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**BILL GALVANO**
*President of the Senate*

**JOSE R. OLIVA**
*Speaker of the House of Representatives*

August 31, 2020

Adam J. Teitzman, Commission Clerk
Florida Public Service Commission
2540 Shumard Oak Boulevard
Tallahassee, Florida 32399-0850

**Re: Docket No. 20200051-GU**

Dear Mr. Teitzman,

Please find enclosed for filing in the above referenced docket the Direct Testimony and Exhibits of David J. Garrett. This filing is being made via the Florida Public Service Commission's Web Based Electronic Filing portal.

If you have any questions or concerns; please do not hesitate to contact me. Thank you for your assistance in this matter.

Sincerely,

***/s/ A. Mireille Fall-Fry***
A. Mireille Fall-Fry
Associate Public Counsel

cc: All Parties of Record

**CERTIFICATE OF SERVICE**
**Docket No. 20200051-EI**

**I HEREBY CERTIFY** that a true and correct copy of the foregoing has been furnished by electronic mail on this 31st day of August 2020, to the following:

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***/s/A. Mireille Fall-Fry***
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**BEFORE THE FLORIDA PUBLIC SERVICE COMMISSION**

| | |
|---|---|
| In re: Petition for rate increase by Peoples Gas System. | DOCKET NO. 20200051-GU |
| In re: Petition for approval of 2020 depreciation study by Peoples Gas System | DOCKET NO. 20200166-GU |

# DIRECT TESTIMONY

# OF

# DAVID J. GARRETT

# ON BEHALF OF THE FLORIDA OFFICE OF PUBLIC COUNSEL


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***PART ONE: COST OF CAPITAL***

## I. INTRODUCTION

**Q. STATE YOUR NAME AND OCCUPATION.**

A. My name is David J. Garrett. I am a consultant specializing in public utility regulation. I am the managing member of Resolve Utility Consulting PLLC.

**Q. SUMMARIZE YOUR EDUCATIONAL BACKGROUND AND PROFESSIONAL EXPERIENCE.**

A. I received a B.B.A. with a major in Finance, an M.B.A., and a Juris Doctor from the University of Oklahoma. I worked in private legal practice for several years before accepting a position as assistant general counsel at the Oklahoma Corporation Commission in 2011. At the commission, I worked in the Office of General Counsel in regulatory proceedings. In 2012, I began working for the Public Utility Division as a regulatory analyst providing testimony in regulatory proceedings. After leaving the commission, I formed Resolve Utility Consulting PLLC, where I have represented various consumer groups and state agencies in utility regulatory proceedings, primarily in the areas of cost of capital and depreciation. I am a Certified Depreciation Professional with the Society of Depreciation Professionals. I am also a Certified Rate of Return Analyst with the Society of Utility and Regulatory Financial Analysts. A more complete description of my qualifications and regulatory experience is included in my curriculum vitae.[1]

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[1] Exhibit DJG-1.

**Q. DESCRIBE THE PURPOSE AND SCOPE OF YOUR TESTIMONY IN THIS PROCEEDING.**

A. I am testifying on behalf of the Florida Office of Public Counsel ("OPC") in response to the petitions for rate increase and approval of the depreciation study by Peoples Gas System ("PGS" or the "Company"). Specifically, I address the cost of capital and fair rate of return for PGS in response to the direct testimony of Company witness Robert B. Hevert. I also address the Company's proposed depreciation rates in response to the direct testimony of Company witness Dane A. Watson, who conducted the Company's depreciation study. Because these two issues are voluminous, I have separated the executive summary and body of my testimony by issue: cost of capital and depreciation.

## II. <u>EXECUTIVE SUMMARY</u>

### *A. <u>Part One: Cost of Capital</u>*

**Q. EXPLAIN THE CONCEPT OF THE "WEIGHTED AVERAGE COST OF CAPITAL."**

A. The term "cost of capital" refers to the weighted average cost of all types of components within a company's capital structure, including debt and equity. Determining the cost of debt is relatively straight-forward. Interest cost rates on bonds are contractual, derived, "embedded costs" that are generally calculated by dividing total interest payments by the book value of outstanding debt. In contrast, determining the cost of equity is more complex. Unlike the known contractual cost of debt, there is no explicit "cost" of equity; thus, the cost of equity must be estimated through various financial models. The overall weighted average cost of capital ("WACC") includes the cost of debt and the estimated cost of equity. It is a "weighted average," because it is based upon the Company's relative levels of debt and equity, or "capital structure." Companies in the competitive market often use their WACC as the discount rate to determine the value of capital projects, so it is important that this figure be closely estimated. The basic WACC equation used in regulatory proceedings is presented as follows:

**Equation 1:**
**Weighted Average Cost of Capital**

$$WACC = \left(\frac{D}{D+E}\right)C_D + \left(\frac{E}{D+E}\right)C_E$$

*where:* $WACC$ = *weighted average cost of capital*
$D$ = *book value of debt*
$C_D$ = *embedded cost of debt capital*
$E$ = *book value of equity*
$C_E$ = *market-based cost of equity capital*

Thus, the three components of the weighted average cost of capital include the following:

1. Cost of Equity
2. Cost of Debt
3. Capital Structure

The term "cost of capital" is necessarily synonymous with the "weighted average cost of capital," and the terms are used interchangeably throughout this testimony.

**Q. DESCRIBE THE RELATIONSHIP BETWEEN THE COST OF EQUITY, REQUIRED RETURN ON EQUITY ("ROE"), EARNED ROE, AND AWARDED ROE.**

A. While "cost of equity," "required ROE," "earned ROE," and "awarded ROE" are interrelated factors and concepts, they are all technically different from each other. The financial models presented in this case were created as tools for estimating the "cost of equity," which is synonymous to the "required ROE" that investors expect based on the amount of risk inherent in the equity investment. In other words, the cost of equity from the company's perspective equals the required ROE from the investor's perspective.

The "earned ROE" is a historical return that is measured from a company's accounting statements, and it is used to measure how much shareholders earned for investing in a company. A company's earned ROE is not the same as the company's cost of equity. For example, an investor who invests in a risky company may *require* a return on investment of 10%. If the company used the same estimates as the investor, then the company will estimate that its *cost* of equity is also 10%. If the company performs poorly and the investor *earns* a return of only 7%, this does not mean that the investor required only 7%, or that the investor will not still require a 10% return the following period. Thus, the cost of equity is not the same as the earned ROE.

Finally, the "awarded" return on equity is unique to the regulatory environment; it is the return authorized by a regulatory commission pursuant to legal guidelines. As discussed later in this testimony, the awarded ROE should be based on the utility's *cost* of equity. The relationship between the terms and concepts discussed thus far could be summarized in the following sentence: If the awarded ROE reflects a utility's cost of equity, then it should allow the utility to achieve an earned ROE that is sufficient to satisfy the required return of its equity investors. Thus, the "required" or "expected" return from an investor's standpoint is not simply what the investor wishes he could get. Likewise, the expected return of a utility investor has nothing to do with what the investor "expects" the ROE awarded by a regulatory commission to be. Rather, the expected return/cost of equity is estimated through objective, mathematical financial modeling based on risk.

**Q. DESCRIBE THE COMPANY'S POSITION REGARDING ITS COST OF CAPITAL IN THIS CASE.**

A. In this case, Mr. Hevert proposes an awarded return on equity of 10.75% for the Company.[2] Mr. Hevert relies on the Discounted Cash Flow ("DCF") Model, the Capital Asset Pricing Model ("CAPM"), and other models in making his recommendation.

**Q. PLEASE DISCUSS THE COMPANY'S ROE PROPOSAL IN THE CONTEXT OF HISTORIC TRENDS IN AWARDED ROES FOR ELECTRIC UTILITIES.**

A. Over the past thirty years, capital costs for all companies have generally declined. This is due in large part to generally declining interest rates over the same period. Likewise, awarded ROEs for electric utilities have also decreased since 1990. The graph below shows a trend in the annual awarded returns for gas utilities from 1990 to 2019.[3]

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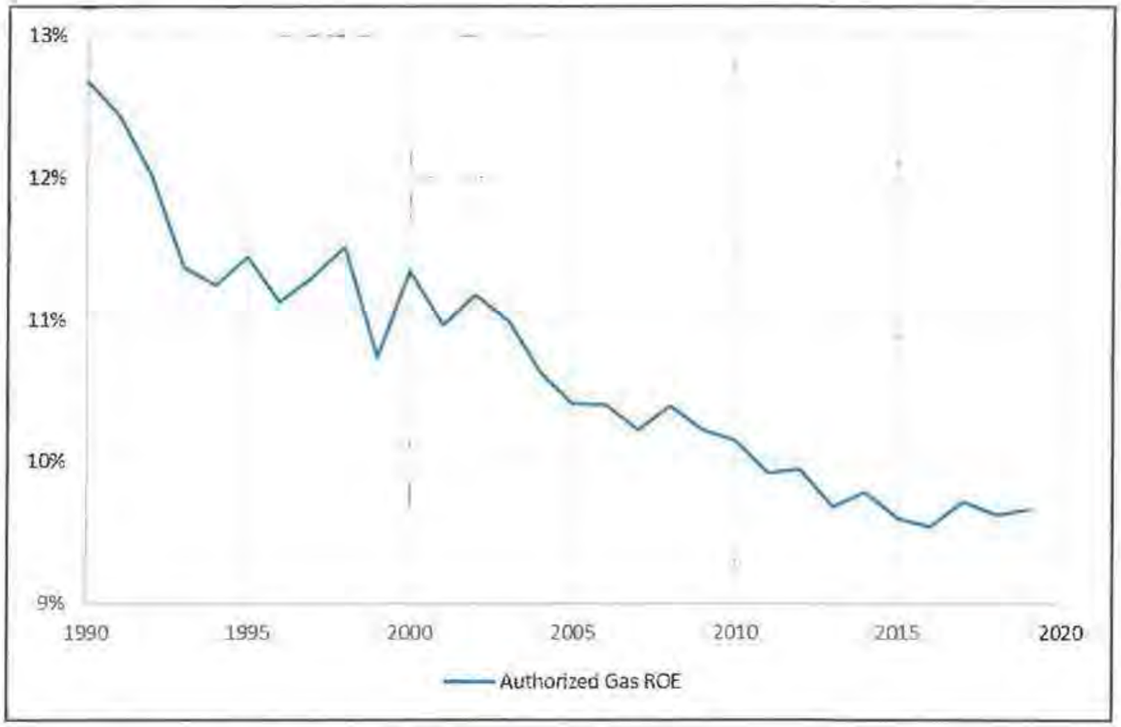
[2] Direct Testimony of Robert B. Hevert, p. 4, line 6.

[3] *See also* Exhibit DJG-14.

**Figure 1:**
**Historic Awarded ROEs for Gas Utilities**




As shown in the graph above, awarded ROEs for gas utilities have generally declined over the past 30 years.[4] To the extent the Commission is inclined to consider the awarded ROEs of other utilities in making its decision in this case, the Commission should also consider this downward trend in awarded ROEs.

**Q. ARE YOU SUGGESTING THAT REGULATORS SHOULD SIMPLY SET ROES ACCORDING TO A NATIONAL AVERAGE OF AWARDED ROES?**

A. No. As illustrated further in my testimony, there is strong evidence suggesting that regulators consistently award ROEs that are notably higher than utilities' actual cost of equity. This is likely due to the fact that over the past 30 years, interest rates and cost of

[4] *See* Exhibit DJG-14.

capital have declined at a faster rate than regulators' willingness to decrease awarded ROEs. In other words, awarded ROEs have appropriately been decreasing in accordance with declining capital costs; however, they have not decreased quickly enough to keep pace. To the extent regulators have been persuaded to conform to a national average of awarded ROEs when making their decisions in a particular case, it has contributed to this "lag" in awarded returns, which have effectively failed to track with declining interest rates over the same time period. In other words, whether objective market indicators influencing cost of equity are rising or falling, simply reverting to a national mean of awarded ROEs will effectively prevent those ROEs from properly rising and falling with the market indicators, such as interest rates. In today's economic environment, if a regulator awards an ROE that is equivalent to the national average, that awarded ROE will be above the market-based cost of equity for a regulated utility. Therefore, to suggest that the Commission simply set the Company's awarded ROE based on a national average would not result in a fair return, and it would promote the perpetuation of a national phenomenon of artificially inflated ROEs for regulated utilities.

**Q. SUMMARIZE YOUR ANALYSES AND CONCLUSIONS REGARDING THE COMPANY'S COST OF EQUITY.**

A. Analysis of an appropriate awarded ROE for a utility should begin with a reasonable estimation of the utility's cost of equity capital. In estimating the Company's cost of equity, I performed a cost of equity analysis on a proxy group of utility companies with relatively similar risk profiles. Based on this proxy group, I evaluated the results of the two most common financial models for calculating cost of equity in utility rate proceedings: the CAPM and DCF Model. Applying reasonable inputs and assumptions to these models indicates that the Company's estimated cost of equity is approximately 6.9%.[5]

**Q. YOUR COST OF EQUITY ESTIMATE FOR THE COMPANY IS NOTABLY LOWER THAN THE ROES TYPICALLY AWARDED IN UTILITY RATE CASES. PLEASE EXPLAIN YOURSELF.**

A. Investors, company managers, and academics around the world have used models such as the CAPM for decades to closely estimate cost of equity. The CAPM in particular is not difficult to understand or calculate, and it requires only three inputs: the risk-free rate, beta, and the equity risk premium. The math involved in the CAPM is also straightforward. Here is the CAPM formula:

**Cost of Equity = Risk-free Rate + Beta × Equity Risk Premium**

Although these terms will be explained in more detail later, let us use Mr. Hevert's inputs for the risk-free rate and beta for this example. Mr. Hevert used a risk-free rate as high as 3.45% and an average beta as high as 0.897.[6] We can plug those numbers into the formula.

**Cost of Equity = 3.45% + 0.897 × Equity Risk Premium**

All we have remaining to complete the formula is one of the single most important numbers in the field of finance: The Equity Risk Premium ("ERP"). Fortunately, because this number is so important, a lot of experts estimate it. Thus, we can consider a variety of objective sources for the Equity Risk Premium, including expert surveys, scholars, and professional analysts. According to these experts, the Equity Risk Premium is

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[5] *See* Exhibit DJG-12.

[6] Exhibit No. (RBH-1), Document No. 6.

approximately 5.5%, and the highest ERP estimate I could find among these various experts is 6.0%.[7] Although I have no reason to believe that thousands of survey respondents and other experts have mistakenly underestimated this very important number, I recommend using 6.0% for the Equity Risk Premium to make absolutely sure we do not underestimate the Company's cost of equity. We can now complete the CAPM formula.

$$\textbf{Cost of Equity} = \mathbf{3.45\% + 0.897 \times 6.0\%}$$

The final cost of equity estimate from our Nobel-prize-winning CAPM is **8.8%**. However, if this was an assignment in a Finance 101 class, we would probably get a B- for this project. First, we have used a risk-free rate that is clearly too high. The current yield on 30-year Treasury bonds (a figure experts use for the risk-free rate) is only about 1.41%, and it hasn't been as high as 3.45% at all this year, or at any time during 2019.[8] Furthermore, we used an equity risk premium, which as discussed above is probably too high. Moreover, our reason for using a high Equity Risk Premium (". . . to make absolutely sure we do not underestimate the Company's cost of equity") is not a very good reason. That is not how professionals think about cost of equity and other important figures in finance and valuation.

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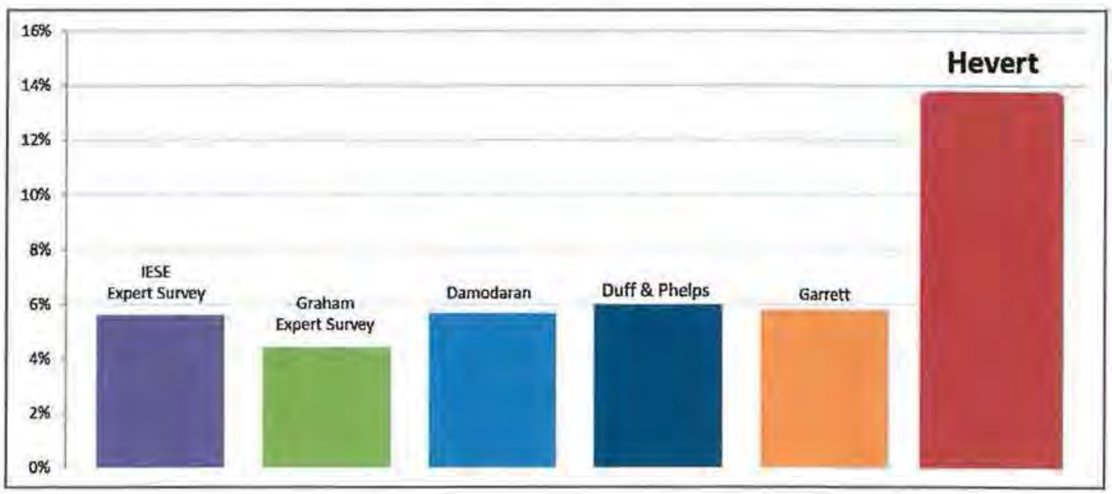
[7] *See* Exhibit DJG-10.

[8] Daily Treasury Yield Curve Rates, https://www.treasury.gov/resource-center/data-chart-center/interest-rates/pages/TextView.aspx?data=yieldYear&year=2019 .

**Q. YOU USED MR. HEVERT'S INPUTS FOR THE RISK-FREE RATE (3.45%) AND BETA (0.897), BUT WHY DIDN'T YOU USE HIS INPUT FOR THE EQUITY RISK PREMIUM?**

A. That's a good question. The following figure compares Mr. Hevert's equity risk premium estimate to the estimate of thousands of expert survey respondents, a highly-respected corporate finance advising firm, and arguably one of the world's leading experts on equity risk premium estimates.

**Figure 2:**
**Equity Risk Premium Comparison**




When compared with other independent, objective sources for the ERP, which do not have a wide variance, Mr. Hevert's ERP estimate is not realistic and is not supported by any independent, objective sources.

**Q. BUT ARE YOU REALLY SURE 8.8% IS A REASONABLE ESTIMATE FOR PGS'S COST OF EQUITY, BECAUSE IT JUST SEEMS VERY LOW GIVEN THE FACT THAT REGULATORS TYPICALLY AWARD ROES THAT ARE ABOVE 9.5%?**

A. Actually, a cost of equity estimate for PGS of 8.8% is clearly too high given the fact that we used an inexplicably high risk-free rate in our basic CAPM example presented above. Regardless, the fact that there is a discrepancy between this estimate and the *status-quo* awarded ROEs from regulators makes no difference. This is due to the fact that awarded ROEs and cost of equity are related, but very different, concepts. Awarded ROEs are decided by elected and appointed officials, influenced by politics, and negotiated in settlements. The *cost* of equity is influenced by none of these things (see Nobel-prize-winning formula discussed above). Indeed, "the market determines the cost of capital. Regulators don't."[9]

**Q. IS THERE SOME WAY WE CAN TEST THE RESULTS OF OUR CAPM TO ASSESS ITS REASONABLENESS?**

A. Yes. The CAPM has been used for decades by investors and company managers to make important investment and capital budgeting decisions (without the input of utility regulators). However, some utility ROE witnesses (such as Mr. Hevert in this case) have suggested that the CAPM underestimates cost of equity for firms in low-beta industries, such as utility companies. However, let's see what the CAPM results would be if we

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[9] Leonard Hyman & William Tilles, "Don't Cry for Utility Shareholders, America," Public Utilities Fortnightly (October 2016).

simply assumed that utilities have a beta equal to 1.0. It is undisputed that the market (i.e., all the stocks) has a collective beta equal to 1.0, and the betas for utility stocks are consistently less than 1.0 (i.e., utilities are less risky than the average company in the market). So, you will see in our CAPM formula below that by using a beta of 1.0, we are effectively estimating the cost of equity of the entire stock market, which will be higher, by definition, than any cost of equity estimate for a low-risk utility company. In our CAPM cost of equity project for PGS discussed above, we got a grade of B- because we used an inexplicably high risk-free rate. This time, for our market cost of equity project, we will use a risk-free rate that actually corresponds with recent yields on 30-year Treasury bonds (or 1.4%).[10] In the interest of reasonableness, we will still use the highest ERP of 6% found from objective sources. Based on these inputs, our market cost of equity calculation is as follows:

$$\textbf{\textit{Market}}\ \textbf{Cost of Equity} = \mathbf{1.4\% + 1.0 \times 6.0\%}$$

Now, the result of our CAPM/market cost of equity estimate is **7.4%**. This means that if an investor bought the entire market, the expected return on that investment would currently be approximately 7.4%. Again, this is the market's cost of equity. Now, to answer the question of whether 8.8% was a reasonable cost of equity estimate for PGS, we can use the following logical steps: (1) It is undisputable that the cost of equity for a company with a beta of less than 1.0 will be less than the market cost of equity; (2) Since utilities consistently, and on average, have betas of less than 1.0, then the cost of equity for any utility company based on a proxy group of utilities must be less than 7.4%. Therefore,

[10] *See* Exhibit DJG-7 and Exhibit DJG-13.

to answer the original question, a cost of equity estimate of 8.8% for PGS is unreasonably high. In fact, the highest reasonable cost of equity estimate for PGS would be 7.4%, and a more realistic cost of equity estimate for PGS is about 6.9%.[11]

**Q. PLEASE SUMMARIZE YOUR RECOMMENDATION TO THE COMMISSION.**

A. Pursuant to the legal and technical standards guiding this issue, the awarded ROE should be based on, or reflective of, the utility's cost of equity. As I explain in more detail below, the Company's estimated cost of equity is approximately 6.9%. However, these legal standards do not mandate the awarded ROE be set exactly equal to the cost of equity. Rather, in *Federal Power Commission v. Hope Natural Gas Co.*,[12] the U.S. Supreme Court ("Court" or "Supreme Court") found that, although the awarded return should be based on a utility's cost of capital, it also indicated that the "end result" should be just and reasonable. If the Commission were to award a return equal to the Company's estimated cost of equity of 6.9%, it would be accurate from a technical standpoint, and it would also significantly reduce the excess wealth transfer from ratepayers to shareholders that would otherwise occur if the Company's proposal were adopted. I recommend, however, the Commission award an ROE to the Company's shareholders that is remarkably higher than the PGS's actual cost of equity in this case. Specifically, I recommend an awarded ROE of 9.5%.

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[11] Exhibit DJG-12.

[12] *See Federal Power Commission v. Hope Natural Gas Co.*, 320 U.S. 591, 603 (1944). Here, the Court states that it is not mandating the various permissible ways in which the rate of return may be determined, but instead indicates that the end result should be just and reasonable. This is sometimes called the "end result" doctrine.

The ratemaking concept of "gradualism," though usually applied from the customer's standpoint to minimize rate shock, could also be applied to shareholders. An awarded return as low as 6.9% in any current rate proceeding would represent a substantial change from the "status quo," which as I prove later in this testimony, involves awarded ROEs that clearly exceed market-based cost of equity for utilities. However, while generally reducing awarded ROEs for utilities would move awarded returns closer to market-based costs and reduce part of the excess transfer of wealth from ratepayers to shareholders, I believe it is advisable to do so gradually. One of the primary reasons the Company's cost of equity is so low is because the Company is a very low-risk asset. In general, utility stocks are low-risk investments because movements in their stock prices are relatively involatile. If the Commission were to make a significant, sudden change in the awarded ROE anticipated by regulatory stakeholders, it could have the undesirable effect of notably increasing the Company's risk profile and would arguably be at odds with the *Hope* Court's "end result" doctrine. An awarded ROE of 9.5% represents a good balance between the Supreme Court's indications that awarded ROEs should be based on cost, while also recognizing that the end result must be reasonable under the circumstances. An awarded ROE of 9.5% also represents a gradual move toward the Company's market-based cost of equity, and it would be fair to the Company's shareholders because 9.5% is over 250 basis points above the Company's market-based cost of equity. Nonetheless, it is clear that the Company's proposed ROE of 10.75% is excessive and unreasonable, as further discussed below.

**Q. PLEASE PROVIDE AN OVERVIEW OF THE PROBLEMS YOU HAVE IDENTIFIED WITH MR. HEVERT'S TESTIMONY REGARDING COST OF EQUITY AND THE AWARDED ROE.**

A. Mr. Hevert proposes a return on equity of 10.75%.[13] Mr. Hevert's recommendations are based on the CAPM, DCF Model, and other models. However, several of his key assumptions and inputs to these models violate fundamental, widely-accepted tenants in finance and valuation, while other assumptions and inputs are simply unrealistic. The key areas of concern are summarized as follows:

**1. Terminal Growth Rate**

In his DCF Model, Mr. Hevert's average long-term growth rate applied to the Company exceeds the long-term growth rate for the entire U.S. economy. In fact, Mr. Hevert's projected growth rates for his proxy companies are as high as 22%,[14] which is more than five times the projected U.S. GDP growth. It is a fundamental concept in finance that, in the long run, a company cannot fundamentally grow at a faster rate than the aggregate economy in which it operates; this is especially true for a regulated utility with a defined service territory. Thus, the results of Mr. Hevert's DCF Model are upwardly biased and are not reflective of current market conditions.

**2. Equity Risk Premium**

Mr. Hevert's estimate for the Equity Risk Premium, the single most important factor in estimating the cost of equity and a key input to the CAPM, is significantly higher

[13] Direct Testimony of Robert B. Hevert, p. 2, line 19.

[14] Exhibit No. (RBH-1), Document No. 2.

than the estimates reported by thousands of experts across the country. In fact, there is no expert who estimates an ERP as high as Mr. Evert. In direct contradiction to Mr. Hevert's assertion that his risk premium analyses are "forward-looking,"[15] Mr. Hevert incorporates ERP data nearly 40 years old into some of his risk premium analyses.[16] Moreover, in estimating the ERP, Mr. Hevert did not follow conventional approaches, but rather conducted a DCF analysis on a sample of the entire market. This decision is especially problematic because Mr. Hevert used long-term growth rates as high as 64% in his analysis.[17] Specifically, Mr. Hevert estimated a long-term growth rate of 64% for Incyte Corp ("Incyte"), a biopharmaceutical company.[18] In 2019, Incyte reported earnings of $447 million.[19] If we apply Mr. Hevert's 64% annual growth rate to Incyte's 2019 earnings, in only 25 years Incyte's earnings would be more than $100 trillion, which would dwarf the GDP of the entire planet. Many of Mr. Hevert's other long-term growth estimates are similarly too high to be considered realistic. This example highlights why it is important not to overestimate long-term growth rates in either the DCF Model or the CAPM. As a result, Mr. Hevert's estimate of the most important factor in the CAPM is more than twice as high as the results estimated and reported by thousands of survey

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[15] *See e.g.*, Direct Testimony of Robert B. Hevert, p. 68, lines 22-23.

[16] Exhibit No. (RBH-1), Document No. 7.

[17] Exhibit No. (RBH-1), Document No. 4.

[18] *Id.*

[19] https://finance.yahoo.com/quote/INCY/financials?p=INCY

respondents and other experts.[20] Thus, Mr. Hevert's CAPM cost of equity estimate is overstated, unsupported, and unreasonable.

**3. Bond Yield Plus Risk Premium Model**

Mr. Hevert's own risk premium model is not market-based in that it considers awarded ROEs dating back to 1980[21] — a contradiction to Mr. Hevert's claim that his cost of equity models are "forward-looking."[22] As discussed in this testimony, awarded ROEs are consistently higher than market-based costs of equity for utility companies. Unlike the CAPM, which is a Nobel-prize-winning risk premium model found in nearly every fundamental textbook on finance and investments, the type of risk premium analysis offered by Mr. Hevert and other utility ROE witnesses are almost exclusively seen in the testimonies of utility ROE witnesses, and it results in cost of equity estimates unreflective of current market conditions. Given the reality that awarded ROEs have consistently exceeded utility market-based costs of equity for decades, any model that attempts to leverage the unbalanced relationship between awarded ROEs and any market-based factor (such as U.S. Treasury bonds in this case) will only serve to perpetuate the unfortunate discrepancy between awarded ROEs and utilities' actual costs of equity. Our purpose here should be to use objective, market-based models (the DCF and CAPM) to estimate the cost of equity so we can then use that estimate to help determine a fair awarded ROE. In contrast, Mr. Hevert's risk premium analysis relies on nothing more than an echo chamber

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[20] *See* Exhibit DJG-10.

[21] Exhibit No. (RBH-1), Document No. 7.

[22] *See e.g.*, Direct Testimony of Robert B. Hevert, p. 68, lines 22-23.

of outdated awarded ROEs that have no bearing on the Company's current, market-based cost of equity.

**Q. WOULD THE RESULTS OF ANY OF MR. HEVERT'S COST OF EQUITY MODELS ACTUALLY EQUATE TO REASONABLE RESULTS FOR PGS'S AWARDED ROE?**

A. Yes. Mr. Hevert conducted several versions of the DCF Model using various growth rates and lengths of time for average stock prices. Mr. Hevert's lowest DCF result was 7.47%.[23] Interestingly, this result is reflective of the market cost of equity estimate I presented above, which is the highest possible estimate for PGS's market-based cost of equity. If the Commission were to set PGS's cost of equity at Mr. Hevert's 7.47% DCF result, it would not only conform with the legal standards governing this issue, but it would also minimize the excess wealth transfer from ratepayers to shareholders relative to Mr. Hevert's other cost of equity estimates. Mr. Hevert's DCF Models also produced results of 7.52%, 7.70%, 8.03%, 8.15%, and 8.46%.[24] Each of these results are much closer to the Company's actual cost of equity than Mr. Hevert's other estimates and his ultimate recommendation.

**Q. DESCRIBE THE HARMFUL IMPACT TO CUSTOMERS AND THE STATE'S ECONOMY IF THE COMMISSION WERE TO ADOPT THE COMPANY'S INFLATED ROE RECOMMENDATION.**

A. When the awarded return is set significantly above the true cost of equity, it results in an inappropriate and excess transfer of wealth from ratepayers to shareholders beyond that

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[23] Exhibit No. (RBH-1), Document No. 2.

[24] *Id.*

which is required by law. This excess outflow of funds from Florida's economy would not benefit its businesses or citizens, nor would it result in better utility service. Instead, Florida businesses in the Company's service territory would be less competitive with businesses in surrounding states, and individual ratepayers would receive inflated costs for basic goods and services, along with higher utility bills.

### *B. Part Two: Depreciation*

**Q. SUMMARIZE THE KEY POINTS OF YOUR TESTIMONY REGARDING DEPRECIATION.**

A. In the context of utility ratemaking, "depreciation" refers to a cost allocation system designed to measure the rate by which a utility may recover its capital investments in a systematic and rational manner. I employed a well-established depreciation system and used actuarial analysis and comparative analysis to analyze the Company's depreciable assets in order to develop reasonable depreciation rates in this case. In this case, I propose adjustments to the service lives and net salvage rates for several of PGS's distribution accounts. For each of these accounts, I propose a longer average remaining life, which results in lower depreciation rates and expense. My proposed adjustments would reduce PGS's proposed depreciation accrual by \$5.5 million.[25]

**Q. PLEASE SUMMARIZE YOUR SERVICE LIFE ADJUSTMENTS.**

A. Based on the Company's historical accounting data, I formed observed life tables and observed survivor curves which provide historical retirement rates for the assets in each

[25] *See* Exhibit DJG-15.

account. I then used standard survivor curves known as "Iowa curves" to project the remaining life in each account based on the historical data. According to the Company's own data, the service life estimates for several of the Company's distribution accounts were shorter than the service life otherwise indicated by the data. All else held constant, shorter service lives result in higher depreciation rates.

**Q. PLEASE SUMMARIZE YOUR NET SALVAGE ADJUSTMENTS.**

A. For several of its accounts, the Company has proposed sizeable decreases in its net salvage rates, which has an increasing effect on depreciation rates. While I do not dispute that there should be net salvage increases in these particular accounts, I would propose that the proposed amount of the increases be reduced based on the ratemaking concept of gradualism. Specifically, I recommend that the amount of the Company's proposed increases in net salvage rates in these accounts be reduced by 50%.

**Q. PLEASE SUMMARIZE YOUR PROPOSED ADJUSTMENTS TO THE COMPANY'S DEPRECIATION PARAMETERS.**

A. The table below summarizes my proposed adjustments to service life (i.e., Iowa curve) and net salvage rates for the accounts at issue.

**Figure 3:**
**Equity Risk Premium Comparison**

| | | Current Parameters | | Company Position | | OPC Position | |
|---|---|---|---|---|---|---|---|
| Account | | Iowa Curve | Net Sal | Iowa Curve | Net Sal | Iowa Curve | Net Sal |
| No. | Description | Type AL | Rate | Type AL | Rate | Type AL | Rate |
| 376.00 | Mains Steel | R2 - 55 | -40% | R1.5 - 65 | -60% | R1.5 - 65 | -50% |
| 376.02 | Mains Plastic | R2 - 75 | -25% | R2 - 75 | -40% | R2 - 75 | -33% |
| 378.00 | Meas & Reg Station Eqp Gen | R1 - 31 | -5% | R1.5 - 40 | -10% | R1 - 46 | -10% |
| 380.00 | Services Steel | R0.5 - 50 | -100% | R0.5 - 52 | -150% | R0.5 - 57 | -125% |
| 380.02 | Services Plastic | R1.5 - 55 | -55% | R1.5 - 55 | -80% | R1.5 - 64 | -68% |
| 382.00 | Meter Installations | R0.5 - 43 | -20% | R1 - 44 | -30% | R1 - 44 | -25% |
| 384.00 | House Regulator Installs | R4 - 27 | -20% | R1 - 47 | -30% | R1 - 47 | -25% |
| 385.00 | Meas & Reg Station Eqp Ind | R4 - 32 | 0% | R3 - 37 | -2% | R3 - 41 | -2% |

The details behind these adjustments are further discussed in the depreciation section of my testimony.

**Q. PLEASE DESCRIBE WHY IT IS IMPORTANT NOT TO OVERESTIMATE DEPRECIATION RATES.**

A. Under the rate base rate of return model, the utility is allowed to recover the original cost of its prudent investments required to provide service. Depreciation systems are designed to allocate those costs in a systematic and rational manner — specifically, over the service life of the utility's assets. If depreciation rates are overestimated (i.e., service lives are underestimated), it encourages economic inefficiency. Unlike competitive firms, regulated utility companies are not always incentivized by natural market forces to make the most economically efficient decisions. If a utility is allowed to recover the cost of an asset before the end of its useful life, this could incentivize the utility to unnecessarily replace the asset in order to increase its rate base, which results in economic waste. Thus, from a public policy perspective, it is preferable for regulators to ensure that assets are not depreciated before the end of their true useful lives. While underestimating the useful lives of depreciable assets could financially harm current ratepayers and encourage economic waste, unintentionally overestimating depreciable lives (i.e., underestimating depreciation rates) does not necessarily harm the Company financially. This is because if an asset's life is overestimated, there are a variety of measures that regulators can use to ensure the utility is not financially harmed. Thus, the process of depreciation strives for a perfect match between actual and estimated useful life. When these estimates are not exact, however, it is better that useful lives are not underestimated for these reasons.

## *PART ONE: COST OF CAPITAL*

### III. LEGAL STANDARDS AND THE AWARDED RETURN

**Q. DISCUSS THE LEGAL STANDARDS GOVERNING THE AWARDED RATE OF RETURN ON CAPITAL INVESTMENTS FOR REGULATED UTILITIES.**

A. In *Wilcox v. Consolidated Gas Co. of New York*, [26] the Supreme Court first addressed the meaning of a fair rate of return for public utilities. The Court found that "the amount of risk in the business is a most important factor" in determining the appropriate allowed rate of return.[27] Later in two landmark cases, the Court set forth the standards by which public utilities are allowed to earn a return on capital investments. In *Bluefield Water Works & Improvement Co. v. Public Service Commission of West Virginia*, [28] the Court held:

> A public utility is entitled to such rates as will permit it to earn a return on the value of the property which it employs for the convenience of the public . . . but it has no constitutional right to profits such as are realized or anticipated in highly profitable enterprises or speculative ventures. The return should be reasonably sufficient to assure confidence in the financial soundness of the utility and should be adequate, under efficient and economical management, to maintain and support its credit and enable it to raise the money necessary for the proper discharge of its public duties.

In *Federal Power Commission v. Hope Natural Gas Company*, [29] the Court expanded on the guidelines set forth in *Bluefield* and stated:

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[26] *Wilcox v. Consolidated Gas Co. of New York*, 212 U.S. 19 (1909).

[27] *Id.* at 48.

[28] *Bluefield Water Works & Improvement Co. v. Public Service Commission of West Virginia*, 262 U.S. 679, 692-93 (1923).

[29] *Federal Power Commission v. Hope Natural Gas Co.*, 320 U.S. 591, 603 (1944) (emphasis added).

> From the investor or company point of view it is important that there be enough revenue not only for operating expenses *but also for the capital costs of the business*. These include service on the debt and dividends on the stock. By that standard the return to the equity owner should be commensurate with returns on investments in other enterprises having corresponding risks. That return, moreover, should be sufficient to assure confidence in the financial integrity of the enterprise, so as to maintain its credit and to attract capital.

The cost of capital models I have employed in this case are in accordance with the foregoing legal standards.

**Q. IS IT IMPORTANT THAT THE AWARDED RATE OF RETURN BE BASED ON THE COMPANY'S ACTUAL COST OF CAPITAL?**

A. Yes. The *Hope* Court makes it clear that the allowed return should be based on the actual cost of capital. Under the rate base rate of return model, a utility should be allowed to recover all its reasonable expenses, its capital investments through depreciation, and a return on its capital investments sufficient to satisfy the required return of its investors. The "required return" from the investors' perspective is synonymous with the "cost of capital" from the utility's perspective. Scholars agree that the allowed rate of return should be based on the actual cost of capital:

> Since by definition the cost of capital of a regulated firm represents precisely the expected return that investors could anticipate from other investments while bearing no more or less risk, and since investors will not provide capital unless the investment is expected to yield its opportunity cost of capital, the correspondence of the definition of the cost of capital with the court's definition of legally required earnings appears clear.[30]

[30] A. Lawrence Kolbe, James A. Read, Jr. & George R. Hall, *The Cost of Capital: Estimating the Rate of Return for Public Utilities* 21 (The MIT Press 1984).

The models I have employed in this case closely estimate the Company's true cost of equity. If the Commission sets the awarded return based on my lower, and more reasonable rate of return, it will comply with the U.S. Supreme Court's standards, allow the Company to maintain its financial integrity, and satisfy the claims of its investors. On the other hand, if the Commission sets the allowed rate of return much *higher* than the true cost of capital, it arguably results in an inappropriate transfer of wealth from ratepayers to shareholders. As Dr. Morin notes:

> [I]f the allowed rate of return is greater than the cost of capital, capital investments are undertaken and investors' opportunity costs are more than achieved. Any excess earnings over and above those required to service debt capital accrue to the equity holders, and the stock price increases. In this case, the wealth transfer occurs from ratepayers to shareholders.[31]

Thus, it is important to understand that the *awarded* return and the *cost* of capital are different but related concepts. The two concepts are related in that the legal and technical standards encompassing this issue require that the awarded return reflect the true cost of capital. On the other hand, the two concepts are different in that the legal standards do not mandate that awarded returns exactly match the cost of capital. Awarded returns are set through the regulatory process and may be influenced by a number of factors other than objective market drivers. The cost of capital, on the other hand, should be evaluated objectively and be closely tied to economic realities. In other words, the cost of capital is driven by stock prices, dividends, growth rates, and — most importantly — it is driven by risk. The cost of capital can be estimated by financial models used by firms, investors, and academics around the world for decades. The problem is, with respect to regulated utilities,

[31] Roger A. Morin, *New Regulatory Finance* 23-24 (Public Utilities Reports, Inc. 2006) (1994).

there has been a trend in which awarded returns fail to closely track with actual market-based cost of capital as further discussed below. To the extent this occurs, the results are detrimental to ratepayers and the state's economy.

**Q. DESCRIBE THE ECONOMIC IMPACT THAT OCCURS WHEN THE AWARDED RETURN STRAYS TOO FAR FROM THE U.S. SUPREME COURT'S COST OF EQUITY STANDARD.**

A. As discussed further in the sections below, Mr. Hevert's recommended awarded ROE is much higher than the Company's actual cost of capital based on objective market data. When the awarded ROE is set far above the *cost* of equity, it runs the risk of violating the U.S. Supreme Court's standards that the awarded return should be *based on the cost of capital*. If the Commission were to adopt the Company's position in this case, it would be permitting an excess transfer of wealth from Florida customers to Company shareholders. Moreover, establishing an awarded return that far exceeds the true cost of capital effectively prevents the awarded returns from changing along with economic conditions. This is especially true given the fact that regulators tend to be influenced by the awarded returns in other jurisdictions, regardless of the various unknown factors influencing those awarded returns. This is yet another reason why it is crucial for regulators to focus on the target utility's actual *cost* of equity, rather than awarded returns from other jurisdictions. Awarded returns may be influenced by settlements and other political factors not based on true market conditions. In contrast, the true cost of equity as estimated through objective models is not influenced by these factors but is instead driven by market-based factors. If regulators rely too heavily on the awarded returns from other jurisdictions, it can create a cycle over time that bears little relation to the market-based cost of equity. In fact, this is exactly what we have observed since 1990.

**Q. ILLUSTRATE AND COMPARE THE RELATIONSHIP BETWEEN AWARDED UTILITY RETURNS AND MARKET COST OF EQUITY SINCE 1990.**

A. As shown in the figure below, awarded returns for public utilities have been above the average required market return since 1990.[32] Because utility stocks are consistently far less risky than the average stock in the marketplace, the cost of equity for utility companies is *less* than the market cost of equity. This is a fact, not an opinion. The graph below shows two trend lines. The top line is the average annual awarded returns since 1990 for U.S. regulated utilities. The bottom line is the required market return over the same period. As discussed in more detail later in my testimony, the required market return is essentially the return that investors would require if they invested in the entire market. In other words, the required market return is essentially the cost of equity of the entire market. Since it is undisputed (even by utility witnesses) that utility stocks are less risky than the average stock in the market, then the utilities' cost of equity must be less than the market cost of equity.[33] Thus, awarded returns (the solid line) should generally be *below* the market cost of equity (the dotted line), since awarded returns are supposed to be based on true cost of equity.

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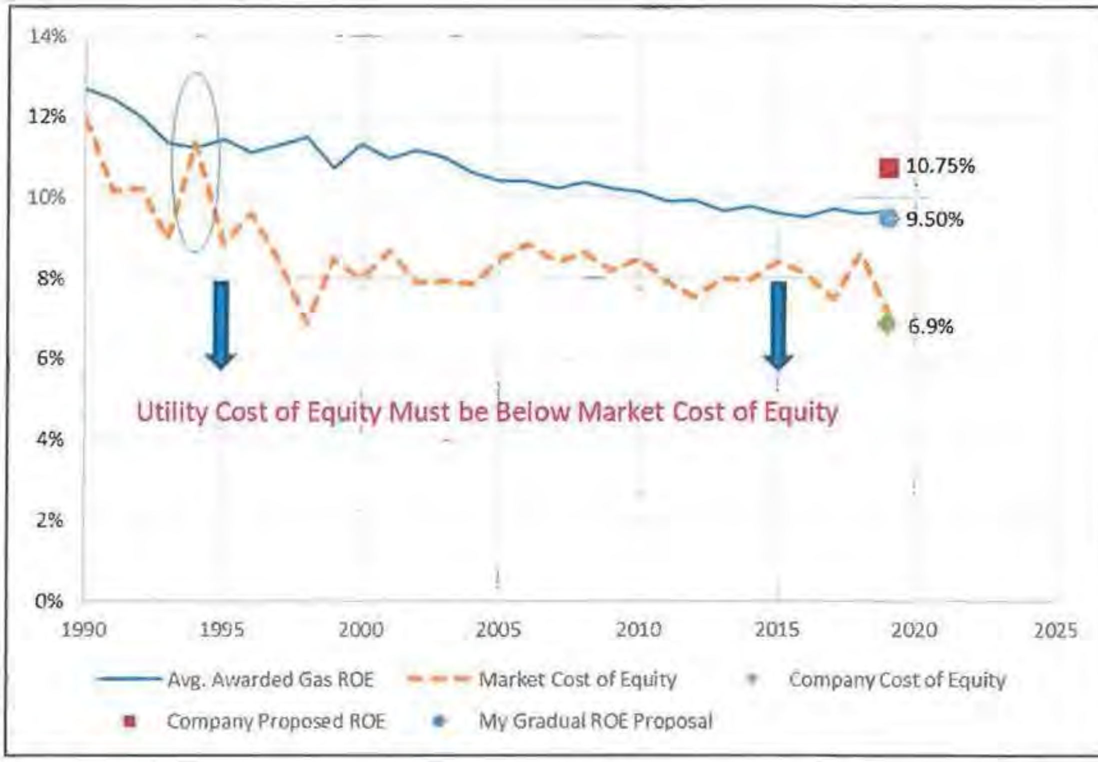
[32] *See* Exhibit DJG-14.

[33] This fact can be objectively measured through a term called "beta," as discussed later in the testimony. Utility betas are less than one, which means utility stocks are less risky than the "average" stock in the market.

**Figure 4:**
**Awarded ROEs vs. Market Cost of Equity**




Because utility stocks are less risky than the average stock in the market, utility cost of equity is *below* market cost of equity (the dotted line in this graph). However, as shown in this graph, awarded ROEs have been consistently *above* the market cost of equity for many years. As shown in the graph, since 1990 there was only one year in which the average awarded ROE was below the market cost of equity — 1994. In other words, 1994 was the year that regulators awarded ROEs that were the closest to utilities' market-based cost of equity. In my opinion, when awarded ROEs for utilities are below the market cost of equity, they more closely conform to the standards set forth by *Hope* and *Bluefield* and minimize the excess wealth transfer from ratepayers to shareholders. The graph also shows the current discrepancy between awarded ROEs and market cost of equity along with the various positions in this case. In this case, Mr. Hevert's proposal of a 10.75% ROE is about 400 basis points above the Company's cost of equity of about 6.9%. As discussed previously, my recommended ROE of 9.5% represents a gradual move towards actual cost, is reasonable under the circumstances, and is in accord with the decisions of the U.S. Supreme Court.

**Q. HAVE OTHER ANALYSTS COMMENTED ON THIS NATIONAL PHENOMENON OF AWARDED ROES EXCEEDING THE MARKET-BASED COST EQUITY FOR UTILITIES?**

A. Yes. In his article published in Public Utilities Fortnightly in 2016, Steve Huntoon observed that even though utility stocks are less risky than the stocks of competitive industries, utility stocks have nonetheless outperformed the broader market.[34] Specifically, Huntoon notes the following three points which lead to a problematic conclusion:

> 1. Jack Bogle, the founder of Vanguard Group and a Wall Street legend, provides rigorous analysis that the long-term total return for the broader market will be around 7 percent going forward. Another Wall Street legend, Professor Burton Malkiel, corroborates that 7 percent in the latest edition of his seminal work, *A Random Walk Down Wall Street*.
>
> 2. Institutions like pension funds are validating [the first point] by piling on risky investments to try and get to a 7.5 percent total return, as reported by the Wall Street Journal.
>
> 3. Utilities are being granted returns on equity around 10 percent.[35]

[34] Steve Huntoon, "Nice Work If you can Get It," Public Utilities Fortnightly (Aug. 2016).

[35] *Id.*

In a follow-up article analyzing and agreeing with Mr. Huntoon's findings, Leonard Hyman and William Tilles found that utility equity investors expect about a 7.5% annual return.[36]

Other scholars have also observed that awarded ROEs have not appropriately tracked with declining interest rates over the years, and that excessive awarded ROEs have negative economic impacts. In a 2017 white paper, Charles S. Griffey stated:

> The "risk premium" being granted to utility shareholders is now higher than it has ever been over the last 35 years. Excessive utility ROEs are detrimental to utility customers and the economy as a whole. From a societal standpoint, granting ROEs that are higher than necessary to attract investment creates an inefficient allocation of capital, diverting available funds away from more efficient investments. From the utility customer perspective, if a utility's awarded and/or achieved ROE is higher than necessary to attract capital, customers pay higher rates without receiving any corresponding benefit.[37]

It is interesting that both Mr. Huntoon and Mr. Griffey use the word "sticky" in their articles to describe the fact that awarded ROEs have declined at a much slower rate than interest rates and other economic factors resulting in a decline in capital costs and expected returns on the market. It is not hard to see why this phenomenon of sticky ROEs has occurred. Because awarded ROEs are often based primarily on a comparison with other awarded ROEs around the country, the average awarded returns effectively fail to adapt to true market conditions, and regulators seem reluctant to deviate from the average. Once utilities and regulatory commissions become accustomed to awarding rates of return higher than

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[36] Leonard Hyman & William Tilles, "Don't Cry for Utility Shareholders, America," Public Utilities Fortnightly (October 2016).

[37] Charles S. Griffey, "When 'What Goes Up' Does Not Come Down: Recent Trends in Utility Returns," White Paper (February 2017).

market conditions actually require, this trend becomes difficult to reverse. Nevertheless, the fact is that utility stocks are *less risky* than the average stock in the market, and thus, awarded ROEs should be less than the expected return on the market. However, that is rarely the case. "Sooner or later, *regulators may see the gap between allowed returns and cost of capital*."[38]

**Q. SUMMARIZE THE LEGAL STANDARDS GOVERNING THE AWARDED ROE ISSUE.**

A. The Commission should strive to move the awarded return to a level more closely aligned with the Company's actual, market-derived cost of capital while keeping in mind the following legal principles:

**1. Risk is the most important factor when determining the awarded return. The awarded return should be commensurate with those on investments of corresponding risk.**

The legal standards articulated in *Hope* and *Bluefield* demonstrate that the Court understands one of the most basic, fundamental concepts in financial theory: the more (less) risk an investor assumes, the more (less) return the investor requires. Since utility stocks are very low risk, the return required by equity investors should be relatively low. I have used financial models in this case to closely estimate PGS' cost of equity, and these financial models account for risk. The public utility industry is one of the least risky industries in the entire country. The cost of equity models confirm this fact in that they

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[38] Leonard Hyman & William Tilles, "Don't Cry for Utility Shareholders, America," Public Utilities Fortnightly (October 2016) (emphasis added).

produce relatively low cost of equity results. In turn, the awarded ROE in this case should reflect the fact that the Company is a low-risk firm.

**2. The awarded return should be sufficient to assure financial soundness under efficient management.**

Because awarded returns in the regulatory environment have not closely tracked market-based trends and commensurate risk, utility companies have been able to remain more than financially sound, perhaps despite management inefficiencies. In fact, the transfer of wealth from ratepayers to shareholders has been so far removed from actual cost-based drivers that even under relatively inefficient management a utility could remain financially sound. Therefore, regulatory commissions should strive to set the awarded return to a regulated utility at a level based on accurate market conditions to promote prudent and efficient management and minimize economic waste.

## IV. GENERAL CONCEPTS AND METHODOLOGY

**Q. DISCUSS YOUR APPROACH TO ESTIMATING THE COST OF EQUITY IN THIS CASE.**

A. While a competitive firm must estimate its own cost of capital to assess the profitability of competing capital projects, regulators determine a utility's cost of capital to establish a fair rate of return. The legal standards set forth above do not include specific guidelines regarding the models that must be used to estimate the cost of equity. Over the years, however, regulatory commissions have consistently relied on several models. The models I have employed in this case have been the two most widely used and accepted in regulatory proceedings for many years. These models are the Discounted Cash Flow Model ("DCF

Model") and the Capital Asset Pricing Model ("CAPM"). The specific inputs and calculations for these models are described in more detail below.

**Q. PLEASE EXPLAIN WHY MULTIPLE MODELS ARE USED TO ESTIMATE THE COST OF EQUITY.**

A. The models used to estimate the cost of equity attempt to measure the return on equity required by investors by estimating several different inputs. It is preferable to use multiple models because the results of any one model may contain a degree of imprecision, especially depending on the reliability of the inputs used at the time of conducting the model. By using multiple models, the analyst can compare the results of the models and look for outlying results and inconsistencies. Likewise, if multiple models produce a similar result, it may indicate a narrower range for the cost of equity estimate.

