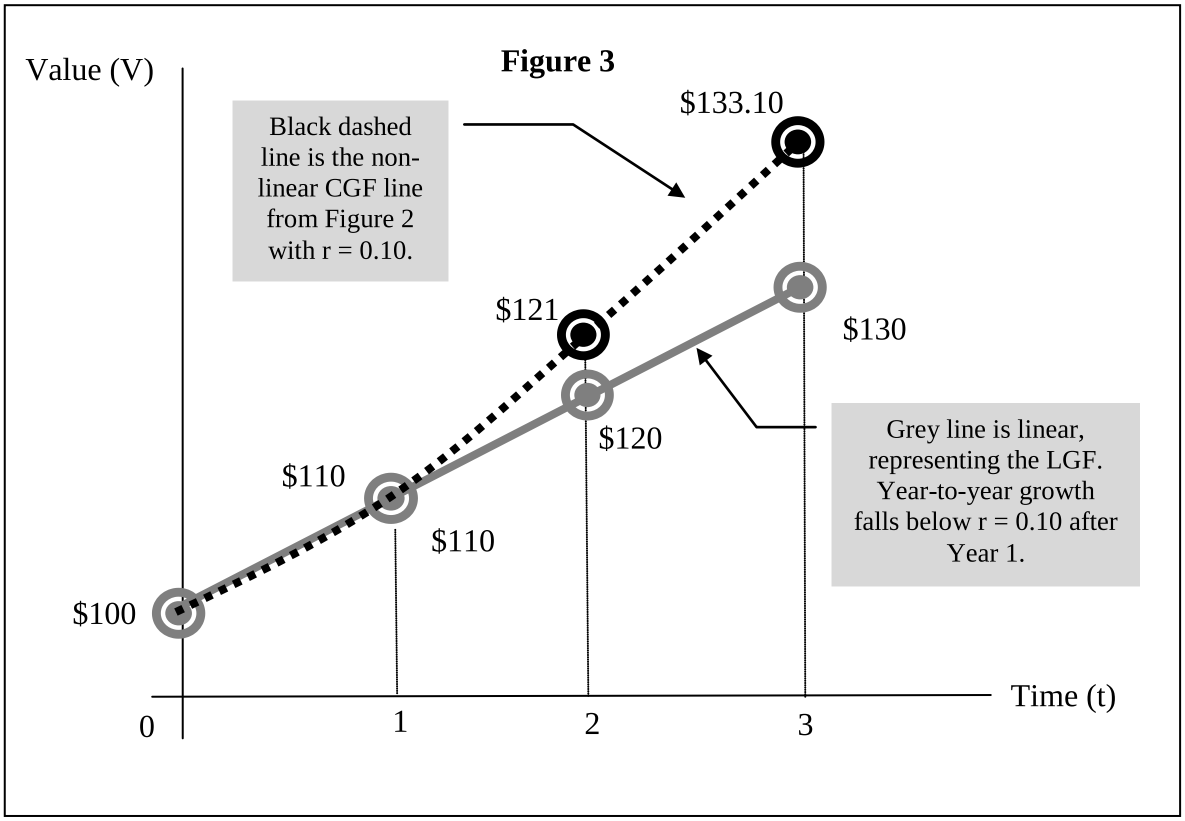


Figure 3

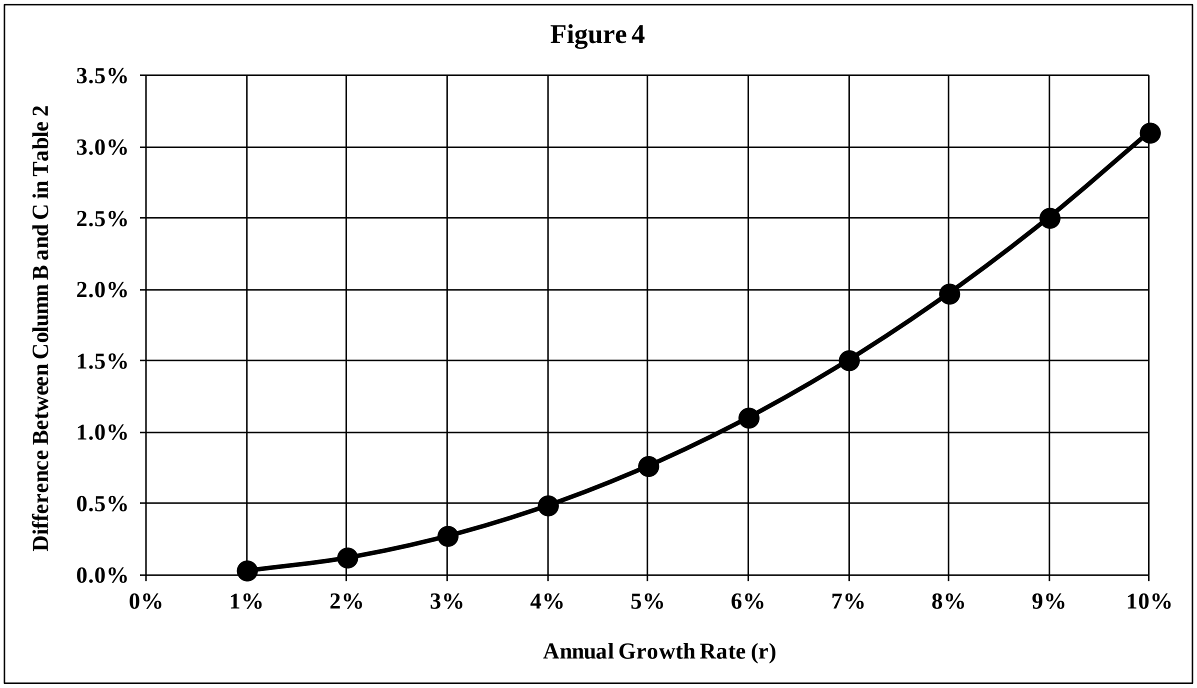
The grey line shows the path of the LGF with V_0 = $100 and r = 0.10. After t = 1, the LGF is always below the black-dashed line, which represents CGF path with r = 0.10. As time increases, the difference between the two lines will continue to increase. This means applying the LGF when V_t is following the CGF will generate increasingly large errors over time. It is important to note that with the LGF, year-to-year growth no longer equals r after t = 1. Using Figure 3, the percentage change at the end of Year 1, r_1, is $r_1 = (110 – 100)/100 = 0.10$; for Year 2, $r_2 = (120 – 110)/110 = 0.091$; and for Year 3, $r_3 = (130 – 120)/120 = 0.083$. This means as t increases, the year-to-year percentage change is falling. In contrast, as noted above, $r_t = r$ in the CGF.

Q. For a given number of years into the future, how significant is the difference between the cumulative growth rate using the CGF and LGF?

A. It can be easily shown that when $r > 0$, $r*t$ will always be less than $(1+r)^t - 1$ for any t over one year. In other words, for $t > 1$, $r*t$ will under-estimate cumulative growth when a value is increasing in the non-linear fashion of the CGF. The degree of understatement increases as the growth rate, r, increases. That is, the larger r is, the larger the difference between $R_t = (1+r)^t - 1$ and $t*r$ for any $t > 1$. The simple example in Table 1 below highlights this point. The first column (column A) shows annual compounding growth rates, r, from 1% to 10%. Column B shows the cumulative growth rate