**Q. PLEASE DISCUSS THE BENEFITS OF CHOOSING A PROXY GROUP OF COMPANIES IN CONDUCTING COST OF CAPITAL ANALYSES.**

A. The cost of equity models in this case can be used to estimate the cost of capital of any individual, publicly-traded company. There are advantages, however, to conducting cost of capital analysis on a "proxy group" of companies that are comparable to the target company. First, it is better to assess the financial soundness of a utility by comparing it to a group of other financially sound utilities. Second, using a proxy group provides more reliability and confidence in the overall results because there is a larger sample size. Finally, the use of a proxy group is often a pure necessity when the target company is a subsidiary that is not publicly traded. This is because the financial models used to estimate the cost of equity require information from publicly-traded firms, such as stock prices and dividends.

**Q. DESCRIBE THE PROXY GROUP YOU SELECTED IN THIS CASE.**

A. In this case, I chose to use the same proxy group used by Mr. Hevert. There could be reasonable arguments made for the inclusion or exclusion of a particular company in a proxy group; however, the cost of equity results are influenced far more by the underlying assumptions and inputs to the various financial models than the composition of the proxy groups.[39] By using the same proxy group, we can remove a relatively insignificant variable from the equation and focus on the primary factors driving the Company's cost of equity estimate in this case.

## V. RISK AND RETURN CONCEPTS

**Q. DISCUSS THE GENERAL RELATIONSHIP BETWEEN RISK AND RETURN.**

A. Risk is among the most important factors for the Commission to consider when determining the allowed return. Thus, it is necessary to understand the relationship between risk and return. There is a direct relationship between risk and return: the more (or less) risk an investor assumes, the larger (or smaller) return the investor will demand. There are two primary types of risk: firm-specific risk and market risk. Firm-specific risk affects individual companies, while market risk affects all companies in the market to varying degrees.

[39] *See* Exhibit DJG-2.

**Q. DISCUSS THE DIFFERENCES BETWEEN FIRM-SPECIFIC RISK AND MARKET RISK.**

A. Firm-specific risk affects individual companies, rather than the entire market. For example, a competitive firm might overestimate customer demand for a new product, resulting in reduced sales revenue. This is an example of a firm-specific risk called "project risk."[40] There are several other types of firm-specific risks, including: (1) "financial risk" — the risk that equity investors of leveraged firms face as residual claimants on earnings; (2) "default risk" — the risk that a firm will default on its debt securities; and (3) "business risk" — which encompasses all other operating and managerial factors that may result in investors realizing less than their expected return in that particular company. While firm-specific risk affects individual companies, market risk affects all companies in the market to varying degrees. Examples of market risk include interest rate risk, inflation risk, and the risk of major socio-economic events. When there are changes in these risk factors, they affect all firms in the market to some extent.[41]

Analysis of the U.S. market in 2001 provides a good example for contrasting firm-specific risk and market risk. During that year, Enron Corp.'s stock fell from $80 per share and the company filed bankruptcy at the end of the year. If an investor's portfolio had held only Enron stock at the beginning of 2001, this irrational investor would have lost the entire investment by the end of the year due to assuming the full exposure of Enron's firm-specific risk (in that case, imprudent management). On the other hand, a rational,

[40] Aswath Damodaran, *Investment Valuation: Tools and Techniques for Determining the Value of Any Asset* 62-63 (3rd ed., John Wiley & Sons, Inc. 2012).

[41] *See* Zvi Bodie, Alex Kane & Alan J. Marcus, *Essentials of Investments* 149 (9th ed., McGraw-Hill/Irwin 2013).

diversified investor who invested the same amount of capital in a portfolio holding every stock in the S&P 500 would have had a much different result that year. The rational investor would have been relatively unaffected by the fall of Enron because his portfolio included about 499 other stocks. Each of those stocks, however, would have been affected by various *market* risk factors that occurred that year, including the terrorist attacks on September 11th, which affected all stocks in the market. Thus, the rational investor would have incurred a relatively minor loss due to market risk factors, while the irrational investor would have lost everything due to firm-specific risk factors.

**Q. CAN INVESTORS EASILY MINIMIZE FIRM-SPECIFIC RISK?**

A. Yes. A fundamental concept in finance is that firm-specific risk can be eliminated through diversification.[42] If someone irrationally invested all their funds in one firm, they would be exposed to all the firm-specific risk *and* the market risk inherent in that single firm. Rational investors, however, are risk-averse and seek to eliminate risk they can control. Investors can essentially eliminate firm-specific risk by adding more stocks to their portfolio through a process called "diversification." There are two reasons why diversification eliminates firm-specific risk. First, each stock in a diversified portfolio represents a much smaller percentage of the overall portfolio than it would in a portfolio of just one or a few stocks. Thus, any firm-specific action that changes the stock price of one stock in the diversified portfolio will have only a small impact on the entire portfolio.[43]

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[42] *See* John R. Graham, Scott B. Smart & William L. Megginson, *Corporate Finance: Linking Theory to What Companies Do* 179-80 (3rd ed., South Western Cengage Learning 2010).

[43] *See* Aswath Damodaran, *Investment Valuation: Tools and Techniques for Determining the Value of Any Asset* 64 (3rd ed., John Wiley & Sons, Inc. 2012).

The second reason why diversification eliminates firm-specific risk is that the effects of firm-specific actions on stock prices can be either positive or negative for each stock. Thus, in large diversified portfolios, the net effect of these positive and negative firm-specific risk factors will be essentially zero and will not affect the value of the overall portfolio.[44] Firm-specific risk is also called "diversifiable risk" because it can be easily eliminated through diversification.

**Q. IS IT WELL-KNOWN AND ACCEPTED THAT, BECAUSE FIRM-SPECIFIC RISK CAN BE EASILY ELIMINATED THROUGH DIVERSIFICATION, THE MARKET DOES NOT REWARD SUCH RISK THROUGH HIGHER RETURNS?**

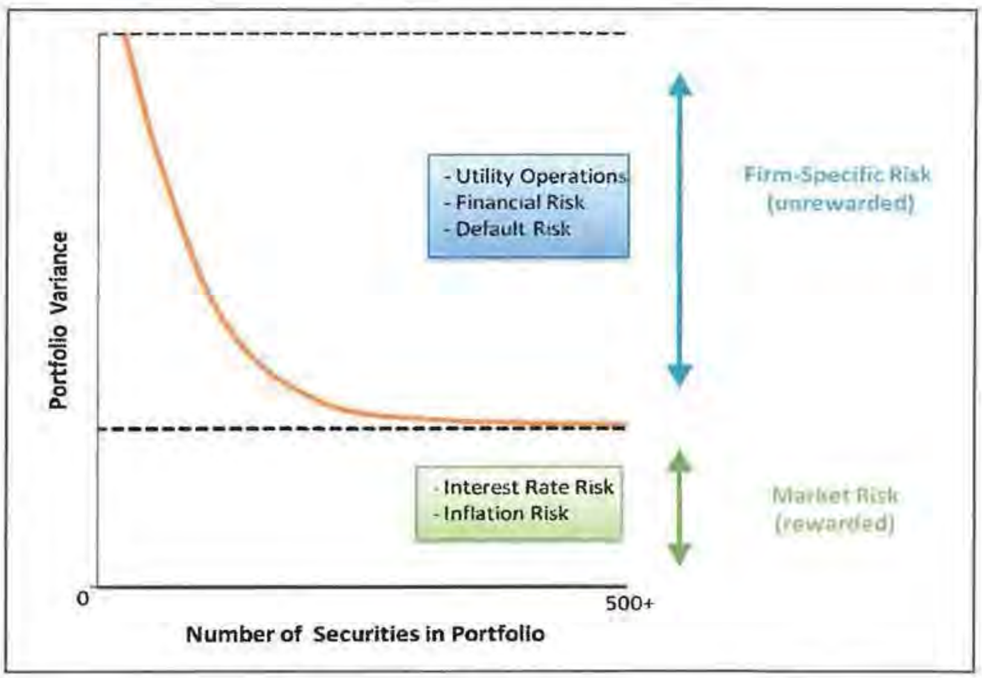
A. Yes. Because investors eliminate firm-specific risk through diversification, they know they cannot expect a higher return for assuming the firm-specific risk in any one company. Thus, the risks associated with an individual firm's operations are not rewarded by the market. In fact, firm-specific risk is also called "unrewarded" risk for this reason. Market risk, on the other hand, cannot be eliminated through diversification. Because market risk cannot be eliminated through diversification, investors expect a return for assuming this type of risk. Market risk is also called "systematic risk." Scholars recognize the fact that market risk, or "systematic risk," is the only type of risk for which investors expect a return for bearing:

[44] *Id.*

> If investors can cheaply eliminate some risks through diversification, then we should not expect a security to earn higher returns for risks that can be eliminated through diversification. Investors can expect compensation *only* for bearing systematic risk (i.e., risk that cannot be diversified away).[45]

These important concepts are illustrated in the figure below. Some form of this figure is found in many financial textbooks.

**Figure 5:**
**Effects of Portfolio Diversification**




This figure shows that as stocks are added to a portfolio, the amount of firm-specific risk is reduced until it is essentially eliminated. No matter how many stocks are added, however, there remains a certain level of fixed market risk. The level of market risk will vary from firm to firm. Market risk is the only type of risk that is rewarded by the market

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[45] *See* John R. Graham, Scott B. Smart & William L. Megginson, *Corporate Finance: Linking Theory to What Companies Do* 180 (3rd ed., South Western Cengage Learning 2010).

and is thus the primary type of risk the Commission should consider when determining the allowed return.

**Q. DESCRIBE HOW MARKET RISK IS MEASURED.**

A. Investors who want to eliminate firm-specific risk must hold a fully diversified portfolio. To determine the amount of risk that a single stock adds to the overall market portfolio, investors measure the covariance between a single stock and the market portfolio. The result of this calculation is called "beta."[46] Beta represents the sensitivity of a given security to the market as a whole. The market portfolio of all stocks has a beta equal to one. Stocks with betas greater than one are relatively more sensitive to market risk than the average stock. For example, if the market increases (decreases) by 1.0%, a stock with a beta of 1.5 will, on average, increase (decrease) by 1.5%. In contrast, stocks with betas of less than one are less sensitive to market risk, such that if the market increases (decreases) by 1.0%, a stock with a beta of 0.5 will, on average, only increase (decrease) by 0.5%. Thus, stocks with low betas are relatively insulated from market conditions. The beta term is used in the CAPM to estimate the cost of equity, which is discussed in more detail later.[47]

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[46] *Id.* at 180-81.

[47] Though it will be discussed in more detail later, Exhibit DJG-8 shows that the average beta of the proxy group was less than 1.0. This confirms the well-known concept that utilities are relatively low-risk firms.

**Q. ARE PUBLIC UTILITIES CHARACTERIZED AS DEFENSIVE FIRMS THAT HAVE LOW BETAS, LOW MARKET RISK, AND ARE RELATIVELY INSULATED FROM OVERALL MARKET CONDITIONS?**

A. Yes. Although market risk affects all firms in the market, it affects different firms to varying degrees. Firms with high betas are affected more than firms with low betas, which is why firms with high betas are riskier. Stocks with betas greater than one are generally known as "cyclical stocks." Firms in cyclical industries are sensitive to recurring patterns of recession and recovery known as the "business cycle."[48] Thus, cyclical firms are exposed to a greater level of market risk. Securities with betas less than one, on the other hand, are known as "defensive stocks." Companies in defensive industries, such as public utility companies, "will have low betas and performance that is comparatively unaffected by overall market conditions."[49] In fact, financial textbooks often use utility companies as prime examples of low-risk, defensive firms. The figure below compares the betas of several industries and illustrates that the utility industry is one of the least risky industries in the U.S. market.[50]

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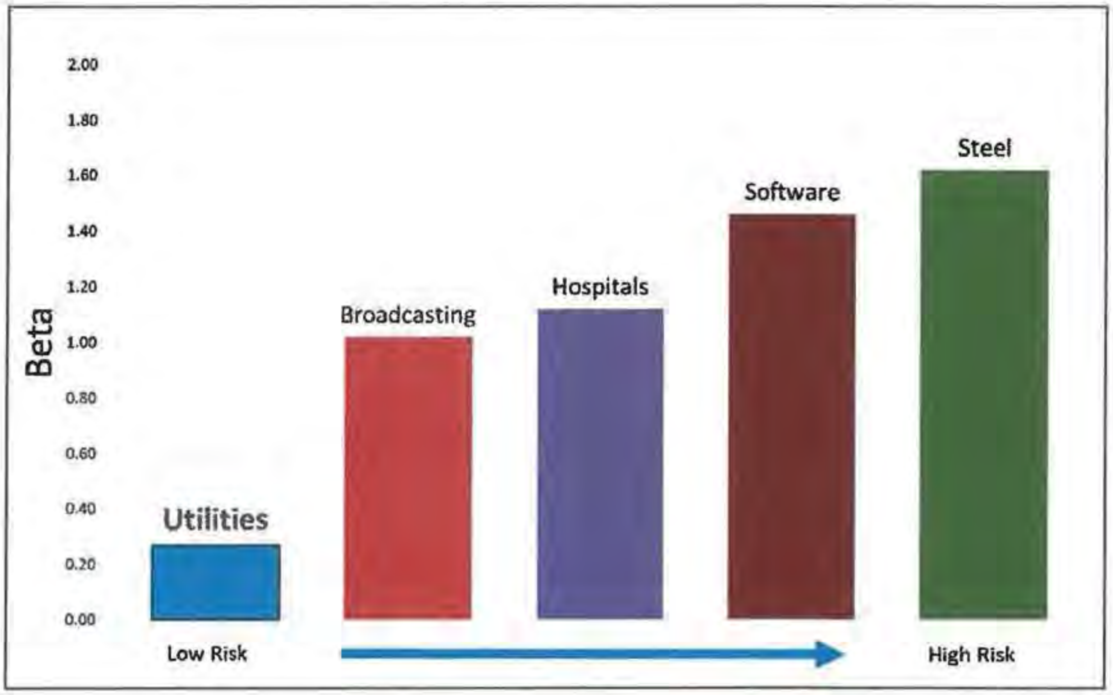
[48] *See* Zvi Bodie, Alex Kane & Alan J. Marcus, *Essentials of Investments* 382 (9th ed., McGraw-Hill/Irwin 2013).

[49] *Id.* at 383.

[50] *See* Betas by Sector (US) available at http://pages.stern.nyu.edu/~adamodar/ (2018). (After clicking the link, click "Data" then "Current Data" then "Risk / Discount Rate" from the drop down menu, then "Total Beta by Industry Sector"). The exact beta calculations are not as important as illustrating the well-known fact that utilities are very low-risk companies. The fact that the utility industry is one of the lowest risk industries in the country should not change from year to year.

**Figure 6:**
**Beta by Industry**




The fact that utilities are defensive firms that are exposed to little market risk is beneficial to society. When the business cycle enters a recession, consumers can be assured that their utility companies will be able to maintain normal business operations and provide safe and reliable service under prudent management. Likewise, utility investors can be confident that utility stock prices will not widely fluctuate. So, while it is recognized and accepted that utilities are defensive firms that experience little market risk and are relatively insulated from market conditions, this fact should also be appropriately reflected in the Company's awarded return.

## VI. DISCOUNTED CASH FLOW ANALYSIS

**Q. DESCRIBE THE DISCOUNTED CASH FLOW ("DCF") MODEL.**

A. The Discounted Cash Flow ("DCF") Model is based on a fundamental financial model called the "dividend discount model," which maintains that the value of a security is equal to the present value of the future cash flows it generates. Cash flows from common stock are paid to investors in the form of dividends. There are several variations of the DCF Model. These versions, along with other formulas and theories related to the DCF Model are discussed in more detail in Exhibit DJG 25, Appendix A. For this case, I chose to use the Quarterly Approximation DCF Model.

**Q. DESCRIBE THE INPUTS TO THE DCF MODEL.**

A. There are three primary inputs in the DCF Model: (1) stock price; (2) dividend; and (3) the long-term growth rate. The stock prices and dividends are known inputs based on recorded data, while the growth rate projection must be estimated. I discuss each of these inputs separately below.

### A. Stock Price

**Q. HOW DID YOU DETERMINE THE STOCK PRICE INPUT OF THE DCF MODEL?**

A. For the stock price ($P_0$), I used a 30-day average of stock prices for each company in the proxy group.[51] Analysts sometimes rely on average stock prices for longer periods (e.g.,

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[51] Exhibit DJG-3.

60, 90, or 180 days). According to the efficient market hypothesis, however, markets reflect all relevant information available at a particular time, and prices adjust instantaneously to the arrival of new information.[52] Past stock prices, in essence, reflect outdated information. The DCF Model used in utility rate cases is a derivation of the dividend discount model, which is used to determine the current value of an asset. Thus, according to the dividend discount model and the efficient market hypothesis, the value for the "$P_0$" term in the DCF Model should technically be the current stock price, rather than an average.

**Q. WHY DID YOU USE A 30-DAY AVERAGE FOR THE CURRENT STOCK PRICE INPUT?**

A. Using a short-term average of stock prices for the current stock price input adheres to market efficiency principles while avoiding any irregularities that may arise from using a single current stock price. In the context of a utility rate proceeding, there is a significant length of time from when an application is filed, and testimony is due. Choosing a current stock price for one particular day could raise a separate issue concerning which day was chosen to be used in the analysis. In addition, a single stock price on a particular day may be unusually high or low. It is arguably ill-advised to use a single stock price in a model that is ultimately used to set rates for several years, especially if a stock is experiencing

[52] *See* Eugene F. Fama, *Efficient Capital Markets: A Review of Theory and Empirical Work*, Vol. 25, No. 2 The Journal of Finance 383 (1970); *see also* John R. Graham, Scott B. Smart & William L. Megginson, *Corporate Finance: Linking Theory to What Companies Do* 357 (3rd ed., South Western Cengage Learning 2010). The efficient market hypothesis was formally presented by Eugene Fama in 1970 and is a cornerstone of modern financial theory and practice.

some volatility. Thus, it is preferable to use a short-term average of stock prices, which represents a good balance between adhering to well-established principles of market efficiency while avoiding any unnecessary contentions that may arise from using a single stock price on a given day. The stock prices I used in my DCF analysis are based on 30-day averages of adjusted closing stock prices for each company in the proxy group.[53]

## B. Dividend

**Q. DESCRIBE HOW YOU DETERMINED THE DIVIDEND INPUT OF THE DCF MODEL.**

A. The dividend term in the Quarterly Approximation DCF Model is the current quarterly dividend per share. I obtained the most recent quarterly dividend paid for each proxy company.[54] The Quarterly Approximation DCF Model assumes that the company increases its dividend payments each quarter. Thus, the model assumes that each quarterly dividend is greater than the previous one by $(1 + g)^{0.25}$. This expression could be described as the dividend quarterly growth rate, where the term "g" is the growth rate and the exponential term "0.25" signifies one quarter of the year.

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[53] Exhibit DJG-3. Adjusted closing prices, rather than actual closing prices, are ideal for analyzing historical stock prices. The adjusted price provides an accurate representation of the firm's equity value beyond the mere market price because it accounts for stock splits and dividends.

[54] Exhibit DJG-4. Nasdaq Dividend History, available at http://www.nasdaq.com/quotes/dividend-history.aspx.

**Q. DOES THE QUARTERLY APPROXIMATION DCF MODEL RESULT IN THE HIGHEST COST OF EQUITY IN THIS CASE RELATIVE TO OTHER DCF MODELS, ALL ELSE HELD CONSTANT?**

A. Yes. The DCF Model I employed in this case results in a higher DCF cost of equity estimate than the annual or semi-annual DCF Models due to the quarterly compounding of dividends inherent in the model. In essence, the Quarterly Compounding DCF Model I used results in the *highest* cost of equity estimate, all else held constant.

**Q. ARE THE STOCK PRICE AND DIVIDEND INPUTS FOR EACH PROXY COMPANY A SIGNIFICANT ISSUE IN THIS CASE?**

A. No. Although my stock price and dividend inputs are more recent than those used by Mr. Hevert, there is not a statistically significant difference between them because utility stock prices and dividends are generally quite stable. This is another reason that cost of capital models such as the CAPM and the DCF Model are well-suited to be conducted on utilities. The differences between my DCF Model and Mr. Hevert's DCF Model are primarily driven by differences in our growth rate estimates, which are further discussed below.

## C. Growth Rate

**Q. SUMMARIZE THE GROWTH RATE INPUT IN THE DCF MODEL.**

A. The most critical input in the DCF Model is the growth rate. Unlike the stock price and dividend inputs, the growth rate input must be estimated. As a result, the growth rate is often the most contentious DCF input in utility rate cases. The DCF model used in this case is based on the constant growth valuation model. Under this model, a stock is valued by the present value of its future cash flows in the form of dividends. Before future cash flows are discounted by the cost of equity, however, they must be "grown" into the future by a long-term growth rate. As stated above, one of the inherent assumptions of this model is that these cash flows in the form of dividends grow at a constant rate forever. Thus, the growth rate term in the constant growth DCF model is often called the "constant," "stable," or "terminal" growth rate. For young, high-growth firms, estimating the growth rate to be used in the model can be especially difficult, and may require the use of multi-stage growth models. For mature, low-growth firms such as utilities, however, estimating the terminal growth rate is more transparent. The growth term of the DCF Model is one of the most important, yet apparently most misunderstood aspects of cost of equity estimations in utility regulatory proceedings. Therefore, I have devoted a more detailed explanation of this issue in the following sections, which are organized as follows:

(1) The Various Determinants of Growth

(2) Reasonable Estimates for Long-Term Growth

(3) Quantitative vs. Qualitative Determinants of Utility Growth: Circular References, "Flatworm" Growth, and the Problem with Analysts' Growth Rates

(4) Growth Rate Recommendation

### 1. <u>The Various Determinants of Growth</u>

**Q. DESCRIBE THE VARIOUS DETERMINANTS OF GROWTH.**

A. Although the DCF Model directly considers the growth of dividends, there are a variety of growth determinants that should be considered when estimating growth rates. It should be noted that these various growth determinants are used primarily to determine the short-term growth rates in multi-stage DCF models. For utility companies, it is necessary to focus primarily on long-term growth rates, which are discussed in the following section.

That is not to say that these growth determinants cannot be considered when estimating long-term growth; however, as discussed below, long-term growth must be constrained much more than short-term growth, especially for young firms with high growth opportunities. Additionally, I briefly discuss these growth determinants here because it may reveal some of the source of confusion in this area.

1. Historical Growth

Looking at a firm's actual historical experience may theoretically provide a good starting point for estimating short-term growth. However, past growth is not always a good indicator of future growth. Some metrics that might be considered here are historical growth in revenues, operating income, and net income. Since dividends are paid from earnings, estimating historical earnings growth may provide an indication of future earnings and dividend growth. In general, however, revenue growth tends to be more consistent and predictable than earnings growth because it is less likely to be influenced by accounting adjustments.[55]

2. Analyst Growth Rates

Analyst growth rates refer to short-term projections of earnings growth published by institutional research analysts such as Value Line and Bloomberg. A more detailed discussion of analyst growth rates, including the problems with using them in the DCF Model to estimate utility cost of equity, is provided in a later section.

[55] *See* Aswath Damodaran, *Investment Valuation: Tools and Techniques for Determining the Value of Any Asset* 279 (3rd ed., John Wiley & Sons, Inc. 2012).

3. Fundamental Determinants of Growth

Fundamental growth determinants refer to firm-specific financial metrics that arguably provide better indications of near-term sustainable growth. One such metric for fundamental growth considers the return on equity and the retention ratio. The idea behind this metric is that firms with high ROEs and retention ratios should have higher opportunities for growth.[56]

**Q. DID YOU USE ANY OF THESE GROWTH DETERMINANTS IN YOUR DCF MODEL?**

A. No. Primarily, these growth determinants discussed above would provide better indications of short to mid-term growth for firms with average to high growth opportunities. However, utilities are mature, low-growth firms. While it may not be unreasonable on its face to use any of these growth determinants for the growth input in the DCF Model, we must keep in mind that the stable growth DCF Model considers only *long-term* growth rates, which are constrained by certain economic factors, as discussed further below.

**2. Reasonable Estimates for Long-Term Growth**

**Q. DESCRIBE WHAT IS MEANT BY LONG-TERM GROWTH.**

A. In order to make the DCF a viable, practical model, an infinite stream of future cash flows must be estimated and then discounted back to the present. Otherwise, each annual cash

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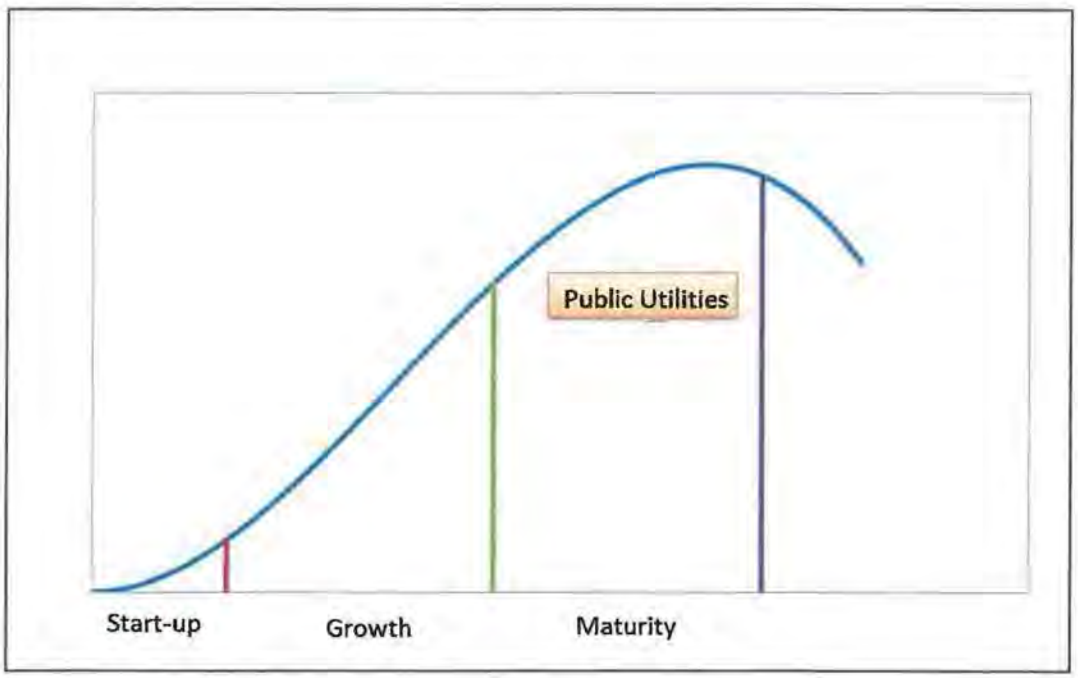
[56] *Id*. at 291-292.

flow would have to be estimated separately. Some analysts use "multi-stage" DCF Models to estimate the value of high-growth firms through two or more stages of growth, with the final stage of growth being constant. However, it is not necessary to use multi-stage DCF Models to analyze the cost of equity of regulated utility companies. This is because regulated utilities are already in their "terminal," low growth stage. Unlike most competitive firms, the growth of regulated utilities is constrained by physical service territories and limited primarily by the customer and load growth within those territories. The figure below illustrates the well-known business/industry life-cycle pattern.

**Figure 7:**
**Industry Life Cycle**




In an industry's early stages, there are ample opportunities for growth and profitable reinvestment. In the maturity stage however, growth opportunities diminish, and firms choose to pay out a larger portion of their earnings in the form of dividends instead of reinvesting them in operations to pursue further growth opportunities. Once a firm is in the maturity stage, it is not necessary to consider higher short-term growth metrics in multi-stage DCF Models; rather, it is sufficient to analyze the cost of equity using a stable growth DCF Model with one terminal, long-term growth rate. Because utilities are in their maturity stage, their real growth opportunities are primarily limited to the population growth within their defined service territories, which is usually less than 2%.

**Q. IS IT TRUE THAT THE TERMINAL GROWTH RATE CANNOT EXCEED THE GROWTH RATE OF THE ECONOMY, ESPECIALLY FOR A REGULATED UTILITY COMPANY?**

A. Yes. A fundamental concept in finance is that no firm can grow forever at a rate higher than the growth rate of the economy in which it operates.[57] Thus, the terminal growth rate used in the DCF Model should not exceed the aggregate economic growth rate. This is especially true when the DCF Model is conducted on public utilities because these firms have defined service territories. As stated by Dr. Damodaran:

> "If a firm is a purely domestic company, either because of internal constraints . . . or external constraints (such as those imposed by a government), the growth rate in the domestic economy will be the limiting value."[58]

In fact, it is reasonable to assume that a regulated utility would grow at a rate that is *less* than the U.S. economic growth rate. Unlike competitive firms, which might increase their growth by launching a new product line, franchising, or expanding into new and developing

[57] *See generally* Aswath Damodaran, *Investment Valuation: Tools and Techniques for Determining the Value of Any Asset* 306 (3rd ed., John Wiley & Sons, Inc. 2012).

[58] *Id.*

markets, utility operating companies with defined service territories cannot do any of these things to grow. Gross domestic product ("GDP") is one of the most widely used measures of economic production and is used to measure aggregate economic growth. According to the Congressional Budget Office's Budget Outlook, the long-term forecast for nominal U.S. GDP growth is 3.9%, which includes an inflation rate of 2%.[59] For mature companies in mature industries, such as utility companies, the terminal growth rate will likely fall between the expected rate of inflation and the expected rate of nominal GDP growth. Thus, PGS's terminal growth rate is realistically between 2% and 4%.

**Q. IS IT REASONABLE TO ASSUME THAT THE TERMINAL GROWTH RATE WILL NOT EXCEED THE RISK-FREE RATE?**

A. Yes. In the long term, the risk-free rate will converge on the growth rate of the economy. For this reason, financial analysts sometimes use the risk-free rate for the terminal growth rate value in the DCF model.[60] I discuss the risk-free rate in further detail later in this testimony.

**Q. PLEASE SUMMARIZE THE VARIOUS LONG-TERM GROWTH RATE ESTIMATES THAT CAN BE USED AS THE TERMINAL GROWTH RATE IN THE DCF MODEL.**

A. The reasonable long-term growth rate determinants are summarized as follows:

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[59] Congressional Budget Office – The 2019 Long-Term Budget Outlook p. 54, https://www.cbo.gov/publication/55331.

[60] Aswath Damodaran, *Investment Valuation: Tools and Techniques for Determining the Value of Any Asset* 307 (3rd ed., John Wiley & Sons, Inc. 2012).

1. Nominal GDP Growth

2. Inflation

3. Current Risk-Free Rate

Any of the foregoing growth determinants could provide a reasonable input for the terminal growth rate in the DCF Model for a utility company, including PGS.[61] In general, we should expect that utilities will, at the very least, grow at the rate of projected inflation. However, the long-term growth rate of any U.S. company, especially utilities, will be constrained by nominal U.S. GDP growth.

**3. <u>Qualitative Growth: The Problem with Analysts' Growth Rates</u>**

**Q. DESCRIBE THE DIFFERENCES BETWEEN "QUANTITATIVE" AND "QUALITATIVE" GROWTH DETERMINANTS.**

A. Assessing "quantitative" growth simply involves mathematically calculating a historic metric for growth (such as revenues or earnings) or calculating various fundamental growth determinants using various figures from a firm's financial statements (such as ROE and the retention ratio). However, any thorough assessment of company growth should be based upon a "qualitative" analysis. Such an analysis would consider specific strategies that company management will implement to achieve a sustainable growth in earnings. Therefore, it is important to begin the analysis of PGS' growth rate with this simple, qualitative question: How is this regulated utility going to achieve a sustained growth in earnings? If this question were asked of a competitive firm, there could be several answers

[61] Any extraordinary growth and additional risk resulting from PGS's discretionary venture into providing liquefied natural gas (LNG) services to end users in domestic and foreign markets may not be properly attributable to its regulated operations.]

depending on the type of business model, such as launching a new product line, franchising, rebranding to target a new demographic, or expanding into a developing market. Regulated utilities, however, cannot engage in these potential growth opportunities.

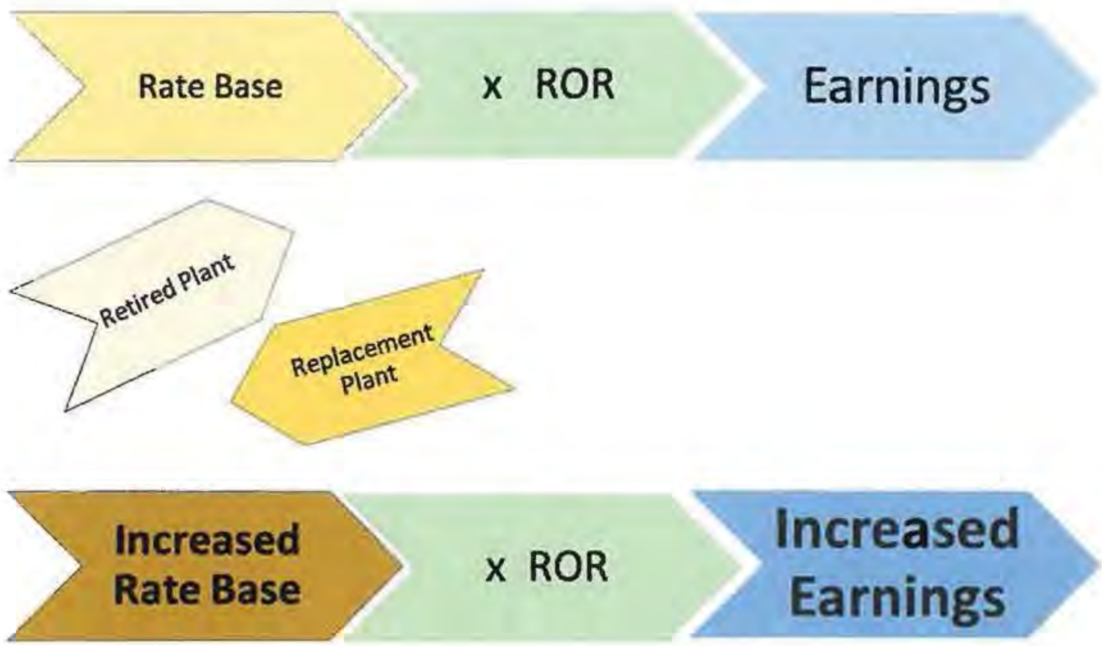
**Q. WHY IS IT ESPECIALLY IMPORTANT TO EMPHASIZE REAL, QUALITATIVE GROWTH DETERMINANTS WHEN ANALYZING THE GROWTH RATES OF REGULATED UTILITIES?**

A. While qualitative growth analysis is important regardless of the entity being analyzed, it is especially important in the context of utility ratemaking. This is because the rate base rate of return model inherently possesses two factors that can contribute to distorted views of utility growth when considered exclusively from a quantitative perspective. These two factors are (1) rate base and (2) the awarded ROE. I will discuss each factor further below. It is important to keep in mind that the ultimate objective of this analysis is to provide a foundation upon which to base the fair rate of return for the utility. Thus, we should strive to ensure that each individual component of the financial models used to estimate the cost of equity are also "fair." If we consider only quantitative growth determinants, it may lead to projected growth rates that are overstated and ultimately unfair, because they result in inflated cost of equity estimates.

**Q. HOW DOES RATE BASE RELATE TO GROWTH DETERMINANTS FOR UTILITIES?**

A. Under the rate base rate of return model, a utility's rate base is multiplied by its awarded rate of return to produce the required level of operating income. Therefore, increases to rate base generally result in increased earnings. Thus, utilities have a natural financial incentive to increase rate base. In short, utilities have a financial incentive to increase rate base regardless of whether such increases are driven by a corresponding increase in demand. Under these circumstances, utilities have been able to increase their rate bases by a far greater extent than what any concurrent increase in demand would have required. In other words, utilities "grew" their earnings by simply retiring old assets and replacing them with new assets. If the tail of a flatworm is removed and regenerated, it does not mean the flatworm actually grew. Likewise, if a competitive, unregulated firm announced plans to close production plants and replace them with new plants, it would not be considered a real determinant of growth unless analysts believed this decision would directly result in increased market share for the company and a real opportunity for sustained increases in revenues and earnings. In the case of utilities, the mere replacement of old plant with new plant does not increase market share, attract new customers, create franchising opportunities, or allow utilities to penetrate developing markets, but may result in short-term, quantitative earnings growth. This "flatworm growth" in earnings was merely the quantitative byproduct of the rate base rate of return model, and not an indication of real, fair, or qualitative growth. The following diagram illustrates this concept.

**Figure 8:**
**Analysts' Earnings Growth Projections: The "Flatworm Growth" Problem**




Of course, utilities might sometimes add new plant to meet a modest growth in customer demand. However, as the foregoing discussion demonstrates, it would be more appropriate to consider load growth projections and other qualitative indicators, rather than mere increases to rate base or earnings, to attain a fair assessment of growth.

**Q. PLEASE DISCUSS THE OTHER WAY IN WHICH ANALYSTS' EARNINGS GROWTH PROJECTIONS DO NOT PROVIDE INDICATIONS OF FAIR, QUALITATIVE GROWTH FOR REGULATED UTILITIES.**

A. If we give undue weight to analysts' projections for utilities' earnings growth, it will not provide an accurate reflection of real, qualitative growth because a utility's earnings are heavily influenced by the ultimate figure that all this analysis is supposed to help us estimate: the awarded return on equity. This creates a circular reference problem or feedback loop. In other words, if a regulator awards an ROE that is above market-based cost of capital (which is often the case, as discussed above), this could lead to higher short-term growth rate projections from analysts. If these same inflated, short-term growth rate estimates are used in the DCF Model (and they often are by utility witnesses), it could lead to higher awarded ROEs; and the cycle continues, as illustrated in the following figure:

**Figure 9:**
**Analysts' Earnings Growth Projections: The "Circular Reference" Problem**


Therefore, it is not advisable to simply consider the quantitative growth projections published by analysts, as this practice will not necessarily provide fair indications of real utility growth.

**Q. ARE THERE ANY OTHER PROBLEMS WITH RELYING ON ANALYSTS' GROWTH PROJECTIONS?**

A. Yes. While the foregoing discussion shows two reasons why we cannot rely on analysts' growth rate projections to provide fair, qualitative indicators of utility growth in a stable growth DCF Model, the third reason is perhaps the most obvious and indisputable. Various institutional analysts, such as Zacks, Value Line, and Bloomberg, publish estimated projections of earnings growth for utilities. These estimates, however, are *short-term* growth rate projections, ranging from 3 – 10 years. Many utility ROE analysts, however, inappropriately insert these short-term growth projections into the DCF Model as *long-term* growth rate projections. For example, assume that an analyst at Bloomberg estimates that a utility's earnings will grow by 7% per year over the next 3 years. This analyst may have based this short-term forecast on a utility's plans to replace depreciated rate base (i.e., "flatworm" growth) or on an anticipated awarded return that is above market-based cost of equity (i.e., "circular reference" problem). When a utility witness uses this figure in a DCF Model, however, it is the *witness*, not the Bloomberg analyst that is testifying to the regulator that the utility's earnings will qualitatively grow by 7% per year over the *long-term*, which is an unrealistic assumption.

**4. Long-Term Growth Rate Recommendation**

**Q. DESCRIBE THE GROWTH RATE INPUT USED IN YOUR DCF MODEL.**

A. I considered various qualitative determinants of growth for the Company, along with the maximum allowed growth rate under basic principles of finance and economics. The following chart shows the various long-term growth determinants discussed in this section.[62]

**Figure 10:**
**Terminal Growth Rate Determinants**

| Terminal Growth Determinants | Rate |
|---|---|
| Nominal GDP | 3.9% |
| Inflation | 2.0% |
| Risk Free Rate | 1.4% |
| **Highest** | **3.9%** |

For the long-term growth rate in my DCF model, I selected the maximum, reasonable long-term growth rate of 3.90%, which means my model assumes that the Company's qualitative growth in earnings will match the nominal growth rate of the entire U.S. economy over the long run.

**Q. PLEASE DESCRIBE THE FINAL RESULTS OF YOUR DCF MODEL.**

A. I used the Quarterly Approximation DCF Model discussed above to estimate the Company's cost of equity capital. I obtained an average of reported dividends and stock prices from the proxy group, and I used a reasonable terminal growth rate estimate for the Company. Applying this model, my DCF cost of equity estimate for the Company is 7.3%.[63] As noted above, this estimate is likely at the higher end of the reasonable range due to my relatively high estimate for the long-term growth rate. That is, my long-term

[62] Exhibit DJG-5.

[63] Exhibit DJG-6.

growth rate input assumes PGS' earnings will qualitatively grow at the same rate as the U.S. economy over the long-run — a very generous assumption.

### D. <u>Response to Mr. Hevert's DCF Model</u>

**Q. MR. HEVERT'S DCF MODEL YIELDED MUCH HIGHER RESULTS. DID YOU FIND ANY ERRORS IN HIS ANALYSIS?**

A. Yes, I found several errors. Mr. Hevert's DCF Model produced cost of equity results as high as 13%.[64] The results of Mr. Hevert's DCF Model are overstated primarily because of a fundamental error regarding his growth rate inputs.

#### 1. <u>Long-Term Growth Rates</u>

**Q. DESCRIBE THE PROBLEMS WITH MR. HEVERT'S LONG-TERM GROWTH INPUT.**

A. Mr. Hevert used long-term growth rates in his proxy group as high as 22%,[65] which is more than five times higher than the projected, long-term nominal U.S. GDP growth (approximately 4.0%). This means Mr. Hevert's growth rate assumption violates the basic principle that no company can grow at a greater rate than the economy in which it operates over the long-term, especially a regulated utility company with a defined service territory. Furthermore, Mr. Hevert used short-term, quantitative growth estimates published by analysts. As discussed above, these analysts' estimates are inappropriate to use in the DCF

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[64] Exhibit No. (RBH-1), Document No. 2.

[65] *Id.*

Model as long-term growth rates because they are estimates for short-term growth. For example, Mr. Hevert incorporated a 22% long-term growth rate for Northwest Natural Holding Company ("NWN"), which was reported by Value Line.[66] This means that an analyst from Value Line apparently thinks that NWN's earnings will quantitatively increase by 22% each year over the next *several* years. However, it is Mr. Hevert, not the Value Line analyst, who is suggesting to the Commission that NWN's earnings will grow by three times the amount of U.S. GDP growth every year for many decades into the future.[67] This assumption is simply not realistic, and it contradicts fundamental concepts of long-term growth. The growth rate assumptions used by Mr. Hevert for many of the proxy companies suffer from the same unrealistic assumptions.[68]

**2. <u>Flotation Costs</u>**

**Q. WHAT ADDITIONAL ERRORS DID YOU FIND IN MR. HEVERT'S DCF ANALYSIS?**

A. A proper DCF analysis considers the market-based stock price of a firm for the stock price input of the model. In this case, Mr. Hevert inappropriately considered flotation costs when making his awarded return recommendation.[69] When companies issue equity securities, they typically hire at least one investment bank as an underwriter for the securities.

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[66] *Id.*

[67] *Id.* Technically, the constant growth rate in the DCF Model grows dividends each year to "infinity." Yet, even if we assumed that the growth rate applied to only a few decades, the annual growth rate would still be too high to be considered realistic.

[68] *Id.*

[69] *See* Direct Testimony of Robert B. Hevert, p. 42.

"Flotation costs" generally refer to the underwriter's compensation for the services it provides in connection with the securities offering.

**Q. DO YOU AGREE WITH MR. HEVERT THAT FLOTATION COSTS SHOULD BE CONSIDERED WHEN ASSESSING THE COMPANY'S COST OF EQUITY?**

A. No. Mr. Hevert's flotation cost allowance is inappropriate for several reasons, as discussed further below.

1. <u>Flotation costs are not actual "out-of-pocket" costs.</u>

The Company has not experienced any out-of-pocket costs for flotation. Underwriters are not compensated in this fashion. Instead, underwriters are compensated through an "underwriting spread." An underwriting spread is the difference between the price at which the underwriter purchases the shares from the firm, and the price at which the underwriter sells the shares to investors.[70] Furthermore, PGS is not a publicly traded company, which means it does not issue securities to the public and thus would have no need to retain an underwriter. Accordingly, the Company has not experienced any out-of-pocket flotation costs, and if it has, those costs should be included in the Company's expense schedules.

2. <u>The market already accounts for flotation costs.</u>

When an underwriter markets a firm's securities to investors, the investors are well aware of the underwriter's fees. In other words, the investors know that a portion of the price they are paying for the shares does not go directly to the company, but instead goes

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[70] *See* John R. Graham, Scott B. Smart & William L. Megginson, *Corporate Finance: Linking Theory to What Companies Do* 509 (3rd ed., South Western Cengage Learning 2010).

to compensate the underwriter for its services. In fact, federal law requires that the underwriter's compensation be disclosed on the front page of the prospectus.[71] Thus, investors have already considered and accounted for flotation costs when making their decision to purchase shares at the quoted price. As a result, there is no need for PGS' shareholders to receive additional compensation to account for costs they have already considered and agreed to. We see similar compensation structures in other kinds of business transactions. For example, a homeowner may hire a realtor and sell a home for \$100,000. After the realtor takes a six percent commission, the seller nets \$94,000. The buyer and seller agreed to the transaction notwithstanding the realtor's commission. Obviously, it would be unreasonable for the buyer or seller to demand additional funds from anyone after the deal is completed to reimburse them for the realtor's fees. Likewise, investors of competitive firms do not expect additional compensation for flotation costs. Thus, it would not be appropriate for a commission standing in the place of competition to award a utility's investors with this additional compensation.

3. <u>It is inappropriate to add any additional basis points to an awarded ROE proposal that is already far above the Company's cost of equity.</u>

For the reasons discussed above, flotation costs should be disallowed from a technical standpoint; they should also be disallowed from a practical standpoint. PGS is asking this Commission to award it a cost of equity that is more than 300 basis points above its market-based cost of equity. Under these circumstances, it is especially inappropriate

[71] *See* Regulation S-K, 17 C.F.R. § 229.501(b)(3) (requiring that the underwriter's discounts and commissions be disclosed on the outside cover page of the prospectus). A prospectus is a legal document that provides details about an investment offering.

to suggest that flotation costs should be considered in any way to increase an already inflated ROE proposal.

## VII. CAPITAL ASSET PRICING MODEL ANALYSIS

**Q. DESCRIBE THE CAPITAL ASSET PRICING MODEL.**

A. The Capital Asset Pricing Model ("CAPM") is a market-based model founded on the principle that investors expect higher returns for incurring additional risk.[72] The CAPM estimates this expected return. The various assumptions, theories, and equations involved in the CAPM are discussed further in Exhibit DJG 25, Appendix B. Using the CAPM to estimate the cost of equity of a regulated utility is consistent with the legal standards governing the fair rate of return. The U.S. Supreme Court has recognized that "the amount of *risk* in the business is a most important factor" in determining the allowed rate of return,[73] and that "the return to the equity owner should be commensurate with returns on investments in other enterprises having corresponding *risks*."[74] The CAPM is a useful model because it directly considers the amount of risk inherent in a business and directly measures the most important component of a fair rate of return analysis: Risk.

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[72] William F. Sharpe, *A Simplified Model for Portfolio Analysis* 277-93 (Management Science IX 1963); *see also* John R. Graham, Scott B. Smart & William L. Megginson, *Corporate Finance: Linking Theory to What Companies Do* 208 (3rd ed., South Western Cengage Learning 2010).

[73] *Wilcox*, 212 U.S. at 48 (emphasis added).

[74] *Hope Natural Gas Co.*, 320 U.S. at 603 (emphasis added).

**Q. DESCRIBE THE INPUTS FOR THE CAPM.**

A. The basic CAPM equation requires only three inputs to estimate the cost of equity: (1) the risk-free rate; (2) the beta coefficient; and (3) the equity risk premium. Each input is discussed separately below.

### A. <u>The Risk-Free Rate</u>

**Q. EXPLAIN THE RISK-FREE RATE.**

A. The first term in the CAPM is the risk-free rate ($R_F$). The risk-free rate is simply the level of return investors can achieve without assuming any risk. The risk-free rate represents the bare minimum return that any investor would require on a risky asset. Even though no investment is technically void of risk, investors often use U.S. Treasury securities to represent the risk-free rate because they accept that those securities essentially contain no default risk. The Treasury issues securities with different maturities, including short-term Treasury Bills, intermediate-term Treasury Notes, and long-term Treasury Bonds.

**Q. IS IT PREFERABLE TO USE THE YIELD ON LONG-TERM TREASURY BONDS FOR THE RISK-FREE RATE IN THE CAPM?**

A. Yes. In valuing an asset, investors estimate cash flows over long periods of time. Common stock is viewed as a long-term investment, and the cash flows from dividends are assumed to last indefinitely. As a result, short-term Treasury bill yields are rarely used in the CAPM to represent the risk-free rate. Short-term rates are subject to greater volatility and thus can lead to unreliable estimates. Instead, long-term Treasury bonds are usually used to represent the risk-free rate in the CAPM. I considered a 30-day average of daily Treasury yield curve rates on 30-year Treasury bonds in my risk-free rate estimate, which resulted in a risk-free rate of 1.41%.[75]

## B. The Beta Coefficient

**Q. HOW IS THE BETA COEFFICIENT USED IN THIS MODEL?**

A. As discussed above, beta represents the sensitivity of a given security to movements in the overall market. The CAPM states that in efficient capital markets, the expected risk premium on each investment is proportional to its beta. Recall that a security with a beta greater (less) than one is more (less) risky than the market portfolio. An index such as the S&P 500 Index is used as a proxy for the market portfolio. The historical betas for publicly traded firms are published by various institutional analysts. Beta may also be calculated through a linear regression analysis, which provides additional statistical information about the relationship between a single stock and the market portfolio. As discussed above, beta also represents the sensitivity of a given security to the market as a whole. The market portfolio of all stocks has a beta equal to one. Stocks with betas greater than one are relatively more sensitive to market risk than the average stock. For example, if the market increases (decreases) by 1.0%, a stock with a beta of 1.5 will, on average, increase (decrease) by 1.5%. In contrast, stocks with betas of less than one are less sensitive to market risk. For example, if the market increases (decreases) by 1.0%, a stock with a beta of 0.5 will, on average, only increase (decrease) by 0.5%.

[75] Exhibit DJG-7.

**Q. DESCRIBE THE SOURCE FOR THE BETAS YOU USED IN YOUR CAPM ANALYSIS.**

A. I used betas recently published by Value Line Investment Survey. The beta for each proxy company is less than 1.0, and the average beta for the proxy group is only 0.85.[76] Thus, we have an objective measure to prove the well-known concept that utility stocks are less risky than the average stock in the market. While there is evidence suggesting that betas published by sources such as Value Line may actually overestimate the risk of utilities (and thus overestimate the CAPM), I used the betas published by Value Line in the interest of reasonableness.[77]

### C. The Equity Risk Premium

**Q. DESCRIBE THE EQUITY RISK PREMIUM.**

A. The final term of the CAPM is the equity risk premium ("ERP"), which is the required return on the market portfolio less the risk-free rate ($R_M - R_F$). In other words, the ERP is the level of return investors expect above the risk-free rate in exchange for investing in risky securities. Many experts agree that "the single most important variable for making investment decisions is the equity risk premium."[78] Likewise, the ERP is arguably the single most important factor in estimating the cost of capital in this matter. There are three basic methods that can be used to estimate the ERP: (1) calculating a historical average;

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[76] Exhibit DJG-8.

[77] *See* Appendix B for a more detailed discussion of raw beta calculations and adjustments.

[78] Elroy Dimson, Paul Marsh & Mike Staunton, *Triumph of the Optimists: 101 Years of Global Investment Returns* 4 (Princeton University Press 2002).

(2) taking a survey of experts; and (3) calculating the implied ERP. I will discuss each method in turn, noting advantages and disadvantages of these methods.

### 1. <u>HISTORICAL AVERAGE</u>

**Q. DESCRIBE THE HISTORICAL EQUITY RISK PREMIUM.**

A. The historical ERP may be calculated by simply taking the difference between returns on stocks and returns on government bonds over a certain period of time. Many practitioners rely on the historical ERP as an estimate for the forward-looking ERP because it is easy to obtain. However, there are disadvantages to relying on the historical ERP.

**Q. WHAT ARE THE LIMITATIONS OF RELYING SOLELY ON A HISTORICAL AVERAGE TO ESTIMATE THE CURRENT OR FORWARD-LOOKING ERP?**

A. As I mentioned, many investors use the historic ERP because it is convenient and easy to calculate. What matters in the CAPM model, however, is not the actual risk premium from the past, but rather the current and forward-looking risk premium.[79] Some investors may think that a historic ERP provides some indication of what the prospective risk premium is; however, there is empirical evidence to suggest the prospective, forward-looking ERP is actually *lower* than the historical ERP. In a landmark publication on risk premiums around the world, *Triumph of the Optimists*, the authors suggest through extensive empirical research that the prospective ERP is lower than the historical ERP.[80] This is due

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[79] John R. Graham, Scott B. Smart & William L. Megginson, *Corporate Finance: Linking Theory to What Companies Do* 330 (3rd ed., South Western Cengage Learning 2010).

[80] Elroy Dimson, Paul Marsh & Mike Staunton, Triumph of the Optimists: 101 Years of Global Investment Returns 194 (Princeton University Press 2002).

in large part to what is known as "survivorship bias" or "success bias" — a tendency for failed companies to be excluded from historical indices.[81] From their extensive analysis, the authors make the following conclusion regarding the prospective ERP:

> The result is a forward-looking, geometric mean risk premium for the United States . . . of around 2½ to 4 percent and an arithmetic mean risk premium . . . that falls within a range from a little below 4 to a little above 5 percent.[82]

Indeed, these results are lower than many reported historical risk premiums. Other noted experts agree:

> The historical risk premium obtained by looking at U.S. data is biased upwards because of survivor bias. . . . The true premium, it is argued, is much lower. This view is backed up by a study of large equity markets over the twentieth century (*Triumph of the Optimists*), which concluded that the historical risk premium is closer to 4%.[83]

Regardless of the variations in historic ERP estimates, many leading scholars and practitioners agree that simply relying on a historic ERP to estimate the risk premium going forward is not ideal. Fortunately, "a naïve reliance on long-run historical averages is not the only approach for estimating the expected risk premium."[84]

**Q. DID YOU RELY ON THE HISTORICAL ERP AS PART OF YOUR CAPM ANALYSIS IN THIS CASE?**

A. No. Due to the limitations of this approach, I primarily relied on the ERP reported in expert surveys and the implied ERP method discussed below.

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[81] *Id.* at 34.

[82] *Id.* at 194.

[83] Aswath Damodaran, *Equity Risk Premiums: Determinants, Estimation and Implications – The 2015 Edition* 17 (New York University 2015).

[84] John R. Graham, Scott B. Smart & William L. Megginson, *Corporate Finance: Linking Theory to What Companies Do* 330 (3rd ed., South Western Cengage Learning 2010).

### 2. <u>EXPERT SURVEYS</u>

**Q. DESCRIBE THE EXPERT SURVEY APPROACH TO ESTIMATING THE ERP.**

A. As its name implies, the expert survey approach to estimating the ERP involves conducting a survey of experts including professors, analysts, chief financial officers and other executives around the country and asking them what they think the ERP is. Graham and Harvey have performed such a survey since 1996. In their 2018 survey, they found that experts around the country believe the current ERP is only 4.4%.[85] The IESE Business School conducts a similar expert survey. Their 2020 expert survey reported an average ERP of 5.6%.[86]

### 3. <u>IMPLIED EQUITY RISK PREMIUM</u>

**Q. DESCRIBE THE IMPLIED EQUITY RISK PREMIUM APPROACH.**

A. The third method of estimating the ERP is arguably the best. The implied ERP relies on the stable growth model proposed by Gordon, often called the "Gordon Growth Model," which is a basic stock valuation model widely used in finance for many years.[87] This model is a mathematical derivation of the DCF Model. In fact, the underlying concept in both models is the same: The current value of an asset is equal to the present value of its future

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[85] John R. Graham and Campbell R. Harvey, *The Equity Risk Premium in 2018*, at 3 (Fuqua School of Business, Duke University 2014), copy available at https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3151162.

[86] Pablo Fernandez, Pablo Linares & Isabel F. Acin, *Market Risk Premium used in 59 Countries in 2018: A Survey,* at 3 (IESE Business School 2018), copy available at http://www.valumonics.com/wp-content/uploads/2017/06/Discount-rate-Pablo-Fern%C3%A1ndez.pdf. IESE Business School is the graduate business school of the University of Navarra. IESE offers Master of Business Administration (MBA), Executive MBA and Executive Education programs. IESE is consistently ranked among the leading business schools in the world.

[87] Myron J. Gordon and Eli Shapiro, *Capital Equipment Analysis: The Required Rate of Profit* 102-10 (Management Science Vol. 3, No. 1 Oct. 1956).

cash flows. Instead of using this model to determine the discount rate of one company, we can use it to determine the discount rate for the entire market by substituting the inputs of the model. Specifically, instead of using the current stock price ($P_0$), we will use the current value of the S&P 500 ($V_{500}$). Instead of using the dividends of a single firm, we will consider the dividends paid by the entire market. Additionally, we should consider potential dividends. In other words, stock buybacks should be considered in addition to paid dividends, as stock buybacks represent another way for the firm to transfer free cash flow to shareholders. Focusing on dividends alone without considering stock buybacks could understate the cash flow component of the model, and ultimately understate the implied ERP. The market dividend yield plus the market buyback yield gives us the gross cash yield to use as our cash flow in the numerator of the discount model. This gross cash yield is increased each year over the next five years by the growth rate. These cash flows must be discounted to determine their present value. The discount rate in each denominator is the risk-free rate ($R_F$) plus the discount rate (K). The following formula shows how the implied return is calculated. Since the current value of the S&P is known, we can solve for K: The implied market return.[88]

**Equation 2:**
**Implied Market Return**

$$V_{500} = \frac{CY_1(1+g)^1}{(1+R_F+K)^1} + \frac{CY_2(1+g)^2}{(1+R_F+K)^2} + \cdots + \frac{CY_5(1+g)^5 + TV}{(1+R_F+K)^5}$$

[88] *See* Exhibit DJG-9 for detailed calculation.

*where:* $V_{500}$ = *current value of index (S&P 500)*
$CY_{1-5}$ = *average cash yield over last five years (includes dividends and buybacks)*
$g$ = *compound growth rate in earnings over last five years*
$R_F$ = *risk-free rate*
$K$ = *implied market return (this is what we are solving for)*
$TV$ = *terminal value* $= CY_5\,(1+R_F)\,/\,K$

The discount rate is called the "implied" return here because it is based on the current value of the index as well as the value of free cash flow to investors projected over the next five years. Thus, based on these inputs, the market is "implying" the expected return; or in other words, based on the current value of all stocks (the index price) and the projected value of future cash flows, the market is telling us the return expected by investors for investing in the market portfolio. After solving for the implied market return (K), we simply subtract the risk-free rate from it to arrive at the implied ERP.

**Equation 3:**
**Implied Equity Risk Premium**

$$Implied\ Expected\ Market\ Return - R_F = Implied\ ERP$$

**Q. DISCUSS THE RESULTS OF YOUR IMPLIED ERP CALCULATION.**

A. After collecting data for the index value, operating earnings, dividends, and buybacks for the S&P 500 over the past six years, I calculated the dividend yield, buyback yield, and gross cash yield for each year. I also calculated the compound annual growth rate (g) from operating earnings. I used these inputs, along with the risk-free rate and current value of the index to calculate a current expected return on the entire market of 7.21%.[89] I subtracted the risk-free rate to arrive at the implied equity risk premium of 5.8%.[90] Dr.

[89] *Id.*

[90] *Id.*

Damodaran, arguably one of the world's leading experts on the ERP, promotes the implied ERP method discussed above. Using variations of this method, he calculates and publishes his ERP results each month. Dr. Damodaran's *highest* ERP estimate for July 2020 using several implied ERP variations was only 5.68%.[91]

**Q. WHAT ARE THE RESULTS OF YOUR FINAL ERP ESTIMATE?**

A. For the final ERP estimate I used in my CAPM analysis, I considered the results of the ERP surveys, the implied ERP calculations discussed above, and the estimated ERP reported by Duff & Phelps.[92] The results are presented in the following figure:

**Figure 11:**
**Equity Risk Premium Results**

| | |
|---|---|
| IESE Business School Survey | 5.6% |
| Graham & Harvey Survey | 4.4% |
| Duff & Phelps Report | 6.0% |
| Damodaran | 5.7% |
| Garrett | 5.8% |
| **Average** | **5.5%** |
| **Highest** | **6.0%** |

While it would be reasonable to select any one of these ERP estimates to use in the CAPM, I conservatively selected the *highest* ERP estimate of 6.0% to use in my CAPM analysis.

[91] http://pages.stern.nyu.edu/~adamodar/

[92] *See also* Exhibit DJG-10.

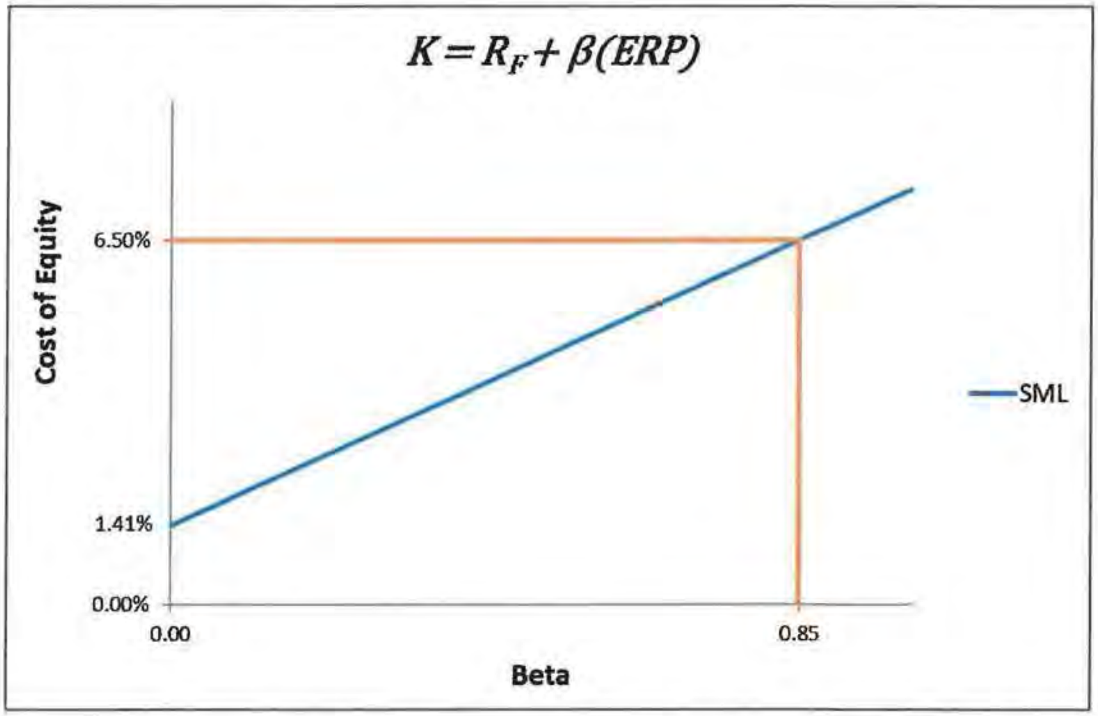
All else held constant, a higher ERP used in the CAPM will result in a higher cost of equity estimate.

**Q. PLEASE EXPLAIN THE FINAL RESULTS OF YOUR CAPM ANALYSIS.**

A. Using the inputs for the risk-free rate, beta coefficient, and equity risk premium discussed above, I estimate that the Company's CAPM cost of equity is 6.5%.[93] The CAPM can be displayed graphically through what is known as the Security Market Line ("SML"). The following figure shows the expected return (cost of equity) on the y-axis, and the average beta for the proxy group on the x-axis. The SML intercepts the y-axis at the level of the risk-free rate. The slope of the SML is the equity risk premium.

[93] Exhibit DJG-11.

**Figure 12:**
**CAPM Graph**




The SML provides the rate of return that will compensate investors for the beta risk of that investment. Thus, at an average beta of 0.85 for the proxy group, the estimated CAPM cost of equity for the Company is 6.5%.

### D. Response to Mr. Hevert's CAPM Analysis and Other Issues

**Q. MR. HEVERT'S CAPM ANALYSIS YIELDS CONSIDERABLY HIGHER RESULTS. DID YOU FIND SPECIFIC PROBLEMS WITH MR. HEVERT'S CAPM ASSUMPTIONS AND INPUTS?**

A. Yes. The results of Mr. Hevert's various CAPMs are as high as 14%,[94] which is considerably higher than my estimate. The main problem with Mr. Hevert's CAPM cost of equity result stems primarily from his estimate of the equity risk premium ("ERP").

#### 1. Equity Risk Premium

**Q. DID MR. HEVERT RELY ON A REASONABLE MEASURE FOR THE ERP?**

A. No, he did not. Mr. Hevert estimates an ERP as high as 13%.[95] The ERP is one of three inputs in the CAPM equation, and it is one of the most single important factors for estimating the cost of equity in this case. As discussed above, I used three widely accepted methods for estimating the ERP, including consulting expert surveys, calculating the implied ERP based on aggregate market data, and considering the ERPs published by reputable analysts. The highest ERP found from my research and analysis is only 6.0%.[96] This means that Mr. Hevert's ERP estimate is more than twice as high as the highest reasonable ERP I could either find or calculate. And, as noted, it is also considerably higher than that of reputable analysts.

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[94] Exhibit No. (RBH-1), Document No. 6.

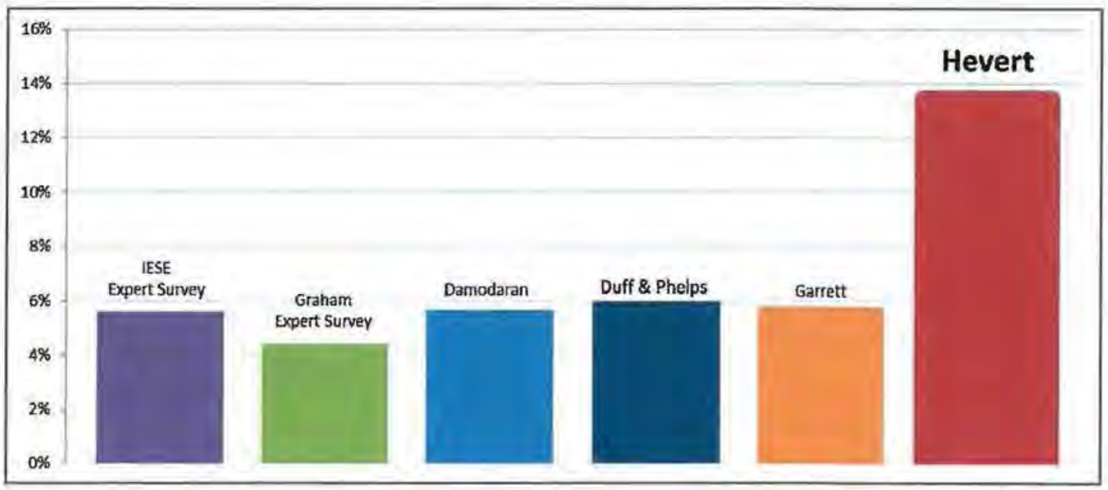
[95] *Id.*

[96] Exhibit DJG-10.

**Q. PLEASE DISCUSS AND ILLUSTRATE HOW MR. HEVERT'S ERP COMPARES WITH OTHER ESTIMATES FOR THE ERP.**

A. As discussed above, Graham and Harvey's 2018 expert survey reports an average ERP of 4.4%. The 2020 IESE Business School expert survey reports an average ERP of 5.6%. Similarly, Duff & Phelps recently estimated an ERP of 6.0%. The following chart illustrates that Mr. Hevert's ERP estimate is far out of line with industry norms.[97]

**Figure 13:**
**Equity Risk Premium Comparison**




When compared with other independent sources for the ERP (as well as my estimate), which do not have a wide variance, Mr. Hevert's ERP estimate is clearly not within the range of reasonableness. As a result, his CAPM cost of equity estimate is overstated and unreliable.

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[97] *See* Exhibit DJG-10. The ERP estimated by Dr. Damodaran is the highest of several ERP estimates under varying assumptions.

### 2. Other Risk Premium Analyses

**Q. DID YOU REVIEW MR. HEVERT'S OTHER RISK PREMIUM ANALYSES?**

A. Yes. I am addressing Mr. Hevert's other risk premium analyses in this section because the CAPM itself is a risk premium model. In this case, Mr. Hevert conducted what he calls a "bond yield plus risk premium" analysis.[98] Many utility-company ROE witnesses conduct what they call a "historical risk premium analysis," "bond yield plus risk premium analysis" or "allowed return premium analysis." In short, these types of analyses simply compare the difference between awarded ROEs in the past with bond yields.

**Q. DO YOU AGREE WITH THE RESULTS OF MR. HEVERT'S RISK PREMIUM ANALYSIS?**

A. No. I disagree with the entire premise of the analysis. First, Mr. Hevert looked at awarded ROEs dating back to 1980 — a direct contradiction to Mr. Hevert's claim that the cost of equity is a "forward-looking" concept.[99] As discussed earlier in this testimony, it is clear that awarded ROEs are consistently higher than market-based cost of equity, and they have been for many years. Thus, these types of risk premium "models" are merely clever devices used to perpetuate the discrepancy between awarded ROEs and market-based cost of equity. In other words, since awarded ROEs are consistently higher than market-based cost, a model that simply compares the discrepancy between awarded ROEs and any market-based factor (such as bond yields) will simply ensure that the discrepancy

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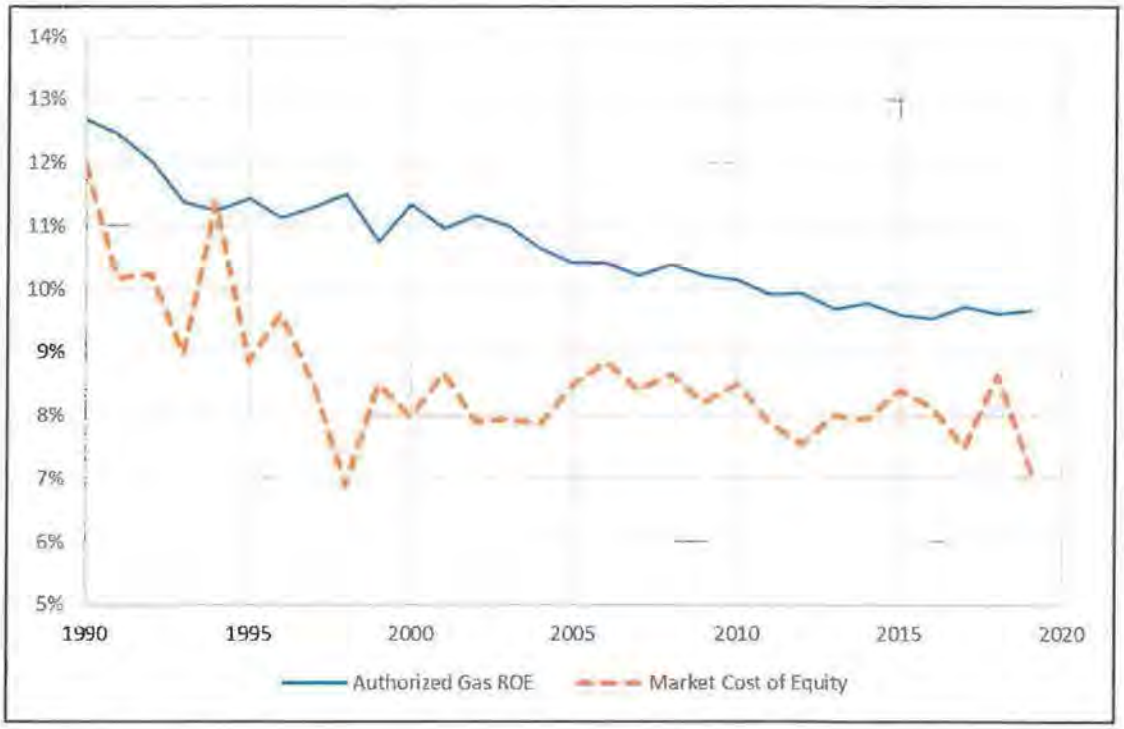
[98] Direct Testimony of Robert B. Hevert, p. 78.

[99] *See e.g.*, Direct Testimony of Robert B. Hevert, p. 68, lines 22-23.

continues. The following graph shows the clear disconnect between awarded ROEs and utility cost of equity.[100]




Since it is indisputable that utility stocks are *less risky* than average stock in the market (with a beta equal to 1.0), utility cost of equity is *below* the market cost of equity (the dotted line in the graph above). The gap between the market cost of equity and inflated ROEs represents an excess transfer of wealth from customers to shareholders.

Furthermore, the risk premium analysis offered by Mr. Hevert is completely unnecessary when we already have a real risk premium model to use: the CAPM. The CAPM itself is a "risk premium" model; it takes the bare minimum return any investor would require for buying a stock (the risk-free rate), then adds a *premium* to compensate

[100] *See also* Exhibit DJG-14.

the investor for the extra risk he or she assumes by buying a stock rather than a riskless U.S. Treasury security. The CAPM has been utilized by companies around the world for decades for the same purpose we are using it in this case — to estimate cost of equity.

In stark contrast to the Nobel-prize-winning CAPM, the risk premium models relied upon by utility ROE witnesses are not market-based, and therefore have no value in helping us estimate the market-based cost of equity. Unlike the CAPM, which is found in almost every comprehensive financial textbook, the risk premium models used by utility witnesses are almost exclusively found in the texts and testimonies of such witnesses. Specifically, these risk premium models attempt to create an inappropriate link between market-based factors, such as interest rates, with awarded returns on equity. Inevitably, this type of model is used to justify a cost of equity that is much higher than one that would be dictated by market forces.

## VIII. COST OF EQUITY SUMMARY

**Q. PLEASE SUMMARIZE THE RESULTS OF THE CAPM AND DCF MODEL DISCUSSED ABOVE.**

A. The following table shows the cost of equity results from each model I employed in this case.[101]

[101] *See* Exhibit DJG-12.

**Figure 14:**
**Cost of Equity Summary**

| Model | Cost of Equity |
|---|---|
| Discounted Cash Flow Model | 7.3% |
| Capital Asset Pricing Model | 6.5% |
| **Average** | **6.9%** |

The cost of equity indicated by the results of the DCF Model and the CAPM is approximately 6.9%.

**Q. IS THERE A MARKET INDICATOR THAT YOU CAN USE TO TEST THE REASONABLENESS OF YOUR COST OF EQUITY ESTIMATE?**

A. Yes, there is. The CAPM is a risk premium model based on the fact that all investors will require, at a minimum, a return equal to the risk-free rate when investing in equity securities. Of course, the investors will also require a premium on top of the risk-free rate to compensate them for the risk they have assumed. If an investor bought every stock in the market portfolio, he would require the risk-free rate, plus the ERP discussed above. Recall that the risk-free rate plus the ERP is called the required return on the market portfolio. This could also be called the market cost of equity. It is undisputed that the cost of equity of utility stocks must be less than the total market cost of equity. This is because utility stocks are less risky than the average stock in the market. (We proved this above by showing that utility betas were less than one). Therefore, once we determine the market cost of equity, it gives us a "ceiling" below which the Company's actual cost of equity must lie.

**Q. DESCRIBE HOW YOU ESTIMATED THE MARKET COST OF EQUITY.**

A. The methods used to estimate the market cost of equity are necessarily related to the methods used to estimate the ERP discussed above. In fact, the ERP is calculated by taking the market cost of equity less the risk-free rate. Therefore, in estimating the market cost of equity, I relied on the same methods discussed above to estimate the ERP: (1) consulting expert surveys; and (2) calculating the implied ERP. The results of my market cost of equity analysis are presented in the following table:[102]

**Figure 15:**
**Market Cost of Equity Summary**

| Source | Estimate |
|---|---|
| IESE Survey | 7.0% |
| Graham Harvey Survey | 5.8% |
| Duff & Phelps | 7.4% |
| Damodaran | 7.1% |
| Garrett | 7.2% |
| **Highest** | 7.4% |

As shown in this table, the average market cost of equity from these sources is only 7.4%. Therefore, it is not surprising that the CAPM and DCF Model indicate a cost of equity for the Company of only 6.9%. In other words, any cost of equity estimates for the Company

[102] *See* Exhibit DJG-13.

(or any regulated utility) that is *above* the market cost of equity should be viewed as unreasonable (again, the cost of equity is a different concept that the awarded ROE).

## IX. CONCLUSION AND RECOMMENDATION — COST OF CAPITAL

**Q. SUMMARIZE THE KEY POINTS OF YOUR COST OF CAPITAL TESTIMONY.**

A. The awarded ROE in this case should be based on PGS's cost of equity. Closely estimating the cost of equity with the CAPM and other models is a relatively straightforward process that has been used in the competitive marketplace for many decades. While regulators determine the awarded return for utilities, they do not determine the cost of capital, which is primarily driven by the equity risk premium and other market forces. Any objective estimation of PGS's cost of equity would result in one that is remarkably less than the awarded ROEs that are generally given to utility shareholders. While there may be policy reasons as to why the awarded return should be set higher than the cost of equity, we must be intellectually honest about where the cost of equity for a very low-risk company such as PGS actually is. Using reasonable and conservative inputs, the CAPM and DCF Model indicate that PGS's cost of equity is about 6.9%. This strongly indicates that the Company's proposed ROE of 10.75% is excessive and unreasonable.

**Q. PLEASE SUMMARIZE YOUR RECOMMENDATION TO THE COMMISSION REGARDING PGS'S COST OF CAPITAL.**

A. I recommend the Commission award the Company with a 9.5% ROE. Although PGS's cost of equity is clearly much lower than 9.5% by any objective measure, the Commission should gradually reduce PGS's awarded return towards market-based levels, consistent with the *Hope* Court's end result doctrine.

**Q. DOES THIS CONCLUDE THE COST OF CAPITAL PORTION OF YOUR TESTIMONY?**

A. Yes. The following sections of my testimony are related to depreciation.

## *PART TWO: DEPRECIATION*

### X. LEGAL STANDARDS

**Q. DISCUSS THE STANDARD BY WHICH REGULATED UTILITIES ARE ALLOWED TO RECOVER DEPRECIATION EXPENSE.**

A. In *Lindheimer v. Illinois Bell Telephone Co.*,[103] the U.S. Supreme Court stated that "depreciation is the loss, not restored by current maintenance, which is due to all the factors causing the ultimate retirement of the property. These factors embrace wear and tear, decay, inadequacy, and obsolescence." The *Lindheimer* Court also recognized that the original cost of plant assets, rather than present value or some other measure, is the proper basis for calculating depreciation expense.[104] Moreover, the *Lindheimer* Court found:

> [T]he company has the burden of making a convincing showing that the amounts it has charged to operating expenses for depreciation have not been excessive. That burden is not sustained by proof that its general accounting system has been correct. The calculations are mathematical, but the predictions underlying them are essentially matters of opinion.[105]

Thus, the Commission must ultimately determine if the Company has met its burden of proof by making a convincing showing that its proposed depreciation rates are not excessive.

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[103] *Lindheimer v. Illinois Bell Tel. Co.*, 292 U.S. 151, 167 (1934).

[104] *Id.* (Referring to the straight-line method, the *Lindheimer* Court stated that "[a]ccording to the principle of this accounting practice, the loss is computed upon the actual cost of the property as entered upon the books, less the expected salvage, and the amount charged each year is one year's pro rata share of the total amount."). The original cost standard was reaffirmed by the Court in *Federal Power Commission v. Hope Natural Gas Co.*, 320 U.S. 591, 606 (1944). The *Hope* Court stated: "Moreover, this Court recognized in [*Lindheimer*], supra, the propriety of basing annual depreciation on cost. By such a procedure the utility is made whole and the integrity of its investment maintained. No more is required."

[105] *Id.* at 169.

**Q. SHOULD DEPRECIATION REPRESENT AN ALLOCATED COST OF CAPITAL TO OPERATION, RATHER THAN A MECHANISM TO DETERMINE LOSS OF VALUE?**

A. Yes. While the *Lindheimer* case and other early literature recognized depreciation as a necessary expense, the language indicated that depreciation was primarily a mechanism to determine loss of value.[106] Adoption of this "value concept" would require annual appraisals of extensive utility plant, and thus, is not practical in this context. Rather, the "cost allocation concept" recognizes that depreciation is a cost of providing service, and that in addition to receiving a "return on" invested capital through the allowed rate of return, a utility should also receive a "return of" its invested capital in the form of recovered depreciation expense. The cost allocation concept also satisfies several fundamental accounting principles, including verifiability, neutrality, and the matching principle.[107] The definition of "depreciation accounting" published by the American Institute of Certified Public Accountants ("AICPA") properly reflects the cost allocation concept:

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[106] *See* Frank K. Wolf & W. Chester Fitch, *Depreciation Systems* 71 (Iowa State University Press 1994).

[107] National Association of Regulatory Utility Commissioners, *Public Utility Depreciation Practices* 12 (NARUC 1996).

> Depreciation accounting is a system of accounting that aims to distribute cost or other basic value of tangible capital assets, less salvage (if any), over the estimated useful life of the unit (which may be a group of assets) in a systematic and rational manner. It is a process of allocation, not of valuation.[108]

Thus, the concept of depreciation as "the allocation of cost has proven to be the most useful and most widely used concept."[109]

## XI. ANALYTIC METHODS

**Q. DISCUSS YOUR APPROACH TO ANALYZING THE COMPANY'S DEPRECIABLE PROPERTY IN THIS CASE.**

A. I obtained and reviewed all of the data that was used to conduct the Company's depreciation study. I used the same plant data in my analysis to develop my proposed depreciation rates and applied those rates to the Company's updated plant balances to arrive at OPC's final adjustment to depreciation expense.[110]

**Q. DISCUSS THE DEFINITION AND PURPOSE OF A DEPRECIATION SYSTEM, AS WELL AS THE DEPRECIATION SYSTEM YOU EMPLOYED FOR THIS PROJECT.**

A. The legal standards set forth above do not mandate a specific procedure for conducting a depreciation analysis. These standards, however, direct that analysts use a system for estimating depreciation rates that will result in the "systematic and rational" allocation of

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[108] American Institute of Accountants, *Accounting Terminology Bulletins Number 1: Review and Résumé* 25 (American Institute of Accountants 1953).

[109] Wolf *supra* n. 105, at 73.

[110] *See* Exhibit DJG-15.

capital recovery for the utility. Over the years, analysts have developed "depreciation systems" designed to analyze grouped property in accordance with this standard. A depreciation system may be defined by several primary parameters: 1) a *method* of allocation; 2) a *procedure* for applying the method of allocation; 3) a *technique* of applying the depreciation rate; and 4) a *model* for analyzing the characteristics of vintage property groups.[111] In this case, I used the straight line method, the average life procedure, the remaining life technique, and the broad group model to analyze the Company's actuarial data; this system would be denoted as an "SL-AL-RL-BG" system. This depreciation system conforms to the legal standards set forth above, and is commonly used by depreciation analysts in regulatory proceedings. I provide a more detailed discussion of depreciation system parameters, theories, and equations in Exhibit DJG 25, Appendix C.

**Q. ARE THERE OTHER REASONABLE DEPRECIATION SYSTEMS THAT ANALYSTS MAY USE?**

A. Yes. There are multiple combinations of depreciation systems that analysts may use to develop deprecation rates. For example, many analysts use the broad group model instead of the equal life group model. In this case, however, I used the same depreciation system that Company Witness Watson used. Although some of our assumptions and inputs are different, the analytical system we applied is essentially the same.

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[111] *See* Wolf *supra* n. 105, at 70, 140.

## XII. ACTUARIAL ANALYSIS

**Q. DESCRIBE THE ACTUARIAL PROCESS YOU USED TO ANALYZE THE COMPANY'S DEPRECIABLE PROPERTY.**

A. The study of retirement patterns of industrial property is derived from the actuarial process used to study human mortality. Just as actuarial analysts study historical human mortality data in order to predict how long a group of people will live, depreciation analysts study historical plant data in order to estimate the average lives of property groups. The most common actuarial method used by depreciation analysts is called the "retirement rate method." In the retirement rate method, original property data, including additions, retirements, transfers, and other transactions, are organized by vintage and transaction year.[112] The retirement rate method is ultimately used to develop an "observed life table," ("OLT") which shows the percentage of property surviving at each age interval. This pattern of property retirement is described as a "survivor curve." The survivor curve derived from the observed life table, however, must be fitted and smoothed with a complete curve in order to determine the ultimate average life of the group.[113] The most widely used survivor curves for this curve fitting process were developed at Iowa State University in the early 1900s and are commonly known as the "Iowa curves."[114] A more detailed explanation of how the Iowa curves are used in the actuarial analysis of depreciable

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[112] The "vintage" year refers to the year that a group of property was placed in service (aka "placement" year). The "transaction" year refers to the accounting year in which a property transaction occurred, such as an addition, retirement, or transfer (aka "experience" year).

[113] *See* Exhibit DJG 25, Appendix E for a more detailed discussion of the actuarial analysis used to determine the average lives of grouped industrial property.

[114] *See* Exhibit DJG 25, Appendix D for a more detailed discussion of the Iowa curves.

property is set forth in Exhibit DJG 25, Appendix E. For a few of PGS's accounts, there were sufficient aged data to conduct actuarial analysis and traditional Iowa curve fitting techniques. Regardless of whether a particular account had sufficient aged data, I began my analysis of each account by organizing the data to develop observed life tables, which is discussed further below.

**Q. GENERALLY DESCRIBE YOUR APPROACH IN ESTIMATING THE SERVICE LIVES OF MASS PROPERTY.**

A. I used all of the Company's aged property data to create an OLT for each account. The data points on the OLT can be plotted to form a curve (the "OLT curve"). The OLT curve is not a theoretical curve, rather, it is actual observed data from the Company's records that indicate the rate of retirement for each property group. An OLT curve by itself, however, is rarely a smooth curve, and is often not a "complete" curve (i.e., it does not end at zero percent surviving). In order to calculate average life (the area under a curve), a complete survivor curve is needed. The Iowa curves are empirically-derived curves based on the extensive studies of the actual mortality patterns of many different types of industrial property. The curve-fitting process involves selecting the best Iowa curve to fit the OLT curve. This can be accomplished through a combination of visual and mathematical curve-fitting techniques, as well as professional judgment. The first step of my approach to curve-fitting involves visually inspecting the OLT curve for any irregularities. For example, if the "tail" end of the curve is erratic and shows a sharp decline over a short period of time, it may indicate that this portion of the data is less reliable, as further discussed below. After inspecting the OLT curve, I use a mathematical curve-fitting technique which essentially involves measuring the distance between the OLT curve and the selected Iowa curve in order to get an objective, mathematical assessment of how well the curve fits. After selecting an Iowa curve, I observe the OLT curve along with the Iowa curve on the same graph to determine how well the curve fits. I may repeat this process several times for any given account to ensure that the most reasonable Iowa curve is selected.

**Q. DO YOU ALWAYS SELECT THE MATHEMATICALLY BEST-FITTING CURVE?**

A. Not necessarily. Mathematical fitting is an important part of the curve-fitting process because it promotes objective, unbiased results. While mathematical curve fitting is important, however, it may not always yield the optimum result; therefore, it should not necessarily be adopted without further analysis.

**Q. SHOULD EVERY PORTION OF THE OLT CURVE BE GIVEN EQUAL WEIGHT?**

A. Not necessarily. Many analysts have observed that the points comprising the "tail end" of the OLT curve may often have less analytical value than other portions of the curve. In fact, "[p]oints at the end of the curve are often based on fewer exposures and may be given less weight than points based on larger samples. The weight placed on those points will depend on the size of the exposures."[115] In accordance with this standard, an analyst may decide to truncate the tail end of the OLT curve at a certain percent of initial exposures, such as one percent. Using this approach puts a greater emphasis on the most valuable portions of the curve. For my analysis in this case, I not only considered the entirety of the OLT curve, but I also conducted further analyses that involved fitting Iowa curves to the

[115] Wolf *supra* n. 105, at 46.

most significant part of the OLT curve for certain accounts. In other words, to verify the accuracy of my curve selection, I narrowed the focus of my additional calculation to consider the top 99% of the "exposures" (i.e., dollars exposed to retirement) and to eliminate the tail end of the curve representing the bottom 1% of exposures. I will illustrate an example of this approach in the discussion below.

**Q. GENERALLY, DESCRIBE THE DIFFERENCES BETWEEN THE COMPANY'S SERVICE LIFE PROPOSALS AND YOUR SERVICE LIFE PROPOSALS.**

A. For each of these accounts discussed below, the Company's proposed service life, as estimated through Iowa curves, is too short to accurately describe the mortality characteristics of the account in my opinion. For the accounts in which I propose a longer service life, I took the objective approach and chose an Iowa curve that provides a better mathematical and/or visual fit to the observed historical retirement pattern derived from the Company's plant data.

**Q. HAS THE COMPANY MADE A CONVINCING SHOWING THAT THE PROPOSED SERVICE LIFE ESTIMATES FOR THE FOLLOWING ACCOUNTS ARE NOT EXCESSIVE?**

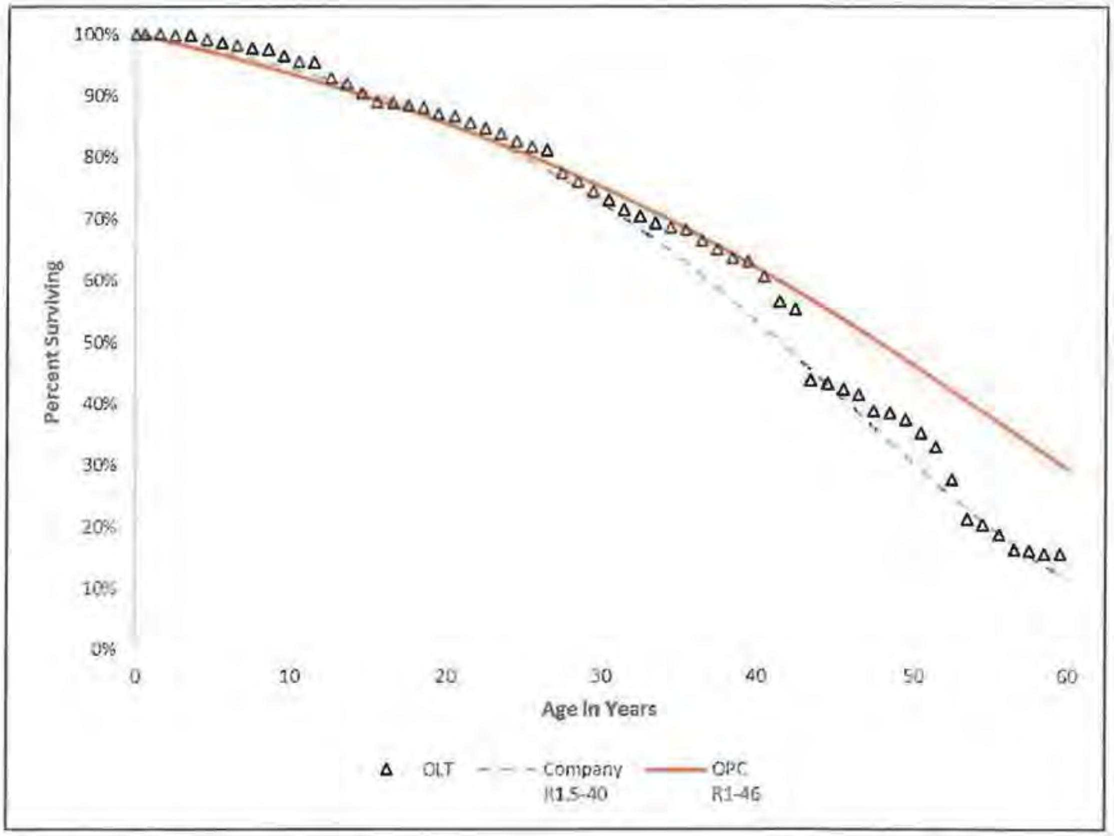
A. No, not in my opinion. As stated in the legal standards discussed above, the Company has the burden to make a convincing showing that its proposed depreciation rates are not excessive. Necessarily, this standard must include making convincing showings that service life and net salvage estimates are not excessive. Both Mr. Watson and I are primarily relying upon the historical, statistical retirement data observed in the Company's continuing property records to conduct our analysis. In making my recommended service life estimates, I use a combination of visual and mathematical curve fitting along with professional judgment. Unless the Company presents a convincing reason to deviate from the historical service retirement patterns observed in its accounts when projecting future remaining life, it is my opinion that the best service life estimates as indicated by mathematical curve fitting should be given primary consideration. For the accounts discussed below, the Company has failed to make a convincing showing that its service life estimates are not excessively short (i.e., shorter service life estimates result in higher depreciation rates).

### A. Account 368 – Measuring and Regulating Station Equipment

**Q. DESCRIBE YOUR SERVICE LIFE ESTIMATE FOR ACCOUNT 368 AND COMPARE IT WITH THE COMPANY'S ESTIMATE.**

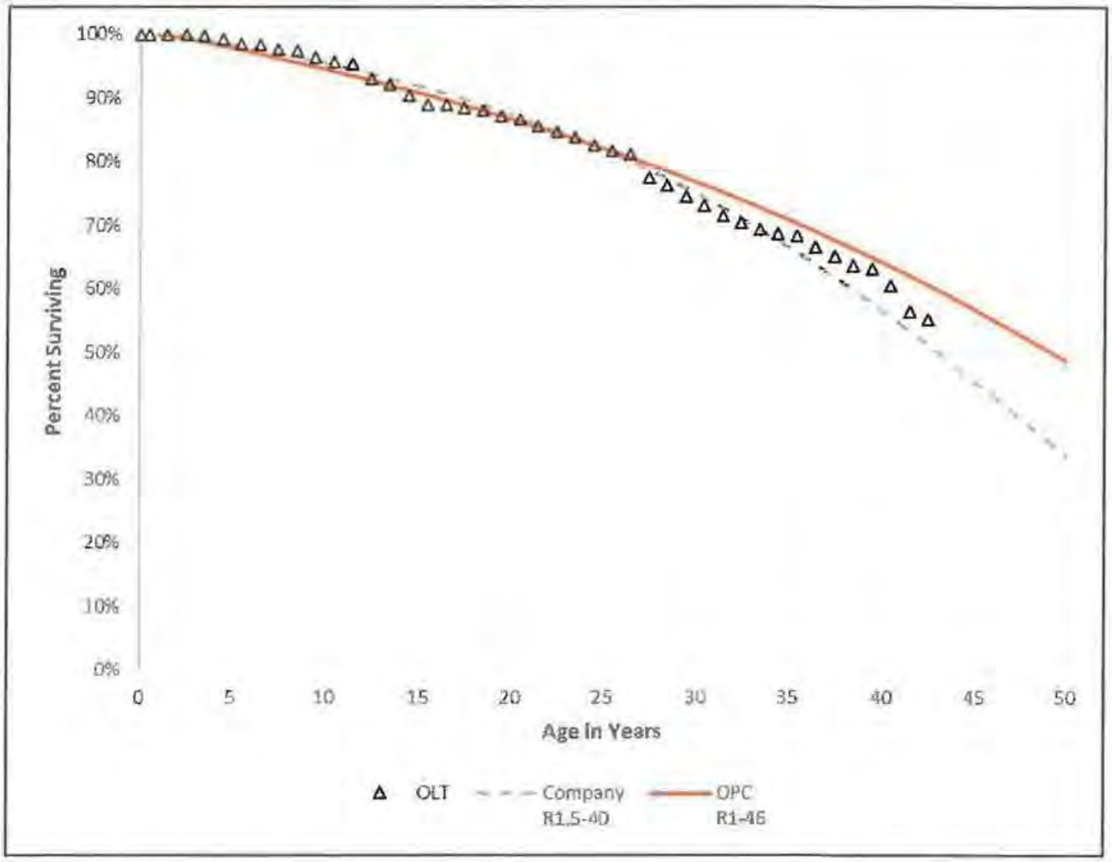
A. The OLT curve for this account is shown in the graph below. The graph also shows the Iowa curves that Mr. Watson and I selected to estimate the average life for this account. The average life is determined by calculating the area under the Iowa curves. Thus, a longer curve will produce a longer average life, and it will also result in a lower depreciation rate. For this account, Mr. Watson selected the R1.5-40 Iowa curve, and I selected the R1-46 Iowa curve. The average lives resulting from each curve are indicated by the numbers after the dashes (40 and 46 in this case). Both Iowa curves are shown with the OLT curve in the graph below.

**Figure 16:**
**Account 368 – Measuring and Regulating Station Equipment**




From a visual perspective, it appears that both of the selected Iowa curves provide good fits to data points on the OLT curve through the first 30 years. After that point, it initially appears that the R1.5-40 curve selected by Mr. Watson provides a closer fit. However, the data points occurring after the 40-year age interval are not statistically relevant pursuant to the 1% cutoff benchmark discussed above. This is because the dollars exposed to retirement for these data points at the tail end of this OLT curve are relatively insignificant. For example, the dollars exposed to retirement at 60 years is only $13,000, whereas the initial dollars exposed to retirement (at age zero), is $20 million. Notice on the OLT curve there is a sharp drop in the curve around age 43. The data points occurring after this drop off are relatively insignificant. The following graph shows the same OLT curve and Iowa graph, except with only the most significant portions of the OLT curve showing.

**Figure 17:**
**Account 368 – With Relevant OLT Curve**




Considering the relevant OLT curve, both Iowa curves appear to provide relatively good fits. We can use mathematical curve fitting to measure which Iowa curve provides the closer fit.

**Q. DOES THE IOWA CURVE YOU SELECTED PROVIDE A BETTER MATHEMATICAL FIT TO THE RELEVANT OLT CURVE FOR THIS ACCOUNT?**

A. Yes. While visual curve-fitting techniques helped us to identify the most statistically relevant portions of the OLT curve for this account, mathematical curve-fitting techniques can help us determine which of the two Iowa curves provides the better fit. Mathematical curve fitting essentially involves measuring the distance between the OLT curve and the selected Iowa curve. The best mathematically-fitted curve is the one that minimizes the distance between the OLT curve and the Iowa curve, thus providing the closest fit. The "distance" between the curves is calculated using the "sum-of-squared differences" ("SSD") technique. For this account, the SSD, or "distance" between the OLT curve and the Company's R1.5-40 Iowa curve is 0.0475, while the SSD between the OLT curve and the R1-46 Iowa curve I selected is only 0.0119.[116] Thus, the R1-46 curve results in a closer mathematical fit.

### B. Account 380 – Services – Steel

**Q. DESCRIBE YOUR SERVICE LIFE ESTIMATE FOR THIS ACCOUNT AND COMPARE IT WITH THE COMPANY'S ESTIMATE.**

A. For this account, Mr. Watson selected the R0.5-42 curve, and I selected the R0.5-57 curve. Thus, both Iowa curves have the same "shape," but the Iowa curve I selected has a longer average life. Both Iowa curves are shown with the OLT curve in the graph below.

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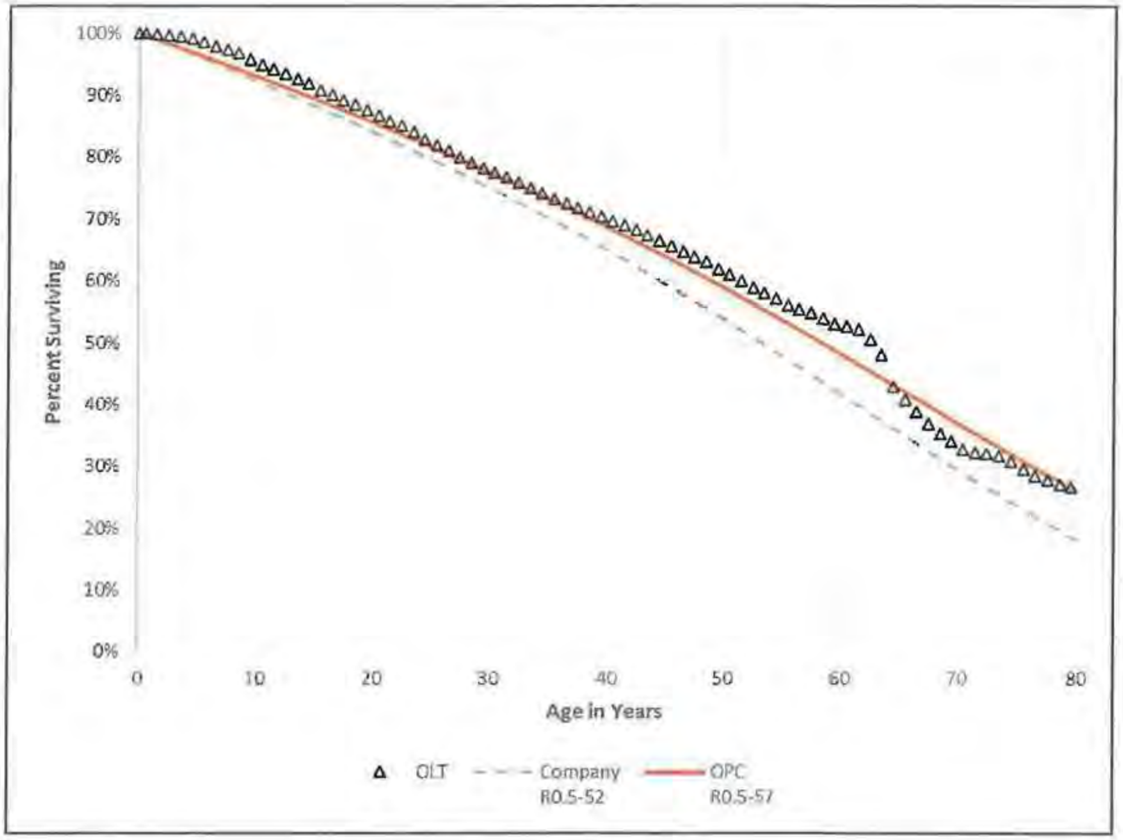
[116] Exhibit DJG-19.

**Figure 18:**
**Account 380 – Services – Steel**




From a visual perspective, it is clear that the R0.5-57 curve provides a better fit throughout the OLT curve. Specifically, the R0.5-52 curve selected by Mr. Watson is too short to provide an accurate fit to the OLT curve. As a result, his depreciation rate for this account is overstated.

**Q. DOES THE IOWA CURVE YOU SELECTED PROVIDE A BETTER MATHEMATICAL FIT TO THE OLT CURVE FOR THIS ACCOUNT?**

A. Yes. Although it is visually clear that the R0.5-57 curve provides the better fit, we can confirm the results mathematically. Specifically, the total SSD for the Company's curve is 0.3169, while the SSD for the R0.5-57 curve is only 0.0556, which means it provides the closer fit.[117]

### C. Account 380.02 – Services – Plastic

**Q. DESCRIBE YOUR SERVICE LIFE ESTIMATE FOR THIS ACCOUNT AND COMPARE IT WITH THE COMPANY'S ESTIMATE.**

A. For this account, Mr. Watson selected the R1.5-55 curve, and I selected the R1.5-64 curve. Both Iowa curves are shown with the OLT curve in the graph below.