over three years ($t = 3$) using the non-linear cumulative rate, $R_3 = (1+r)^3 - 1$. Column C shows the linear cumulative rate, $3*r$. Column D shows column B minus column C, which is the difference between the non-linear cumulative rate and the cumulative linear rate. Column D shows that as r increases, the difference between the cumulative growth rates increases at an increasing rate. The relationship between column A and B is graphed in Figure 4.

Table 1

A: Annual Growth Rate (r)	B: Compounded Accumulated Growth, t =3	C: Linear Accumulated Growth, t = 3	D: Difference: B minus C
1.0%	3.03%	3.00%	0.0%
2.0%	6.12%	6.00%	0.1%
3.0%	9.27%	9.00%	0.3%
4.0%	12.49%	12.00%	0.5%
5.0%	15.76%	15.00%	0.8%
6.0%	19.10%	18.00%	1.1%
7.0%	22.50%	21.00%	1.5%
8.0%	25.97%	24.00%	2.0%
9.0%	29.50%	27.00%	2.5%
10.0%	33.10%	30.00%	3.1%



Q. Does this mean that the linear rate is only a problem when it involves higher values of the growth rate, r?

A. No. If the growth rate, r, appears small, but is being applied to large dollar amounts, then small differences can amount to significant differences in the accumulation of dollars over time.

V. THE GEOMETRIC AVERAGE RATE OF GROWTH

Q. What is the geometric average growth rate (GAR)?

A. Using historical data from the 2001-2013 period the annual growth rate is calculated using the geometric average growth rate (GAR). That is r = GAR in the trend analysis. GAR is the ***exact compounding growth rate*** that would cause some starting value, V_0, to grow to some ending value, V_t, over t years. In other words, GAR is the growth rate that ensures $V_t = V_0*(1+ GAR)^t$ holds exactly.