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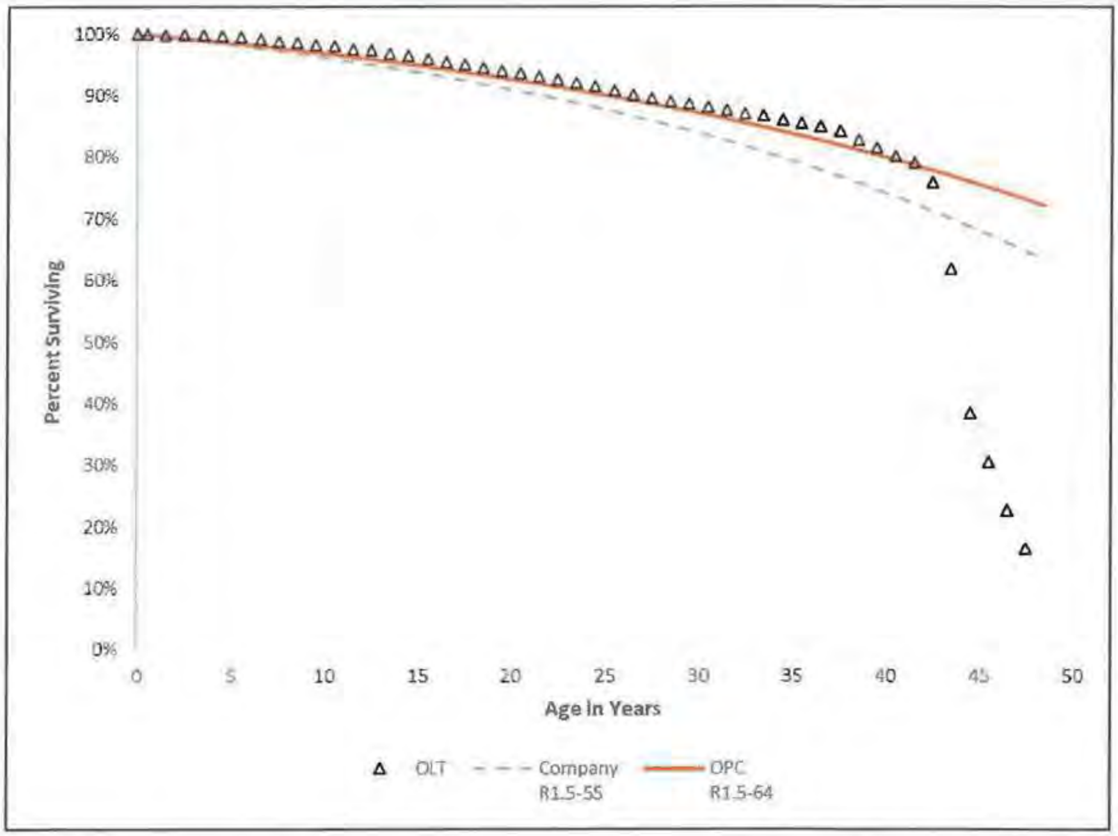
[117] Exhibit DJG-20.

**Figure 19:**
**Account 380.02 – Services – Plastic**




As shown in this graph, both Iowa curves properly ignore the tail end of this OLT curve — where the OLT data points begin to drastically decline. Regardless, a visual inspection reveals that the R1.5-64 curve provides a closer fit. We can nonetheless confirm the results mathematically.

**Q. DOES THE IOWA CURVE YOU SELECTED PROVIDE A BETTER MATHEMATICAL FIT TO THE OLT CURVE FOR THIS ACCOUNT?**

A. Yes. Specifically, the total SSD for the Company's curve is 0.0490, while the SSD for the R1.5-64 curve I selected is only 0.0065, which means it provides the closer fit.[118]

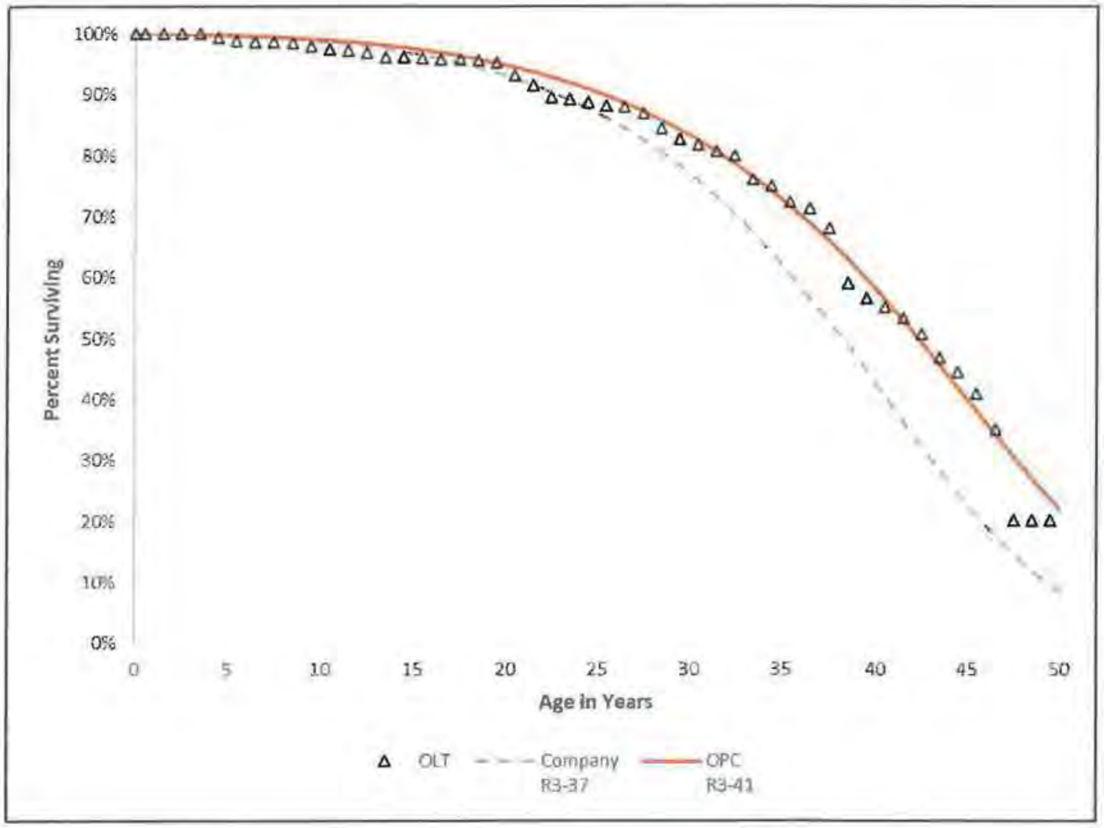
**D. Account 385 – Industrial Measuring and Regulating Station Equipment**

**Q. DESCRIBE YOUR SERVICE LIFE ESTIMATE FOR THIS ACCOUNT AND COMPARE IT WITH THE COMPANY'S ESTIMATE.**

A. For this account, Mr. Watson selected the R3-37 curve, and I selected the R3-41 curve. Both Iowa curves are shown with the OLT curve in the graph below.

[118] Exhibit DJG-21.

**Figure 20:**
**Account 385 – Industrial Measuring and Regulating Station Equipment**




As with the other accounts discussed above, even from a visual perspective it is clear that the Iowa curve I selected provides a better fit to the observed data. The fact that the Iowa curve I selected provides a better fit to the historical data is a strong indication that the remaining life calculated from the Iowa curve I selected is more accurate and reasonable than that proposed by the Company.

**Q. DOES THE IOWA CURVE YOU SELECTED PROVIDE A BETTER MATHEMATICAL FIT TO THE OLT CURVE FOR THIS ACCOUNT?**

A. Yes. The total SSD for the Company's curve is 0.3842, while the SSD for the R3-41 curve I selected is only 0.0288, which means it provides the closer fit.[119]

## XIII. <u>NET SALVAGE ANALYSIS</u>

**Q. DESCRIBE THE CONCEPT OF NET SALVAGE.**

A. If an asset has any value left when it is retired from service, a utility might decide to sell the asset. The proceeds from this transaction are called "gross salvage." The corresponding expense associated with the removal of the asset from service is called the "cost of removal." The term "net salvage" equates to gross salvage less the cost of removal. Often, the net salvage for utility assets is a negative number (or percentage) because the cost of removing the assets from service exceeds any proceeds received from selling the assets. When a negative net salvage rate is applied to an account to calculate the depreciation rate, it results in increasing the total depreciable base to be recovered over a particular period of time and increases the depreciation rate. Therefore, a greater *negative* net salvage rate equates to a higher depreciation rate and expense, all else held constant.

**Q. HAS THERE BEEN A TREND IN INCREASING NEGATIVE NET SALVAGE IN THE UTILITY INDUSTRY?**

A. Yes. As discussed above, negative net salvage rates occur when the cost of removal exceeds the gross salvage of an asset when it is removed from service. Net salvage rates

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[119] Exhibit DJG-22.

are calculated by considering gross salvage and removal costs as a percent of the original cost of the assets retired. In other words, salvage and removal costs are based on current dollars (when the assets are removed from service), while retirements are based on historical dollars, reflecting uninflated cost figures from years, and often decades earlier. Increasing labor costs associated with asset removal combined with the fact that original costs remain the same have contributed to increasing negative net salvage over time.

**Q. PLEASE SUMMARIZE MR. WATSON'S PROPOSED NET SALVAGE RATES.**

A. Mr. Watson is proposing significant net salvage decreases for several of the Company's distribution accounts. He is not proposing net salvage increases for any of the Company's distribution accounts.

**Q. ARE YOU RECOMMENDING ANY ADJUSTMENTS TO THE COMPANY'S PROPOSED NET SALVAGE RATES?**

A. Yes. I identified six distribution accounts to which Mr. Watson is proposing substantial net salvage decreases. While I would not disagree with Mr. Watson that there should be decreases to these accounts, I am recommending that the Commission implement the changes in net salvage rates for these accounts more gradually than that proposed by the Company. Specifically, I recommend limiting the proposed net salvage decreases by one half of the decrease proposed by Mr. Watson. The accounts to which I propose net salvage adjustments are summarized in the table below.

**Figure 21:**
**Net Salvage Adjustments**

| Account No. | Description | Current NS | Watson NS | Garrett NS |
|---|---|---|---|---|
| 376.00 | Mains Steel | -40% | -60% | -50% |
| 376.02 | Mains Plastic | -25% | -40% | -33% |
| 380.00 | Services Steel | -100% | -150% | -125% |
| 380.02 | Services Plastic | -55% | -80% | -68% |
| 382.00 | Meter Installations | -20% | -30% | -25% |
| 384.00 | House Regulator Installs | -20% | -30% | -25% |

As shown in the table, my proposed net salvage rates are in between the current rates and the rates proposed by Mr. Watson.

**Q. ARE YOU AWARE OF OTHER COMMISSIONS WHO LIMIT NET SALVAGE INCREASES AS A MATTER OF POLICY, BASED ON GRADUALISM?**

A. Yes. The California Commission has expressed concerns over the phenomenon of increasing net salvage rates. In Pacific Gas & Electric's ("PG&E") 2014 general rate case, the California commission stated: "We remain concerned with the growing cost burden associated with increasing cost trends for negative net salvage."[120] The Commission also expressed an interest in the ratemaking concept of gradualism. According to the Commission:

[120] Decision Authorizing Pacific Gas and Electric Company's General Rate Case Revenue Requirement for 2014-2016, D.14-08-032, p. 597

> In evaluating whether a proposed increase reflects gradualism, however, we believe the more appropriate measure is how the change affects customers' retail rates. The fact that PG&E previously proposed higher removal costs than adopted has no bearing on how a proposed change would impact current ratepayers. Accordingly, we apply the principle of gradualism based on how a proposed change in estimate compares to adopted costs reflected in current rates, irrespective of what PG&E may have forecasted in an earlier depreciation study.[121]

In PG&E's 2014 GRC, the Office of Ratepayer Advocates proposed a 25% cap on increased net salvage rates to mitigate sudden increases in net salvage and instead provide for more gradual levels of increases. The Commission ultimately found: "As a general approach, we adopt no more than 25% of PG&E's estimated increases in the accrual provision for removal costs. This limitation tempers the impacts on current ratepayers. . . ."[122] In PGS's case, I recommend the Commission consider a similar approach regarding net salvage except with a 50% limit instead of a 25% limit.

## XIV. CONCLUSION AND RECOMMENDATION — DEPRECIATION

**Q. PLEASE SUMMARIZE THE KEY POINTS OF YOUR DEPRECIATION TESTIMONY.**

A. I employed a well-established depreciation system and used actuarial and simulated analysis to statistically analyze the Company's depreciable assets in order to develop reasonable depreciation rates in this case. I made adjustments to the Company's proposed service life and net salvage for several accounts. Regarding service life, the Company's own historical data indicates that for several accounts, Mr. Watson has recommended

[121] *Id*. at 598.

[122] Id. at 602.

service lives that are too short, which has resulted in overestimated depreciation rate proposals. Regarding net salvage, I recommend the Commission limit the Company's proposed net salvage increases by 50% for several accounts in the interest of gradualism.

**Q. WHAT IS YOUR RECOMMENDATION TO THE COMMISSION REGARDING DEPRECIATION?**

A. I recommend the Commission adopt the depreciation rates and parameters presented in Exhibit DJG-16.

**Q. DOES THIS CONCLUDE YOUR TESTIMONY?**

A. Yes. I reserve the right to supplement this testimony as needed with any additional information that has been requested from the Company but not yet provided. To the extent I have not addressed an issue, method, calculation, account, or other matter relevant to the Company's proposals in this proceeding, it should not be construed that I am in agreement with the same.

## APPENDIX A:

## DISCOUNTED CASH FLOW MODEL THEORY

The Discounted Cash Flow ("DCF") Model is based on a fundamental financial model called the "dividend discount model," which maintains that the value of a security is equal to the present value of the future cash flows it generates. Cash flows from common stock are paid to investors in the form of dividends. There are several variations of the DCF Model. In its most general form, the DCF Model is expressed as follows:[123]

**Equation 4:**
**General Discounted Cash Flow Model**

$$P_0 = \frac{D_1}{(1+k)} + \frac{D_2}{(1+k)^2} + \cdots + \frac{D_n}{(1+k)^n}$$

*where:* $P_0$ = *current stock price*
$D_1 \ldots D_n$ = *expected future dividends*
$k$ = *discount rate / required return*

The General DCF Model would require an estimation of an infinite stream of dividends. Since this would be impractical, analysts use more feasible variations of the General DCF Model, which are discussed further below.

The DCF Models rely on the following four assumptions:

1. Investors evaluate common stocks in the classical valuation framework; that is, they trade securities rationally at prices reflecting their perceptions of value;

2. Investors discount the expected cash flows at the same rate (K) in every future period;

[123] *See* Zvi Bodie, Alex Kane & Alan J. Marcus, *Essentials of Investments* 410 (9th ed., McGraw-Hill/Irwin 2013).

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# DAVID J. GARRETT

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## EDUCATION

University of Oklahoma — Norman, OK
**Master of Business Administration** — 2014
Areas of Concentration: Finance, Energy

University of Oklahoma College of Law — Norman, OK
**Juris Doctor** — 2007
Member, American Indian Law Review

University of Oklahoma — Norman, OK
**Bachelor of Business Administration** — 2003
Major: Finance

## PROFESSIONAL DESIGNATIONS

Society of Depreciation Professionals
**Certified Depreciation Professional (CDP)**

Society of Utility and Regulatory Financial Analysts
**Certified Rate of Return Analyst (CRRA)**

The Mediation Institute
**Certified Civil / Commercial & Employment Mediator**

## WORK EXPERIENCE

Resolve Utility Consulting PLLC — Oklahoma City, OK
**Managing Member** — 2016 – Present
Provide expert analysis and testimony specializing in depreciation and cost of capital issues for clients in utility regulatory proceedings.

Oklahoma Corporation Commission — Oklahoma City, OK
**Public Utility Regulatory Analyst** — 2012 – 2016
**Assistant General Counsel** — 2011 – 2012
Represented commission staff in utility regulatory proceedings and provided legal opinions to commissioners. Provided expert analysis and testimony in depreciation, cost of capital, incentive compensation, payroll and other issues.

Perebus Counsel, PLLC — Oklahoma City, OK
**Managing Member** — 2009 – 2011
Represented clients in the areas of family law, estate planning, debt negotiations, business organization, and utility regulation.

Moricoli & Schovanec, P.C. — Oklahoma City, OK
**Associate Attorney** — 2007 – 2009
Represented clients in the areas of contracts, oil and gas, business structures and estate administration.

## TEACHING EXPERIENCE

**University of Oklahoma** — Norman, OK
Adjunct Instructor – "Conflict Resolution" — 2014 – Present
Adjunct Instructor – "Ethics in Leadership"

**Rose State College** — Midwest City, OK
Adjunct Instructor – "Legal Research" — 2013 – 2015
Adjunct Instructor – "Oil & Gas Law"

## PUBLICATIONS

**American Indian Law Review** — Norman, OK
"Vine of the Dead: Reviving Equal Protection Rites for Religious Drug Use" — 2006
(31 Am. Indian L. Rev. 143)

## VOLUNTEER EXPERIENCE

**Calm Waters** — Oklahoma City, OK
Board Member — 2015 – 2018
Participate in management of operations, attend meetings, review performance, compensation, and financial records. Assist in fundraising events.

Group Facilitator & Fundraiser — 2014 – 2018
Facilitate group meetings designed to help children and families cope with divorce and tragic events. Assist in fundraising events.

**St. Jude Children's Research Hospital** — Oklahoma City, OK
Oklahoma Fundraising Committee — 2008 – 2010
Raised money for charity by organizing local fundraising events.

## PROFESSIONAL ASSOCIATIONS

**Oklahoma Bar Association** — 2007 – Present

**Society of Depreciation Professionals** — 2014 – Present
Board Member – President — 2017
Participate in management of operations, attend meetings, review performance, organize presentation agenda.

**Society of Utility Regulatory Financial Analysts** — 2014 – Present

## SELECTED CONTINUING PROFESSIONAL EDUCATION

Society of Depreciation Professionals — Austin, TX
**"Life and Net Salvage Analysis"** — 2015
Extensive instruction on utility depreciation, including actuarial and simulation life analysis modes, gross salvage, cost of removal, life cycle analysis, and technology forecasting.

Society of Depreciation Professionals — New Orleans, LA
**"Introduction to Depreciation" and "Extended Training"** — 2014
Extensive instruction on utility depreciation, including average lives and net salvage.

Society of Utility and Regulatory Financial Analysts — Indianapolis, IN
**46th Financial Forum. "The Regulatory Compact: Is it Still Relevant?"** — 2014
Forum discussions on current issues.

New Mexico State University, Center for Public Utilities — Santa Fe, NM
**Current Issues 2012, "The Santa Fe Conference"** — 2012
Forum discussions on various current issues in utility regulation.

Michigan State University, Institute of Public Utilities — Clearwater, FL
**"39th Eastern NARUC Utility Rate School"** — 2011
One-week, hands-on training emphasizing the fundamentals of the utility ratemaking process.

New Mexico State University, Center for Public Utilities — Albuquerque, NM
**"The Basics: Practical Regulatory Training for the Changing Electric Industries"** — 2010
One-week, hands-on training designed to provide a solid foundation in core areas of utility ratemaking.

The Mediation Institute — Oklahoma City, OK
**"Civil / Commercial & Employment Mediation Training"** — 2009
Extensive instruction and mock mediations designed to build foundations in conducting mediations in civil matters.

# Utility Regulatory Proceedings

| Regulatory Agency | Utility Applicant | Docket Number | Issues Addressed | Parties Represented |
|---|---|---|---|---|
| Railroad Commission of Texas | Texas Gas Services Company | GUD 10928 | Depreciation rates, service lives, net salvage | Gulf Coast Service Area Steering Committee |
| Public Utilities Commission of the State of California | Southern California Edison | A.19-08-013 | Depreciation rates, service lives, net salvage | The Utility Reform Network |
| Massachusetts Department of Public Utilities | NSTAR Gas Company | D.P.U. 19-120 | Depreciation rates, service lives, net salvage | Massachusetts Office of the Attorney General, Office of Ratepayer Advocacy |
| Georgia Public Service Commission | Liberty Utilities (Peach State Natural Gas) | 42959 | Depreciation rates, service lives, net salvage | Public Interest Advocacy Staff |
| Florida Public Service Commission | Florida Public Utilities Company | 20190155-EI<br>20190156-EI<br>20190174-EI | Depreciation rates, service lives, net salvage | Florida Office of Public Counsel |
| Illinois Commerce Commission | Commonwealth Edison Company | 20-0393 | Depreciation rates, service lives, net salvage | The Office of the Illinois Attorney General |
| Public Utility Commission of Texas | Southwestern Public Service Company | PUC 49831 | Depreciation rates, service lives, net salvage | Alliance of Xcel Municipalities |
| South Carolina Public Service Commission | Blue Granite Water Company | 2019-290-WS | Depreciation rates, service lives, net salvage | South Carolina Office of Regulatory Staff |
| Railroad Commission of Texas | CenterPoint Energy Resources | GUD 10920 | Depreciation rates and grouping procedure | Alliance of CenterPoint Municipalities |
| Pennsylvania Public Utility Commission | Aqua Pennsylvania Wastewater | A-2019-3009052 | Fair market value estimates for wastewater assets | Pennsylvania Office of Consumer Advocate |
| New Mexico Public Regulation Commission | Southwestern Public Service Company | 19-00170-UT | Cost of capital and authorized rate of return | The New Mexico Large Customer Group; Occidental Permian |
| Indiana Utility Regulatory Commission | Duke Energy Indiana | 45253 | Cost of capital, depreciation rates, net salvage | Indiana Office of Utility Consumer Counselor |
| Maryland Public Service Commission | Columbia Gas of Maryland | 9609 | Depreciation rates, service lives, net salvage | Maryland Office of People's Counsel |
| Washington Utilities & Transportation Commission | Avista Corporation | UE-190334 | Cost of capital, awarded rate of return, capital structure | Washington Office of Attorney General |

# Utility Regulatory Proceedings

| Regulatory Agency | Utility Applicant | Docket Number | Issues Addressed | Parties Represented |
|---|---|---|---|---|
| Indiana Utility Regulatory Commission | Indiana Michigan Power Company | 45235 | Cost of capital, depreciation rates, net salvage | Indiana Office of Utility Consumer Counselor |
| Public Utilities Commission of the State of California | Pacific Gas & Electric Company | 18-12-009 | Depreciation rates, service lives, net salvage | The Utility Reform Network |
| Oklahoma Corporation Commission | The Empire District Electric Company | PUD 201800133 | Cost of capital, authorized ROE, depreciation rates | Oklahoma Industrial Energy Consumers and Oklahoma Energy Results |
| Arkansas Public Service Commission | Southwestern Electric Power Company | 19-008-U | Cost of capital, depreciation rates, net salvage | Western Arkansas Large Energy Consumers |
| Public Utility Commission of Texas | CenterPoint Energy Houston Electric | PUC 49421 | Depreciation rates, service lives, net salvage | Texas Coast Utilities Coalition |
| Massachusetts Department of Public Utilities | Massachusetts Electric Company and Nantucket Electric Company | D.P.U. 18-150 | Depreciation rates, service lives, net salvage | Massachusetts Office of the Attorney General, Office of Ratepayer Advocacy |
| Oklahoma Corporation Commission | Oklahoma Gas & Electric Company | PUD 201800140 | Cost of capital, authorized ROE, depreciation rates | Oklahoma Industrial Energy Consumers and Oklahoma Energy Results |
| Public Service Commission of the State of Montana | Montana-Dakota Utilities Company | D2018.9.60 | Depreciation rates, service lives, net salvage | Montana Consumer Counsel and Denbury Onshore |
| Indiana Utility Regulatory Commission | Northern Indiana Public Service Company | 45159 | Depreciation rates, grouping procedure, demolition costs | Indiana Office of Utility Consumer Counselor |
| Public Service Commission of the State of Montana | NorthWestern Energy | D2018.2.12 | Depreciation rates, service lives, net salvage | Montana Consumer Counsel |
| Oklahoma Corporation Commission | Public Service Company of Oklahoma | PUD 201800097 | Depreciation rates, service lives, net salvage | Oklahoma Industrial Energy Consumers and Wal-Mart |
| Nevada Public Utilities Commission | Southwest Gas Corporation | 18-05031 | Depreciation rates, service lives, net salvage | Nevada Bureau of Consumer Protection |
| Public Utility Commission of Texas | Texas-New Mexico Power Company | PUC 48401 | Depreciation rates, service lives, net salvage | Alliance of Texas-New Mexico Power Municipalities |
| Oklahoma Corporation Commission | Oklahoma Gas & Electric Company | PUD 201700496 | Depreciation rates, service lives, net salvage | Oklahoma Industrial Energy Consumers and Oklahoma Energy Results |

# Utility Regulatory Proceedings

| Regulatory Agency | Utility Applicant | Docket Number | Issues Addressed | Parties Represented |
|---|---|---|---|---|
| Maryland Public Service Commission | Washington Gas Light Company | 9481 | Depreciation rates, service lives, net salvage | Maryland Office of People's Counsel |
| Indiana Utility Regulatory Commission | Citizens Energy Group | 45039 | Depreciation rates, service lives, net salvage | Indiana Office of Utility Consumer Counselor |
| Public Utility Commission of Texas | Entergy Texas, Inc. | PUC 48371 | Depreciation rates, decommissioning costs | Texas Municipal Group |
| Washington Utilities & Transportation Commission | Avista Corporation | UE-180167 | Depreciation rates, service lives, net salvage | Washington Office of Attorney General |
| New Mexico Public Regulation Commission | Southwestern Public Service Company | 17-00255-UT | Cost of capital and authorized rate of return | HollyFrontier Navajo Refining; Occidental Permian |
| Public Utility Commission of Texas | Southwestern Public Service Company | PUC 47527 | Depreciation rates, plant service lives | Alliance of Xcel Municipalities |
| Public Service Commission of the State of Montana | Montana-Dakota Utilities Company | D2017.9.79 | Depreciation rates, service lives, net salvage | Montana Consumer Counsel |
| Florida Public Service Commission | Florida City Gas | 20170179-GU | Cost of capital, depreciation rates | Florida Office of Public Counsel |
| Washington Utilities & Transportation Commission | Avista Corporation | UE-170485 | Cost of capital and authorized rate of return | Washington Office of Attorney General |
| Wyoming Public Service Commission | Powder River Energy Corporation | 10014-182-CA-17 | Credit analysis, cost of capital | Private customer |
| Oklahoma Corporation Commission | Public Service Co. of Oklahoma | PUD 201700151 | Depreciation, terminal salvage, risk analysis | Oklahoma Industrial Energy Consumers |
| Public Utility Commission of Texas | Oncor Electric Delivery Company | PUC 46957 | Depreciation rates, simulated analysis | Alliance of Oncor Cities |
| Nevada Public Utilities Commission | Nevada Power Company | 17-06004 | Depreciation rates, service lives, net salvage | Nevada Bureau of Consumer Protection |
| Public Utility Commission of Texas | El Paso Electric Company | PUC 46831 | Depreciation rates, interim retirements | City of El Paso |

# Utility Regulatory Proceedings

| Regulatory Agency | Utility Applicant | Docket Number | Issues Addressed | Parties Represented |
|---|---|---|---|---|
| Idaho Public Utilities Commission | Idaho Power Company | IPC-E-16-24 | Accelerated depreciation of North Valmy plant | Micron Technology, Inc. |
| Idaho Public Utilities Commission | Idaho Power Company | IPC-E-16-23 | Depreciation rates, service lives, net salvage | Micron Technology, Inc. |
| Public Utility Commission of Texas | Southwestern Electric Power Company | PUC 46449 | Depreciation rates, decommissioning costs | Cities Advocating Reasonable Deregulation |
| Massachusetts Department of Public Utilities | Eversource Energy | D.P.U. 17-05 | Cost of capital, capital structure, and rate of return | Sunrun Inc.; Energy Freedom Coalition of America |
| Railroad Commission of Texas | Atmos Pipeline - Texas | GUD 10580 | Depreciation rates, grouping procedure | City of Dallas |
| Public Utility Commission of Texas | Sharyland Utility Company | PUC 45414 | Depreciation rates, simulated analysis | City of Mission |
| Oklahoma Corporation Commission | Empire District Electric Company | PUD 201600468 | Cost of capital, depreciation rates | Oklahoma Industrial Energy Consumers |
| Railroad Commission of Texas | CenterPoint Energy Texas Gas | GUD 10567 | Depreciation rates, simulated plant analysis | Texas Coast Utilities Coalition |
| Arkansas Public Service Commission | Oklahoma Gas & Electric Company | 160-159-GU | Cost of capital, depreciation rates, terminal salvage | Arkansas River Valley Energy Consumers; Wal-Mart |
| Florida Public Service Commission | Peoples Gas | 160-159-GU | Depreciation rates, service lives, net salvage | Florida Office of Public Counsel |
| Arizona Corporation Commission | Arizona Public Service Company | E-01345A-16-0036 | Cost of capital, depreciation rates, terminal salvage | Energy Freedom Coalition of America |
| Nevada Public Utilities Commission | Sierra Pacific Power Company | 16-06008 | Depreciation rates, net salvage, theoretical reserve | Northern Nevada Utility Customers |
| Oklahoma Corporation Commission | Oklahoma Gas & Electric Co. | PUD 201500273 | Cost of capital, depreciation rates, terminal salvage | Public Utility Division |
| Oklahoma Corporation Commission | Public Service Co. of Oklahoma | PUD 201500208 | Cost of capital, depreciation rates, terminal salvage | Public Utility Division |

# Utility Regulatory Proceedings

| Regulatory Agency | Utility Applicant | Docket Number | Issues Addressed | Parties Represented |
|---|---|---|---|---|
| Oklahoma Corporation Commission | Oklahoma Natural Gas Company | PUD 201500213 | Cost of capital, depreciation rates, net salvage | Public Utility Division |

# Proxy Group Summary



| | | [1] | [2] | [3] | [4] |
|---|---|---|---|---|---|
| Company | Ticker | Market Cap. ($ millions) | Market Category | Value Line Safety Rank | Financial Strength |
| Atmos Energy Corporation | ATO | 12,100 | Large Cap | 1 | A+ |
| New Jersey Resources Corporation | NJR | 3,200 | Mid Cap | 2 | A+ |
| Northwest Natural Holding Company | NWN | 1,900 | Small Cap | 1 | A |
| ONE Gas, Inc. | OGS | 4,300 | Mid Cap | 2 | A |
| South Jersey Industries, Inc. | SJI | 2,600 | Mid Cap | 2 | B++ |
| Southwest Gas Holdings, Inc. | SWX | 4,100 | Mid Cap | 3 | A |
| Spire Inc. | SR | 3,700 | Mid Cap | 2 | B++ |

[1], [3], [4] Value Line Investment Survey

[2] Large Cap > $10 billion; Mid Cap > $2 billion; Small Cap > $200 million

# DCF Stock and Index Prices

| Ticker | ^GSPC | ATO | NJR | NWN | OGS | SJI | SWX | SR |
|---|---|---|---|---|---|---|---|---|
| 30-day Average | 3137 | 100.25 | 31.82 | 55.19 | 76.19 | 24.40 | 68.72 | 66.16 |
| Standard Deviation | 68.9 | 1.64 | 1.04 | 2.94 | 2.25 | 1.23 | 2.24 | 2.63 |
| 06/09/20 | 3207 | 104.32 | 35.69 | 64.04 | 83.95 | 28.09 | 74.51 | 74.46 |
| 06/10/20 | 3190 | 103.74 | 34.22 | 61.99 | 82.48 | 27.42 | 71.06 | 72.60 |
| 06/11/20 | 3002 | 99.27 | 31.85 | 57.62 | 76.71 | 25.13 | 67.10 | 67.69 |
| 06/12/20 | 3041 | 100.43 | 31.30 | 57.13 | 76.93 | 25.06 | 66.78 | 67.63 |
| 06/15/20 | 3067 | 101.08 | 31.56 | 58.48 | 77.62 | 25.19 | 68.67 | 68.84 |
| 06/16/20 | 3125 | 102.26 | 32.60 | 58.80 | 78.45 | 26.15 | 69.02 | 69.66 |
| 06/17/20 | 3113 | 101.18 | 31.58 | 57.00 | 76.22 | 25.28 | 67.22 | 67.29 |
| 06/18/20 | 3115 | 101.45 | 31.65 | 57.07 | 76.35 | 25.15 | 68.61 | 66.63 |
| 06/19/20 | 3098 | 99.72 | 31.63 | 54.85 | 74.51 | 24.67 | 66.06 | 65.46 |
| 06/22/20 | 3118 | 100.12 | 31.62 | 55.81 | 75.74 | 24.67 | 66.69 | 66.08 |
| 06/23/20 | 3131 | 98.84 | 31.19 | 55.83 | 75.42 | 24.39 | 66.27 | 65.65 |
| 06/24/20 | 3050 | 98.96 | 30.94 | 54.43 | 74.96 | 24.17 | 65.69 | 64.43 |
| 06/25/20 | 3084 | 97.07 | 31.03 | 53.89 | 74.05 | 23.85 | 65.37 | 63.96 |
| 06/26/20 | 3009 | 97.46 | 31.26 | 52.96 | 73.51 | 23.65 | 65.52 | 62.17 |
| 06/29/20 | 3053 | 98.38 | 32.23 | 55.00 | 74.85 | 24.56 | 67.52 | 64.39 |
| 06/30/20 | 3100 | 99.58 | 32.65 | 55.79 | 77.05 | 24.99 | 69.05 | 65.71 |
| 07/01/20 | 3116 | 100.69 | 32.22 | 55.75 | 77.00 | 24.61 | 67.80 | 66.59 |
| 07/02/20 | 3130 | 101.18 | 32.40 | 55.68 | 77.35 | 24.53 | 68.46 | 67.17 |
| 07/06/20 | 3180 | 101.24 | 32.45 | 54.62 | 76.39 | 23.99 | 69.46 | 67.07 |
| 07/07/20 | 3145 | 100.07 | 31.90 | 53.36 | 75.37 | 23.60 | 68.87 | 66.35 |
| 07/08/20 | 3170 | 99.38 | 31.25 | 52.61 | 75.42 | 23.45 | 68.27 | 65.32 |
| 07/09/20 | 3152 | 97.69 | 30.17 | 51.02 | 74.07 | 22.68 | 66.95 | 63.22 |
| 07/10/20 | 3185 | 99.09 | 31.03 | 52.84 | 75.14 | 23.27 | 68.99 | 65.55 |
| 07/13/20 | 3155 | 99.69 | 31.29 | 52.35 | 75.69 | 23.24 | 69.72 | 65.26 |
| 07/14/20 | 3198 | 100.43 | 31.42 | 52.32 | 75.30 | 23.28 | 71.07 | 64.93 |
| 07/15/20 | 3227 | 100.64 | 32.06 | 52.75 | 75.44 | 23.34 | 71.81 | 64.91 |
| 07/16/20 | 3216 | 100.55 | 31.44 | 52.57 | 74.78 | 23.43 | 71.13 | 64.47 |
| 07/17/20 | 3225 | 101.06 | 31.92 | 53.44 | 75.05 | 23.63 | 72.07 | 64.52 |
| 07/20/20 | 3252 | 99.81 | 30.62 | 52.25 | 73.89 | 23.07 | 70.57 | 62.73 |
| 07/21/20 | 3257 | 102.15 | 31.47 | 53.39 | 75.88 | 23.43 | 71.36 | 64.06 |

All prices are adjusted closing prices reported by Yahoo! Finance, http://finance.yahoo.com

# DCF Dividend Yields

| | | [1] | [2] | [3] |
|---|---|---|---|---|
| Company | Ticker | Dividend | Stock Price | Dividend Yield |
| Atmos Energy Corporation | ATO | 0.575 | 100.25 | 0.57% |
| New Jersey Resources Corporation | NJR | 0.313 | 31.82 | 0.98% |
| Northwest Natural Holding Company | NWN | 0.477 | 55.19 | 0.86% |
| ONE Gas, Inc. | OGS | 0.540 | 76.19 | 0.71% |
| South Jersey Industries, Inc. | SJI | 0.295 | 24.40 | 1.21% |
| Southwest Gas Holdings, Inc. | SWX | 0.570 | 68.72 | 0.83% |
| Spire Inc. | SR | 0.623 | 66.16 | 0.94% |
| **Average** | | **$0.48** | **$60.39** | **0.87%** |

[1] Most recent reported quarterly dividends per share. Nasdaq.com
[2] Average stock price from DJG stock price exhibit.
[3] = [1] / [2] (quarterly)

# DCF Terminal Growth Rate Determinants



| Terminal Growth Determinants | Rate | |
|---|---|---|
| Nominal GDP | 3.9% | [1] |
| Inflation | 2.0% | [2] |
| Risk Free Rate | 1.4% | [3] |
| **Highest** | **3.9%** | |

[1], [2] CBO, The 2019 Long-Term Budget Outlook, p. 54, June 2019
[3] From DJG risk-free rate exhibit

# DCF Final Results



| [1] | [2] | [3] | [4] |
|---|---|---|---|
| Dividend ($d_0$) | Stock Price ($P_0$) | Growth Rate (g) | **DCF Result** |
| $0.48 | $60.39 | 3.90% | **7.3%** |

[1] Average proxy dividend from DJG dividend exhibit

[2] Average proxy stock price from DJG dividend exhibit

[3] Highest growth rate from DJG growth determinant exhibit

[4] Quarterly DCF Approximation = $[d_0(1 + g)^{0.25}/P_0 + (1 + g)^{0.25}]^4 - 1$

# CAPM Risk-Free Rate



| Date | Rate |
|---|---|
| 06/09/20 | 1.59% |
| 06/10/20 | 1.53% |
| 06/11/20 | 1.41% |
| 06/12/20 | 1.45% |
| 06/15/20 | 1.45% |
| 06/16/20 | 1.54% |
| 06/17/20 | 1.52% |
| 06/18/20 | 1.47% |
| 06/19/20 | 1.47% |
| 06/22/20 | 1.46% |
| 06/23/20 | 1.49% |
| 06/24/20 | 1.44% |
| 06/25/20 | 1.43% |
| 06/26/20 | 1.37% |
| 06/29/20 | 1.39% |
| 06/30/20 | 1.41% |
| 07/01/20 | 1.43% |
| 07/02/20 | 1.43% |
| 07/06/20 | 1.45% |
| 07/07/20 | 1.38% |
| 07/08/20 | 1.39% |
| 07/09/20 | 1.32% |
| 07/10/20 | 1.33% |
| 07/13/20 | 1.33% |
| 07/14/20 | 1.30% |
| 07/15/20 | 1.33% |
| 07/16/20 | 1.31% |
| 07/17/20 | 1.33% |
| 07/20/20 | 1.32% |
| 07/21/20 | 1.31% |
| **Average** | **1.41%** |

*Daily Treasury Yield Curve Rates on 30-year T-bonds, http://www.treasury.gov/resources-center/data-chart-center/interest-rates/.

# CAPM Beta Coefficient



| Company | Ticker | Beta |
|---|---|---|
| Atmos Energy Corporation | ATO | 0.80 |
| New Jersey Resources Corporation | NJR | 0.90 |
| Northwest Natural Holding Company | NWN | 0.80 |
| ONE Gas, Inc. | OGS | 0.80 |
| South Jersey Industries, Inc. | SJI | 0.95 |
| Southwest Gas Holdings, Inc. | SWX | 0.90 |
| Spire Inc. | SR | 0.80 |
| Average | | 0.85 |

Betas from Value Line Investment Survey
NR - not reported

# CAPM Implied Equity Risk Premium Estimate



| | [1] | [2] | [3] | [4] | [5] | [6] | [7] | [8] |
|---|---|---|---|---|---|---|---|---|
| Year | Market Value | Operating Earnings | Dividends | Buybacks | Earnings Yield | Dividend Yield | Buyback Yield | Gross Cash Yield |
| 2014 | 18,245 | 1,004 | 350 | 553 | 5.50% | 1.92% | 3.03% | 4.95% |
| 2015 | 17,900 | 885 | 382 | 572 | 4.95% | 2.14% | 3.20% | 5.33% |
| 2016 | 19,268 | 920 | 397 | 536 | 4.77% | 2.06% | 2.78% | 4.85% |
| 2017 | 22,821 | 1,066 | 420 | 519 | 4.67% | 1.84% | 2.28% | 4.12% |
| 2018 | 21,027 | 1,282 | 456 | 806 | 6.10% | 2.17% | 3.84% | 6.01% |
| 2019 | 26,760 | 1,305 | 485 | 729 | 4.88% | 1.81% | 2.72% | 4.54% |

| | | |
|---|---|---|
| Cash Yield | 4.81% | [9] |
| Growth Rate | 5.37% | [10] |
| Risk-free Rate | 1.41% | [11] |
| Current Index Value | 3,137 | [12] |

| | [13] | [14] | [15] | [16] | [17] |
|---|---|---|---|---|---|
| Year | 1 | 2 | 3 | 4 | 5 |
| Expected Dividends | 159 | 168 | 177 | 186 | 196 |
| Expected Terminal Value | | | | | 3428 |
| Present Value | 148 | 146 | 143 | 141 | 2559 |
| Intrinsic Index Value | 3137 | [18] | | | |
| Required Return on Market | 7.21% | [19] | | | |
| **Implied Equity Risk Premium** | $\boxed{5.8\%}$ | [20] | | | |

[1-4] S&P Quarterly Press Releases, data found at https://us.spindices.com/indices/equity/sp-500 (additional info tab) (all dollar figures are in $ billions)
[1] Market value of S&P 500
[5] = [2] / [1]
[6] = [3] / [1]
[7] = [4] / [1]
[8] = [6] + [7]
[9] = Average of [8]
[10] = Compund annual growth rate of [2] = (end value / beginning value)$^{\wedge 1/4}$-1
[11] Risk-free rate from DJG risk-free rate exhibit
[12] 30-day average of closing index prices from DJG stock price exhibit
[13-16] Expected dividends = [9]*[12]*(1+[10])$^n$ ; Present value = expected dividend / (1+[11]+[19])$^n$
[17] Expected terminal value = expected dividend * (1+[11]) / [19] ; Present value = (expected dividend + expected terminal value) / (1+[11]+[19])$^n$
[18] = Sum([13-17]) present values.
[19] = [20] + [11]
[20] Internal rate of return calculation setting [18] equal to [12] and solving for the discount rate

# CAPM Equity Risk Premium Results

| | | |
|---|---|---|
| IESE Business School Survey | 5.6% | [1] |
| Graham & Harvey Survey | 4.4% | [2] |
| Duff & Phelps Report | 6.0% | [3] |
| Damodaran | 5.7% | [4] |
| Garrett | 5.8% | [5] |
| **Average** | **5.5%** | |
| **Highest** | **6.0%** | |

[1] IESE Business School Survey 2020
[2] Graham and Harvey Survey 2018
[3] Duff & Phelps, 3-5-2020
[4] http://pages.stern.nyu.edu/~adamodar/ , 7-1-20
[5] From DJG implied ERP exhibit

# CAPM Final Results



| | | [1] | [2] | [3] | [4] |
|---|---|---|---|---|---|
| Company | Ticker | Risk-Free Rate | Value Line Beta | Risk Premium | CAPM Results |
| Atmos Energy Corporation | ATO | 1.41% | 0.800 | 6.0% | 6.2% |
| New Jersey Resources Corporation | NJR | 1.41% | 0.900 | 6.0% | 6.8% |
| Northwest Natural Holding Company | NWN | 1.41% | 0.800 | 6.0% | 6.2% |
| ONE Gas, Inc. | OGS | 1.41% | 0.800 | 6.0% | 6.2% |
| South Jersey Industries, Inc. | SJI | 1.41% | 0.950 | 6.0% | 7.1% |
| Southwest Gas Holdings, Inc. | SWX | 1.41% | 0.900 | 6.0% | 6.8% |
| Spire Inc. | SR | 1.41% | 0.800 | 6.0% | 6.2% |
| **Average** | | | 0.850 | | **6.5%** |

[1] From DJG risk-free rate exhibit
[2] From DJG beta exhibit
[3] From DJG equity risk premium exhibit
[6] = [1] + [2] * [3]

# Cost of Equity Summary

| Model | Cost of Equity |
|---|---|
| Discounted Cash Flow Model | 7.3% |
| Capital Asset Pricing Model | 6.5% |
| **Average** | **6.9%** |

# Market Cost of Equity

| Source | Estimate | |
|---|---|---|
| IESE Survey | 7.0% | [1] |
| Graham Harvey Survey | 5.8% | [2] |
| Duff & Phelps | 7.4% | |
| Damodaran | 7.1% | [3] |
| Garrett | 7.2% | [4] |
| **Highest** | 7.4% | |

[1] Average reported ERP + riskfree rate
[2] Average reported ERP + risk-free rate
[3] Recent highest reported ERP + risk-free rate
[4] From Implied ERP exhibit

# Utility Awarded Returns vs. Market Cost of Equity



| | [1] | | [2] | | [3] | | [4] | [5] | [6] | [7] |
|---|---|---|---|---|---|---|---|---|---|---|
| | Electric Utilities | | Gas Utilities | | Total Utilities | | S&P 500 | T-Bond | Risk | Market |
| Year | ROE | # | ROE | # | ROE | # | Returns | Rate | Premium | COE |
| 1990 | 12.70% | 38 | 12.68% | 33 | 12.69% | 71 | -3.06% | 8.07% | 3.89% | 11.96% |
| 1991 | 12.54% | 42 | 12.45% | 31 | 12.50% | 73 | 30.23% | 6.70% | 3.48% | 10.18% |
| 1992 | 12.09% | 45 | 12.02% | 28 | 12.06% | 73 | 7.49% | 6.68% | 3.55% | 10.23% |
| 1993 | 11.46% | 28 | 11.37% | 40 | 11.41% | 68 | 9.97% | 5.79% | 3.17% | 8.96% |
| 1994 | 11.21% | 28 | 11.24% | 24 | 11.22% | 52 | 1.33% | 7.82% | 3.55% | 11.37% |
| 1995 | 11.58% | 28 | 11.44% | 13 | 11.54% | 41 | 37.20% | 5.57% | 3.29% | 8.86% |
| 1996 | 11.40% | 18 | 11.12% | 17 | 11.26% | 35 | 22.68% | 6.41% | 3.20% | 9.61% |
| 1997 | 11.33% | 10 | 11.30% | 12 | 11.31% | 22 | 33.10% | 5.74% | 2.73% | 8.47% |
| 1998 | 11.77% | 10 | 11.51% | 10 | 11.64% | 20 | 28.34% | 4.65% | 2.26% | 6.91% |
| 1999 | 10.72% | 6 | 10.74% | 6 | 10.73% | 12 | 20.89% | 6.44% | 2.05% | 8.49% |
| 2000 | 11.58% | 9 | 11.34% | 13 | 11.44% | 22 | -9.03% | 5.11% | 2.87% | 7.98% |
| 2001 | 11.07% | 15 | 10.96% | 5 | 11.04% | 20 | -11.85% | 5.05% | 3.62% | 8.67% |
| 2002 | 11.21% | 14 | 11.17% | 19 | 11.19% | 33 | -21.97% | 3.81% | 4.10% | 7.91% |
| 2003 | 10.96% | 20 | 10.99% | 25 | 10.98% | 45 | 28.36% | 4.25% | 3.69% | 7.94% |
| 2004 | 10.81% | 21 | 10.63% | 22 | 10.72% | 43 | 10.74% | 4.22% | 3.65% | 7.87% |
| 2005 | 10.51% | 24 | 10.41% | 26 | 10.46% | 50 | 4.83% | 4.39% | 4.08% | 8.47% |
| 2006 | 10.32% | 26 | 10.40% | 15 | 10.35% | 41 | 15.61% | 4.70% | 4.16% | 8.86% |
| 2007 | 10.30% | 38 | 10.22% | 35 | 10.26% | 73 | 5.48% | 4.02% | 4.37% | 8.39% |
| 2008 | 10.41% | 37 | 10.39% | 32 | 10.40% | 69 | -36.55% | 2.21% | 6.43% | 8.64% |
| 2009 | 10.52% | 40 | 10.22% | 30 | 10.39% | 70 | 25.94% | 3.84% | 4.36% | 8.20% |
| 2010 | 10.37% | 61 | 10.15% | 39 | 10.28% | 100 | 14.82% | 3.29% | 5.20% | 8.49% |
| 2011 | 10.29% | 42 | 9.92% | 16 | 10.19% | 58 | 2.10% | 1.88% | 6.01% | 7.89% |
| 2012 | 10.17% | 58 | 9.94% | 35 | 10.08% | 93 | 15.89% | 1.76% | 5.78% | 7.54% |
| 2013 | 10.03% | 49 | 9.68% | 21 | 9.93% | 70 | 32.15% | 3.04% | 4.96% | 8.00% |
| 2014 | 9.91% | 38 | 9.78% | 26 | 9.86% | 64 | 13.52% | 2.17% | 5.78% | 7.95% |
| 2015 | 9.85% | 30 | 9.60% | 16 | 9.76% | 46 | 1.38% | 2.27% | 6.12% | 8.39% |
| 2016 | 9.77% | 42 | 9.54% | 26 | 9.68% | 68 | 11.77% | 2.45% | 5.69% | 8.14% |
| 2017 | 9.74% | 53 | 9.72% | 24 | 9.73% | 77 | 21.61% | 2.41% | 5.08% | 7.49% |
| 2018 | 9.64% | 37 | 9.62% | 26 | 9.63% | 63 | -4.23% | 2.68% | 5.96% | 8.64% |
| 2019 | 9.64% | 67 | 9.67% | 27 | 9.65% | 94 | 31.22% | 1.92% | 5.20% | 7.12% |

[1], [2], [3] Average annual authorized ROE for electric and gas utilities, RRA Regulatory Focus: Major Rate Case Decisions

[3] = [1] + [2]

[4], [5], [6] Annual S&P 500 return, 10-year T-bond Rate, and equity risk premium published by NYU Stern School of Business

[7] = [5] + [6] ; Market cost of equity represents the required return for investing in all stocks in the market for a given year

# Summary Accrual Adjustment

| Plant Function | Plant Balance 12/31/2020 | Company Proposal | OPC Proposal | OPC Adjustment |
|---|---|---|---|---|
| Distribution | 2,035,932,594 | 48,739,863 | 43,273,741 | (5,466,122) |
| General | 31,902,517 | 1,812,056 | 1,812,056 | - |
| **Total** | $ 2,067,835,111 | $ 50,551,919 | $ 45,085,797 | **$ (5,466,122)** |

# Depreciation Parameter Comparison

| Account | | Current Parameters | | | | | Company Position | | | | | OPC Position | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Iowa Curve | | Net Sal | Depr | Annual | Iowa Curve | | Net Sal | Depr | Annual | Iowa Curve | | Net Sal | Depr | Annual |
| No. | Description | Type | AL | Rate | Rate | Accrual | Type | AL | Rate | Rate | Accrual | Type | AL | Rate | Rate | Accrual |
| 376.00 | Mains Steel | R2 | 55 | -40% | 1.80% | 9,866,079 | R1.5 | 65 | -60% | 2.30% | 12,611,340 | R1.5 | 65 | -50% | 2.11% | 11,581,723 |
| 376.02 | Mains Plastic | R2 | 75 | -25% | 1.40% | 9,232,092 | R2 | 75 | -40% | 1.70% | 11,041,852 | R2 | 75 | -33% | 1.57% | 10,338,991 |
| 378.00 | Meas & Reg Station Eqp Gen | R1 | 31 | -5% | 3.30% | 623,215 | R1.5 | 40 | -10% | 2.70% | 511,792 | R1 | 46 | -10% | 2.25% | 424,056 |
| 380.00 | Services Steel | R0.5 | 50 | -100% | 2.60% | 1,454,799 | R0.5 | 52 | -150% | 4.70% | 2,603,273 | R0.5 | 57 | -125% | 3.55% | 1,983,800 |
| 380.02 | Services Plastic | R1.5 | 55 | -55% | 2.30% | 9,418,630 | R1.5 | 55 | -80% | 2.90% | 12,029,079 | R1.5 | 64 | -68% | 2.24% | 9,182,015 |
| 382.00 | Meter Installations | R0.5 | 43 | -20% | 2.80% | 2,048,794 | R1 | 44 | -30% | 2.40% | 1,720,255 | R1 | 44 | -25% | 2.21% | 1,617,568 |
| 384.00 | House Regulator Installs | R4 | 27 | -20% | 4.40% | 1,124,774 | R1 | 47 | -30% | 2.00% | 509,521 | R1 | 47 | -25% | 1.86% | 475,246 |
| 385.00 | Meas & Reg Station Eqp Ind | R4 | 32 | 0% | 3.10% | 378,044 | R3 | 37 | -2% | 2.30% | 274,437 | R3 | 41 | -2% | 1.90% | 232,027 |

# Detailed Rate Comparison



| | | [1] | [3] | | [4] | | [6] | |
|---|---|---|---|---|---|---|---|---|
| | | | Company Proposal | | OPC Proposal | | OPC Adjustment | |
| Account No. | Description | Original Cost | Rate | Annual Accrual | Rate | Annual Accrual | Rate | Annual Accrual |
| | **DISTRIBUTION PLANT** | | | | | | | |
| 374.02 | Land Rights | 4,268,873 | 1.30% | 55,808 | 1.31% | 55,808 | 0.01% | 0 |
| 375.00 | Structures & Improvements | 26,284,145 | 2.80% | 741,608 | 2.82% | 741,608 | 0.02% | 0 |
| 376.00 | Mains Steel | 548,115,480 | 2.30% | 12,611,340 | 2.11% | 11,581,723 | -0.19% | -1,029,617 |
| 376.02 | Mains Plastic | 659,435,120 | 1.70% | 11,041,852 | 1.57% | 10,338,991 | -0.13% | -702,861 |
| 378.00 | Meas & Reg Station Eqp Gen | 18,885,293 | 2.70% | 511,792 | 2.25% | 424,056 | -0.45% | -87,735 |
| 379.00 | Meas & Reg Station Eqp City | 96,523,663 | 2.10% | 2,053,561 | 2.13% | 2,053,561 | 0.03% | 0 |
| 380.00 | Services Steel | 55,953,817 | 4.70% | 2,603,273 | 3.55% | 1,983,800 | -1.15% | -619,473 |
| 380.02 | Services Plastic | 409,505,670 | 2.90% | 12,029,079 | 2.24% | 9,182,015 | -0.66% | -2,847,064 |
| 381.00 | Meters | 78,709,924 | 5.00% | 3,974,768 | 5.05% | 3,974,768 | 0.05% | 0 |
| 382.00 | Meter Installations | 73,171,228 | 2.40% | 1,720,255 | 2.21% | 1,617,568 | -0.19% | -102,687 |
| 383.00 | House Regulators | 17,697,139 | 1.80% | 320,569 | 1.81% | 320,569 | 0.01% | 0 |
| 384.00 | House Regulator Installs | 25,563,041 | 2.00% | 509,521 | 1.86% | 475,246 | -0.14% | -34,275 |
| 385.00 | Meas & Reg Station Eqp Ind | 12,194,965 | 2.30% | 274,437 | 1.90% | 232,027 | -0.40% | -42,410 |
| 387.00 | Other Equipment | 9,624,238 | 3.00% | 292,001 | 3.03% | 292,001 | 0.03% | 0 |
| | Total Distribution Plant | 2,035,932,594 | 2.39% | 48,739,863 | 2.13% | 43,273,741 | -0.27% | -5,466,122 |
| | **GENERAL PLANT** | | | | | | | |
| 390.00 | Structures & Improvements | 28,184 | 2.40% | 669 | 2.37% | 669 | -0.03% | 0 |
| 392.01 | Vehicles up to 1/2 Tons | 12,072,999 | 7.00% | 849,758 | 7.04% | 849,758 | 0.04% | 0 |
| 392.02 | Vehicles from 1/2 - 1 Tons | 12,134,491 | 5.60% | 677,650 | 5.58% | 677,650 | -0.02% | 0 |
| 392.04 | Trailers & Other | 2,563,258 | 2.90% | 73,951 | 2.89% | 73,951 | -0.01% | 0 |
| 392.05 | Vehicles over 1 Ton | 1,900,118 | 6.60% | 124,475 | 6.55% | 124,475 | -0.05% | 0 |
| 396.00 | Power Operated Equipment | 3,203,465 | 2.70% | 85,553 | 2.67% | 85,553 | -0.03% | 0 |
| | Total General Plant | 31,902,517 | 5.68% | 1,812,056 | 5.68% | 1,812,056 | 0.00% | 0 |
| | **TOTAL PLANT STUDIED** | **2,067,835,111** | **2.44%** | **50,551,919** | **2.18%** | **45,085,797** | **-0.26%** | **-5,466,122** |

[1], [2], [3] From Company depreciation study
[4] From DJG rate development exhibit
[5] = [4] - [2]
[6] = [4] - [3]

# Depreciation Rate Development

| Account No. | Description | [1] Original Cost | [2] Iowa Curve Type - AL | [3] Net Salvage | [4] Depreciable Base | [5] Book Reserve | [6] Future Accruals | [7] Remaining Life | [8] Service Life Accrual | [9] Service Life Rate | [10] Net Salvage Accrual | [11] Net Salvage Rate | [12] Total Accrual | [13] Total Rate |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | DISTRIBUTION PLANT | | | | | | | | | | | | | |
| 374.02 | Land Rights | 4,268,873 | SQ - 75 | 0% | 4,268,873 | 928,144 | 3,340,729 | 59.86 | 55,808 | 1.31% | 0 | 0.00% | 55,808 | 1.31% |
| 375.00 | Structures & Improvements | 26,284,145 | L0 - 33 | 0% | 26,284,145 | 7,108,903 | 19,175,242 | 25.86 | 741,608 | 2.82% | 0 | 0.00% | 741,608 | 2.82% |
| 376.00 | Mains Steel | 548,115,480 | R1.5 - 65 | -50% | 822,173,220 | 205,621,383 | 616,551,837 | 53.23 | 6,433,639 | 1.17% | 5,148,084 | 0.94% | 11,581,723 | 2.11% |
| 376.02 | Mains Plastic | 659,435,120 | R2 - 75 | -33% | 877,048,710 | 198,034,805 | 679,013,905 | 65.68 | 7,025,502 | 1.07% | 3,313,489 | 0.50% | 10,338,991 | 1.57% |
| 378.00 | Meas & Reg Station Eqp Gen | 18,885,293 | R1 46 | -10% | 20,773,822 | 4,320,431 | 16,453,392 | 38.80 | 375,383 | 1.99% | 48,673 | 0.26% | 424,056 | 2.25% |
| 379.00 | Meas & Reg Station Eqp City | 96,523,663 | R2.5 - 50 | -10% | 106,176,029 | 12,806,989 | 93,369,041 | 45.47 | 1,841,266 | 1.91% | 212,294 | 0.22% | 2,053,561 | 2.13% |
| 380.00 | Services Steel | 55,953,817 | R0.5 - 57 | -125% | 125,896,088 | 40,295,122 | 85,600,966 | 43.15 | 362,890 | 0.65% | 1,620,910 | 2.90% | 1,983,800 | 3.55% |
| 380.02 | Services Plastic | 409,505,670 | R1.5 - 64 | -68% | 687,969,525 | 183,234,187 | 504,735,339 | 54.97 | 4,116,272 | 1.01% | 5,065,742 | 1.24% | 9,182,015 | 2.24% |
| 381.00 | Meters | 78,709,924 | R2 - 19 | 3% | 76,348,626 | 29,722,478 | 46,626,148 | 11.73 | 4,176,063 | 5.31% | -201,295 | -0.26% | 3,974,768 | 5.05% |
| 382.00 | Meter Installations | 73,171,228 | R1 - 44 | -25% | 91,464,034 | 33,832,634 | 57,631,400 | 35.63 | 1,104,135 | 1.51% | 513,433 | 0.70% | 1,617,568 | 2.21% |
| 383.00 | House Regulators | 17,697,139 | S1 - 42 | 0% | 17,697,139 | 8,433,989 | 9,263,150 | 28.90 | 320,569 | 1.81% | 0 | 0.00% | 320,569 | 1.81% |
| 384.00 | House Regulator Installs | 25,563,041 | R1 - 47 | -25% | 31,953,801 | 14,231,437 | 17,722,364 | 37.29 | 303,870 | 1.19% | 171,376 | 0.67% | 475,246 | 1.86% |
| 385.00 | Meas & Reg Station Eqp Ind | 12,194,965 | R3 - 41 | -2% | 12,438,864 | 6,942,133 | 5,496,730 | 23.69 | 221,732 | 1.82% | 10,205 | 0.08% | 232,027 | 1.90% |
| 387.00 | Other Equipment | 9,624,238 | L2 - 24 | 0% | 9,624,238 | 4,644,498 | 4,979,740 | 17.05 | 292,001 | 3.03% | 0 | 0.00% | 292,001 | 3.03% |
| | Total Distribution Plant | 2,035,932,594 | | -43% | 2,910,117,115 | 750,157,132 | 2,159,959,983 | 49.91 | 27,370,739 | 1.34% | 15,903,003 | 0.78% | 43,273,741 | 2.13% |
| | GENERAL PLANT | | | | | | | | | | | | | |
| 390.00 | Structures & Improvements | 28,184 | L0 - 25 | 0% | 28,184 | 14,206 | 13,979 | 20.89 | 669 | 2.37% | 0 | 0.00% | 669 | 2.37% |
| 392.01 | Vehicles up to 1/2 Tons | 12,072,999 | L2.5 - 9 | 11% | 10,744,969 | 5,989,326 | 4,755,643 | 5.60 | 1,087,056 | 9.00% | -237,298 | -1.97% | 849,758 | 7.04% |
| 392.02 | Vehicles from 1/2 - 1 Tons | 12,134,491 | L3 - 10 | 11% | 10,799,697 | 6,619,614 | 4,180,083 | 6.17 | 894,039 | 7.37% | -216,389 | -1.78% | 677,650 | 5.58% |
| 392.04 | Trailers & Other | 2,563,258 | R2 - 27 | 15% | 2,178,770 | 505,321 | 1,673,449 | 22.63 | 90,942 | 3.55% | -16,991 | -0.66% | 73,951 | 2.89% |
| 392.05 | Vehicles over 1 Ton | 1,900,118 | L2 - 12 | 4% | 1,824,114 | 999,340 | 824,774 | 6.63 | 135,945 | 7.15% | -11,471 | -0.60% | 124,475 | 6.55% |
| 396.00 | Power Operated Equipment | 3,203,465 | L1.5 - 18 | 10% | 2,883,119 | 1,926,552 | 956,567 | 11.18 | 114,204 | 3.57% | -28,651 | -0.89% | 85,553 | 2.67% |
| | Total General Plant | 31,902,517 | | 11% | 28,458,853 | 16,054,359 | 12,404,494 | 6.85 | 2,322,855 | 7.28% | -510,799 | -1.60% | 1,812,056 | 5.68% |
| | TOTAL PLANT STUDIED | 2,067,835,111 | | -42% | 2,938,575,967 | 766,211,490 | 2,172,364,477 | 48.18 | 29,693,593 | 1.44% | 15,392,208 | 0.74% | 45,085,797 | 2.18% |

| | |
|---|---|
| R1.5 65 | -60% |
| R2 75 | -40% |
| R1.5 - 40 | [illegible] |
| R0.5 - 52 | -150% |
| R1.5 - 55 | -80% |
| R1 - 44 | -30% |
| R1 - 47 | -30% |
| R3 - 37 | [illegible] |

[1] Company depreciation study
[2] Average life and Iowa curve shape developed through actuarial analysis and professional judgment
[3] Net salvage estimates developed through statistical analysis and professional judgment
[4] = [1]*(1-[3])
[5] From depreciation study
[6] = [4] - [5]
[7] Composite remaining life based on Iowa curve in [2]; see remaining life exhibit for detailed calculations
[8] = ([1] - [5]) / [7]
[9] = [8] / [1]
[10] = [12] - [8]
[11] = [13] - [9]
[12] = [6] / [7]
[13] = [12] / [1]

# Account 378 Curve Fitting



| [1] Age (Years) | [2] Exposures (Dollars) | [3] Observed Life Table (OLT) | [4] Company R1.5-40 | [5] OPC R1-46 | [6] Company SSD | [7] OPC SSD |
|---|---|---|---|---|---|---|
| 0.0 | 20,059,181 | 100.00% | 100.00% | 100.00% | 0.0000 | 0.0000 |
| 0.5 | 20,095,514 | 99.99% | 99.78% | 99.72% | 0.0000 | 0.0000 |
| 1.5 | 18,500,082 | 99.99% | 99.32% | 99.14% | 0.0000 | 0.0001 |
| 2.5 | 16,945,292 | 99.94% | 98.84% | 98.55% | 0.0001 | 0.0002 |
| 3.5 | 15,728,826 | 99.80% | 98.34% | 97.94% | 0.0002 | 0.0003 |
| 4.5 | 14,297,397 | 99.22% | 97.81% | 97.32% | 0.0002 | 0.0004 |
| 5.5 | 12,712,374 | 98.60% | 97.26% | 96.68% | 0.0002 | 0.0004 |
| 6.5 | 11,253,000 | 98.28% | 96.68% | 96.02% | 0.0003 | 0.0005 |
| 7.5 | 9,904,403 | 97.73% | 96.07% | 95.34% | 0.0003 | 0.0006 |
| 8.5 | 7,514,209 | 97.50% | 95.44% | 94.65% | 0.0004 | 0.0008 |
| 9.5 | 6,802,635 | 96.43% | 94.78% | 93.93% | 0.0003 | 0.0006 |
| 10.5 | 6,502,480 | 95.65% | 94.10% | 93.21% | 0.0002 | 0.0006 |
| 11.5 | 5,977,490 | 95.34% | 93.38% | 92.46% | 0.0004 | 0.0008 |
| 12.5 | 5,683,172 | 92.99% | 92.63% | 91.70% | 0.0000 | 0.0002 |
| 13.5 | 5,319,149 | 92.09% | 91.85% | 90.93% | 0.0000 | 0.0001 |
| 14.5 | 5,093,869 | 90.39% | 91.04% | 90.14% | 0.0000 | 0.0000 |
| 15.5 | 4,780,887 | 89.06% | 90.19% | 89.33% | 0.0001 | 0.0000 |
| 16.5 | 4,643,721 | 88.91% | 89.31% | 88.50% | 0.0000 | 0.0000 |
| 17.5 | 4,255,244 | 88.49% | 88.39% | 87.66% | 0.0000 | 0.0001 |
| 18.5 | 3,895,230 | 88.17% | 87.42% | 86.80% | 0.0001 | 0.0002 |
| 19.5 | 3,061,462 | 87.14% | 86.42% | 85.92% | 0.0001 | 0.0001 |
| 20.5 | 2,880,141 | 86.67% | 85.36% | 85.02% | 0.0002 | 0.0003 |
| 21.5 | 2,356,968 | 85.58% | 84.26% | 84.09% | 0.0002 | 0.0002 |
| 22.5 | 2,069,327 | 84.70% | 83.11% | 83.15% | 0.0003 | 0.0002 |
| 23.5 | 1,949,216 | 83.81% | 81.91% | 82.18% | 0.0004 | 0.0003 |
| 24.5 | 1,820,369 | 82.66% | 80.66% | 81.18% | 0.0004 | 0.0002 |
| 25.5 | 1,677,125 | 81.79% | 79.35% | 80.17% | 0.0006 | 0.0003 |
| 26.5 | 1,481,115 | 81.17% | 77.98% | 79.12% | 0.0010 | 0.0004 |
| 27.5 | 1,260,654 | 77.44% | 76.55% | 78.05% | 0.0001 | 0.0000 |
| 28.5 | 1,148,242 | 76.17% | 75.06% | 76.95% | 0.0001 | 0.0001 |
| 29.5 | 1,121,533 | 74.47% | 73.51% | 75.82% | 0.0001 | 0.0002 |
| 30.5 | 1,012,155 | 73.08% | 71.90% | 74.66% | 0.0001 | 0.0002 |
| 31.5 | 930,353 | 71.52% | 70.22% | 73.47% | 0.0002 | 0.0004 |
| 32.5 | 892,559 | 70.40% | 68.48% | 72.25% | 0.0004 | 0.0003 |
| 33.5 | 785,244 | 69.30% | 66.67% | 71.00% | 0.0007 | 0.0003 |
| 34.5 | 708,329 | 68.59% | 64.80% | 69.72% | 0.0014 | 0.0001 |
| 35.5 | 675,794 | 68.21% | 62.87% | 68.40% | 0.0029 | 0.0000 |
| 36.5 | 544,885 | 66.48% | 60.87% | 67.06% | 0.0031 | 0.0000 |
| 37.5 | 521,854 | 65.13% | 58.82% | 65.69% | 0.0040 | 0.0000 |
| 38.5 | 491,619 | 63.64% | 56.72% | 64.29% | 0.0048 | 0.0000 |
| 39.5 | 456,126 | 63.15% | 54.56% | 62.86% | 0.0074 | 0.0000 |
| 40.5 | 412,561 | 60.57% | 52.35% | 61.39% | 0.0068 | 0.0001 |
| 41.5 | 357,732 | 56.48% | 50.11% | 59.91% | 0.0041 | 0.0012 |
| 42.5 | 349,168 | 55.24% | 47.82% | 58.39% | 0.0055 | 0.0010 |
| 43.5 | 255,457 | 43.83% | 45.52% | 56.85% | 0.0003 | 0.0170 |
| 44.5 | 218,070 | 43.26% | 43.19% | 55.29% | 0.0000 | 0.0145 |
| 45.5 | 200,652 | 42.41% | 40.85% | 53.70% | 0.0002 | 0.0127 |
| 46.5 | 182,352 | 41.40% | 38.50% | 52.09% | 0.0008 | 0.0114 |

# Account 378 Curve Fitting

| [1] Age (Years) | [2] Exposures (Dollars) | [3] Observed Life Table (OLT) | [4] Company R1.5-40 | [5] OPC R1-46 | [6] Company SSD | [7] OPC SSD |
|---|---|---|---|---|---|---|
| 47.5 | 159,185 | 38.83% | 36.17% | 50.46% | 0.0007 | 0.0135 |
| 48.5 | 152,765 | 38.46% | 33.85% | 48.81% | 0.0021 | 0.0107 |
| 49.5 | 144,010 | 37.34% | 31.56% | 47.15% | 0.0033 | 0.0096 |
| 50.5 | 133,598 | 35.23% | 29.31% | 45.48% | 0.0035 | 0.0105 |
| 51.5 | 114,266 | 32.94% | 27.11% | 43.79% | 0.0034 | 0.0118 |
| 52.5 | 77,624 | 27.56% | 24.96% | 42.10% | 0.0007 | 0.0211 |
| 53.5 | 57,598 | 21.23% | 22.88% | 40.40% | 0.0003 | 0.0367 |
| 54.5 | 48,863 | 20.30% | 20.88% | 38.69% | 0.0000 | 0.0338 |
| 55.5 | 42,999 | 18.76% | 18.96% | 36.99% | 0.0000 | 0.0332 |
| 56.5 | 32,521 | 16.31% | 17.12% | 35.29% | 0.0001 | 0.0360 |
| 57.5 | 31,106 | 16.10% | 15.38% | 33.59% | 0.0001 | 0.0306 |
| 58.5 | 26,788 | 15.60% | 13.73% | 31.91% | 0.0003 | 0.0266 |
| 59.5 | 26,170 | 15.60% | 12.18% | 30.23% | 0.0012 | 0.0214 |
| 60.5 | 13,273 | 15.11% | 10.73% | 28.57% | 0.0019 | 0.0181 |
| 61.5 | 5,601 | 15.11% | 9.39% | 26.93% | 0.0033 | 0.0140 |
| 62.5 | 456 | 15.11% | 8.14% | 25.31% | 0.0049 | 0.0104 |
| 63.5 | | | 6.99% | 23.72% | | |
| Sum of Squared Differences | | | | [8] | 0.0746 | 0.4058 |
| Up to 1% of Beginning Exposures | | | | [9] | 0.0475 | 0.0119 |

[1] Age in years using half-year convention

[2] Dollars exposed to retirement at the beginning of each age interval

[3] Observed life table based on the Company's property records. These numbers form the original survivor curve.

[4] The Company's selected Iowa curve to be fitted to the OLT.

[5] My selected Iowa curve to be fitted to the OLT.

[6] = ([4] - [3])^2. This is the squared difference between each point on the Company's curve and the observed survivor curve.

[7] = ([5] - [3])^2. This is the squared difference between each point on my curve and the observed survivor curve.

[8] = Sum of squared differences. The smallest SSD represents the best mathematical fit.

# Account 380 Curve Fitting

| [1] Age (Years) | [2] Exposures (Dollars) | [3] Observed Life Table (OLT) | [4] Company R0.5-52 | [5] OPC R0.5-57 | [6] Company SSD | [7] OPC SSD |
|---|---|---|---|---|---|---|
| 0.0 | 59,540,564 | 100.00% | 100.00% | 100.00% | 0.0000 | 0.0000 |
| 0.5 | 59,718,123 | 100.00% | 99.64% | 99.67% | 0.0000 | 0.0000 |
| 1.5 | 57,273,774 | 99.88% | 98.90% | 99.00% | 0.0001 | 0.0001 |
| 2.5 | 55,983,302 | 99.67% | 98.16% | 98.32% | 0.0002 | 0.0002 |
| 3.5 | 54,192,327 | 99.45% | 97.41% | 97.64% | 0.0004 | 0.0003 |
| 4.5 | 51,607,540 | 99.11% | 96.66% | 96.96% | 0.0006 | 0.0005 |
| 5.5 | 50,124,739 | 98.62% | 95.90% | 96.27% | 0.0007 | 0.0006 |
| 6.5 | 48,275,551 | 97.96% | 95.13% | 95.57% | 0.0008 | 0.0006 |
| 7.5 | 46,394,869 | 97.43% | 94.36% | 94.87% | 0.0009 | 0.0007 |
| 8.5 | 45,004,709 | 96.83% | 93.58% | 94.16% | 0.0011 | 0.0007 |
| 9.5 | 44,635,096 | 95.84% | 92.79% | 93.45% | 0.0009 | 0.0006 |
| 10.5 | 44,963,839 | 94.98% | 92.00% | 92.73% | 0.0009 | 0.0005 |
| 11.5 | 44,038,952 | 94.24% | 91.19% | 92.00% | 0.0009 | 0.0005 |
| 12.5 | 42,773,309 | 93.56% | 90.39% | 91.27% | 0.0010 | 0.0005 |
| 13.5 | 41,351,621 | 92.65% | 89.57% | 90.54% | 0.0009 | 0.0004 |
| 14.5 | 40,338,498 | 91.82% | 88.76% | 89.80% | 0.0009 | 0.0004 |
| 15.5 | 39,239,636 | 90.80% | 87.93% | 89.05% | 0.0008 | 0.0003 |
| 16.5 | 38,363,302 | 90.03% | 87.10% | 88.30% | 0.0009 | 0.0003 |
| 17.5 | 37,351,397 | 89.20% | 86.26% | 87.54% | 0.0009 | 0.0003 |
| 18.5 | 35,953,696 | 88.54% | 85.41% | 86.78% | 0.0010 | 0.0003 |
| 19.5 | 35,629,437 | 87.63% | 84.56% | 86.01% | 0.0009 | 0.0003 |
| 20.5 | 33,166,377 | 86.66% | 83.70% | 85.24% | 0.0009 | 0.0002 |
| 21.5 | 31,898,610 | 85.85% | 82.84% | 84.46% | 0.0009 | 0.0002 |
| 22.5 | 30,560,008 | 85.07% | 81.96% | 83.68% | 0.0010 | 0.0002 |
| 23.5 | 29,330,313 | 84.00% | 81.08% | 82.89% | 0.0009 | 0.0001 |
| 24.5 | 28,435,596 | 82.87% | 80.19% | 82.09% | 0.0007 | 0.0001 |
| 25.5 | 27,507,595 | 81.88% | 79.29% | 81.29% | 0.0007 | 0.0000 |
| 26.5 | 26,294,686 | 81.01% | 78.38% | 80.48% | 0.0007 | 0.0000 |
| 27.5 | 25,137,204 | 80.03% | 77.46% | 79.66% | 0.0007 | 0.0000 |
| 28.5 | 23,941,626 | 79.14% | 76.53% | 78.83% | 0.0007 | 0.0000 |
| 29.5 | 22,597,543 | 78.29% | 75.59% | 78.00% | 0.0007 | 0.0000 |
| 30.5 | 21,616,393 | 77.58% | 74.64% | 77.16% | 0.0009 | 0.0000 |
| 31.5 | 20,710,334 | 76.76% | 73.68% | 76.31% | 0.0009 | 0.0000 |
| 32.5 | 19,805,679 | 75.88% | 72.71% | 75.45% | 0.0010 | 0.0000 |
| 33.5 | 19,009,745 | 75.02% | 71.72% | 74.58% | 0.0011 | 0.0000 |
| 34.5 | 18,306,235 | 74.14% | 70.73% | 73.70% | 0.0012 | 0.0000 |
| 35.5 | 17,432,943 | 73.27% | 69.72% | 72.82% | 0.0013 | 0.0000 |
| 36.5 | 16,822,440 | 72.59% | 68.71% | 71.92% | 0.0015 | 0.0000 |
| 37.5 | 16,218,586 | 71.79% | 67.68% | 71.02% | 0.0017 | 0.0001 |
| 38.5 | 15,626,464 | 71.12% | 66.63% | 70.10% | 0.0020 | 0.0001 |
| 39.5 | 14,987,232 | 70.36% | 65.58% | 69.18% | 0.0023 | 0.0001 |
| 40.5 | 14,574,940 | 69.62% | 64.51% | 68.25% | 0.0026 | 0.0002 |
| 41.5 | 13,817,484 | 68.93% | 63.44% | 67.30% | 0.0030 | 0.0003 |
| 42.5 | 13,022,286 | 68.21% | 62.35% | 66.35% | 0.0034 | 0.0003 |
| 43.5 | 12,563,150 | 67.38% | 61.24% | 65.38% | 0.0038 | 0.0004 |
| 44.5 | 12,018,499 | 66.55% | 60.13% | 64.41% | 0.0041 | 0.0005 |
| 45.5 | 11,188,601 | 65.59% | 59.01% | 63.43% | 0.0043 | 0.0005 |
| 46.5 | 10,045,372 | 64.76% | 57.87% | 62.43% | 0.0047 | 0.0005 |
| 47.5 | 8,789,857 | 63.89% | 56.72% | 61.43% | 0.0051 | 0.0006 |
| 48.5 | 7,956,787 | 63.09% | 55.57% | 60.41% | 0.0057 | 0.0007 |
| 49.5 | 7,233,378 | 61.90% | 54.40% | 59.39% | 0.0056 | 0.0006 |
| 50.5 | 6,765,801 | 60.97% | 53.23% | 58.36% | 0.0060 | 0.0007 |
| 51.5 | 6,166,924 | 59.94% | 52.04% | 57.32% | 0.0062 | 0.0007 |
| 52.5 | 5,558,402 | 58.79% | 50.85% | 56.27% | 0.0063 | 0.0006 |
| 53.5 | 4,810,464 | 57.90% | 49.65% | 55.21% | 0.0068 | 0.0007 |
| 54.5 | 4,127,094 | 57.06% | 48.44% | 54.15% | 0.0074 | 0.0008 |
| 55.5 | 3,796,115 | 56.00% | 47.23% | 53.07% | 0.0077 | 0.0009 |
| 56.5 | 3,489,606 | 55.33% | 46.01% | 51.99% | 0.0087 | 0.0011 |

# Account 380 Curve Fitting



| [1] Age (Years) | [2] Exposures (Dollars) | [3] Observed Life Table (OLT) | [4] Company R0.5-52 | [5] OPC R0.5-57 | [6] Company SSD | [7] OPC SSD |
|---|---|---|---|---|---|---|
| 57.5 | 3,267,258 | 54.76% | 44.79% | 50.90% | 0.0099 | 0.0015 |
| 58.5 | 3,030,659 | 53.95% | 43.56% | 49.81% | 0.0108 | 0.0017 |
| 59.5 | 2,799,113 | 52.96% | 42.33% | 48.71% | 0.0113 | 0.0018 |
| 60.5 | 2,351,866 | 52.57% | 41.10% | 47.60% | 0.0132 | 0.0025 |
| 61.5 | 1,262,037 | 52.06% | 39.86% | 46.49% | 0.0149 | 0.0031 |
| 62.5 | 1,010,664 | 50.49% | 38.63% | 45.38% | 0.0141 | 0.0026 |
| 63.5 | 858,606 | 48.08% | 37.39% | 44.26% | 0.0114 | 0.0015 |
| 64.5 | 687,909 | 42.98% | 36.16% | 43.14% | 0.0046 | 0.0000 |
| 65.5 | 603,443 | 40.79% | 34.93% | 42.02% | 0.0034 | 0.0002 |
| 66.5 | 547,140 | 38.73% | 33.71% | 40.89% | 0.0025 | 0.0005 |
| 67.5 | 482,156 | 36.78% | 32.49% | 39.76% | 0.0018 | 0.0009 |
| 68.5 | 439,669 | 35.35% | 31.27% | 38.64% | 0.0017 | 0.0011 |
| 69.5 | 400,896 | 34.06% | 30.07% | 37.51% | 0.0016 | 0.0012 |
| 70.5 | 375,327 | 32.84% | 28.87% | 36.39% | 0.0016 | 0.0013 |
| 71.5 | 348,934 | 32.24% | 27.68% | 35.27% | 0.0021 | 0.0009 |
| 72.5 | 301,236 | 32.00% | 26.51% | 34.15% | 0.0030 | 0.0005 |
| 73.5 | 276,023 | 31.68% | 25.34% | 33.03% | 0.0040 | 0.0002 |
| 74.5 | 251,309 | 30.83% | 24.19% | 31.92% | 0.0044 | 0.0001 |
| 75.5 | 240,272 | 29.65% | 23.05% | 30.82% | 0.0044 | 0.0001 |
| 76.5 | 223,426 | 28.59% | 21.93% | 29.72% | 0.0044 | 0.0001 |
| 77.5 | 194,923 | 27.75% | 20.82% | 28.63% | 0.0048 | 0.0001 |
| 78.5 | 181,637 | 27.04% | 19.74% | 27.55% | 0.0053 | 0.0000 |
| 79.5 | 171,257 | 26.68% | 18.67% | 26.47% | 0.0064 | 0.0000 |
| 80.5 | 165,652 | 25.82% | 17.62% | 25.41% | 0.0067 | 0.0000 |
| 81.5 | 162,572 | 25.66% | 16.59% | 24.36% | 0.0082 | 0.0002 |
| 82.5 | 126,007 | 24.70% | 15.59% | 23.32% | 0.0083 | 0.0002 |
| 83.5 | 106,913 | 22.08% | 14.61% | 22.29% | 0.0056 | 0.0000 |
| 84.5 | 95,290 | 20.81% | 13.65% | 21.28% | 0.0051 | 0.0000 |
| 85.5 | 92,768 | 20.48% | 12.72% | 20.28% | 0.0060 | 0.0000 |
| 86.5 | 82,455 | 19.10% | 11.81% | 19.29% | 0.0053 | 0.0000 |
| 87.5 | 61,893 | 14.97% | 10.93% | 18.33% | 0.0016 | 0.0011 |
| 88.5 | 42,029 | 10.51% | 10.07% | 17.38% | 0.0000 | 0.0047 |
| 89.5 | 26,007 | 9.99% | 9.25% | 16.44% | 0.0001 | 0.0042 |
| 90.5 | 17,364 | 9.21% | 8.45% | 15.53% | 0.0001 | 0.0040 |
| 91.5 | | | 7.67% | 14.63% | | |
| Sum of Squared Differences | | | | [8] | 0.3169 | 0.0556 |
| Up to 1% of Beginning Exposures | | | | [9] | 0.2218 | 0.0343 |

[1] Age in years using half-year convention
[2] Dollars exposed to retirement at the beginning of each age interval
[3] Observed life table based on the Company's property records. These numbers form the original survivor curve.
[4] The Company's selected Iowa curve to be fitted to the OLT.
[5] My selected Iowa curve to be fitted to the OLT.
[6] = ([4] - [3])^2. This is the squared difference between each point on the Company's curve and the observed survivor curve.
[7] = ([5] - [3])^2. This is the squared difference between each point on my curve and the observed survivor curve.
[8] = Sum of squared differences. The smallest SSD represents the best mathematical fit.

# Account 380.02 Curve Fitting



| [1] | [2] | [3] | [4] | [5] | [6] | [7] |
|---|---|---|---|---|---|---|
| Age (Years) | Exposures (Dollars) | Observed Life Table (OLT) | Company R1.5-55 | OPC R1.5-64 | Company SSD | OPC SSD |
| 0.0 | 424,302,227 | 100.00% | 100.00% | 100.00% | 0.0000 | 0.0000 |
| 0.5 | 398,823,837 | 100.00% | 99.84% | 99.86% | 0.0000 | 0.0000 |
| 1.5 | 361,350,244 | 99.95% | 99.51% | 99.58% | 0.0000 | 0.0000 |
| 2.5 | 312,386,107 | 99.88% | 99.17% | 99.29% | 0.0001 | 0.0000 |
| 3.5 | 288,435,262 | 99.78% | 98.82% | 98.99% | 0.0001 | 0.0001 |
| 4.5 | 263,515,899 | 99.66% | 98.45% | 98.68% | 0.0001 | 0.0001 |
| 5.5 | 245,380,126 | 99.44% | 98.07% | 98.37% | 0.0002 | 0.0001 |
| 6.5 | 228,602,762 | 99.14% | 97.68% | 98.04% | 0.0002 | 0.0001 |
| 7.5 | 214,330,493 | 98.86% | 97.28% | 97.71% | 0.0002 | 0.0001 |
| 8.5 | 202,230,058 | 98.54% | 96.86% | 97.36% | 0.0003 | 0.0001 |
| 9.5 | 192,555,204 | 98.27% | 96.43% | 97.01% | 0.0003 | 0.0002 |
| 10.5 | 183,799,460 | 98.01% | 95.99% | 96.64% | 0.0004 | 0.0002 |
| 11.5 | 176,963,356 | 97.64% | 95.53% | 96.27% | 0.0004 | 0.0002 |
| 12.5 | 168,350,234 | 97.29% | 95.06% | 95.88% | 0.0005 | 0.0002 |
| 13.5 | 158,031,848 | 96.86% | 94.57% | 95.48% | 0.0005 | 0.0002 |
| 14.5 | 146,569,279 | 96.47% | 94.07% | 95.08% | 0.0006 | 0.0002 |
| 15.5 | 135,612,149 | 96.01% | 93.55% | 94.66% | 0.0006 | 0.0002 |
| 16.5 | 124,089,559 | 95.50% | 93.01% | 94.23% | 0.0006 | 0.0002 |
| 17.5 | 112,732,708 | 94.99% | 92.46% | 93.79% | 0.0006 | 0.0001 |
| 18.5 | 102,623,588 | 94.55% | 91.89% | 93.33% | 0.0007 | 0.0001 |
| 19.5 | 99,435,240 | 94.05% | 91.30% | 92.87% | 0.0008 | 0.0001 |
| 20.5 | 76,589,313 | 93.64% | 90.70% | 92.39% | 0.0009 | 0.0002 |
| 21.5 | 68,667,718 | 93.13% | 90.08% | 91.90% | 0.0009 | 0.0002 |
| 22.5 | 62,421,449 | 92.52% | 89.43% | 91.40% | 0.0010 | 0.0001 |
| 23.5 | 56,266,688 | 92.03% | 88.77% | 90.89% | 0.0011 | 0.0001 |
| 24.5 | 50,925,431 | 91.49% | 88.09% | 90.36% | 0.0012 | 0.0001 |
| 25.5 | 45,864,164 | 90.85% | 87.38% | 89.81% | 0.0012 | 0.0001 |
| 26.5 | 40,523,573 | 90.18% | 86.65% | 89.25% | 0.0012 | 0.0001 |
| 27.5 | 35,361,799 | 89.59% | 85.90% | 88.68% | 0.0014 | 0.0001 |
| 28.5 | 31,503,357 | 89.03% | 85.12% | 88.09% | 0.0015 | 0.0001 |
| 29.5 | 27,683,785 | 88.62% | 84.31% | 87.49% | 0.0019 | 0.0001 |
| 30.5 | 23,672,226 | 88.13% | 83.48% | 86.86% | 0.0022 | 0.0002 |
| 31.5 | 20,586,901 | 87.63% | 82.63% | 86.22% | 0.0025 | 0.0002 |
| 32.5 | 17,219,808 | 87.13% | 81.75% | 85.56% | 0.0029 | 0.0002 |
| 33.5 | 14,448,609 | 86.67% | 80.83% | 84.89% | 0.0034 | 0.0003 |
| 34.5 | 11,868,756 | 86.04% | 79.89% | 84.19% | 0.0038 | 0.0003 |
| 35.5 | 10,028,228 | 85.55% | 78.92% | 83.48% | 0.0044 | 0.0004 |
| 36.5 | 8,449,422 | 85.00% | 77.91% | 82.74% | 0.0050 | 0.0005 |
| 37.5 | 4,969,331 | 84.16% | 76.88% | 81.99% | 0.0053 | 0.0005 |
| 38.5 | 3,609,791 | 82.90% | 75.81% | 81.21% | 0.0050 | 0.0003 |
| 39.5 | 2,443,896 | 81.64% | 74.71% | 80.42% | 0.0048 | 0.0001 |
| 40.5 | 1,573,206 | 80.17% | 73.58% | 79.60% | 0.0043 | 0.0000 |
| 41.5 | 772,862 | 79.08% | 72.42% | 78.76% | 0.0044 | 0.0000 |
| 42.5 | 281,846 | 75.86% | 71.22% | 77.89% | 0.0022 | 0.0004 |
| 43.5 | 144,586 | 61.87% | 69.98% | 77.00% | 0.0066 | 0.0229 |
| 44.5 | 89,941 | 38.48% | 68.72% | 76.09% | 0.0914 | 0.1415 |
| 45.5 | 71,183 | 30.46% | 67.42% | 75.16% | 0.1366 | 0.1998 |
| 46.5 | 52,779 | 22.58% | 66.08% | 74.20% | 0.1892 | 0.2664 |

# Account 380.02 Curve Fitting

| [1] Age (Years) | [2] Exposures (Dollars) | [3] Observed Life Table (OLT) | [4] Company R1.5-55 | [5] OPC R1.5-64 | [6] Company SSD | [7] OPC SSD |
|---|---|---|---|---|---|---|
| 47.5 | 38,594 | 16.51% | 64.71% | 73.21% | 0.2323 | 0.3215 |
| 48.5 | | | 63.31% | 72.20% | | |
| Sum of Squared Differences | | | | [8] | 0.7259 | 0.9594 |
| Up to 1% of Beginning Exposures | | | | [9] | 0.0490 | 0.0065 |

[1] Age in years using half-year convention

[2] Dollars exposed to retirement at the beginning of each age interval

[3] Observed life table based on the Company's property records. These numbers form the original survivor curve.

[4] The Company's selected Iowa curve to be fitted to the OLT.

[5] My selected Iowa curve to be fitted to the OLT.

[6] = ([4] - [3])^2. This is the squared difference between each point on the Company's curve and the observed survivor curve.

[7] = ([5] - [3])^2. This is the squared difference between each point on my curve and the observed survivor curve.

[8] = Sum of squared differences. The smallest SSD represents the best mathematical fit.

# Account 385 Curve Fitting



| [1] Age (Years) | [2] Exposures (Dollars) | [3] Observed Life Table (OLT) | [4] Company R3-37 | [5] OPC R3-41 | [6] Company SSD | [7] OPC SSD |
|---|---|---|---|---|---|---|
| 0.0 | 13,628,465 | 100.00% | 100.00% | 100.00% | 0.0000 | 0.0000 |
| 0.5 | 13,646,274 | 100.00% | 99.98% | 99.98% | 0.0000 | 0.0000 |
| 1.5 | 11,486,907 | 100.00% | 99.93% | 99.94% | 0.0000 | 0.0000 |
| 2.5 | 11,120,169 | 99.98% | 99.87% | 99.88% | 0.0000 | 0.0000 |
| 3.5 | 11,129,473 | 99.98% | 99.79% | 99.82% | 0.0000 | 0.0000 |
| 4.5 | 10,471,211 | 99.29% | 99.69% | 99.74% | 0.0000 | 0.0000 |
| 5.5 | 10,462,425 | 98.79% | 99.58% | 99.64% | 0.0001 | 0.0001 |
| 6.5 | 10,454,464 | 98.67% | 99.44% | 99.53% | 0.0001 | 0.0001 |
| 7.5 | 10,350,620 | 98.60% | 99.28% | 99.40% | 0.0000 | 0.0001 |
| 8.5 | 10,341,528 | 98.51% | 99.09% | 99.25% | 0.0000 | 0.0001 |
| 9.5 | 10,274,492 | 97.86% | 98.86% | 99.07% | 0.0001 | 0.0001 |
| 10.5 | 10,231,890 | 97.44% | 98.59% | 98.87% | 0.0001 | 0.0002 |
| 11.5 | 10,208,045 | 97.21% | 98.29% | 98.63% | 0.0001 | 0.0002 |
| 12.5 | 10,130,613 | 96.82% | 97.93% | 98.36% | 0.0001 | 0.0002 |
| 13.5 | 10,011,769 | 96.24% | 97.52% | 98.05% | 0.0002 | 0.0003 |
| 14.5 | 9,570,851 | 96.10% | 97.05% | 97.69% | 0.0001 | 0.0003 |
| 15.5 | 9,246,719 | 95.93% | 96.51% | 97.30% | 0.0000 | 0.0002 |
| 16.5 | 9,062,907 | 95.85% | 95.91% | 96.85% | 0.0000 | 0.0001 |
| 17.5 | 8,453,178 | 95.75% | 95.23% | 96.34% | 0.0000 | 0.0000 |
| 18.5 | 8,225,320 | 95.58% | 94.47% | 95.78% | 0.0001 | 0.0000 |
| 19.5 | 8,124,388 | 95.21% | 93.61% | 95.16% | 0.0003 | 0.0000 |
| 20.5 | 7,250,612 | 93.12% | 92.66% | 94.47% | 0.0000 | 0.0002 |
| 21.5 | 6,649,635 | 91.48% | 91.60% | 93.70% | 0.0000 | 0.0005 |
| 22.5 | 6,153,598 | 89.60% | 90.44% | 92.85% | 0.0001 | 0.0011 |
| 23.5 | 5,840,764 | 89.30% | 89.14% | 91.92% | 0.0000 | 0.0007 |
| 24.5 | 5,561,217 | 88.67% | 87.72% | 90.91% | 0.0001 | 0.0005 |
| 25.5 | 5,316,975 | 88.09% | 86.16% | 89.79% | 0.0004 | 0.0003 |
| 26.5 | 4,653,944 | 87.99% | 84.44% | 88.57% | 0.0013 | 0.0000 |
| 27.5 | 4,228,966 | 86.99% | 82.56% | 87.24% | 0.0020 | 0.0000 |
| 28.5 | 3,869,514 | 84.43% | 80.51% | 85.79% | 0.0015 | 0.0002 |
| 29.5 | 3,462,120 | 82.71% | 78.26% | 84.22% | 0.0020 | 0.0002 |
| 30.5 | 2,129,894 | 81.79% | 75.82% | 82.51% | 0.0036 | 0.0001 |
| 31.5 | 1,833,554 | 80.76% | 73.17% | 80.66% | 0.0058 | 0.0000 |
| 32.5 | 1,315,126 | 80.06% | 70.30% | 78.66% | 0.0095 | 0.0002 |
| 33.5 | 1,022,273 | 76.18% | 67.20% | 76.49% | 0.0081 | 0.0000 |
| 34.5 | 652,075 | 74.98% | 63.90% | 74.16% | 0.0123 | 0.0001 |
| 35.5 | 452,642 | 72.36% | 60.38% | 71.65% | 0.0144 | 0.0001 |
| 36.5 | 332,243 | 71.35% | 56.66% | 68.97% | 0.0216 | 0.0006 |
| 37.5 | 228,650 | 68.12% | 52.78% | 66.10% | 0.0235 | 0.0004 |
| 38.5 | 112,270 | 59.09% | 48.75% | 63.06% | 0.0107 | 0.0016 |
| 39.5 | 77,700 | 56.54% | 44.63% | 59.85% | 0.0142 | 0.0011 |
| 40.5 | 71,394 | 55.17% | 40.45% | 56.48% | 0.0217 | 0.0002 |
| 41.5 | 68,687 | 53.32% | 36.29% | 52.97% | 0.0290 | 0.0000 |
| 42.5 | 65,343 | 50.72% | 32.19% | 49.35% | 0.0344 | 0.0002 |
| 43.5 | 53,875 | 46.74% | 28.21% | 45.64% | 0.0343 | 0.0001 |
| 44.5 | 49,905 | 44.43% | 24.41% | 41.88% | 0.0401 | 0.0006 |
| 45.5 | 40,931 | 40.95% | 20.85% | 38.11% | 0.0404 | 0.0008 |
| 46.5 | 26,069 | 35.07% | 17.56% | 34.38% | 0.0307 | 0.0000 |

# Account 385 Curve Fitting

| [1] Age (Years) | [2] Exposures (Dollars) | [3] Observed Life Table (OLT) | [4] Company R3-37 | [5] OPC R3-41 | [6] Company SSD | [7] OPC SSD |
|---|---|---|---|---|---|---|
| 47.5 | 15,025 | 20.21% | 14.57% | 30.71% | 0.0032 | 0.0110 |
| 48.5 | 14,314 | 20.21% | 11.90% | 27.17% | 0.0069 | 0.0048 |
| 49.5 | 7,431 | 20.21% | 9.55% | 23.79% | 0.0114 | 0.0013 |
| 50.5 | 931 | 18.20% | 7.53% | 20.60% | | |
| Sum of Squared Differences | | | | [8] | 0.3842 | 0.0288 |
| Up to 1% of Beginning Exposures | | | | [9] | 0.1074 | 0.0070 |

[1] Age in years using half-year convention

[2] Dollars exposed to retirement at the beginning of each age interval

[3] Observed life table based on the Company's property records. These numbers form the original survivor curve.

[4] The Company's selected Iowa curve to be fitted to the OLT.

[5] My selected Iowa curve to be fitted to the OLT.

[6] = ([4] - [3])^2. This is the squared difference between each point on the Company's curve and the observed survivor curve.

[7] = ([5] - [3])^2. This is the squared difference between each point on my curve and the observed survivor curve.

[8] = Sum of squared differences. The smallest SSD represents the best mathematical fit.