Q. How is GAR calculated?

A. There are two formulas that can produce GAR. Both formulas produce the same GAR, but it is instructive to examine both. The more commonly used GAR formula comes directly from the formula $V_t = V_0*(1 + GAR)^t$. Rearranging terms to solve for GAR produces the following formula: $GAR = (V_t/V_0)^{1/t} – 1$. Therefore, to calculate GAR all one needs is a historical starting value,V_0, ending value, V_t, and the number of years (t) between V_0 and V_t.

An alternative formula for calculating GAR is $GAR = [(1 + g_1)*(1 + g_2)*(1 + g_3)*…*(1+ g_{t-1})*(1 + g_t)]^{1/t} – 1$. Here g is the annual growth rate of V going from one year to the next through year t. For example, $g_1 = (V_1 – V_0)/V_0$; $g_2 = (V_2 – V_1)/V_1$; $g_3 = (V_3 – V_2)/V_2$; and so on through V_t. ***This formula highlights that GAR is really averaging multiple growth rates using the geometric average rather than the simple average***. A common misunderstanding is that GAR is only using two data points when, in fact, it is equivalent to using multiple data points that have been converted into annual growth rates.

Q. Can these formulas be demonstrated with a simple example?

A. Yes. Table 2 below shows a series that is growing over time. Value is V_t for years zero through six. Annual Growth is "g" the growth rate for each of the six years.

Table 2

Year	Value (V)	Annual Growth (g)
0	$56	-
1	$62	0.107 or 10.7%
2	$68	0.097 or 9.7%
3	$75	0.103 or 10.3%
4	$84	0.120 or 12%
5	$91	0.083 or 8.3%
6	$100	0.099 or 9.9%

Using the value column to first calculate GAR can be done easily: GAR = $(V_t/V_0)^{1/t} - 1 = (100/56)^{1/6} - 1 = 0.10146$ or 10.146%. Note that $V_0*(1+GAR)^t = 56*(1 + 0.10146)^6 = 100$. This shows that GAR is the single average growth rate that will generate the same value in year 6 as applying the actual annual growth rates starting from V_0: $56*(1 + 0.10146)^6 = 56*(1 + 0.107)*(1 + 0.097)*(1 + 0.103)*(1 + 0.120)*(1 + 0.083)*(1 + 0.099)$. GAR converts six individual growth rates into single geometric average growth rate so we can say, "On average over these six years, the starting value of $56 grew at an annual compounding rate equivalent to 10.146%." The alternative GAR formula is GAR = $[(1 + g_1)*(1 + g_2)*(1 + g_3)\ldots(1 + g_t)]^{1/t} - 1 = [(1 + 0.107)*(1 + 0.097)*(1 + 0.103)*(1 + 0.120)*(1 + 0.083)*(1 + 0.099)]^{1/6} - 1 = 0.10146$. Again, this GAR formula demonstrates that GAR is equivalent to using multiple annual growth rates to generate a single, compounding equivalent growth rate.

Q. What are the geometric average growth rates for the 2001-2013 historical period?

A. GAR was calculated using the 2001-2013 period for both electric and natural gas expenditures. The resulting GAR for each expenditure category is shown in Lines 7 to 12 of Page 9 of Ms. Andrews Exhibits (EMA-2) and (EMA-3). These growth rates were used by Ms. Andrews as the starting point in developing appropriate growth rates for her attrition analysis.

VI. CONCLUSION

Q. What conclusions follow from your analysis?

A. The following points should be emphasized:

(1) Data used for a trend analysis for the purpose of an attrition study should reflect, as closely as possible, the Company's recent and planned expenditures. Regardless of the methodology for determining expenditure growth rates, using time periods that no longer represent recent and planned expenditures can lead to inaccurate representations of future growth.

(2) Annual capital investment for the 2001-2013 period clearly shows a significant shift in the expenditure trend starting in 2007. In fact, the expectation is that expenditures will experience additional accelerated, non-linear growth during the 2014-2016 period from that experienced during 2007-2013.

(3) The compound growth formula (CGF) is appropriate when a given variable—for example, a dollar value—is expected to increase in a non-linear fashion over time. The use of linear models would significantly under-estimate future expenditure levels. The CGF can be directly applied to any historical expenditure series to generate a single growth rate that represents a mathematically consistent average annual growth rate for that historical period.

Q. Does this conclude your pre-filed direct testimony?

A. Yes.