# *PGS*

## *Gas Division*

### *378.00 Meas. & Reg. Sta. Eq - General*

## *Observed Life Table*

*Retirement Expr. 1970 TO 2020*
*Placement Years 1940 TO 2019*

| *Age Interval* | *$ Surviving At Beginning of Age Interval* | *$ Retired During The Age Interval* | *Retirement Ratio* | *% Surviving At Beginning of Age Interval* |
|---|---|---|---|---|
| 0.0 - 0.5 | $20,059,180.78 | $1,564.95 | 0.00008 | 100.00 |
| 0.5 - 1.5 | $20,095,514.25 | $0.00 | 0.00000 | 99.99 |
| 1.5 - 2.5 | $18,500,081.55 | $9,610.93 | 0.00052 | 99.99 |
| 2.5 - 3.5 | $16,945,291.59 | $24,390.08 | 0.00144 | 99.94 |
| 3.5 - 4.5 | $15,728,826.19 | $90,848.44 | 0.00578 | 99.80 |
| 4.5 - 5.5 | $14,297,397.12 | $88,657.44 | 0.00620 | 99.22 |
| 5.5 - 6.5 | $12,712,374.06 | $42,021.74 | 0.00331 | 98.60 |
| 6.5 - 7.5 | $11,253,000.42 | $63,264.59 | 0.00562 | 98.28 |
| 7.5 - 8.5 | $9,904,402.78 | $23,083.93 | 0.00233 | 97.73 |
| 8.5 - 9.5 | $7,514,209.23 | $82,030.03 | 0.01092 | 97.50 |
| 9.5 - 10.5 | $6,802,635.19 | $55,604.77 | 0.00817 | 96.43 |
| 10.5 - 11.5 | $6,502,480.01 | $20,509.64 | 0.00315 | 95.65 |
| 11.5 - 12.5 | $5,977,490.48 | $147,304.87 | 0.02464 | 95.34 |
| 12.5 - 13.5 | $5,683,172.25 | $55,459.80 | 0.00976 | 92.99 |
| 13.5 - 14.5 | $5,319,149.48 | $97,898.44 | 0.01840 | 92.09 |
| 14.5 - 15.5 | $5,093,868.71 | $75,166.81 | 0.01476 | 90.39 |
| 15.5 - 16.5 | $4,780,886.54 | $8,150.66 | 0.00170 | 89.06 |
| 16.5 - 17.5 | $4,643,720.50 | $21,803.32 | 0.00470 | 88.91 |
| 17.5 - 18.5 | $4,255,243.96 | $15,137.70 | 0.00356 | 88.49 |
| 18.5 - 19.5 | $3,895,230.29 | $45,901.94 | 0.01178 | 88.17 |
| 19.5 - 20.5 | $3,061,462.44 | $16,421.06 | 0.00536 | 87.14 |
| 20.5 - 21.5 | $2,880,140.95 | $36,020.11 | 0.01251 | 86.67 |
| 21.5 - 22.5 | $2,356,968.21 | $24,478.53 | 0.01039 | 85.58 |
| 22.5 - 23.5 | $2,069,326.74 | $21,548.81 | 0.01041 | 84.70 |
| 23.5 - 24.5 | $1,949,215.94 | $26,823.20 | 0.01376 | 83.81 |
| 24.5 - 25.5 | $1,820,368.96 | $19,254.12 | 0.01058 | 82.66 |
| 25.5 - 26.5 | $1,677,124.97 | $12,660.60 | 0.00755 | 81.79 |
| 26.5 - 27.5 | $1,481,114.51 | $68,085.01 | 0.04597 | 81.17 |
| 27.5 - 28.5 | $1,260,654.05 | $20,588.27 | 0.01633 | 77.44 |
| 28.5 - 29.5 | $1,148,242.34 | $25,676.26 | 0.02236 | 76.17 |
| 29.5 - 30.5 | $1,121,532.73 | $20,985.12 | 0.01871 | 74.47 |
| 30.5 - 31.5 | $1,012,154.66 | $21,481.92 | 0.02122 | 73.08 |
| 31.5 - 32.5 | $930,352.78 | $14,644.35 | 0.01574 | 71.52 |
| 32.5 - 33.5 | $892,558.77 | $13,914.30 | 0.01559 | 70.40 |
| 33.5 - 34.5 | $785,243.71 | $8,085.52 | 0.01030 | 69.30 |
| 34.5 - 35.5 | $708,329.47 | $3,941.34 | 0.00556 | 68.59 |
| 35.5 - 36.5 | $675,793.53 | $17,093.36 | 0.02529 | 68.21 |

# PGS

## Gas Division

### 378.00 Meas. & Reg. Sta. Eq - General

## Observed Life Table

**Retirement Expr. 1970 TO 2020**
**Placement Years 1940 TO 2019**

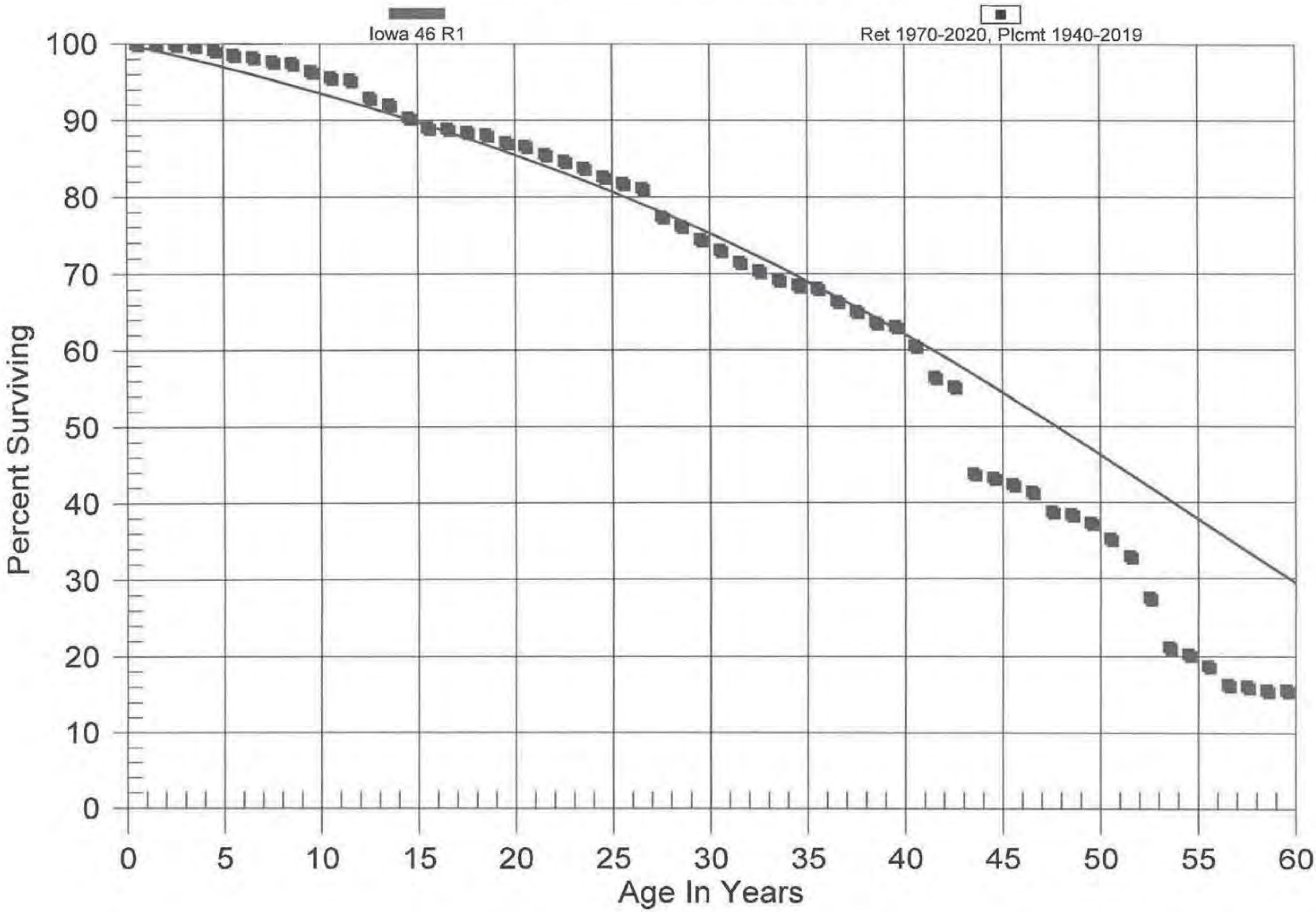
| Age Interval | $ Surviving At Beginning of Age Interval | $ Retired During The Age Interval | Retirement Ratio | % Surviving At Beginning of Age Interval |
|---|---|---|---|---|
| 36.5 - 37.5 | $544,884.60 | $11,046.24 | 0.02027 | 66.48 |
| 37.5 - 38.5 | $521,854.36 | $11,936.91 | 0.02287 | 65.13 |
| 38.5 - 39.5 | $491,619.41 | $3,811.13 | 0.00775 | 63.64 |
| 39.5 - 40.5 | $456,126.01 | $18,646.58 | 0.04088 | 63.15 |
| 40.5 - 41.5 | $412,561.05 | $27,873.91 | 0.06756 | 60.57 |
| 41.5 - 42.5 | $357,731.78 | $7,837.79 | 0.02191 | 56.48 |
| 42.5 - 43.5 | $349,168.38 | $72,087.29 | 0.20645 | 55.24 |
| 43.5 - 44.5 | $255,456.53 | $3,338.50 | 0.01307 | 43.83 |
| 44.5 - 45.5 | $218,069.65 | $4,316.09 | 0.01979 | 43.26 |
| 45.5 - 46.5 | $200,651.58 | $4,763.09 | 0.02374 | 42.41 |
| 46.5 - 47.5 | $182,352.15 | $11,301.93 | 0.06198 | 41.40 |
| 47.5 - 48.5 | $159,184.85 | $1,515.40 | 0.00952 | 38.83 |
| 48.5 - 49.5 | $152,764.81 | $4,450.19 | 0.02913 | 38.46 |
| 49.5 - 50.5 | $144,010.37 | $8,130.74 | 0.05646 | 37.34 |
| 50.5 - 51.5 | $133,597.70 | $8,697.89 | 0.06511 | 35.23 |
| 51.5 - 52.5 | $114,265.55 | $18,654.85 | 0.16326 | 32.94 |
| 52.5 - 53.5 | $77,623.66 | $17,820.67 | 0.22958 | 27.56 |
| 53.5 - 54.5 | $57,598.21 | $2,546.83 | 0.04422 | 21.23 |
| 54.5 - 55.5 | $48,863.01 | $3,691.12 | 0.07554 | 20.30 |
| 55.5 - 56.5 | $42,999.27 | $5,617.30 | 0.13064 | 18.76 |
| 56.5 - 57.5 | $32,520.73 | $416.30 | 0.01280 | 16.31 |
| 57.5 - 58.5 | $31,105.82 | $964.99 | 0.03102 | 16.10 |
| 58.5 - 59.5 | $26,787.83 | $0.00 | 0.00000 | 15.60 |
| 59.5 - 60.5 | $26,169.83 | $825.82 | 0.03156 | 15.60 |
| 60.5 - 61.5 | $13,272.63 | $0.00 | 0.00000 | 15.11 |
| 61.5 - 62.5 | $5,600.74 | $0.00 | 0.00000 | 15.11 |
| 62.5 - 63.5 | $455.57 | $0.00 | 0.00000 | 15.11 |

# PGS

## Gas Division

## 378.00 Meas. & Reg. Sta. Eq - General

## Original And Smooth Survivor Curves



# *PGS*

## *Gas Division*

### *380.00 Services - Steel*

## *Observed Life Table*

*Retirement Expr. 1970 TO 2020*
*Placement Years 1910 TO 2020*

| Age Interval | $ Surviving At Beginning of Age Interval | $ Retired During The Age Interval | Retirement Ratio | % Surviving At Beginning of Age Interval |
|---|---|---|---|---|
| 0.0 - 0.5 | $59,540,563.66 | $2,863.30 | 0.00005 | 100.00 |
| 0.5 - 1.5 | $59,718,123.45 | $68,727.71 | 0.00115 | 100.00 |
| 1.5 - 2.5 | $57,273,773.76 | $121,045.29 | 0.00211 | 99.88 |
| 2.5 - 3.5 | $55,983,301.90 | $125,302.04 | 0.00224 | 99.67 |
| 3.5 - 4.5 | $54,192,326.50 | $183,013.60 | 0.00338 | 99.45 |
| 4.5 - 5.5 | $51,607,539.55 | $256,156.36 | 0.00496 | 99.11 |
| 5.5 - 6.5 | $50,124,738.77 | $335,861.13 | 0.00670 | 98.62 |
| 6.5 - 7.5 | $48,275,550.84 | $259,896.19 | 0.00538 | 97.96 |
| 7.5 - 8.5 | $46,394,868.73 | $285,555.28 | 0.00615 | 97.43 |
| 8.5 - 9.5 | $45,004,709.00 | $459,547.40 | 0.01021 | 96.83 |
| 9.5 - 10.5 | $44,635,095.73 | $399,509.21 | 0.00895 | 95.84 |
| 10.5 - 11.5 | $44,963,839.41 | $352,989.73 | 0.00785 | 94.98 |
| 11.5 - 12.5 | $44,038,952.25 | $314,980.12 | 0.00715 | 94.24 |
| 12.5 - 13.5 | $42,773,308.95 | $418,725.81 | 0.00979 | 93.56 |
| 13.5 - 14.5 | $41,351,620.56 | $368,647.50 | 0.00891 | 92.65 |
| 14.5 - 15.5 | $40,338,498.20 | $447,079.88 | 0.01108 | 91.82 |
| 15.5 - 16.5 | $39,239,636.04 | $334,398.36 | 0.00852 | 90.80 |
| 16.5 - 17.5 | $38,363,301.66 | $352,527.37 | 0.00919 | 90.03 |
| 17.5 - 18.5 | $37,351,397.14 | $276,216.17 | 0.00740 | 89.20 |
| 18.5 - 19.5 | $35,953,696.07 | $369,298.62 | 0.01027 | 88.54 |
| 19.5 - 20.5 | $35,629,437.09 | $396,668.27 | 0.01113 | 87.63 |
| 20.5 - 21.5 | $33,166,376.94 | $308,825.92 | 0.00931 | 86.66 |
| 21.5 - 22.5 | $31,898,610.28 | $289,649.30 | 0.00908 | 85.85 |
| 22.5 - 23.5 | $30,560,007.99 | $384,506.79 | 0.01258 | 85.07 |
| 23.5 - 24.5 | $29,330,312.66 | $393,490.90 | 0.01342 | 84.00 |
| 24.5 - 25.5 | $28,435,596.06 | $340,901.93 | 0.01199 | 82.87 |
| 25.5 - 26.5 | $27,507,595.48 | $293,752.75 | 0.01068 | 81.88 |
| 26.5 - 27.5 | $26,294,685.68 | $316,947.53 | 0.01205 | 81.01 |
| 27.5 - 28.5 | $25,137,204.20 | $279,493.16 | 0.01112 | 80.03 |
| 28.5 - 29.5 | $23,941,626.11 | $256,201.85 | 0.01070 | 79.14 |
| 29.5 - 30.5 | $22,597,542.80 | $206,660.67 | 0.00915 | 78.29 |
| 30.5 - 31.5 | $21,616,392.59 | $228,546.90 | 0.01057 | 77.58 |
| 31.5 - 32.5 | $20,710,334.07 | $236,729.23 | 0.01143 | 76.76 |
| 32.5 - 33.5 | $19,805,679.36 | $225,332.50 | 0.01138 | 75.88 |
| 33.5 - 34.5 | $19,009,745.35 | $223,166.10 | 0.01174 | 75.02 |
| 34.5 - 35.5 | $18,306,234.86 | $214,206.38 | 0.01170 | 74.14 |
| 35.5 - 36.5 | $17,432,943.10 | $161,042.00 | 0.00924 | 73.27 |

# *PGS*

## *Gas Division*

### *380.00 Services - Steel*

## *Observed Life Table*

### *Retirement Expr. 1970 TO 2020*
### *Placement Years 1910 TO 2020*

| *Age Interval* | *$ Surviving At Beginning of Age Interval* | *$ Retired During The Age Interval* | *Retirement Ratio* | *% Surviving At Beginning of Age Interval* |
|---|---|---|---|---|
| 36.5 - 37.5 | $16,822,439.52 | $186,848.15 | 0.01111 | 72.59 |
| 37.5 - 38.5 | $16,218,586.09 | $150,718.39 | 0.00929 | 71.79 |
| 38.5 - 39.5 | $15,626,464.12 | $165,889.84 | 0.01062 | 71.12 |
| 39.5 - 40.5 | $14,987,232.14 | $157,966.61 | 0.01054 | 70.36 |
| 40.5 - 41.5 | $14,574,939.56 | $145,456.07 | 0.00998 | 69.62 |
| 41.5 - 42.5 | $13,817,484.04 | $144,381.55 | 0.01045 | 68.93 |
| 42.5 - 43.5 | $13,022,286.35 | $158,232.59 | 0.01215 | 68.21 |
| 43.5 - 44.5 | $12,563,149.75 | $154,395.24 | 0.01229 | 67.38 |
| 44.5 - 45.5 | $12,018,499.34 | $172,717.74 | 0.01437 | 66.55 |
| 45.5 - 46.5 | $11,188,600.70 | $141,612.14 | 0.01266 | 65.59 |
| 46.5 - 47.5 | $10,045,372.01 | $135,077.90 | 0.01345 | 64.76 |
| 47.5 - 48.5 | $8,789,857.27 | $110,817.06 | 0.01261 | 63.89 |
| 48.5 - 49.5 | $7,956,786.55 | $149,298.16 | 0.01876 | 63.09 |
| 49.5 - 50.5 | $7,233,378.27 | $109,032.35 | 0.01507 | 61.90 |
| 50.5 - 51.5 | $6,765,801.46 | $114,769.64 | 0.01696 | 60.97 |
| 51.5 - 52.5 | $6,166,923.55 | $118,397.89 | 0.01920 | 59.94 |
| 52.5 - 53.5 | $5,558,402.14 | $83,575.63 | 0.01504 | 58.79 |
| 53.5 - 54.5 | $4,810,463.93 | $69,663.34 | 0.01448 | 57.90 |
| 54.5 - 55.5 | $4,127,093.79 | $76,577.16 | 0.01855 | 57.06 |
| 55.5 - 56.5 | $3,796,114.55 | $45,895.27 | 0.01209 | 56.00 |
| 56.5 - 57.5 | $3,489,606.04 | $35,574.93 | 0.01019 | 55.33 |
| 57.5 - 58.5 | $3,267,258.45 | $48,603.27 | 0.01488 | 54.76 |
| 58.5 - 59.5 | $3,030,658.68 | $55,750.02 | 0.01840 | 53.95 |
| 59.5 - 60.5 | $2,799,113.36 | $20,409.16 | 0.00729 | 52.96 |
| 60.5 - 61.5 | $2,351,865.50 | $22,841.49 | 0.00971 | 52.57 |
| 61.5 - 62.5 | $1,262,037.01 | $38,048.31 | 0.03015 | 52.06 |
| 62.5 - 63.5 | $1,010,664.40 | $48,256.49 | 0.04775 | 50.49 |
| 63.5 - 64.5 | $858,605.91 | $91,006.37 | 0.10599 | 48.08 |
| 64.5 - 65.5 | $687,909.32 | $35,125.62 | 0.05106 | 42.98 |
| 65.5 - 66.5 | $603,443.14 | $30,421.00 | 0.05041 | 40.79 |
| 66.5 - 67.5 | $547,139.65 | $27,600.66 | 0.05045 | 38.73 |
| 67.5 - 68.5 | $482,156.12 | $18,779.68 | 0.03895 | 36.78 |
| 68.5 - 69.5 | $439,668.70 | $15,933.46 | 0.03624 | 35.35 |
| 69.5 - 70.5 | $400,895.72 | $14,400.64 | 0.03592 | 34.06 |
| 70.5 - 71.5 | $375,326.95 | $6,862.06 | 0.01828 | 32.84 |
| 71.5 - 72.5 | $348,934.38 | $2,646.39 | 0.00758 | 32.24 |
| 72.5 - 73.5 | $301,235.51 | $2,985.91 | 0.00991 | 32.00 |

# PGS

## Gas Division

### 380.00 Services - Steel

## Observed Life Table

### Retirement Expr. 1970 TO 2020
### Placement Years 1910 TO 2020

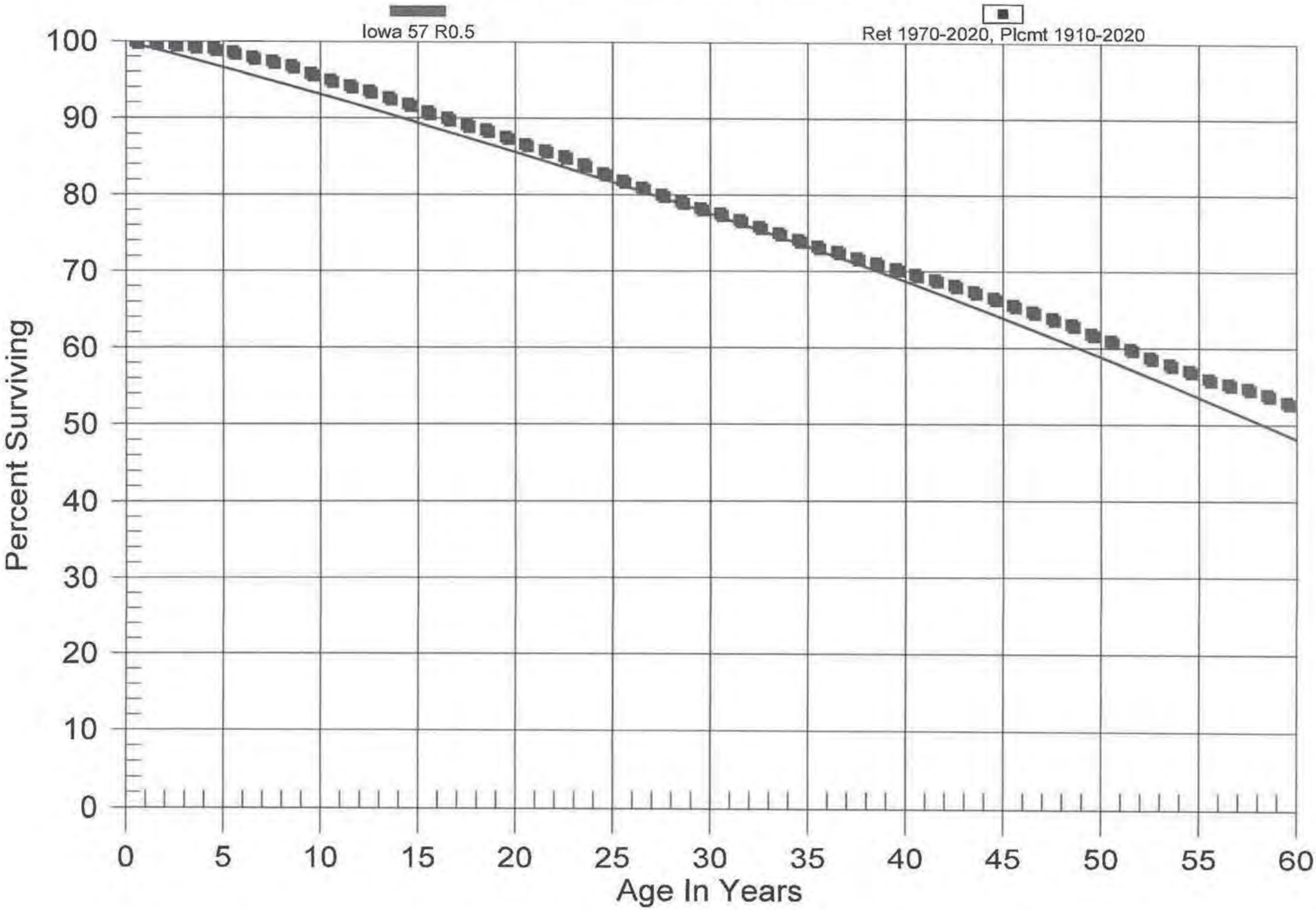
| Age Interval | $ Surviving At Beginning of Age Interval | $ Retired During The Age Interval | Retirement Ratio | % Surviving At Beginning of Age Interval |
|---|---|---|---|---|
| 73.5 - 74.5 | $276,023.32 | $7,431.73 | 0.02692 | 31.68 |
| 74.5 - 75.5 | $251,308.81 | $9,579.62 | 0.03812 | 30.83 |
| 75.5 - 76.5 | $240,271.63 | $8,592.34 | 0.03576 | 29.65 |
| 76.5 - 77.5 | $223,425.75 | $6,566.90 | 0.02939 | 28.59 |
| 77.5 - 78.5 | $194,922.82 | $4,988.67 | 0.02559 | 27.75 |
| 78.5 - 79.5 | $181,637.49 | $2,420.53 | 0.01333 | 27.04 |
| 79.5 - 80.5 | $171,257.39 | $5,524.32 | 0.03226 | 26.68 |
| 80.5 - 81.5 | $165,652.00 | $990.71 | 0.00598 | 25.82 |
| 81.5 - 82.5 | $162,572.02 | $6,084.78 | 0.03743 | 25.66 |
| 82.5 - 83.5 | $126,007.11 | $13,404.93 | 0.10638 | 24.70 |
| 83.5 - 84.5 | $106,912.84 | $6,150.60 | 0.05753 | 22.08 |
| 84.5 - 85.5 | $95,290.00 | $1,510.21 | 0.01585 | 20.81 |
| 85.5 - 86.5 | $92,767.69 | $6,255.73 | 0.06743 | 20.48 |
| 86.5 - 87.5 | $82,454.95 | $17,812.82 | 0.21603 | 19.10 |
| 87.5 - 88.5 | $61,892.51 | $18,460.88 | 0.29827 | 14.97 |
| 88.5 - 89.5 | $42,029.02 | $2,052.23 | 0.04883 | 10.51 |
| 89.5 - 90.5 | $26,007.24 | $2,040.13 | 0.07844 | 9.99 |
| 90.5 - 91.5 | $17,363.74 | $13,104.76 | 0.75472 | 9.21 |

# PGS

## Gas Division

## 380.00 Services - Steel

## Original And Smooth Survivor Curves



# PGS

## Gas Division

### 380.02 Services - Plastic

## Observed Life Table

### Retirement Expr. 1970 TO 2020
### Placement Years 1959 TO 2020

| Age Interval | $ Surviving At Beginning of Age Interval | $ Retired During The Age Interval | Retirement Ratio | % Surviving At Beginning of Age Interval |
|---|---|---|---|---|
| 0.0 - 0.5 | $424,302,227.24 | $6,071.24 | 0.00001 | 100.00 |
| 0.5 - 1.5 | $398,823,837.16 | $195,515.12 | 0.00049 | 100.00 |
| 1.5 - 2.5 | $361,350,244.13 | $269,083.03 | 0.00074 | 99.95 |
| 2.5 - 3.5 | $312,386,106.74 | $287,434.17 | 0.00092 | 99.88 |
| 3.5 - 4.5 | $288,435,261.62 | $360,872.37 | 0.00125 | 99.78 |
| 4.5 - 5.5 | $263,515,899.04 | $571,531.83 | 0.00217 | 99.66 |
| 5.5 - 6.5 | $245,380,125.80 | $737,555.81 | 0.00301 | 99.44 |
| 6.5 - 7.5 | $228,602,761.90 | $643,643.13 | 0.00282 | 99.14 |
| 7.5 - 8.5 | $214,330,492.68 | $699,627.66 | 0.00326 | 98.86 |
| 8.5 - 9.5 | $202,230,058.41 | $553,970.50 | 0.00274 | 98.54 |
| 9.5 - 10.5 | $192,555,204.05 | $520,349.93 | 0.00270 | 98.27 |
| 10.5 - 11.5 | $183,799,459.89 | $677,184.41 | 0.00368 | 98.01 |
| 11.5 - 12.5 | $176,963,356.21 | $651,456.01 | 0.00368 | 97.64 |
| 12.5 - 13.5 | $168,350,234.11 | $741,991.70 | 0.00441 | 97.29 |
| 13.5 - 14.5 | $158,031,848.30 | $629,357.77 | 0.00398 | 96.86 |
| 14.5 - 15.5 | $146,569,278.89 | $704,849.21 | 0.00481 | 96.47 |
| 15.5 - 16.5 | $135,612,149.40 | $716,773.34 | 0.00529 | 96.01 |
| 16.5 - 17.5 | $124,089,559.07 | $663,599.99 | 0.00535 | 95.50 |
| 17.5 - 18.5 | $112,732,708.19 | $523,381.82 | 0.00464 | 94.99 |
| 18.5 - 19.5 | $102,623,587.54 | $537,988.60 | 0.00524 | 94.55 |
| 19.5 - 20.5 | $99,435,239.72 | $431,485.99 | 0.00434 | 94.05 |
| 20.5 - 21.5 | $76,589,313.44 | $419,456.74 | 0.00548 | 93.64 |
| 21.5 - 22.5 | $68,667,718.43 | $448,816.26 | 0.00654 | 93.13 |
| 22.5 - 23.5 | $62,421,448.53 | $333,031.10 | 0.00534 | 92.52 |
| 23.5 - 24.5 | $56,266,688.06 | $330,017.35 | 0.00587 | 92.03 |
| 24.5 - 25.5 | $50,925,430.51 | $355,891.03 | 0.00699 | 91.49 |
| 25.5 - 26.5 | $45,864,163.76 | $340,514.21 | 0.00742 | 90.85 |
| 26.5 - 27.5 | $40,523,573.01 | $261,796.23 | 0.00646 | 90.18 |
| 27.5 - 28.5 | $35,361,799.01 | $221,268.83 | 0.00626 | 89.59 |
| 28.5 - 29.5 | $31,503,357.22 | $145,285.59 | 0.00461 | 89.03 |
| 29.5 - 30.5 | $27,683,785.25 | $154,461.53 | 0.00558 | 88.62 |
| 30.5 - 31.5 | $23,672,226.08 | $134,623.69 | 0.00569 | 88.13 |
| 31.5 - 32.5 | $20,586,900.62 | $117,413.22 | 0.00570 | 87.63 |
| 32.5 - 33.5 | $17,219,807.68 | $90,802.98 | 0.00527 | 87.13 |
| 33.5 - 34.5 | $14,448,609.04 | $105,125.36 | 0.00728 | 86.67 |
| 34.5 - 35.5 | $11,868,756.27 | $66,515.03 | 0.00560 | 86.04 |
| 35.5 - 36.5 | $10,028,228.15 | $64,814.68 | 0.00646 | 85.55 |

# PGS

## Gas Division

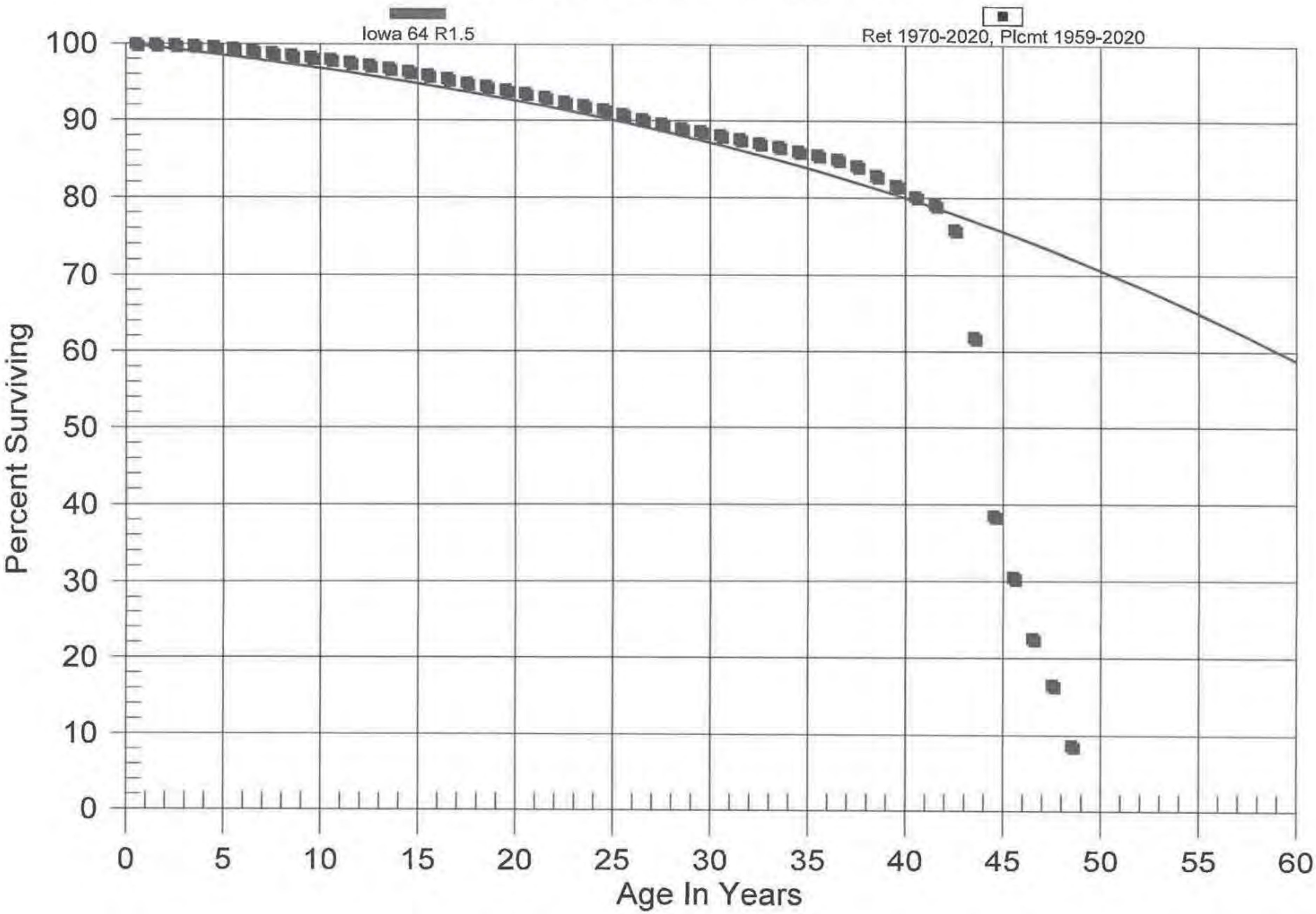
### 380.02 Services - Plastic

## Observed Life Table

### Retirement Expr. 1970 TO 2020
### Placement Years 1959 TO 2020

| Age Interval | $ Surviving At Beginning of Age Interval | $ Retired During The Age Interval | Retirement Ratio | % Surviving At Beginning of Age Interval |
|---|---|---|---|---|
| 36.5 - 37.5 | $8,449,421.61 | $83,313.58 | 0.00986 | 85.00 |
| 37.5 - 38.5 | $4,969,330.80 | $74,839.61 | 0.01506 | 84.16 |
| 38.5 - 39.5 | $3,609,791.31 | $54,839.25 | 0.01519 | 82.90 |
| 39.5 - 40.5 | $2,443,895.83 | $43,796.59 | 0.01792 | 81.64 |
| 40.5 - 41.5 | $1,573,205.87 | $21,354.86 | 0.01357 | 80.17 |
| 41.5 - 42.5 | $772,861.50 | $31,528.55 | 0.04079 | 79.08 |
| 42.5 - 43.5 | $281,846.16 | $51,991.00 | 0.18447 | 75.86 |
| 43.5 - 44.5 | $144,585.99 | $54,644.70 | 0.37794 | 61.87 |
| 44.5 - 45.5 | $89,941.29 | $18,757.92 | 0.20856 | 38.48 |
| 45.5 - 46.5 | $71,183.37 | $18,404.75 | 0.25855 | 30.46 |
| 46.5 - 47.5 | $52,778.62 | $14,185.07 | 0.26877 | 22.58 |
| 47.5 - 48.5 | $38,593.55 | $18,338.00 | 0.47516 | 16.51 |

# PGS
## Gas Division
## 380.02 Services - Plastic
## Original And Smooth Survivor Curves



# PGS

## Gas Division

### 385.00 Ind. Meas. & Reg. Sta. Equip

## Observed Life Table

**Retirement Expr. 1970 TO 2020**
**Placement Years 1958 TO 2019**

| Age Interval | $ Surviving At Beginning of Age Interval | $ Retired During The Age Interval | Retirement Ratio | % Surviving At Beginning of Age Interval |
|---|---|---|---|---|
| 0.0 - 0.5 | $13,628,465.44 | $0.00 | 0.00000 | 100.00 |
| 0.5 - 1.5 | $13,646,273.59 | $0.00 | 0.00000 | 100.00 |
| 1.5 - 2.5 | $11,486,907.09 | $2,698.85 | 0.00023 | 100.00 |
| 2.5 - 3.5 | $11,120,168.85 | $0.00 | 0.00000 | 99.98 |
| 3.5 - 4.5 | $11,129,473.18 | $76,879.25 | 0.00691 | 99.98 |
| 4.5 - 5.5 | $10,471,210.80 | $52,362.30 | 0.00500 | 99.29 |
| 5.5 - 6.5 | $10,462,425.05 | $12,733.09 | 0.00122 | 98.79 |
| 6.5 - 7.5 | $10,454,464.20 | $7,040.23 | 0.00067 | 98.67 |
| 7.5 - 8.5 | $10,350,619.94 | $9,906.96 | 0.00096 | 98.60 |
| 8.5 - 9.5 | $10,341,527.55 | $68,123.22 | 0.00659 | 98.51 |
| 9.5 - 10.5 | $10,274,491.66 | $44,400.50 | 0.00432 | 97.86 |
| 10.5 - 11.5 | $10,231,890.21 | $24,099.92 | 0.00236 | 97.44 |
| 11.5 - 12.5 | $10,208,044.55 | $40,849.69 | 0.00400 | 97.21 |
| 12.5 - 13.5 | $10,130,612.81 | $60,757.64 | 0.00600 | 96.82 |
| 13.5 - 14.5 | $10,011,768.65 | $14,671.54 | 0.00147 | 96.24 |
| 14.5 - 15.5 | $9,570,851.05 | $16,414.18 | 0.00172 | 96.10 |
| 15.5 - 16.5 | $9,246,719.45 | $7,577.47 | 0.00082 | 95.93 |
| 16.5 - 17.5 | $9,062,907.10 | $9,521.24 | 0.00105 | 95.85 |
| 17.5 - 18.5 | $8,453,178.46 | $14,884.44 | 0.00176 | 95.75 |
| 18.5 - 19.5 | $8,225,319.59 | $32,121.04 | 0.00391 | 95.58 |
| 19.5 - 20.5 | $8,124,387.51 | $178,162.45 | 0.02193 | 95.21 |
| 20.5 - 21.5 | $7,250,612.25 | $128,095.66 | 0.01767 | 93.12 |
| 21.5 - 22.5 | $6,649,635.12 | $136,769.58 | 0.02057 | 91.48 |
| 22.5 - 23.5 | $6,153,598.43 | $20,267.18 | 0.00329 | 89.60 |
| 23.5 - 24.5 | $5,840,763.96 | $41,034.63 | 0.00703 | 89.30 |
| 24.5 - 25.5 | $5,561,216.75 | $36,285.43 | 0.00652 | 88.67 |
| 25.5 - 26.5 | $5,316,974.66 | $6,170.63 | 0.00116 | 88.09 |
| 26.5 - 27.5 | $4,653,944.03 | $52,776.73 | 0.01134 | 87.99 |
| 27.5 - 28.5 | $4,228,965.67 | $124,610.15 | 0.02947 | 86.99 |
| 28.5 - 29.5 | $3,869,514.42 | $78,862.02 | 0.02038 | 84.43 |
| 29.5 - 30.5 | $3,462,120.24 | $38,472.35 | 0.01111 | 82.71 |
| 30.5 - 31.5 | $2,129,893.98 | $26,776.92 | 0.01257 | 81.79 |
| 31.5 - 32.5 | $1,833,553.89 | $16,011.41 | 0.00873 | 80.76 |
| 32.5 - 33.5 | $1,315,125.67 | $63,719.36 | 0.04845 | 80.06 |
| 33.5 - 34.5 | $1,022,273.27 | $16,051.72 | 0.01570 | 76.18 |
| 34.5 - 35.5 | $652,074.50 | $22,852.04 | 0.03505 | 74.98 |
| 35.5 - 36.5 | $452,641.77 | $6,301.83 | 0.01392 | 72.36 |

# *PGS*

## *Gas Division*

### *385.00 Ind. Meas. & Reg. Sta. Equip*

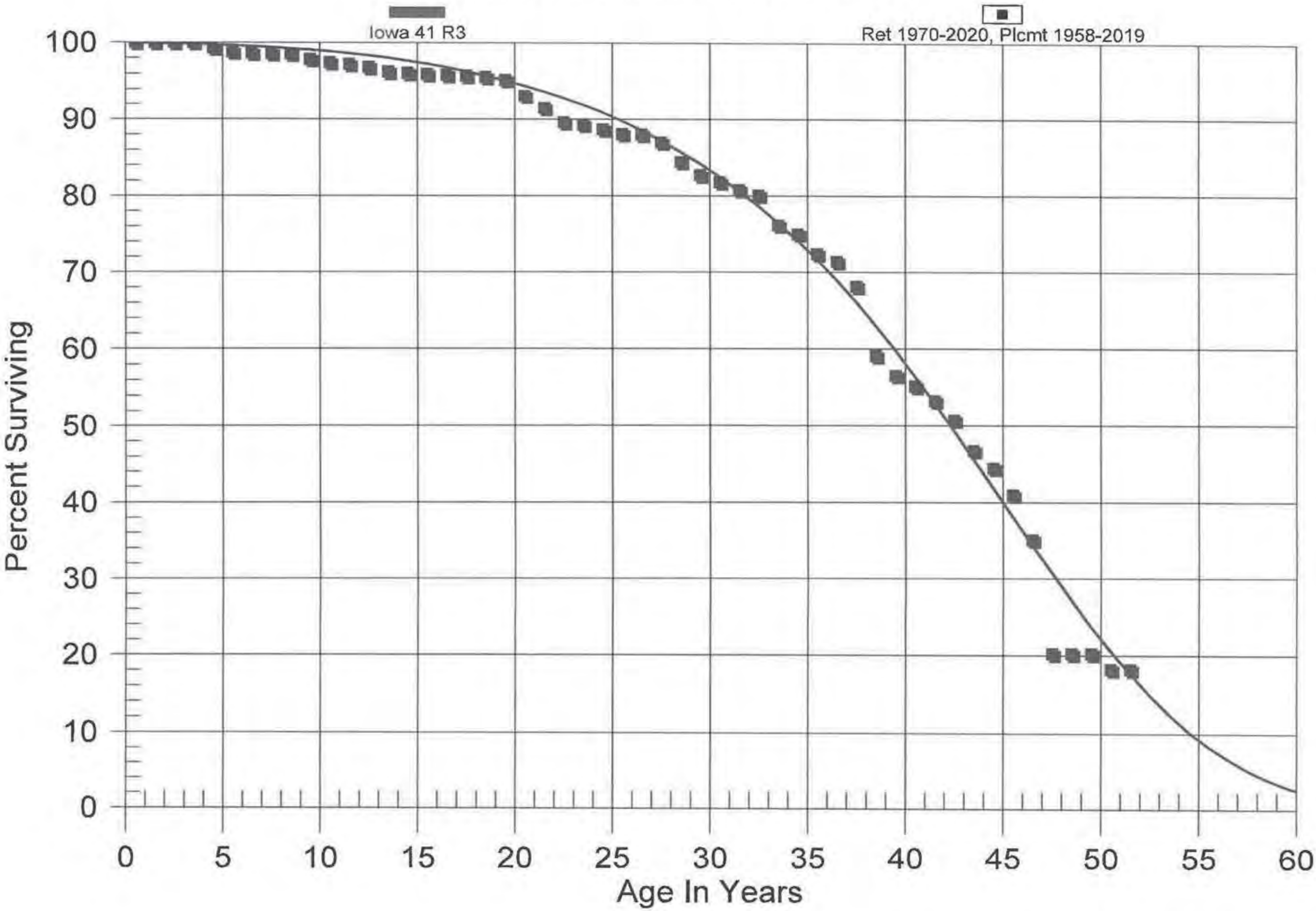
## *Observed Life Table*

***Retirement Expr. 1970 TO 2020***
***Placement Years 1958 TO 2019***

| *Age Interval* | *$ Surviving At Beginning of Age Interval* | *$ Retired During The Age Interval* | *Retirement Ratio* | *% Surviving At Beginning of Age Interval* |
|---|---|---|---|---|
| 36.5 - 37.5 | $332,243.37 | $15,014.28 | 0.04519 | 71.35 |
| 37.5 - 38.5 | $228,650.16 | $30,316.85 | 0.13259 | 68.12 |
| 38.5 - 39.5 | $112,269.60 | $4,848.50 | 0.04319 | 59.09 |
| 39.5 - 40.5 | $77,700.07 | $1,875.17 | 0.02413 | 56.54 |
| 40.5 - 41.5 | $71,393.71 | $2,405.10 | 0.03369 | 55.17 |
| 41.5 - 42.5 | $68,687.14 | $3,344.10 | 0.04869 | 53.32 |
| 42.5 - 43.5 | $65,343.04 | $5,123.64 | 0.07841 | 50.72 |
| 43.5 - 44.5 | $53,875.01 | $2,668.14 | 0.04952 | 46.74 |
| 44.5 - 45.5 | $49,904.60 | $3,907.87 | 0.07831 | 44.43 |
| 45.5 - 46.5 | $40,931.22 | $5,875.23 | 0.14354 | 40.95 |
| 46.5 - 47.5 | $26,068.67 | $11,043.37 | 0.42363 | 35.07 |
| 47.5 - 48.5 | $15,025.30 | $0.00 | 0.00000 | 20.21 |
| 48.5 - 49.5 | $14,314.27 | $0.00 | 0.00000 | 20.21 |
| 49.5 - 50.5 | $7,431.32 | $741.59 | 0.09979 | 20.21 |
| 50.5 - 51.5 | $930.64 | $0.00 | 0.00000 | 18.20 |

# PGS

## Gas Division
## 385.00 Ind. Meas. & Reg. Sta. Equip
## Original And Smooth Survivor Curves



# *PGS*

## *Gas Division*

### *378.00 Meas. & Reg. Sta. Eq - General*

## *Original Cost Of Utility Plant In Service*

### *And Development Of Composite Remaining Life as of December 31, 2020*

### *Based Upon Broad Group/Remaining Life Procedure and Technique*

*Average Service Life:* ***46*** *Survivor Curve:* ***R1***

| *Year* (1) | *Original Cost* (2) | *Avg. Service Life* (3) | *Avg. Annual Accrual* (4) | *Avg. Remaining Life* (5) | *Future Annual Accruals* (6) |
|---|---|---|---|---|---|
| 1957 | 455.57 | 46.00 | 9.90 | 9.44 | 93.45 |
| 1958 | 5,145.17 | 46.00 | 111.85 | 9.81 | 1,097.26 |
| 1959 | 7,671.89 | 46.00 | 166.78 | 10.19 | 1,699.53 |
| 1960 | 12,071.38 | 46.00 | 262.42 | 10.58 | 2,775.47 |
| 1961 | 618.00 | 46.00 | 13.43 | 10.97 | 147.35 |
| 1962 | 3,353.00 | 46.00 | 72.89 | 11.37 | 828.46 |
| 1963 | 998.61 | 46.00 | 21.71 | 11.77 | 255.51 |
| 1964 | 4,861.24 | 46.00 | 105.68 | 12.18 | 1,287.23 |
| 1965 | 2,172.62 | 46.00 | 47.23 | 12.60 | 594.98 |
| 1966 | 6,188.37 | 46.00 | 134.53 | 13.02 | 1,751.66 |
| 1967 | 2,204.78 | 46.00 | 47.93 | 13.45 | 644.68 |
| 1968 | 17,987.04 | 46.00 | 391.01 | 13.89 | 5,430.18 |
| 1969 | 10,634.26 | 46.00 | 231.17 | 14.33 | 3,312.91 |
| 1970 | 2,281.93 | 46.00 | 49.61 | 14.78 | 733.23 |
| 1971 | 4,304.25 | 46.00 | 93.57 | 15.24 | 1,425.80 |
| 1972 | 4,904.64 | 46.00 | 106.62 | 15.70 | 1,674.23 |
| 1973 | 11,865.37 | 46.00 | 257.94 | 16.17 | 4,171.92 |
| 1974 | 13,536.34 | 46.00 | 294.26 | 16.65 | 4,900.29 |
| 1975 | 13,101.98 | 46.00 | 284.82 | 17.14 | 4,881.44 |
| 1976 | 34,048.38 | 46.00 | 740.16 | 17.63 | 13,050.56 |
| 1977 | 21,624.56 | 46.00 | 470.09 | 18.13 | 8,523.91 |
| 1978 | 725.61 | 46.00 | 15.77 | 18.64 | 294.05 |
| 1979 | 26,955.36 | 46.00 | 585.97 | 19.16 | 11,225.76 |
| 1980 | 24,918.38 | 46.00 | 541.69 | 19.68 | 10,660.95 |
| 1981 | 31,682.27 | 46.00 | 688.73 | 20.21 | 13,920.42 |
| 1982 | 18,298.04 | 46.00 | 397.77 | 20.75 | 8,253.90 |
| 1983 | 11,984.00 | 46.00 | 260.52 | 21.30 | 5,548.00 |

# PGS

## Gas Division

### 378.00 Meas. & Reg. Sta. Eq - General

## Original Cost Of Utility Plant In Service

### And Development Of Composite Remaining Life as of December 31, 2020

### Based Upon Broad Group/Remaining Life Procedure and Technique

*Average Service Life:* ***46*** *Survivor Curve:* ***R1***

| Year<br>(1) | Original Cost<br>(2) | Avg. Service Life<br>(3) | Avg. Annual Accrual<br>(4) | Avg. Remaining Life<br>(5) | Future Annual Accruals<br>(6) |
|---|---|---|---|---|---|
| 1984 | 113,815.57 | 46.00 | 2,474.19 | 21.85 | 54,063.75 |
| 1985 | 28,594.60 | 46.00 | 621.61 | 22.41 | 13,931.71 |
| 1986 | 68,828.72 | 46.00 | 1,496.24 | 22.98 | 34,385.37 |
| 1987 | 93,400.76 | 46.00 | 2,030.40 | 23.56 | 47,830.84 |
| 1988 | 23,149.66 | 46.00 | 503.24 | 24.14 | 12,148.62 |
| 1989 | 60,319.96 | 46.00 | 1,311.27 | 24.73 | 32,430.96 |
| 1990 | 88,392.95 | 46.00 | 1,921.54 | 25.33 | 48,673.42 |
| 1991 | 65,295.08 | 46.00 | 1,419.43 | 25.94 | 36,813.20 |
| 1992 | 91,823.44 | 46.00 | 1,996.12 | 26.55 | 52,990.67 |
| 1993 | 152,375.45 | 46.00 | 3,312.43 | 27.17 | 89,982.46 |
| 1994 | 183,349.86 | 46.00 | 3,985.77 | 27.79 | 110,763.06 |
| 1995 | 123,989.87 | 46.00 | 2,695.37 | 28.42 | 76,606.12 |
| 1996 | 102,023.78 | 46.00 | 2,217.86 | 29.06 | 64,447.00 |
| 1997 | 98,561.99 | 46.00 | 2,142.60 | 29.70 | 63,636.81 |
| 1998 | 263,162.94 | 46.00 | 5,720.80 | 30.35 | 173,618.05 |
| 1999 | 487,152.63 | 46.00 | 10,590.03 | 31.00 | 328,306.82 |
| 2000 | 164,900.43 | 46.00 | 3,584.71 | 31.66 | 113,489.26 |
| 2001 | 787,865.91 | 46.00 | 17,127.12 | 32.32 | 553,592.51 |
| 2002 | 344,875.97 | 46.00 | 7,497.13 | 32.99 | 247,325.33 |
| 2003 | 366,673.22 | 46.00 | 7,970.97 | 33.66 | 268,303.57 |
| 2004 | 129,549.57 | 46.00 | 2,816.23 | 34.33 | 96,693.96 |
| 2005 | 239,514.40 | 46.00 | 5,206.71 | 35.01 | 182,300.15 |
| 2006 | 123,860.39 | 46.00 | 2,692.55 | 35.69 | 96,107.54 |
| 2007 | 369,208.40 | 46.00 | 8,026.08 | 36.38 | 291,982.54 |
| 2008 | 147,468.93 | 46.00 | 3,205.77 | 37.07 | 118,828.72 |
| 2009 | 517,632.34 | 46.00 | 11,252.61 | 37.76 | 424,879.84 |
| 2010 | 321,507.76 | 46.00 | 6,989.14 | 38.45 | 268,753.19 |

# *PGS*

## *Gas Division*

### *378.00 Meas. & Reg. Sta. Eq - General*

## *Original Cost Of Utility Plant In Service*

### *And Development Of Composite Remaining Life as of December 31, 2020*

### *Based Upon Broad Group/Remaining Life Procedure and Technique*

*Average Service Life:* ***46*** *Survivor Curve:* ***R1***

| *Year* (1) | *Original Cost* (2) | *Avg. Service Life* (3) | *Avg. Annual Accrual* (4) | *Avg. Remaining Life* (5) | *Future Annual Accruals* (6) |
|---|---|---|---|---|---|
| 2011 | 663,640.88 | 46.00 | 14,426.64 | 39.15 | 564,821.64 |
| 2012 | 2,373,041.11 | 46.00 | 51,586.64 | 39.85 | 2,055,943.27 |
| 2013 | 1,294,693.44 | 46.00 | 28,144.85 | 40.56 | 1,141,569.51 |
| 2014 | 1,425,605.71 | 46.00 | 30,990.70 | 41.27 | 1,279,016.27 |
| 2015 | 1,516,744.13 | 46.00 | 32,971.93 | 41.99 | 1,384,349.38 |
| 2016 | 1,348,658.25 | 46.00 | 29,317.97 | 42.70 | 1,252,019.67 |
| 2017 | 1,223,650.84 | 46.00 | 26,600.48 | 43.43 | 1,155,220.82 |
| 2018 | 1,554,684.28 | 46.00 | 33,796.69 | 44.16 | 1,492,391.03 |
| 2019 | 1,632,686.81 | 46.00 | 35,492.36 | 44.89 | 1,593,302.88 |
| *Total* | 18,885,293.07 | 46.00 | 410,540.26 | 38.80 | 15,930,703.04 |

***Composite Average Remaining Life ... 38.80 Years***

# PGS

## Gas Division

### 380.00 Services - Steel

## Original Cost Of Utility Plant In Service
## And Development Of Composite Remaining Life as of December 31, 2020
## Based Upon Broad Group/Remaining Life Procedure and Technique

*Average Service Life:* **57** *Survivor Curve:* **R0.5**

| Year (1) | Original Cost (2) | Avg. Service Life (3) | Avg. Annual Accrual (4) | Avg. Remaining Life (5) | Future Annual Accruals (6) |
|---|---|---|---|---|---|
| 1930 | 6,603.37 | 57.00 | 115.85 | 10.36 | 1,200.14 |
| 1931 | 13,969.55 | 57.00 | 245.08 | 10.76 | 2,635.86 |
| 1932 | 1,402.61 | 57.00 | 24.61 | 11.15 | 274.38 |
| 1933 | 2,749.62 | 57.00 | 48.24 | 11.55 | 557.05 |
| 1934 | 4,057.01 | 57.00 | 71.17 | 11.94 | 850.03 |
| 1935 | 1,012.10 | 57.00 | 17.76 | 12.34 | 219.08 |
| 1936 | 5,472.24 | 57.00 | 96.00 | 12.74 | 1,222.65 |
| 1937 | 5,689.34 | 57.00 | 99.81 | 13.13 | 1,310.88 |
| 1938 | 30,480.13 | 57.00 | 534.73 | 13.53 | 7,236.81 |
| 1939 | 2,089.27 | 57.00 | 36.65 | 13.93 | 510.72 |
| 1940 | 81.07 | 57.00 | 1.42 | 14.34 | 20.39 |
| 1941 | 7,959.57 | 57.00 | 139.64 | 14.74 | 2,058.32 |
| 1942 | 8,296.66 | 57.00 | 145.55 | 15.15 | 2,204.70 |
| 1943 | 21,936.03 | 57.00 | 384.84 | 15.56 | 5,986.23 |
| 1944 | 8,253.54 | 57.00 | 144.80 | 15.97 | 2,311.81 |
| 1945 | 1,457.56 | 57.00 | 25.57 | 16.38 | 418.83 |
| 1946 | 17,282.78 | 57.00 | 303.20 | 16.80 | 5,092.44 |
| 1947 | 22,226.28 | 57.00 | 389.93 | 17.21 | 6,712.27 |
| 1948 | 45,052.48 | 57.00 | 790.38 | 17.64 | 13,938.92 |
| 1949 | 19,530.51 | 57.00 | 342.63 | 18.06 | 6,188.10 |
| 1950 | 11,168.13 | 57.00 | 195.93 | 18.49 | 3,622.39 |
| 1951 | 22,839.52 | 57.00 | 400.69 | 18.92 | 7,580.68 |
| 1952 | 23,707.74 | 57.00 | 415.92 | 19.35 | 8,049.50 |
| 1953 | 37,382.87 | 57.00 | 655.83 | 19.79 | 12,979.72 |
| 1954 | 25,882.49 | 57.00 | 454.07 | 20.23 | 9,187.02 |
| 1955 | 49,340.56 | 57.00 | 865.61 | 20.68 | 17,898.54 |
| 1956 | 79,690.22 | 57.00 | 1,398.05 | 21.13 | 29,535.08 |

# PGS

## Gas Division

### 380.00 Services - Steel

## Original Cost Of Utility Plant In Service

### And Development Of Composite Remaining Life as of December 31, 2020

### Based Upon Broad Group/Remaining Life Procedure and Technique

*Average Service Life:* **57** *Survivor Curve:* **R0.5**

| Year (1) | Original Cost (2) | Avg. Service Life (3) | Avg. Annual Accrual (4) | Avg. Remaining Life (5) | Future Annual Accruals (6) |
|---|---|---|---|---|---|
| 1957 | 103,802.00 | 57.00 | 1,821.05 | 21.58 | 39,294.98 |
| 1958 | 213,324.30 | 57.00 | 3,742.46 | 22.03 | 82,461.15 |
| 1959 | 1,066,987.00 | 57.00 | 18,718.71 | 22.49 | 421,055.41 |
| 1960 | 426,838.70 | 57.00 | 7,488.25 | 22.96 | 171,912.17 |
| 1961 | 178,125.80 | 57.00 | 3,124.95 | 23.43 | 73,202.71 |
| 1962 | 187,996.50 | 57.00 | 3,298.12 | 23.90 | 78,813.33 |
| 1963 | 186,772.66 | 57.00 | 3,276.65 | 24.37 | 79,859.02 |
| 1964 | 260,613.24 | 57.00 | 4,572.07 | 24.85 | 113,624.47 |
| 1965 | 254,462.92 | 57.00 | 4,464.17 | 25.34 | 113,102.24 |
| 1966 | 613,706.80 | 57.00 | 10,766.58 | 25.82 | 278,022.81 |
| 1967 | 664,362.58 | 57.00 | 11,655.26 | 26.31 | 306,705.07 |
| 1968 | 490,123.52 | 57.00 | 8,598.49 | 26.81 | 230,531.87 |
| 1969 | 484,108.27 | 57.00 | 8,492.96 | 27.31 | 231,949.09 |
| 1970 | 358,544.46 | 57.00 | 6,290.13 | 27.81 | 174,954.89 |
| 1971 | 574,848.92 | 57.00 | 10,084.87 | 28.32 | 285,628.89 |
| 1972 | 722,429.39 | 57.00 | 12,673.95 | 28.83 | 365,450.86 |
| 1973 | 1,120,803.70 | 57.00 | 19,662.84 | 29.35 | 577,124.33 |
| 1974 | 1,007,943.15 | 57.00 | 17,682.87 | 29.87 | 528,196.33 |
| 1975 | 663,793.43 | 57.00 | 11,645.27 | 30.39 | 353,956.60 |
| 1976 | 452,788.21 | 57.00 | 7,943.50 | 30.92 | 245,637.22 |
| 1977 | 377,370.85 | 57.00 | 6,620.41 | 31.46 | 208,245.08 |
| 1978 | 733,322.78 | 57.00 | 12,865.06 | 31.99 | 411,553.16 |
| 1979 | 638,373.26 | 57.00 | 11,199.31 | 32.53 | 364,310.11 |
| 1980 | 259,772.37 | 57.00 | 4,557.32 | 33.07 | 150,724.06 |
| 1981 | 562,622.09 | 57.00 | 9,870.37 | 33.62 | 331,839.13 |
| 1982 | 484,707.71 | 57.00 | 8,503.48 | 34.17 | 290,557.11 |
| 1983 | 428,733.74 | 57.00 | 7,521.50 | 34.72 | 261,169.95 |

# PGS
## Gas Division
### 380.00 Services - Steel

## Original Cost Of Utility Plant In Service
### And Development Of Composite Remaining Life as of December 31, 2020
### Based Upon Broad Group/Remaining Life Procedure and Technique

*Average Service Life:* 57 *Survivor Curve:* **R0.5**

| Year (1) | Original Cost (2) | Avg. Service Life (3) | Avg. Annual Accrual (4) | Avg. Remaining Life (5) | Future Annual Accruals (6) |
|---|---|---|---|---|---|
| 1984 | 467,514.10 | 57.00 | 8,201.84 | 35.28 | 289,363.20 |
| 1985 | 683,403.70 | 57.00 | 11,989.31 | 35.84 | 429,703.21 |
| 1986 | 518,741.85 | 57.00 | 9,100.56 | 36.40 | 331,289.04 |
| 1987 | 592,113.65 | 57.00 | 10,387.76 | 36.97 | 384,033.01 |
| 1988 | 706,424.36 | 57.00 | 12,393.17 | 37.54 | 465,229.42 |
| 1989 | 772,600.00 | 57.00 | 13,554.12 | 38.11 | 516,564.87 |
| 1990 | 859,884.58 | 57.00 | 15,085.40 | 38.69 | 583,582.73 |
| 1991 | 1,155,481.88 | 57.00 | 20,271.22 | 39.26 | 795,903.20 |
| 1992 | 964,669.72 | 57.00 | 16,923.70 | 39.84 | 674,282.16 |
| 1993 | 876,853.89 | 57.00 | 15,383.10 | 40.42 | 621,852.81 |
| 1994 | 958,145.21 | 57.00 | 16,809.24 | 41.01 | 689,319.66 |
| 1995 | 606,805.36 | 57.00 | 10,645.50 | 41.59 | 442,788.75 |
| 1996 | 558,804.78 | 57.00 | 9,803.40 | 42.18 | 413,526.89 |
| 1997 | 927,100.95 | 57.00 | 16,264.61 | 42.77 | 695,664.10 |
| 1998 | 1,148,112.41 | 57.00 | 20,141.93 | 43.36 | 873,411.16 |
| 1999 | 1,135,186.75 | 57.00 | 19,915.17 | 43.96 | 875,375.11 |
| 2000 | 2,158,713.11 | 57.00 | 37,871.42 | 44.55 | 1,687,149.65 |
| 2001 | 43,906.43 | 57.00 | 770.27 | 45.14 | 34,773.87 |
| 2002 | 1,234,951.44 | 57.00 | 21,665.39 | 45.74 | 991,006.40 |
| 2003 | 745,086.12 | 57.00 | 13,071.43 | 46.34 | 605,715.08 |
| 2004 | 629,097.33 | 57.00 | 11,036.58 | 46.94 | 518,032.76 |
| 2005 | 714,010.93 | 57.00 | 12,526.26 | 47.54 | 595,470.64 |
| 2006 | 745,953.09 | 57.00 | 13,086.64 | 48.14 | 629,975.23 |
| 2007 | 1,142,254.01 | 57.00 | 20,039.15 | 48.74 | 976,721.07 |
| 2008 | 1,100,388.30 | 57.00 | 19,304.68 | 49.34 | 952,572.83 |
| 2009 | 884,794.49 | 57.00 | 15,522.41 | 49.95 | 775,325.90 |
| 2010 | 873,693.91 | 57.00 | 15,327.67 | 50.55 | 774,885.84 |

# PGS

## Gas Division

### 380.00 Services - Steel

## Original Cost Of Utility Plant In Service

### And Development Of Composite Remaining Life as of December 31, 2020

### Based Upon Broad Group/Remaining Life Procedure and Technique

*Average Service Life:* **57** *Survivor Curve:* **R0.5**

| Year (1) | Original Cost (2) | Avg. Service Life (3) | Avg. Annual Accrual (4) | Avg. Remaining Life (5) | Future Annual Accruals (6) |
|---|---|---|---|---|---|
| 2011 | 816,752.87 | 57.00 | 14,328.72 | 51.16 | 733,079.43 |
| 2012 | 1,424,623.53 | 57.00 | 24,992.91 | 51.77 | 1,293,888.96 |
| 2013 | 1,912,732.87 | 57.00 | 33,556.06 | 52.38 | 1,757,675.04 |
| 2014 | 1,827,716.68 | 57.00 | 32,064.58 | 52.99 | 1,699,153.70 |
| 2015 | 1,643,450.00 | 57.00 | 28,831.90 | 53.60 | 1,545,504.61 |
| 2016 | 2,914,108.93 | 57.00 | 51,123.72 | 54.22 | 2,771,845.12 |
| 2017 | 2,566,769.58 | 57.00 | 45,030.17 | 54.83 | 2,469,193.08 |
| 2018 | 2,091,797.43 | 57.00 | 36,697.49 | 55.45 | 2,034,929.27 |
| 2019 | 3,061,991.81 | 57.00 | 53,718.11 | 56.07 | 3,011,965.21 |
| 2020 | 496,289.05 | 57.00 | 8,706.66 | 56.69 | 493,583.03 |
| *Total* | 55,953,816.70 | 57.00 | 981,626.83 | 43.15 | 42,354,020.62 |

***Composite Average Remaining Life ... 43.15 Years***

# PGS

## Gas Division

### 380.02 Services - Plastic

## Original Cost Of Utility Plant In Service

### And Development Of Composite Remaining Life as of December 31, 2020

### Based Upon Broad Group/Remaining Life Procedure and Technique

*Average Service Life:* **64** *Survivor Curve:* **R1.5**

| Year<br>(1) | Original Cost<br>(2) | Avg. Service Life<br>(3) | Avg. Annual Accrual<br>(4) | Avg. Remaining Life<br>(5) | Future Annual Accruals<br>(6) |
|---|---|---|---|---|---|
| 1977 | 85,269.17 | 64.00 | 1,332.32 | 31.87 | 42,464.95 |
| 1978 | 459,486.79 | 64.00 | 7,179.41 | 32.50 | 233,363.55 |
| 1979 | 778,989.51 | 64.00 | 12,171.58 | 33.14 | 403,383.75 |
| 1980 | 826,893.37 | 64.00 | 12,920.07 | 33.79 | 436,523.23 |
| 1981 | 1,111,056.23 | 64.00 | 17,360.07 | 34.44 | 597,811.81 |
| 1982 | 1,284,699.88 | 64.00 | 20,073.22 | 35.09 | 704,448.79 |
| 1983 | 3,396,777.23 | 64.00 | 53,074.08 | 35.76 | 1,897,705.24 |
| 1984 | 1,513,991.86 | 64.00 | 23,655.87 | 36.43 | 861,691.70 |
| 1985 | 1,774,013.09 | 64.00 | 27,718.66 | 37.10 | 1,028,407.06 |
| 1986 | 2,474,727.41 | 64.00 | 38,667.21 | 37.78 | 1,460,918.83 |
| 1987 | 2,680,395.66 | 64.00 | 41,880.74 | 38.47 | 1,611,108.74 |
| 1988 | 3,249,679.72 | 64.00 | 50,775.71 | 39.16 | 1,988,384.24 |
| 1989 | 2,950,701.77 | 64.00 | 46,104.23 | 39.86 | 1,837,637.40 |
| 1990 | 3,857,097.64 | 64.00 | 60,266.51 | 40.56 | 2,444,405.97 |
| 1991 | 3,674,286.38 | 64.00 | 57,410.12 | 41.27 | 2,369,236.38 |
| 1992 | 3,637,172.96 | 64.00 | 56,830.23 | 41.98 | 2,385,740.71 |
| 1993 | 4,899,977.77 | 64.00 | 76,561.34 | 42.70 | 3,269,076.07 |
| 1994 | 5,000,076.54 | 64.00 | 78,125.37 | 43.42 | 3,392,318.54 |
| 1995 | 4,705,375.72 | 64.00 | 73,520.72 | 44.15 | 3,245,769.87 |
| 1996 | 5,011,240.20 | 64.00 | 78,299.80 | 44.88 | 3,514,059.81 |
| 1997 | 5,821,729.37 | 64.00 | 90,963.56 | 45.61 | 4,149,244.81 |
| 1998 | 5,797,453.64 | 64.00 | 90,584.25 | 46.35 | 4,199,022.85 |
| 1999 | 7,502,138.27 | 64.00 | 117,219.67 | 47.10 | 5,520,793.29 |
| 2000 | 22,414,440.29 | 64.00 | 350,221.92 | 47.85 | 16,756,924.30 |
| 2001 | 2,650,359.22 | 64.00 | 41,411.42 | 48.60 | 2,012,541.02 |
| 2002 | 9,585,738.83 | 64.00 | 149,775.58 | 49.35 | 7,392,005.49 |
| 2003 | 10,693,250.89 | 64.00 | 167,080.28 | 50.11 | 8,373,014.86 |

# *PGS*

## *Gas Division*

### *380.02 Services - Plastic*

## *Original Cost Of Utility Plant In Service*

### *And Development Of Composite Remaining Life as of December 31, 2020*

### *Based Upon Broad Group/Remaining Life Procedure and Technique*

*Average Service Life:* **64** *Survivor Curve:* **R1.5**

| *Year* (1) | *Original Cost* (2) | *Avg. Service Life* (3) | *Avg. Annual Accrual* (4) | *Avg. Remaining Life* (5) | *Future Annual Accruals* (6) |
|---|---|---|---|---|---|
| 2004 | 10,805,816.99′ | 64.00 | 168,839.10 | 50.88 | 8,589,904.82 |
| 2005 | 10,252,280.28 | 64.00 | 160,190.18 | 51.64 | 8,272,820.42 |
| 2006 | 10,833,211.64 | 64.00 | 169,267.14 | 52.41 | 8,871,900.52 |
| 2007 | 9,576,394.11 | 64.00 | 149,629.57 | 53.19 | 7,958,594.01 |
| 2008 | 7,961,666.09 | 64.00 | 124,399.72 | 53.97 | 6,713,326.24 |
| 2009 | 6,158,919.27 | 64.00 | 96,232.10 | 54.75 | 5,268,547.58 |
| 2010 | 8,235,451.83 | 64.00 | 128,677.57 | 55.53 | 7,145,994.15 |
| 2011 | 9,120,883.86 | 64.00 | 142,512.30 | 56.32 | 8,026,680.77 |
| 2012 | 11,400,806.61 | 64.00 | 178,135.72 | 57.12 | 10,174,390.61 |
| 2013 | 13,628,626.09 | 64.00 | 212,945.03 | 57.91 | 12,332,013.09 |
| 2014 | 16,039,838.69 | 64.00 | 250,619.83 | 58.71 | 14,714,483.87 |
| 2015 | 17,564,950.62 | 64.00 | 274,449.45 | 59.52 | 16,333,931.88 |
| 2016 | 24,570,676.73 | 64.00 | 383,912.76 | 60.32 | 23,158,880.02 |
| 2017 | 23,667,763.77 | 64.00 | 369,804.90 | 61.13 | 22,607,821.59 |
| 2018 | 48,708,192.95 | 64.00 | 761,057.46 | 61.95 | 47,146,435.05 |
| 2019 | 37,403,970.26 | 64.00 | 584,430.85 | 62.77 | 36,683,008.34 |
| 2020 | 25,739,200.68 | 64.00 | 402,170.75 | 63.59 | 25,573,318.28 |
| *Total* | 409,505,669.88 | 64.00 | 6,398,458.38 | 54.97 | 351,700,054.48 |

***Composite Average Remaining Life ... 54.97 Years***

# PGS

## Gas Division

### 385.00 Ind. Meas. & Reg. Sta. Equip

## Original Cost Of Utility Plant In Service

### And Development Of Composite Remaining Life as of December 31, 2020

### Based Upon Broad Group/Remaining Life Procedure and Technique

*Average Service Life:* **41** *Survivor Curve:* **R3**

| Year (1) | Original Cost (2) | Avg. Service Life (3) | Avg. Annual Accrual (4) | Avg. Remaining Life (5) | Future Annual Accruals (6) |
|---|---|---|---|---|---|
| 1969 | 930.64 | 41.00 | 22.70 | 4.50 | 102.03 |
| 1970 | 5,759.09 | 41.00 | 140.47 | 4.77 | 670.41 |
| 1971 | 6,882.95 | 41.00 | 167.88 | 5.07 | 850.72 |
| 1972 | 711.03 | 41.00 | 17.34 | 5.37 | 93.17 |
| 1974 | 8,987.32 | 41.00 | 219.20 | 6.04 | 1,322.89 |
| 1975 | 5,065.51 | 41.00 | 123.55 | 6.39 | 790.01 |
| 1976 | 1,302.27 | 41.00 | 31.76 | 6.77 | 215.15 |
| 1977 | 6,344.39 | 41.00 | 154.74 | 7.17 | 1,110.23 |
| 1979 | 301.47 | 41.00 | 7.35 | 8.04 | 59.15 |
| 1980 | 4,431.19 | 41.00 | 108.08 | 8.51 | 920.06 |
| 1981 | 29,721.03 | 41.00 | 724.90 | 9.01 | 6,528.82 |
| 1982 | 86,063.71 | 41.00 | 2,099.11 | 9.52 | 19,986.99 |
| 1983 | 88,578.93 | 41.00 | 2,160.46 | 10.06 | 21,736.78 |
| 1984 | 114,096.57 | 41.00 | 2,782.84 | 10.62 | 29,558.97 |
| 1985 | 176,580.69 | 41.00 | 4,306.83 | 11.20 | 48,252.02 |
| 1986 | 354,147.05 | 41.00 | 8,637.71 | 11.81 | 102,007.25 |
| 1987 | 229,133.04 | 41.00 | 5,588.59 | 12.43 | 69,482.58 |
| 1988 | 502,416.81 | 41.00 | 12,254.03 | 13.08 | 160,261.91 |
| 1989 | 269,563.17 | 41.00 | 6,574.69 | 13.74 | 90,336.81 |
| 1990 | 1,293,753.91 | 41.00 | 31,554.88 | 14.42 | 455,067.96 |
| 1991 | 328,532.16 | 41.00 | 8,012.96 | 15.12 | 121,142.09 |
| 1992 | 234,841.10 | 41.00 | 5,727.82 | 15.83 | 90,674.84 |
| 1993 | 372,201.63 | 41.00 | 9,078.06 | 16.56 | 150,345.27 |
| 1994 | 656,860.00 | 41.00 | 16,020.93 | 17.30 | 277,232.60 |
| 1995 | 207,956.66 | 41.00 | 5,072.10 | 18.06 | 91,622.37 |
| 1996 | 238,512.58 | 41.00 | 5,817.36 | 18.84 | 109,572.60 |
| 1997 | 292,567.29 | 41.00 | 7,135.77 | 19.62 | 140,017.70 |

# PGS

## Gas Division

### 385.00 Ind. Meas. & Reg. Sta. Equip

## Original Cost Of Utility Plant In Service

### And Development Of Composite Remaining Life as of December 31, 2020

### Based Upon Broad Group/Remaining Life Procedure and Technique

*Average Service Life:* **41** *Survivor Curve:* **R3**

| Year (1) | Original Cost (2) | Avg. Service Life (3) | Avg. Annual Accrual (4) | Avg. Remaining Life (5) | Future Annual Accruals (6) |
|---|---|---|---|---|---|
| 1998 | 359,267.11 | 41.00 | 8,762.59 | 20.42 | 178,932.58 |
| 1999 | 472,881.47 | 41.00 | 11,533.66 | 21.23 | 244,882.58 |
| 2000 | 695,612.81 | 41.00 | 16,966.12 | 22.06 | 374,192.81 |
| 2001 | 68,811.04 | 41.00 | 1,678.31 | 22.89 | 38,416.81 |
| 2002 | 212,974.43 | 41.00 | 5,194.48 | 23.74 | 123,309.62 |
| 2003 | 600,207.40 | 41.00 | 14,639.16 | 24.60 | 360,074.20 |
| 2004 | 176,234.88 | 41.00 | 4,298.40 | 25.47 | 109,467.93 |
| 2005 | 307,717.42 | 41.00 | 7,505.28 | 26.35 | 197,741.59 |
| 2006 | 426,246.06 | 41.00 | 10,396.22 | 27.24 | 283,172.90 |
| 2007 | 58,086.52 | 41.00 | 1,416.74 | 28.14 | 39,864.36 |
| 2008 | 36,582.05 | 41.00 | 892.24 | 29.05 | 25,917.92 |
| 2013 | 102,723.49 | 41.00 | 2,505.44 | 33.72 | 84,481.07 |
| 2014 | 1,327.53 | 41.00 | 32.38 | 34.67 | 1,122.69 |
| 2016 | 599,736.89 | 41.00 | 14,627.69 | 36.60 | 535,386.78 |
| 2017 | 463.33 | 41.00 | 11.30 | 37.57 | 424.58 |
| 2018 | 394,881.58 | 41.00 | 9,631.23 | 38.55 | 371,253.65 |
| 2019 | 2,164,968.36 | 41.00 | 52,803.95 | 39.53 | 2,087,103.84 |
| *Total* | 12,194,964.56 | 41.00 | 297,437.30 | 23.69 | 7,045,707.31 |

***Composite Average Remaining Life ... 23.69 Years***

# APPENDIX A:

## DISCOUNTED CASH FLOW MODEL THEORY

The Discounted Cash Flow ("DCF") Model is based on a fundamental financial model called the "dividend discount model," which maintains that the value of a security is equal to the present value of the future cash flows it generates. Cash flows from common stock are paid to investors in the form of dividends. There are several variations of the DCF Model. In its most general form, the DCF Model is expressed as follows:[123]

**Equation 4:**
**General Discounted Cash Flow Model**

$$P_0 = \frac{D_1}{(1+k)} + \frac{D_2}{(1+k)^2} + \cdots + \frac{D_n}{(1+k)^n}$$

*where:* $P_0$ = *current stock price*
$D_1 \ldots D_n$ = *expected future dividends*
$k$ = *discount rate / required return*

The General DCF Model would require an estimation of an infinite stream of dividends. Since this would be impractical, analysts use more feasible variations of the General DCF Model, which are discussed further below.

The DCF Models rely on the following four assumptions:

1. Investors evaluate common stocks in the classical valuation framework; that is, they trade securities rationally at prices reflecting their perceptions of value;

2. Investors discount the expected cash flows at the same rate (K) in every future period;

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[123] *See* Zvi Bodie, Alex Kane & Alan J. Marcus, *Essentials of Investments* 410 (9th ed., McGraw-Hill/Irwin 2013).

3. The K obtained from the DCF equation corresponds to that specific stream of future cash flows alone; and

4. Dividends, rather than earnings, constitute the source of value.

The General DCF can be rearranged to make it more practical for estimating the cost of equity. Regulators typically rely on some variation of the Constant Growth DCF Model, which is expressed as follows:

**Equation 5:**
**Constant Growth Discounted Cash Flow Model**

$$K = \frac{D_1}{P_0} + g$$

| | | | |
|---|---|---|---|
| *where:* | $K$ | = | *discount rate / required return on equity* |
| | $D_1$ | = | *expected dividend per share one year from now* |
| | $P_0$ | = | *current stock price* |
| | $g$ | = | *expected growth rate of future dividends* |

Unlike the General DCF Model, the Constant Growth DCF Model solves directly for the required return (K). In addition, by assuming that dividends grow at a constant rate, the dividend stream from the General DCF Model may be essentially substituted with a term representing the expected constant growth rate of future dividends (g). The Constant Growth DCF Model may be considered in two parts. The first part is the dividend yield ($D_1/P_0$), and the second part is the growth rate (g). In other words, the required return in the DCF Model is equivalent to the dividend yield plus the growth rate.

In addition to the four assumptions listed above, the Constant Growth DCF Model relies on four additional assumptions as follows:[124]

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[124] *Id.* at 254-56.

1. The discount rate (K) must exceed the growth rate (g);
2. The dividend growth rate (g) is constant in every year to infinity;
3. Investors require the same return (K) in every year; and
4. There is no external financing; that is, growth is provided only by the retention of earnings.

Since the growth rate in this model is assumed to be constant, it is important not to use growth rates that are unreasonably high. In fact, the constant growth rate estimate for a regulated utility with a defined service territory should not exceed the growth rate for the economy in which it operates.

The basic form of the Constant Growth DCF Model described above is sometimes referred to as the "Annual" DCF Model. This is because the model assumes an annual dividend payment to be paid at the end of every year, as well as an increase in dividends once each year. In reality however, most utilities pay dividends on a quarterly basis. The Constant Growth DCF equation may be modified to reflect the assumption that investors receive successive quarterly dividends and reinvest them throughout the year at the discount rate. This variation is called the Quarterly Approximation DCF Model.[125]

**Equation 6:**
**Quarterly Approximation Discounted Cash Flow Model**

$$K = \left[\frac{d_0(1+g)^{1/4}}{P_0} + (1+g)^{1/4}\right]^4 - 1$$

*where:* $K$ = *discount rate / required return*
$d_0$ = *current quarterly dividend per share*
$P_0$ = *stock price*
$g$ = *expected growth rate of future dividends*

---

[125] *Id.* at 348.

The Quarterly Approximation DCF Model assumes that dividends are paid quarterly, and that each dividend is constant for four consecutive quarters. All else held constant, this model results in the *highest* cost of equity estimate for the utility in comparison to other DCF Models because it accounts for the quarterly compounding of dividends. There are several other variations of the Constant Growth (or Annual) DCF Model, including a Semi-Annual DCF Model which is used by the Federal Energy Regulatory Commission ("FERC"). These models, along with the Quarterly Approximation DCF Model, have been accepted in regulatory proceedings as useful tools for estimating the cost of equity.

## APPENDIX B:

## CAPITAL ASSET PRICING MODEL THEORY

The Capital Asset Pricing Model ("CAPM") is a market-based model founded on the principle that investors demand higher returns for incurring additional risk.[126] The CAPM estimates this required return. The CAPM relies on the following assumptions:

1. Investors are rational, risk-adverse, and strive to maximize profit and terminal wealth;

2. Investors make choices based on risk and return. Return is measured by the mean returns expected from a portfolio of assets; risk is measured by the variance of these portfolio returns;

3. Investors have homogenous expectations of risk and return;

4. Investors have identical time horizons;

5. Information is freely and simultaneously available to investors.

6. There is a risk-free asset, and investors can borrow and lend unlimited amounts at the risk-free rate;

7. There are no taxes, transaction costs, restrictions on selling short, or other market imperfections; and,

8. Total asset quality is fixed, and all assets are marketable and divisible.[127]

While some of these assumptions may appear to be restrictive, they do not outweigh the inherent value of the model. The CAPM has been widely used by firms, analysts, and regulators for decades to estimate the cost of equity capital.

The basic CAPM equation is expressed as follows:

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[126] William F. Sharpe, *A Simplified Model for Portfolio Analysis* 277-93 (Management Science IX 1963); *see also* John R. Graham, Scott B. Smart & William L. Megginson, *Corporate Finance: Linking Theory to What Companies Do* 208 (3rd ed., South Western Cengage Learning 2010).

[127] *Id.*

**Equation 7:**
**Capital Asset Pricing Model**

$$K = R_F + \beta_i(R_M - R_F)$$

*where:* $K$ = *required return*
$R_F$ = *risk-free rate*
$\beta$ = *beta coefficient of asset i*
$R_M$ = *required return on the overall market*

There are essentially three terms within the CAPM equation that are required to calculate the required return (K): (1) the risk-free rate ($R_F$); (2) the beta coefficient ($\beta$); and (3) the equity risk premium ($R_M - R_F$), which is the required return on the overall market less the risk-free rate.

Raw Beta Calculations and Adjustments

A stock's beta equals the covariance of the asset's returns with the returns on a market portfolio, divided by the portfolio's variance, as expressed in the following formula:[128]

**Equation 8:**
**Beta**

$$\beta_i = \frac{\sigma_{im}}{\sigma_m^2}$$

*where:* $\beta_i$ = *beta of asset i*
$\sigma_{im}$ = *covariance of asset i returns with market portfolio returns*
$\sigma^2_m$ = *variance of market portfolio*

Betas that are published by various research firms are typically calculated through a regression analysis that considers the movements in price of an individual stock and movements in the price of the overall market portfolio. The betas produced by this regression analysis are

[128] John R. Graham, Scott B. Smart & William L. Megginson, *Corporate Finance: Linking Theory to What Companies Do* 180-81 (3rd ed., South Western Cengage Learning 2010).

considered "raw" betas. There is empirical evidence that raw betas should be adjusted to account for beta's natural tendency to revert to an underlying mean.[129] Some analysts use an adjustment method proposed by Blume, which adjusts raw betas toward the market mean of one.[130] While the Blume adjustment method is popular due to its simplicity, it is arguably arbitrary, and some would say not useful at all. According to Dr. Damodaran: "While we agree with the notion that betas move toward 1.0 over time, the [Blume adjustment] strikes us as arbitrary and not particularly useful."[131] The Blume adjustment method is especially arbitrary when applied to industries with consistently low betas, such as the utility industry. For industries with consistently low betas, it is better to employ an adjustment method that adjusts raw betas toward an industry average, rather than the market average. Vasicek proposed such a method, which is preferable to the Blume adjustment method because it allows raw betas to be adjusted toward an industry average, and also accounts for the statistical accuracy of the raw beta calculation.[132] In other words, "[t]he Vasicek adjustment seeks to overcome one weakness of the Blume model by not applying the same adjustment to every security; rather, a security-specific adjustment is made depending on the statistical quality of the regression."[133] The Vasicek beta adjustment equation is expressed as follows:

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[129] *See* Michael J. Gombola and Douglas R. Kahl, *Time-Series Processes of Utility Betas: Implications for Forecasting Systematic Risk* 84-92 (Financial Management Autumn 1990).

[130] See Marshall Blume, *On the Assessment of Risk*, Vol. 26, No. 1 The Journal of Finance 1 (1971).

[131] *See* Aswath Damodaran, *Investment Valuation: Tools and Techniques for Determining the Value of Any Asset* 187 (3rd ed., John Wiley & Sons, Inc. 2012).

[132] Oldrich A. Vasicek, *A Note on Using Cross-Sectional Information in Bayesian Estimation of Security Betas* 1233-1239 (Journal of Finance, Vol. 28, No. 5, December 1973).

[133] 2012 Ibbotson Stocks, Bonds, Bills, and Inflation Valuation Yearbook 77-78 (Morningstar 2012).

**Equation 9:**
**Vasicek Beta Adjustment**

$$\beta_{i1} = \frac{\sigma^2_{\beta_{i0}}}{\sigma^2_{\beta 0} + \sigma^2_{\beta_{i0}}}\beta_0 + \frac{\sigma^2_{\beta 0}}{\sigma^2_{\beta 0} + \sigma^2_{\beta_{i0}}}\beta_{i0}$$

*where:*

| | | |
|---|---|---|
| $\beta_{i1}$ | = | *Vasicek adjusted beta for security i* |
| $\beta_{i0}$ | = | *historical beta for security i* |
| $\beta_0$ | = | *beta of industry or proxy group* |
| $\sigma^2_{\beta 0}$ | = | *variance of betas in the industry or proxy group* |
| $\sigma^2_{\beta i0}$ | = | *square of standard error of the historical beta for security i* |

The Vasicek beta adjustment is an improvement on the Blume model because the Vasicek model does not apply the same adjustment to every security. A higher standard error produced by the regression analysis indicates a lower statistical significance of the beta estimate. Thus, a beta with a high standard error should receive a greater adjustment than a beta with a low standard error. As stated in Ibbotson:

> While the Vasicek formula looks intimidating, it is really quite simple. The adjusted beta for a company is a weighted average of the company's historical beta and the beta of the market, industry, or peer group. How much weight is given to the company and historical beta depends on the statistical significance of the company beta statistic. If a company beta has a low standard error, then it will have a higher weighting in the Vasicek formula. If a company beta has a high standard error, then it will have lower weighting in the Vasicek formula. An advantage of this adjustment methodology is that it does not force an adjustment to the market as a whole. Instead, the adjustment can be toward an industry or some other peer group. *This is most useful in looking at companies in industries that on average have high or low betas.*[134]

Thus, the Vasicek adjustment method is statistically more accurate, and is the preferred method to use when analyzing companies in an industry that has inherently low betas, such as the utility industry. The Vasicek method was also confirmed by Gombola, who conducted a study

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[134] *Id.* at 78 (emphasis added).

specifically related to utility companies. Gombola concluded that "[t]he strong evidence of auto-regressive tendencies in *utility* betas lends support to the application of adjustment procedures such as the . . . adjustment procedure presented by Vasicek."[135] Gombola also concluded that adjusting raw betas toward the market mean of 1.0 is *too high*, and that "[i]nstead, they should be adjusted toward a value that is less than one."[136] In conducting the Vasicek adjustment on betas in previous cases, it reveals that utility betas are even lower than those published by Value Line.[137] Gombola's findings are particular important here, because his study was conducted specifically on utility companies. This evidence indicates that using Value Line's betas in a CAPM cost of equity estimate for a utility company may lead to overestimated results. Regardless, adjusting betas to a level that is *higher* than Value Line's betas is not reasonable, and it would produce CAPM cost of equity results that are too high.

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[135] Michael J. Gombola and Douglas R. Kahl, *Time-Series Processes of Utility Betas: Implications for Forecasting Systematic Risk* 92 (Financial Management Autumn 1990) (emphasis added).

[136] *Id.* at 91-92.

[137] *See e.g.* Responsive Testimony of David J. Garrett, filed March 21, 2016 in Cause No. PUD 201500273 before the Corporation Commission of Oklahoma (the Company's 2015 rate case), at pp. 56 – 59.

## APPENDIX C:

## THE DEPRECIATION SYSTEM

A depreciation accounting system may be thought of as a dynamic system in which estimates of life and salvage are inputs to the system, and the accumulated depreciation account is a measure of the state of the system at any given time.[138] The primary objective of the depreciation system is the timely recovery of capital. The process for calculating the annual accruals is determined by the factors required to define the system. A depreciation system should be defined by four primary factors: 1) a *method* of allocation; 2) a *procedure* for applying the method of allocation to a group of property; 3) a *technique* for applying the depreciation rate; and 4) a *model* for analyzing the characteristics of vintage groups comprising a continuous property group.[139] The figure below illustrates the basic concept of a depreciation system and includes some of the available parameters.[140]

There are hundreds of potential combinations of methods, procedures, techniques, and models, but in practice, analysts use only a few combinations. Ultimately, the system selected must result in the systematic and rational allocation of capital recovery for the utility. Each of the four primary factors defining the parameters of a depreciation system is discussed further below.

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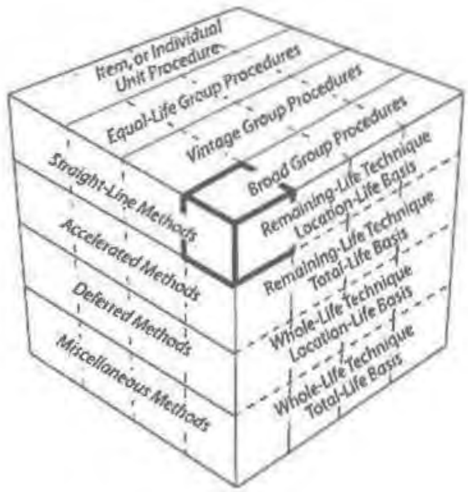
[138] Wolf *supra* n. 105, at 69-70.

[139] *Id.* at 70, 139-40.

[140] Edison Electric Institute, *Introduction to Depreciation* (inside cover) (EEI April 2013). Some definitions of the terms shown in this diagram are not consistent among depreciation practitioners and literature due to the fact that depreciation analysis is a relatively small and fragmented field. This diagram simply illustrates the some of the available parameters of a depreciation system.

**Figure 22:
The Depreciation System Cube**




1. Allocation Methods

The "method" refers to the pattern of depreciation in relation to the accounting periods. The method most commonly used in the regulatory context is the "straight-line method" — a type of age-life method in which the depreciable cost of plant is charged in equal amounts to each accounting period over the service life of plant.[141] Because group depreciation rates and plant balances often change, the amount of the annual accrual rarely remains the same, even when the straight-line method is employed.[142] The basic formula for the straight-line method is as follows:[143]

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[141] NARUC *supra* n. 106, at 56.

[142] *Id.*

[143] *Id.*

**Equation 10:**
**Straight-Line Accrual**

$$Annual\ Accrual = \frac{Gross\ Plant - Net\ Salavage}{Service\ Life}$$

Gross plant is a known amount from the utility's records, while both net salvage and service life must be estimated in order to calculate the annual accrual. The straight-line method differs from accelerated methods of recovery, such as the "sum-of-the-years-digits" method and the "declining balance" method. Accelerated methods are primarily used for tax purposes and are rarely used in the regulatory context for determining annual accruals.[144] In practice, the annual accrual is expressed as a rate which is applied to the original cost of plant in order to determine the annual accrual in dollars. The formula for determining the straight-line rate is as follows:[145]

**Equation 11:**
**Straight-Line Rate**

$$Depreciation\ Rate\ \% = \frac{100 - Net\ Salvage\ \%}{Service\ Life}$$

2. Grouping Procedures

The "procedure" refers to the way the allocation method is applied through subdividing the total property into groups.[146] While single units may be analyzed for depreciation, a group plan of depreciation is particularly adaptable to utility property. Employing a grouping procedure allows for a composite application of depreciation rates to groups of similar property, rather than

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[144] *Id.* at 57.

[145] *Id.* at 56.

[146] Wolf *supra* n. 105, at 74-75.

excessively conducting calculations for each unit. Whereas an individual unit of property has a single life, a group of property displays a dispersion of lives and the life characteristics of the group must be described statistically.[147] When analyzing mass property categories, it is important that each group contains homogenous units of plant that are used in the same general manner throughout the plant and operated under the same general conditions.[148]

The "average life" and "equal life" grouping procedures are the two most common. In the average life procedure, a constant annual accrual rate based on the average life of all property in the group is applied to the surviving property. While property having shorter lives than the group average will not be fully depreciated, and likewise, property having longer lives than the group average will be over-depreciated, the ultimate result is that the group will be fully depreciated by the time of the final retirement.[149] Thus, the average life procedure treats each unit as though its life is equal to the average life of the group. In contrast, the equal life procedure treats each unit in the group as though its life was known.[150] Under the equal life procedure the property is divided into subgroups that each has a common life.[151]

3. Application Techniques

The third factor of a depreciation system is the "technique" for applying the depreciation rate. There are two commonly used techniques: "whole life" and "remaining life." The whole life technique applies the depreciation rate on the estimated average service life of a group, while the

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[147] *Id.* at 74.

[148] NARUC *supra* n. 106, at 61-62.

[149] *See* Wolf *supra* n. 105, at 74-75.

[150] *Id.* at 75.

[151] *Id.*

remaining life technique seeks to recover undepreciated costs over the remaining life of the plant.[152]

In choosing the application technique, consideration should be given to the proper level of the accumulated depreciation account. Depreciation accrual rates are calculated using estimates of service life and salvage. Periodically these estimates must be revised due to changing conditions, which cause the accumulated depreciation account to be higher or lower than necessary. Unless some corrective action is taken, the annual accruals will not equal the original cost of the plant at the time of final retirement.[153] Analysts can calculate the level of imbalance in the accumulated depreciation account by determining the "calculated accumulated depreciation," (a.k.a. "theoretical reserve" and referred to in these appendices as "CAD"). The CAD is the calculated balance that would be in the accumulated depreciation account at a point in time using *current* depreciation parameters.[154] An imbalance exists when the actual accumulated depreciation account does not equal the CAD. The choice of application technique will affect how the imbalance is dealt with.

Use of the whole life technique requires that an adjustment be made to accumulated depreciation after calculation of the CAD. The adjustment can be made in a lump sum or over a period of time. With use of the remaining life technique, however, adjustments to accumulated depreciation are amortized over the remaining life of the property and are automatically included

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[152] NARUC *supra* n. 106, at 63-64.

[153] Wolf *supra* n. 105, at 83.

[154] NARUC *supra* n. 106, at 325.

in the annual accrual.[155] This is one reason that the remaining life technique is popular among practitioners and regulators. The basic formula for the remaining life technique is as follows:[156]

**Equation 12:**
**Remaining Life Accrual**

$$Annual\ Accrual = \frac{Gross\ Plant - Accumulated\ Depreciation - Net\ Salvage}{Average\ Remaining\ Life}$$

The remaining life accrual formula is similar to the basic straight-line accrual formula above with two notable exceptions. First, the numerator has an additional factor in the remaining life formula: the accumulated depreciation. Second, the denominator is "average remaining life" instead of "average life." Essentially, the future accrual of plant (gross plant less accumulated depreciation) is allocated over the remaining life of plant. Thus, the adjustment to accumulated depreciation is "automatic" in the sense that it is built into the remaining life calculation.[157]

4. Analysis Model

The fourth parameter of a depreciation system, the "model," relates to the way of viewing the life and salvage characteristics of the vintage groups that have been combined to form a continuous property group for depreciation purposes.[158] A continuous property group is created when vintage groups are combined to form a common group. Over time, the characteristics of the property may change, but the continuous property group will continue. The two analysis models

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[155] NARUC *supra* n. 106, at 65 ("The desirability of using the remaining life technique is that any necessary adjustments of [accumulated depreciation] . . . are accrued automatically over the remaining life of the property. Once commenced, adjustments to the depreciation reserve, outside of those inherent in the remaining life rate would require regulatory approval.").

[156] *Id.* at 64.

[157] Wolf *supra* n. 105, at 178.

[158] *See* Wolf *supra* n. 105, at 139 (I added the term "model" to distinguish this fourth depreciation system parameter from the other three parameters).

used among practitioners, the "broad group" and the "vintage group," are two ways of viewing the life and salvage characteristics of the vintage groups that have been combined to from a continuous property group.

The broad group model views the continuous property group as a collection of vintage groups that each has the same life and salvage characteristics. Thus, a single survivor curve and a single salvage schedule are chosen to describe all the vintages in the continuous property group. In contrast, the vintage group model views the continuous property group as a collection of vintage groups that may have different life and salvage characteristics. Typically, there is not a significant difference between vintage group and broad group results unless vintages within the applicable property group experienced dramatically different retirement levels than anticipated in the overall estimated life for the group. For this reason, many analysts utilize the broad group procedure because it is more efficient.

# APPENDIX D:

# IOWA CURVES

Early work in the analysis of the service life of industrial property was based on models that described the life characteristics of human populations.[159] This explains why the word "mortality" is often used in the context of depreciation analysis. In fact, a group of property installed during the same accounting period is analogous to a group of humans born during the same calendar year. Each period the group will incur a certain fraction of deaths / retirements until there are no survivors. Describing this pattern of mortality is part of actuarial analysis, and is regularly used by insurance companies to determine life insurance premiums. The pattern of mortality may be described by several mathematical functions, particularly the survivor curve and frequency curve. Each curve may be derived from the other so that if one curve is known, the other may be obtained. A survivor curve is a graph of the percent of units remaining in service expressed as a function of age.[160] A frequency curve is a graph of the frequency of retirements as a function of age. Several types of survivor and frequency curves are illustrated in the figures below.

## 1. Development

The survivor curves used by analysts today were developed over several decades from extensive analysis of utility and industrial property. In 1931 Edwin Kurtz and Robley Winfrey used extensive data from a range of 65 industrial property groups to create survivor curves

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[159] Wolf *supra* n. 105, at 276.

[160] *Id*. at 23.

representing the life characteristics of each group of property.[161] They generalized the 65 curves into 13 survivor curve types and published their results in *Bulletin 103: Life Characteristics of Physical Property*. The 13 type curves were designed to be used as valuable aids in forecasting probable future service lives of industrial property. Over the next few years, Winfrey continued gathering additional data, particularly from public utility property, and expanded the examined property groups from 65 to 176.[162] This resulted in 5 additional survivor curve types for a total of 18 curves. In 1935, Winfrey published *Bulletin 125: Statistical Analysis of Industrial Property Retirements*. According to Winfrey, "[t]he 18 type curves are expected to represent quite well all survivor curves commonly encountered in utility and industrial practices."[163] These curves are known as the "Iowa curves" and are used extensively in depreciation analysis in order to obtain the average service lives of property groups. (Use of Iowa curves in actuarial analysis is further discussed in Exhibit DJG 25, Appendix E.)

In 1942, Winfrey published *Bulletin 155: Depreciation of Group Properties*. In Bulletin 155, Winfrey made some slight revisions to a few of the 18 curve types, and published the equations, tables of the percent surviving, and probable life of each curve at five-percent intervals.[164] Rather than using the original formulas, analysts typically rely on the published tables containing the percentages surviving. This is because absent knowledge of the integration

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[161] *Id.* at 34.

[162] *Id.*

[163] Robley Winfrey, *Bulletin 125: Statistical Analyses of Industrial Property Retirements* 85, Vol. XXXIV, No. 23 (Iowa State College of Agriculture and Mechanic Arts 1935).

[164] Robley Winfrey, Bulletin 155: Depreciation of Group Properties 121-28, Vol XLI, No. 1 (The Iowa State College Bulletin 1942); see also Wolf supra n. 105, at 305-38 (publishing the percent surviving for each Iowa curve, including "O" type curve, at one percent intervals).

technique applied to each age interval, it is not possible to recreate the exact original published table values. In the 1970s, John Russo collected data from over 2,000 property accounts reflecting observations during the period 1965 – 1975 as part of his Ph.D. dissertation at Iowa State. Russo essentially repeated Winfrey's data collection, testing, and analysis methods used to develop the original Iowa curves, except that Russo studied industrial property in service several decades after Winfrey published the original Iowa curves. Russo drew three major conclusions from his research:[165]

1. No evidence was found to conclude that the Iowa curve set, as it stands, is not a valid system of standard curves;

2. No evidence was found to conclude that new curve shapes could be produced at this time that would add to the validity of the Iowa curve set; and

3. No evidence was found to suggest that the number of curves within the Iowa curve set should be reduced.

Prior to Russo's study, some had criticized the Iowa curves as being potentially obsolete because their development was rooted in the study of industrial property in existence during the early 1900s. Russo's research, however, negated this criticism by confirming that the Iowa curves represent a sufficiently wide range of life patterns, and that though technology will change over time, the underlying patterns of retirements remain constant and can be adequately described by the Iowa curves.[166]

Over the years, several more curve types have been added to Winfrey's 18 Iowa curves. In 1967, Harold Cowles added four origin-modal curves. In addition, a square curve is sometimes

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[165] *See* Wolf *supra* n. 105, at 37.

[166] *Id.*

used to depict retirements which are all planned to occur at a given age. Finally, analysts commonly rely on several "half curves" derived from the original Iowa curves. Thus, the term "Iowa curves" could be said to describe up to 31 standardized survivor curves.

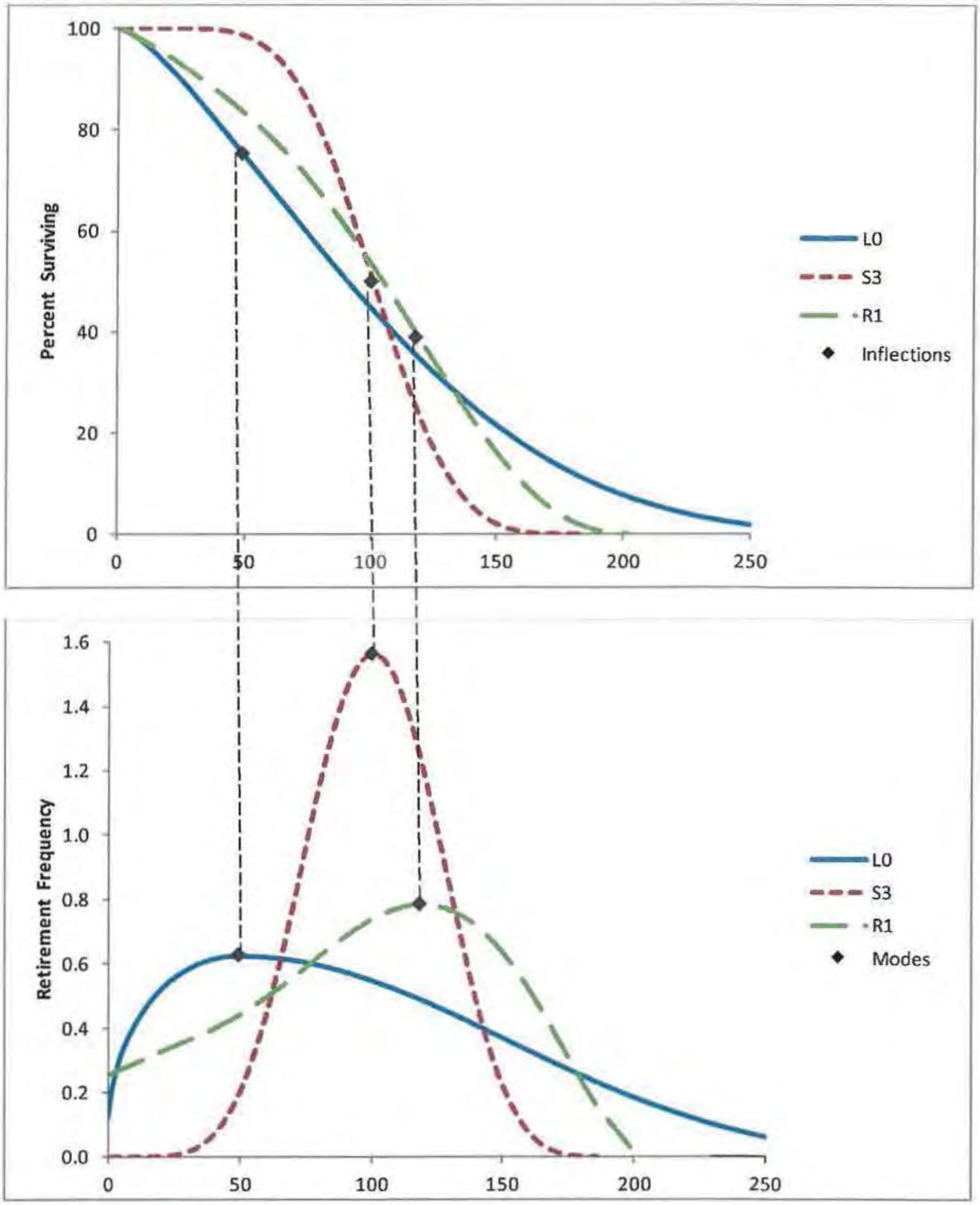
2. Classification

The Iowa curves are classified by three variables: modal location, average life, and variation of life. First, the mode is the percent life that results in the highest point of the frequency curve and the "inflection point" on the survivor curve. The modal age is the age at which the greatest rate of retirement occurs. As illustrated in the figure below, the modes appear at the steepest point of each survivor curve in the top graph, as well as the highest point of each corresponding frequency curve in the bottom graph.

The classification of the survivor curves was made according to whether the mode of the retirement frequency curves was to the left, to the right, or coincident with average service life. There are three modal "families" of curves: six left modal curves (L0, L1, L2, L3, L4, L5); five right modal curves (R1, R2, R3, R4, R5); and seven symmetrical curves (S0, S1, S2, S3, S4, S5, S6).[167] In the figure below, one curve from each family is shown: L0, S3 and R1, with average life at 100 on the x-axis. It is clear from the graphs that the modes for the L0 and R1 curves appear to the left and right of average life respectively, while the S3 mode is coincident with average life.

[167] In 1967, Harold A. Cowles added four origin-modal curves known as "O type" curves. There are also several "half" curves and a square curve, so the total amount of survivor curves commonly called "Iowa" curves is about 31 (see NARUC supra n. 106, at 68).

**Figure 23:**
**Modal Age Illustration**



The second Iowa curve classification variable is average life. The Iowa curves were designed using a single parameter of age expressed as a percent of average life instead of actual age. This was necessary in order for the curves to be of practical value. As Winfrey notes:

> Since the location of a particular survivor on a graph is affected by both its span in years and the shape of the curve, it is difficult to classify a group of curves unless one of these variables can be controlled. This is easily done by expressing the age in percent of average life."[168]

Because age is expressed in terms of percent of average life, any particular Iowa curve type can be modified to forecast property groups with various average lives.

The third variable, variation of life, is represented by the numbers next to each letter. A lower number (e.g., L1) indicates a relatively low mode, large variation, and large maximum life; a higher number (e.g., L5) indicates a relatively high mode, small variation, and small maximum life. All three classification variables – modal location, average life, and variation of life — are used to describe each Iowa curve. For example, a 13-L1 Iowa curve describes a group of property with a 13-year average life, with the greatest number of retirements occurring before (or to the left of) the average life, and a relatively low mode. The graphs below show these 18 survivor curves, organized by modal family.

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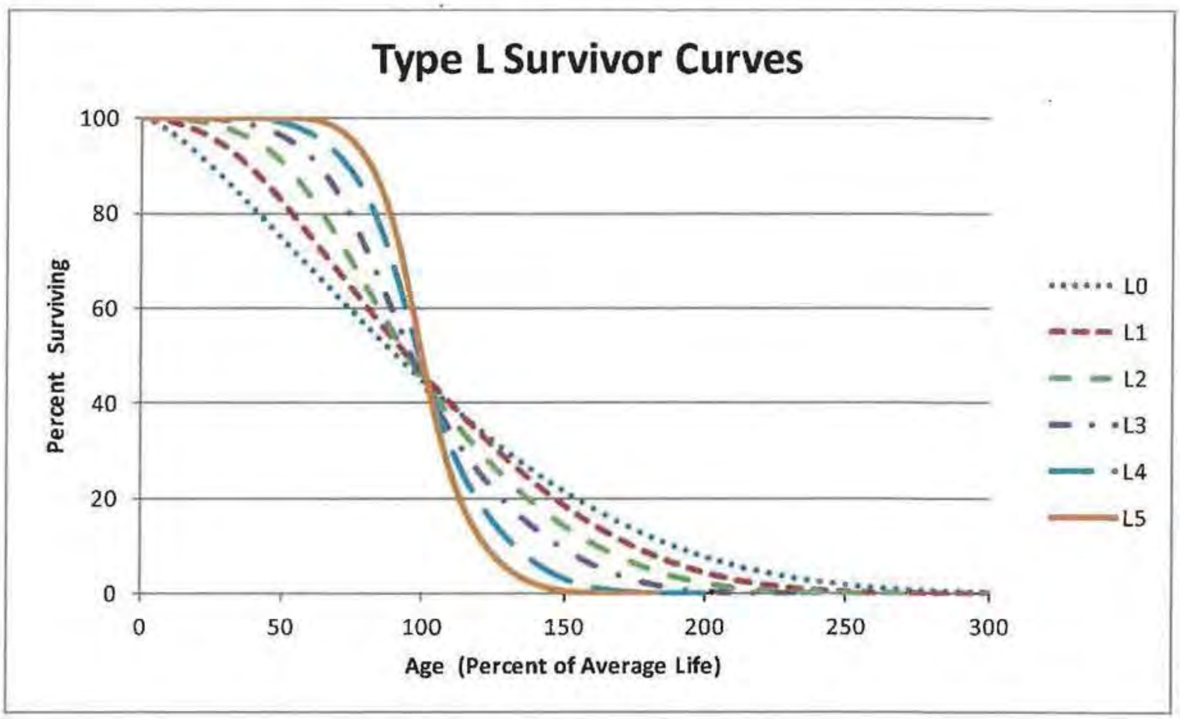
[168] Winfrey *supra* n. 166, at 60.

**Figure 24:**
**Type L Survivor and Frequency Curves**



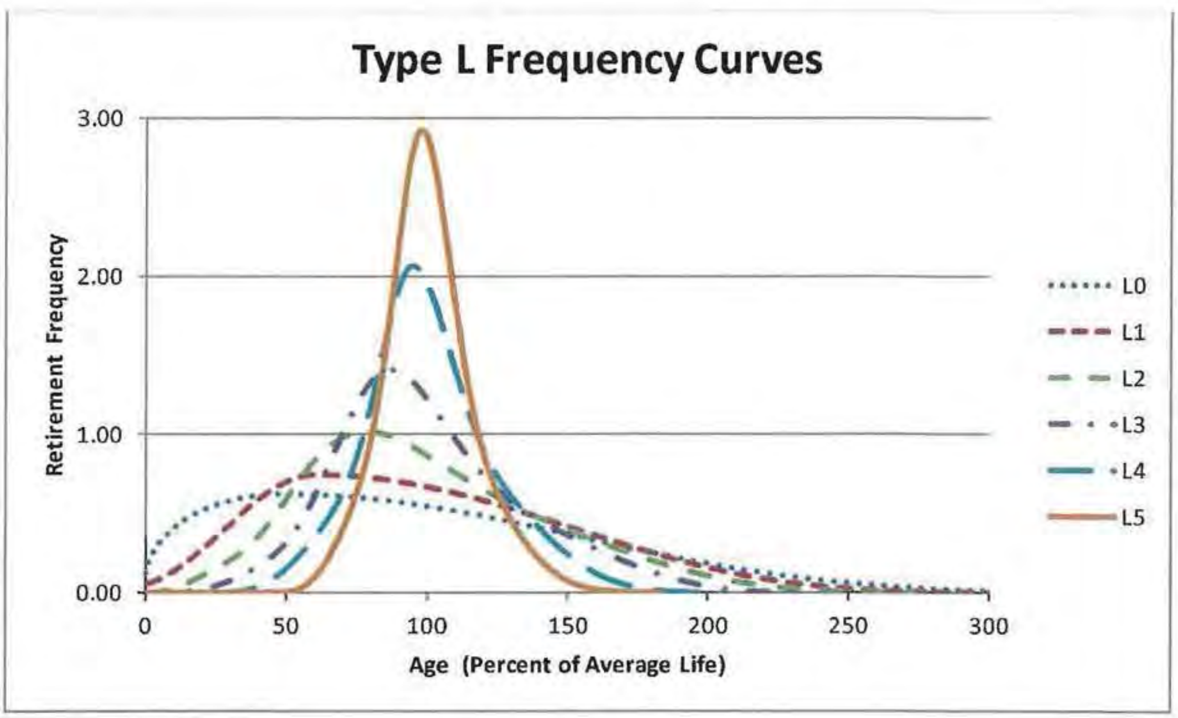
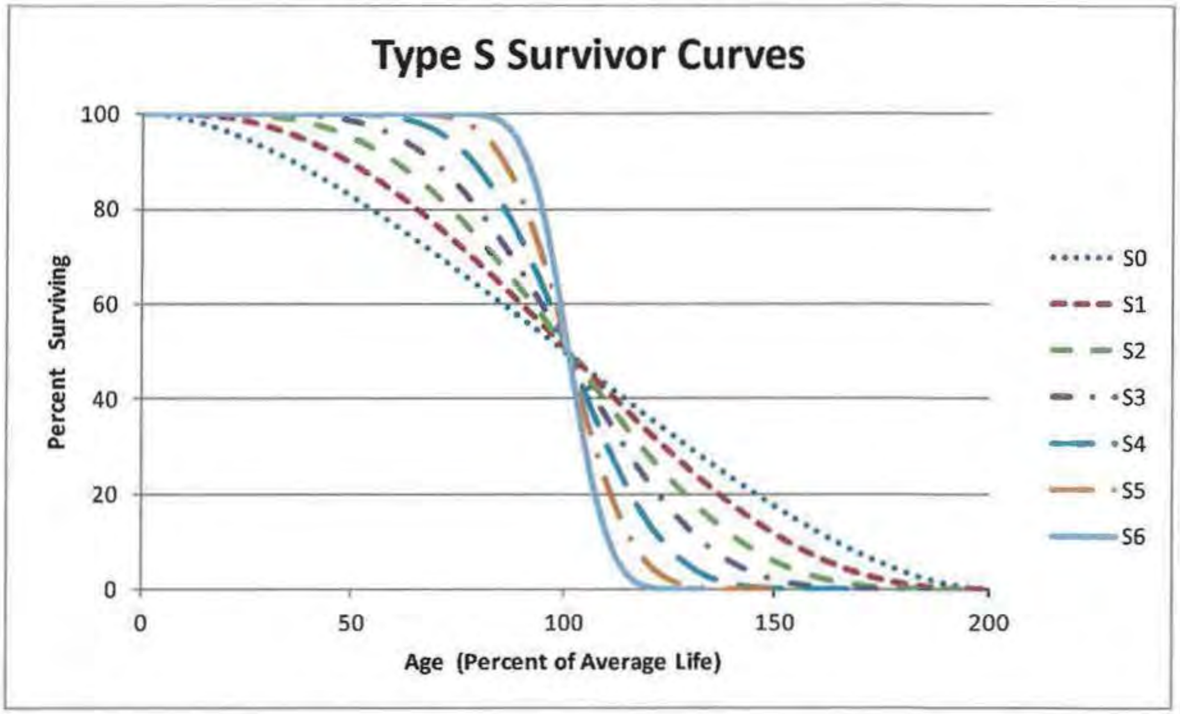



**Figure 25:**
**Type S Survivor and Frequency Curves**



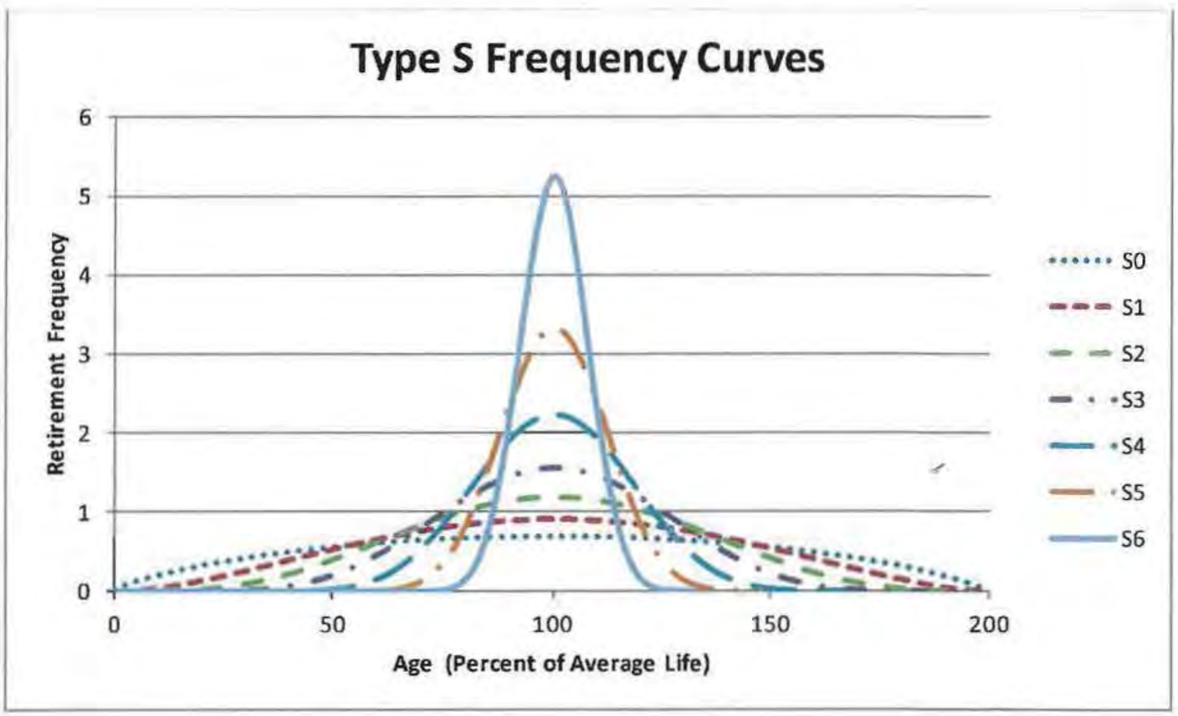
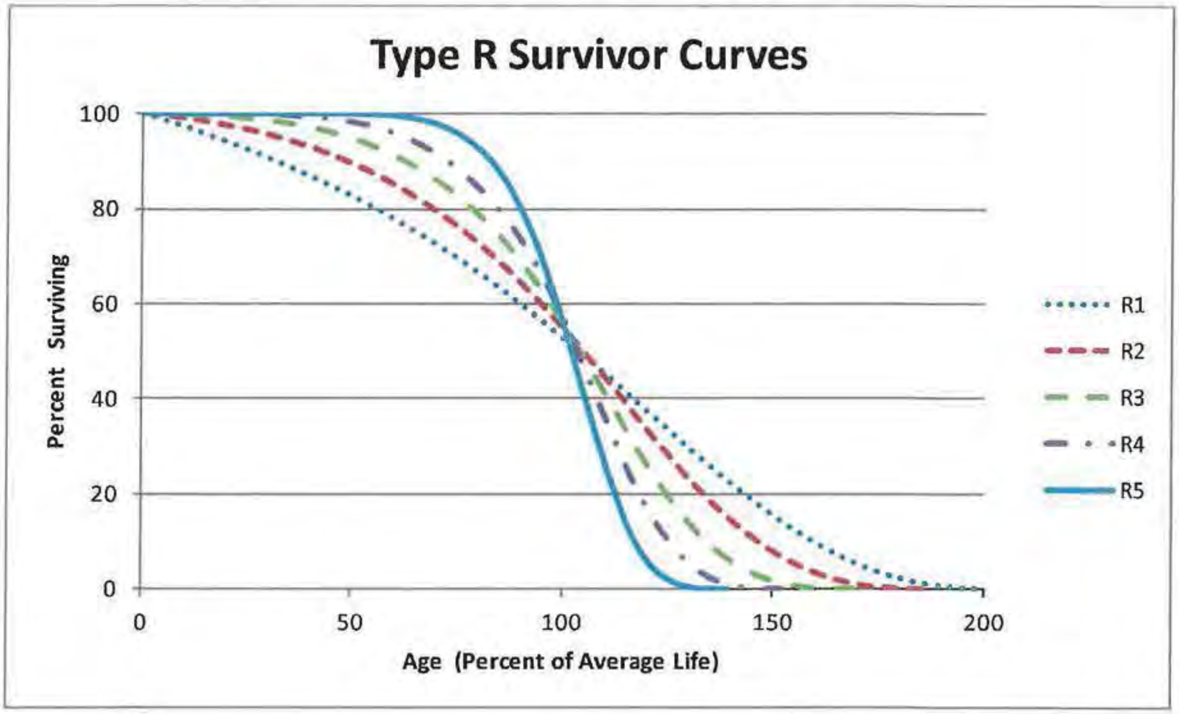
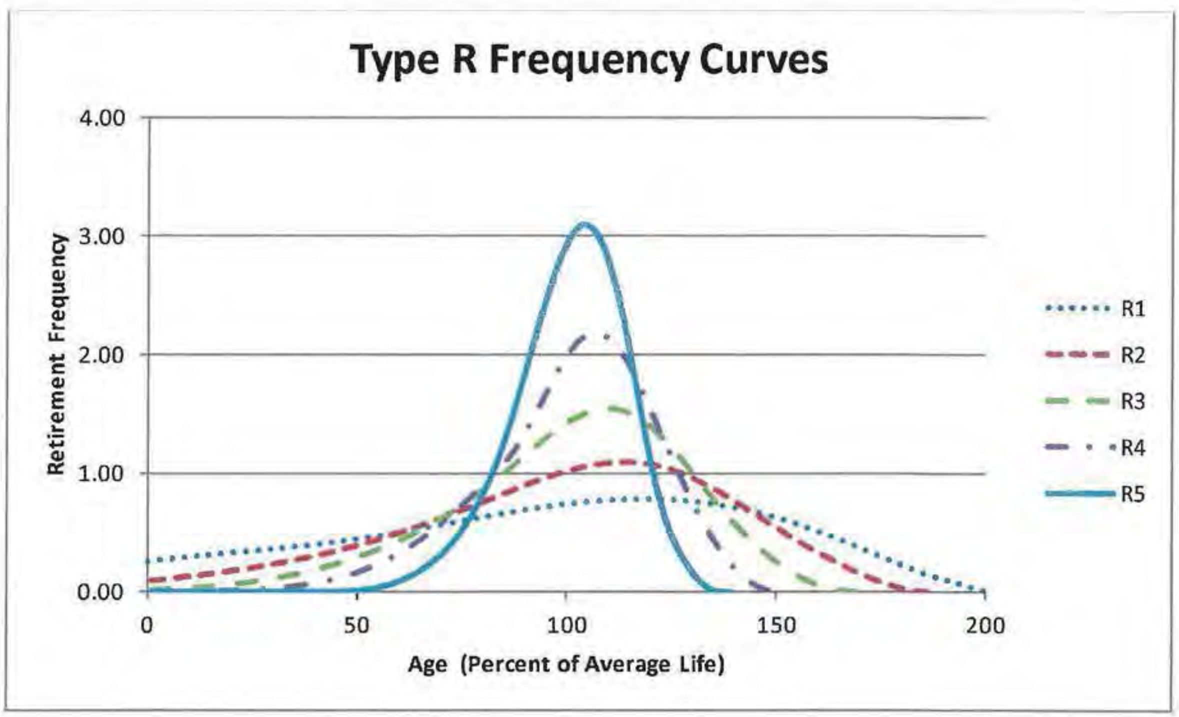



**Figure 26:**
**Type R Survivor and Frequency Curves**



As shown in the graphs above, the modes for the L family frequency curves occur to the left of average life (100% on the x-axis), while the S family modes occur at the average, and the R family modes occur after the average.

3. Types of Lives

Several other important statistical analyses and types of lives may be derived from an Iowa curve. These include: 1) average life; 2) realized life; 3) remaining life; and 4) probable life. The figure below illustrates these concepts. It shows the frequency curve, survivor curve, and probable life curve. Age $M_x$ on the x-axis represents the modal age, while age $AL_x$ represents the average age. Thus, this figure illustrates an "L type" Iowa curve since the mode occurs before the average.[169]

First, average life is the area under the survivor curve from age zero to maximum life. Because the survivor curve is measured in percent, the area under the curve must be divided by 100% to convert it from percent-years to years. The formula for average life is as follows:[170]

**Equation 13:**
**Average Life**

$$Average\ Life = \frac{Area\ Under\ Survivor\ Curve\ from\ Age\ 0\ to\ Max\ Life}{100\%}$$

Thus, average life may not be determined without a complete survivor curve. Many property groups being analyzed will not have experienced full retirement. This results in a "stub" survivor

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[169] From age zero to age $M_x$ on the survivor curve, it could be said that the percent surviving from this property group is decreasing at an increasing rate. Conversely, from point $M_x$ to maximum on the survivor curve, the percent surviving is decreasing at a decreasing rate.

[170] *See* NARUC *supra* n. 106, at 71.

curve. Iowa curves are used to extend stub curves to maximum life in order for the average life calculation to be made (see Exhibit DJG 25, Appendix E).

Realized life is similar to average life, except that realized life is the average years of service experienced to date from the vintage's original installations.[171] As shown in the figure below, realized life is the area under the survivor curve from zero to age $RL_X$. Likewise, unrealized life is the area under the survivor curve from age $RL_X$ to maximum life. Thus, it could be said that average life equals realized life plus unrealized life.

Average remaining life represents the future years of service expected from the surviving property.[172] Remaining life is sometimes referred to as "average remaining life" and "life expectancy." To calculate average remaining life at age x, the area under the estimated future potion of the survivor curve is divided by the percent surviving at age x (denoted $S_X$). Thus, the average remaining life formula is:

**Equation 14:**
**Average Remaining Life**

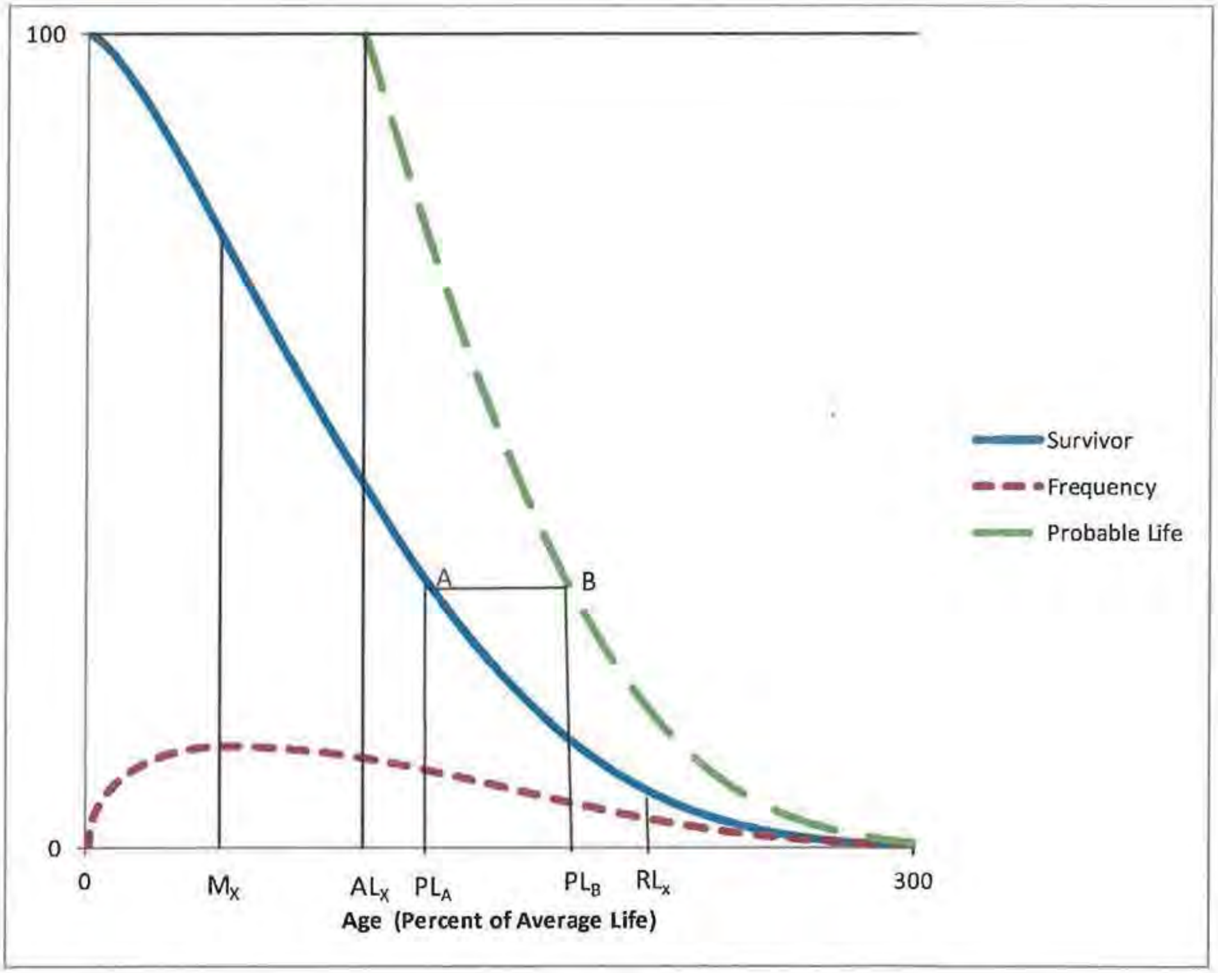
$$Average\ Remaining\ Life = \frac{Area\ Under\ Survivor\ Curve\ from\ Age\ x\ to\ Max\ Life}{S_X}$$

It is necessary to determine average remaining life in order to calculate the annual accrual under the remaining life technique.

[171] *Id*. at 73.

[172] *Id*. at 74.

**Figure 27:**
**Iowa Curve Derivations**




Finally, the probable life may also be determined from the Iowa curve. The probable life of a property group is the total life expectancy of the property surviving at any age and is equal to the remaining life plus the current age.[173] The probable life is also illustrated in this figure. The probable life at age $PL_A$ is the age at point $PL_B$. Thus, to read the probable life at age $PL_A$, see the corresponding point on the survivor curve above at point "A," then horizontally to point "B" on

[173] Wolf *supra* n. 105, at 28.

the probable life curve, and back down to the age corresponding to point "B." It is no coincidence that the vertical line from $AL_X$ connects at the top of the probable life curve. This is because at age zero, probable life equals average life.

## APPENDIX E:

## ACTUARIAL ANALYSIS

Actuarial science is a discipline that applies various statistical methods to assess risk probabilities and other related functions. Actuaries often study human mortality. The results from historical mortality data are used to predict how long similar groups of people who are alive will live today. Insurance companies rely of actuarial analysis in determining premiums for life insurance policies.

The study of human mortality is analogous to estimating service lives of industrial property groups. While some humans die solely from chance, most deaths are related to age; that is, death rates generally increase as age increases. Similarly, physical plant is also subject to forces of retirement. These forces include physical, functional, and contingent factors, as shown in the table below.[174]

**Figure 28:
Forces of Retirement**

| Physical Factors | Functional Factors | Contingent Factors |
|---|---|---|
| Wear and tear<br>Decay or deterioration<br>Action of the elements | Inadequacy<br>Obsolescence<br>Changes in technology<br>Regulations<br>Managerial discretion | Casualties or disasters<br>Extraordinary obsolescence |

While actuaries study historical mortality data in order to predict how long a group of people will live, depreciation analysts must look at a utility's historical data in order to estimate the average lives of property groups. A utility's historical data is often contained in the Continuing Property Records ("CPR"). Generally, a CPR should contain 1) an inventory of property record

[174] NARUC *supra* n. 106, at 14-15.

units; 2) the association of costs with such units; and 3) the dates of installation and removal of plant. Since actuarial analysis includes the examination of historical data to forecast future retirements, the historical data used in the analysis should not contain events that are anomalous or unlikely to recur.[175] Historical data is used in the retirement rate actuarial method, which is discussed further below.

The Retirement Rate Method

There are several systematic actuarial methods that use historical data in order to calculating observed survivor curves for property groups. Of these methods, the retirement rate method is superior, and is widely employed by depreciation analysts.[176] The retirement rate method is ultimately used to develop an observed survivor curve, which can be fitted with an Iowa curve discussed in Exhibit DJG 25, Appendix D in order to forecast average life. The observed survivor curve is calculated by using an observed life table ("OLT"). The figures below illustrate how the OLT is developed. First, historical property data are organized in a matrix format, with placement years on the left forming rows, and experience years on the top forming columns. The placement year (a.k.a. "vintage year" or "installation year") is the year of placement of a group of property. The experience year (a.k.a. "activity year") refers to the accounting data for a particular calendar year. The two matrices below use aged data — that is, data for which the dates of placements, retirements, transfers, and other transactions are known. Without aged data, the retirement rate actuarial method may not be employed. The first matrix is the exposure matrix,

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[175] *Id.* at 112-13.

[176] Anson Marston, Robley Winfrey & Jean C. Hempstead, *Engineering Valuation and Depreciation* 154 (2nd ed., McGraw-Hill Book Company, Inc. 1953).

which shows the exposures at the beginning of each year.[177] An exposure is simply the depreciable property subject to retirement during a period. The second matrix is the retirement matrix, which shows the annual retirements during each year. Each matrix covers placement years 2003–2015, and experience years 2008-2015. In the exposure matrix, the number in the 2009 experience column and the 2003 placement row is \$192,000. This means at the beginning of 2012, there was \$192,000 still exposed to retirement from the vintage group placed in 2003. Likewise, in the retirement matrix, \$19,000 of the dollars invested in 2003 was retired during 2012.

**Figure 29:**
**Exposure Matrix**

| | Experience Years Exposures at January 1 of Each Year (Dollars in 000's) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Placement Years | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | Total at Start of Age Interval | Age Interval |
| 2003 | 261 | 245 | 228 | 211 | **192** | 173 | 152 | 131 | 131 | 11.5 - 12.5 |
| 2004 | 267 | 252 | 236 | 220 | 202 | **184** | 165 | 145 | 297 | 10.5 - 11.5 |
| 2005 | 304 | 291 | 277 | 263 | 248 | 232 | **216** | 198 | 536 | 9.5 - 10.5 |
| 2006 | 345 | 334 | 322 | 310 | 298 | 284 | 270 | **255** | **847** | 8.5 - 9.5 |
| 2007 | 367 | 357 | 347 | 335 | 324 | 312 | 299 | 286 | 1,201 | 7.5 - 8.5 |
| 2008 | 375 | 366 | 357 | 347 | 336 | 325 | 314 | 302 | 1,581 | 6.5 - 7.5 |
| 2009 | | 377 | 366 | 356 | 346 | 336 | 327 | 319 | 1,986 | 5.5 - 6.5 |
| 2010 | | | 381 | 369 | 358 | 347 | 336 | 327 | 2,404 | 4.5 - 5.5 |
| 2011 | | | | 386 | 372 | 359 | 346 | 334 | 2,559 | 3.5 - 4.5 |
| 2012 | | | | | 395 | 380 | 366 | 352 | 2,722 | 2.5 - 3.5 |
| 2013 | | | | | | 401 | 385 | 370 | 2,866 | 1.5 - 2.5 |
| 2014 | | | | | | | 410 | 393 | 2,998 | 0.5 - 1.5 |
| 2015 | | | | | | | | 416 | 3,141 | 0.0 - 0.5 |
| Total | 1919 | 2222 | 2514 | 2796 | 3070 | 3333 | 3586 | 3827 | 23,268 | |

[177] Technically, the last numbers in each column are "gross additions" rather than exposures. Gross additions do not include adjustments and transfers applicable to plant placed in a previous year. Once retirements, adjustments, and transfers are factored in, the balance at the beginning of the next account period is called an "exposure" rather than an addition.

**Figure 30:**
**Retirement Matrix**

| Placement Years | Experience Years<br>Retirments During the Year (Dollars in 000's)<br>2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | Total During Age Interval | Age Interval |
|---|---|---|---|---|---|---|---|---|---|---|
| 2003 | 16 | 17 | 18 | 19 | 19 | 20 | 21 | 23 | 23 | 11.5 - 12.5 |
| 2004 | 15 | 16 | 17 | 17 | 18 | 19 | 20 | 21 | 43 | 10.5 - 11.5 |
| 2005 | 13 | 14 | 14 | 15 | 16 | 17 | 17 | 18 | 59 | 9.5 - 10.5 |
| 2006 | 11 | 12 | 12 | 13 | 13 | 14 | 15 | 15 | 71 | 8.5 - 9.5 |
| 2007 | 10 | 11 | 11 | 12 | 12 | 13 | 13 | 14 | 82 | 7.5 - 8.5 |
| 2008 | 9 | 9 | 10 | 10 | 11 | 11 | 12 | 13 | 91 | 6.5 - 7.5 |
| 2009 | | 11 | 10 | 10 | 9 | 9 | 9 | 8 | 95 | 5.5 - 6.5 |
| 2010 | | | 12 | 11 | 11 | 10 | 10 | 9 | 100 | 4.5 - 5.5 |
| 2011 | | | | 14 | 13 | 13 | 12 | 11 | 93 | 3.5 - 4.5 |
| 2012 | | | | | 15 | 14 | 14 | 13 | 91 | 2.5 - 3.5 |
| 2013 | | | | | | 16 | 15 | 14 | 93 | 1.5 - 2.5 |
| 2014 | | | | | | | 17 | 16 | 100 | 0.5 - 1.5 |
| 2015 | | | | | | | | 18 | 112 | 0.0 - 0.5 |
| Total | 74 | 89 | 104 | 121 | 139 | 157 | 175 | 194 | 1,052 | |

These matrices help visualize how exposure and retirement data are calculated for each age interval. An age interval is typically one year. A common convention is to assume that any unit installed during the year is installed in the middle of the calendar year (i.e., July 1st). This convention is called the "half-year convention" and effectively assumes that all units are installed uniformly during the year.[178] Adoption of the half-year convention leads to age intervals of 0-0.5 years, 0.5-1.5 years, etc., as shown in the matrices.

The purpose of the matrices is to calculate the totals for each age interval, which are shown in the second column from the right in each matrix. This column is calculated by adding each number from the corresponding age interval in the matrix. For example, in the exposure matrix, the total amount of exposures at the beginning of the 8.5-9.5 age interval is \$847,000. This number was calculated by adding the numbers shown on the "stairs" to the left (192+184+216+255=847).

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[178] Wolf *supra* n. 105, at 22.

The same calculation is applied to each number in the column. The amounts retired during the year in the retirements matrix affect the exposures at the beginning of each year in the exposures matrix. For example, the amount exposed to retirement in 2008 from the 2003 vintage is \$261,000. The amount retired during 2008 from the 2003 vintage is \$16,000. Thus, the amount exposed to retirement in 2009 from the 2003 vintage is \$245,000 (\$261,000 - \$16,000). The company's property records may contain other transactions which affect the property, including sales, transfers, and adjusting entries. Although these transactions are not shown in the matrices above, they would nonetheless affect the amount exposed to retirement at the beginning of each year.

The totaled amounts for each age interval in both matrices are used to form the exposure and retirement columns in the OLT, as shown in the chart below. This chart also shows the retirement ratio and the survivor ratio for each age interval. The retirement ratio for an age interval is the ratio of retirements during the interval to the property exposed to retirement at the beginning of the interval. The retirement ratio represents the probability that the property surviving at the beginning of an age interval will be retired during the interval. The survivor ratio is simply the complement to the retirement ratio (1 – retirement ratio). The survivor ratio represents the probability that the property surviving at the beginning of an age interval will survive to the next age interval.

**Figure 31:**
**Observed Life Table**

| Age at Start of Interval | Exposures at Start of Age Interval | Retirements During Age Interval | Retirement Ratio | Survivor Ratio | Percent Surviving at Start of Age Interval |
|---|---|---|---|---|---|
| A | B | C | D = C / B | E = 1 - D | F |
| 0.0 | 3,141 | 112 | 0.036 | 0.964 | **100.00** |
| 0.5 | 2,998 | 100 | 0.033 | 0.967 | **96.43** |
| 1.5 | 2,866 | 93 | 0.032 | 0.968 | **93.21** |
| 2.5 | 2,722 | 91 | 0.033 | 0.967 | **90.19** |
| 3.5 | 2,559 | 93 | 0.037 | 0.963 | **87.19** |
| 4.5 | 2,404 | 100 | 0.042 | 0.958 | **84.01** |
| 5.5 | 1,986 | 95 | 0.048 | 0.952 | **80.50** |
| 6.5 | 1,581 | 91 | 0.058 | 0.942 | **76.67** |
| 7.5 | 1,201 | 82 | 0.068 | 0.932 | **72.26** |
| 8.5 | 847 | 71 | 0.084 | 0.916 | **67.31** |
| 9.5 | 536 | 59 | 0.110 | 0.890 | **61.63** |
| 10.5 | 297 | 43 | 0.143 | 0.857 | **54.87** |
| 11.5 | 131 | 23 | 0.172 | 0.828 | **47.01** |
| | | | | | **38.91** |
| Total | 23,268 | 1,052 | | | |

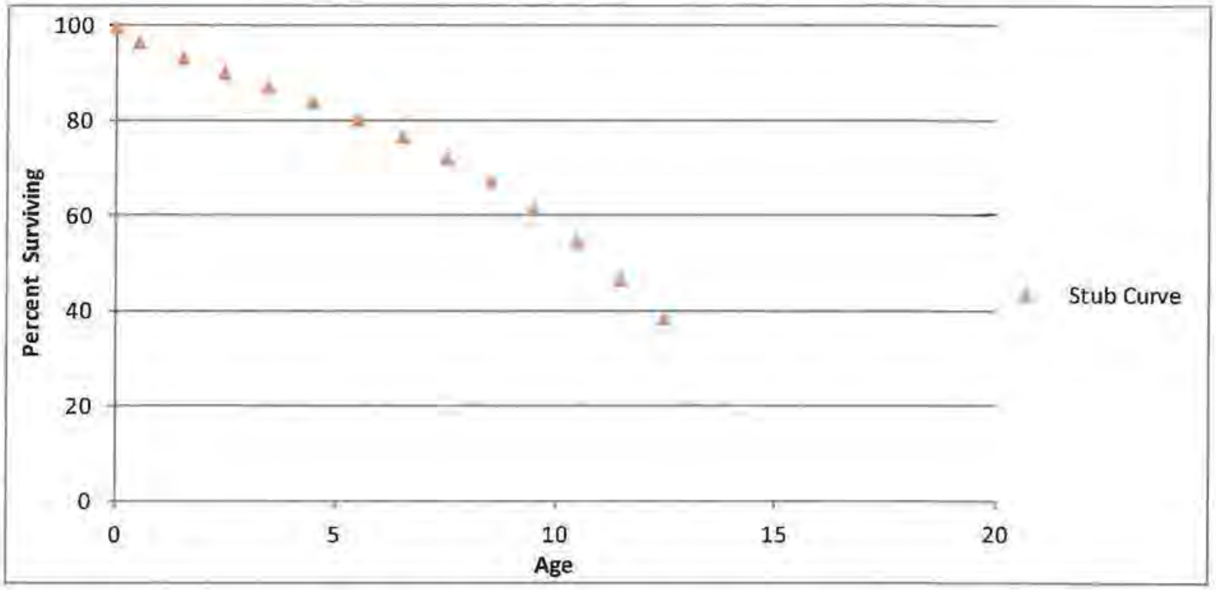
Column F on the right shows the percentages surviving at the beginning of each age interval. This column starts at 100% surviving. Each consecutive number below is calculated by multiplying the percent surviving from the previous age interval by the corresponding survivor ratio for that age interval. For example, the percent surviving at the start of age interval 1.5 is 93.21%, which was calculated by multiplying the percent surviving for age interval 0.5 (96.43%) by the survivor ratio for age interval 0.5 (0.967)[179].

The percentages surviving in Column F are the numbers that are used to form the original survivor curve. This particular curve starts at 100% surviving and ends at 38.91% surviving. An

179 Multiplying 96.43 by 0.967 does not equal 93.21 exactly due to rounding.

observed survivor curve such as this that does not reach zero percent surviving is called a "stub" curve. The figure below illustrates the stub survivor curve derived from the OLT table above.

**Figure 32:**
**Original "Stub" Survivor Curve**




The matrices used to develop the basic OLT and stub survivor curve provide a basic illustration of the retirement rate method in that only a few placement and experience years were used. In reality, analysts may have several decades of aged property data to analyze. In that case, it may be useful to use a technique called "banding" in order to identify trends in the data.

<u>Banding</u>

The forces of retirement and characteristics of industrial property are constantly changing. A depreciation analyst may examine the magnitude of these changes. Analysts often use a technique called "banding" to assist with this process. Banding refers to the merging of several years of data into a single data set for further analysis, and it is a common technique associated with the retirement rate method.[180] There are three primary benefits of using bands in depreciation analysis:

1. Increasing the sample size. In statistical analyses, the larger the sample size in relation to the body of total data, the greater the reliability of the result;

2. Smooth the observed data. Generally, the data obtained from a single activity or vintage year will not produce an observed life table that can be easily fit; and

3. Identify trends. By looking at successive bands, the analyst may identify broad trends in the data that may be useful in projecting the future life characteristics of the property.[181]

Two common types of banding methods are the "placement band" method and the "experience band" method." A placement band, as the name implies, isolates selected placement years for analysis. The figure below illustrates the same exposure matrix shown above, except that only the placement years 2005-2008 are considered in calculating the total exposures at the beginning of each age interval.

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[180] NARUC *supra* n. 106, at 113.

[181] *Id.*

**Figure 33:**
**Placement Bands**

| Placement Years | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | Total at Start of Age Interval | Age Interval |
|---|---|---|---|---|---|---|---|---|---|---|
| | Experience Years<br>Exposures at January 1 of Each Year (Dollars in 000's) | | | | | | | | | |
| 2003 | 261 | 245 | 228 | 211 | 192 | 173 | 152 | 131 | | 11.5 - 12.5 |
| 2004 | 267 | 252 | 236 | 220 | 202 | 184 | 165 | 145 | | 10.5 - 11.5 |
| 2005 | 304 | 291 | 277 | 263 | 248 | 232 | 216 | 198 | 198 | 9.5 - 10.5 |
| 2006 | 345 | 334 | 322 | 310 | 298 | 284 | 270 | 255 | 471 | 8.5 - 9.5 |
| 2007 | 367 | 357 | 347 | 335 | 324 | 312 | 299 | 286 | 788 | 7.5 - 8.5 |
| 2008 | 375 | 366 | 357 | 347 | 336 | 325 | 314 | 302 | 1,133 | 6.5 - 7.5 |
| 2009 | | 377 | 366 | 356 | 346 | 336 | 327 | 319 | 1,186 | 5.5 - 6.5 |
| 2010 | | | 381 | 369 | 358 | 347 | 336 | 327 | 1,237 | 4.5 - 5.5 |
| 2011 | | | | 386 | 372 | 359 | 346 | 334 | 1,285 | 3.5 - 4.5 |
| 2012 | | | | | 395 | 380 | 366 | 352 | 1,331 | 2.5 - 3.5 |
| 2013 | | | | | | 401 | 385 | 370 | 1,059 | 1.5 - 2.5 |
| 2014 | | | | | | | 410 | 393 | 733 | 0.5 - 1.5 |
| 2015 | | | | | | | | 416 | 375 | 0.0 - 0.5 |
| Total | 1919 | 2222 | 2514 | 2796 | 3070 | 3333 | 3586 | 3827 | 9,796 | |

The shaded cells within the placement band equal the total exposures at the beginning of age interval 4.5–5.5 ($1,237). The same placement band would be used for the retirement matrix covering the same placement years of 2005 – 2008. This of course would result in a different OLT and original stub survivor curve than those that were calculated above without the restriction of a placement band.

Analysts often use placement bands for comparing the survivor characteristics of properties with different physical characteristics.[182] Placement bands allow analysts to isolate the effects of changes in technology and materials that occur in successive generations of plant. For example, if in 2005 an electric utility began placing transmission poles with a special chemical treatment that extended the service lives of the poles, an analyst could use placement bands to isolate and analyze the effect of that change in the property group's physical characteristics. While placement

[182] Wolf *supra* n. 105, at 182.

bands are very useful in depreciation analysis, they also possess an intrinsic dilemma. A fundamental characteristic of placement bands is that they yield fairly complete survivor curves for older vintages. However, with newer vintages, which are arguably more valuable for forecasting, placement bands yield shorter survivor curves. Longer "stub" curves are considered more valuable for forecasting average life. Thus, an analyst must select a band width broad enough to provide confidence in the reliability of the resulting curve fit, yet narrow enough so that an emerging trend may be observed.[183]

Analysts also use "experience bands." Experience bands show the composite retirement history for all vintages during a select set of activity years. The figure below shows the same data presented in the previous exposure matrices, except that the experience band from 2011 – 2013 is isolated, resulting in different interval totals.

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[183] NARUC *supra* n. 106, at 114.

**Figure 34:
Experience Bands**

| | Experience Years<br>Exposures at January 1 of Each Year (Dollars in 000's) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Placement Years | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | Total at Start of Age Interval | Age Interval |
| 2003 | 261 | 245 | 228 | 211 | 192 | 173 | 152 | 131 | | 11.5 - 12.5 |
| 2004 | 267 | 252 | 236 | 220 | 202 | 184 | 165 | 145 | | 10.5 - 11.5 |
| 2005 | 304 | 291 | 277 | 263 | 248 | 232 | 216 | 198 | 173 | 9.5 - 10.5 |
| 2006 | 345 | 334 | 322 | 310 | 298 | 284 | 270 | 255 | 376 | 8.5 - 9.5 |
| 2007 | 367 | 357 | 347 | 335 | 324 | 312 | 299 | 286 | 645 | 7.5 - 8.5 |
| 2008 | 375 | 366 | 357 | 347 | 336 | 325 | 314 | 302 | 752 | 6.5 - 7.5 |
| 2009 | | 377 | 366 | 356 | 346 | 336 | 327 | 319 | 872 | 5.5 - 6.5 |
| 2010 | | | 381 | 369 | 358 | 347 | 336 | 327 | 959 | 4.5 - 5.5 |
| 2011 | | | | 386 | 372 | 359 | 346 | 334 | 1,008 | 3.5 – 4.5 |
| 2012 | | | | | 395 | 380 | 366 | 352 | 1,039 | 2.5 – 3.5 |
| 2013 | | | | | | 401 | 385 | 370 | 1,072 | 1.5 - 2.5 |
| 2014 | | | | | | | 410 | 393 | 1,121 | 0.5 - 1.5 |
| 2015 | | | | | | | | 416 | 1,182 | 0.0 - 0.5 |
| Total | 1919 | 2222 | 2514 | 2796 | 3070 | 3333 | 3586 | 3827 | 9,199 | |

The shaded cells within the experience band equal the total exposures at the beginning of age interval 4.5–5.5 ($1,237). The same experience band would be used for the retirement matrix covering the same experience years of 2011 – 2013. This of course would result in a different OLT and original stub survivor than if the band had not been used. Analysts often use experience bands to isolate and analyze the effects of an operating environment over time.[184] Likewise, the use of experience bands allows analysis of the effects of an unusual environmental event. For example, if an unusually severe ice storm occurred in 2013, destruction from that storm would affect an electric utility's line transformers of all ages. That is, each of the line transformers from each placement year would be affected, including those recently installed in 2012, as well as those installed in 2003. Using experience bands, an analyst could isolate or even eliminate the 2013 experience year from the analysis. In contrast, a placement band would not effectively isolate the

[184] *Id.*

ice storm's effect on life characteristics. Rather, the placement band would show an unusually large rate of retirement during 2013, making it more difficult to accurately fit the data with a smooth Iowa curve. Experience bands tend to yield the most complete stub curves for recent bands because they have the greatest number of vintages included. Longer stub curves are better for forecasting. The experience bands, however, may also result in more erratic retirement dispersion making the curve fitting process more difficult.

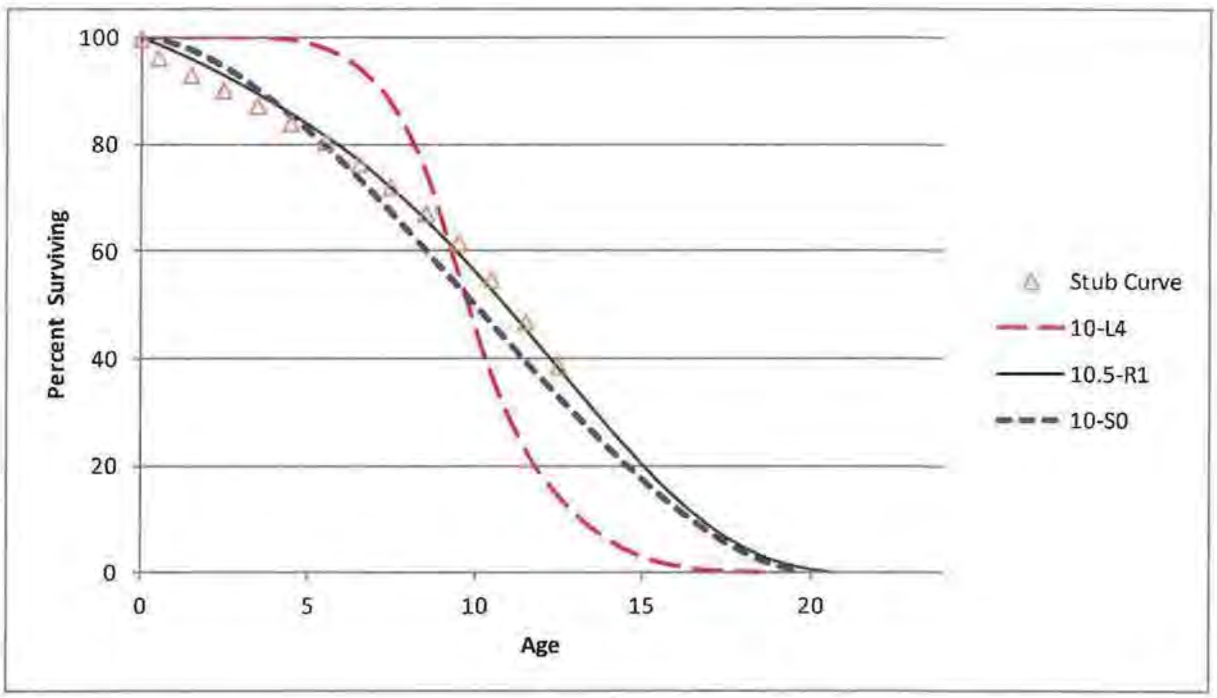
Depreciation analysts must use professional judgment in determining the types of bands to use and the band widths. In practice, analysts may use various combinations of placement and experience bands in order to increase the data sample size, identify trends and changes in life characteristics, and isolate unusual events. Regardless of which bands are used, observed survivor curves in depreciation analysis rarely reach zero percent. This is because, as seen in the OLT above, relatively newer vintage groups have not yet been fully retired at the time the property is studied. An analyst could confine the analysis to older, fully retired vintage groups in order to get complete survivor curves, but such analysis would ignore some the property currently in service and would arguably not provide an accurate description of life characteristics for current plant in service. Because a complete curve is necessary to calculate the average life of the property group, however, curve fitting techniques using Iowa curves or other standardized curves may be employed in order to complete the stub curve.

<u>Curve Fitting</u>

Depreciation analysts typically use the survivor curve rather than the frequency curve to fit the observed stub curves. The most commonly used generalized survivor curves used in the curve fitting process are the Iowa curves discussed above. As Wolf notes, if "the Iowa curves are adopted as a model, an underlying assumption is that the process describing the retirement pattern is one of the 22 [or more] processes described by the Iowa curves."[185]

Curve fitting may be done through visual matching or mathematical matching. In visual curve fitting, the analyst visually examines the plotted data to make an initial judgment about the Iowa curves that may be a good fit. The figure below illustrates the stub survivor curve shown above. It also shows three different Iowa curves: the 10-L4, the 10.5-R1, and the 10-S0. Visually, it is clear that the 10.5-R1 curve is a better fit than the other two curves.

**Figure 35:**
**Visual Curve Fitting**




In mathematical fitting, the least squares method is used to calculate the best fit. This mathematical method would be excessively time consuming if done by hand. With the use of

[185] Wolf *supra* n. 105, at 46 (22 curves includes Winfrey's 18 original curves plus Cowles's four "O" type curves).

modern computer software however, mathematical fitting is an efficient and useful process. The typical logic for a computer program, as well as the software employed for the analysis in this testimony is as follows:

> First (an Iowa curve) curve is arbitrarily selected. . . . If the observed curve is a stub curve, . . . calculate the area under the curve and up to the age at final data point. Call this area the realized life. Then systematically vary the average life of the theoretical survivor curve and calculate its realized life at the age corresponding to the study date. This trial and error procedure ends when you find an average life such that the realized life of the theoretical curve equals the realized life of the observed curve. Call this the average life.
>
> Once the average life is found, calculate the difference between each percent surviving point on the observed survivor curve and the corresponding point on the Iowa curve. Square each difference and sum them. The sum of squares is used as a measure of goodness of fit for that particular Iowa type curve. This procedure is repeated for the remaining 21 Iowa type curves. The "best fit" is declared to be the type of curve that minimizes the sum of differences squared.[186]

Mathematical fitting requires less judgment from the analyst, and is thus less subjective. Blind reliance on mathematical fitting, however, may lead to poor estimates. Thus, analysts should employ both mathematical and visual curve fitting in reaching their final estimates. This way, analysts may utilize the objective nature of mathematical fitting while still employing professional judgment. As Wolf notes: "The results of mathematical curve fitting serve as a guide for the analyst and speed the visual fitting process. But the results of the mathematical fitting should be checked visually and the final determination of the best fit be made by the analyst."[187]

In the graph above, visual fitting was sufficient to determine that the 10.5-R1 Iowa curve was a better fit than the 10-L4 and the 10-S0 curves. Using the sum of least squares method, mathematical fitting confirms the same result. In the chart below, the percentages surviving from

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[186] Wolf *supra* n. 105, at 47.

[187] *Id.* at 48.

the OLT that formed the original stub curve are shown in the left column, while the corresponding percentages surviving for each age interval are shown for the three Iowa curves. The right portion of the chart shows the differences between the points on each Iowa curve and the stub curve. These differences are summed at the bottom. Curve 10.5-R1 is the best fit because the sum of the squared differences for this curve is less than the same sum of the other two curves. Curve 10-L4 is the worst fit, which was also confirmed visually.

**Figure 36:
Mathematical Fitting**

| Age | Stub | Iowa Curves | | | Squared Differences | | |
|---|---|---|---|---|---|---|---|
| Interval | Curve | 10-L4 | 10-S0 | 10.5-R1 | 10-L4 | 10-S0 | 10.5-R1 |
| 0.0 | 100.0 | 100.0 | 100.0 | 100.0 | 0.0 | 0.0 | 0.0 |
| 0.5 | 96.4 | 100.0 | 99.7 | 98.7 | 12.7 | 10.3 | 5.3 |
| 1.5 | 93.2 | 100.0 | 97.7 | 96.0 | 46.1 | 19.8 | 7.6 |
| 2.5 | 90.2 | 100.0 | 94.4 | 92.9 | 96.2 | 18.0 | 7.2 |
| 3.5 | 87.2 | 100.0 | 90.2 | 89.5 | 162.9 | 9.3 | 5.2 |
| 4.5 | 84.0 | 99.5 | 85.3 | 85.7 | 239.9 | 1.6 | 2.9 |
| 5.5 | 80.5 | 97.9 | 79.7 | 81.6 | 301.1 | 0.7 | 1.2 |
| 6.5 | 76.7 | 94.2 | 73.6 | 77.0 | 308.5 | 9.5 | 0.1 |
| 7.5 | 72.3 | 87.6 | 67.1 | 71.8 | 235.2 | 26.5 | 0.2 |
| 8.5 | 67.3 | 75.2 | 60.4 | 66.1 | 62.7 | 48.2 | 1.6 |
| 9.5 | 61.6 | 56.0 | 53.5 | 59.7 | 31.4 | 66.6 | 3.6 |
| 10.5 | 54.9 | 36.8 | 46.5 | 52.9 | 325.4 | 69.6 | 3.9 |
| 11.5 | 47.0 | 23.1 | 39.6 | 45.7 | 572.6 | 54.4 | 1.8 |
| 12.5 | 38.9 | 14.2 | 32.9 | 38.2 | 609.6 | 36.2 | 0.4 |
| SUM | | | | | 3004.2 | 371.0 | 41.0 |