COMMONWEALTH OF MASSACHUSETTS
DEPARTMENT OF PUBLIC UTILITIES

Petition of Boston Gas Company d/b/a National Grid for Approval of an Increase in Base Distribution Rates and Performance-Based Ratemaking Plan for Gas Service Pursuant to General Laws Chapter 164, § 94 and 220 C.M.R. §§ 5.00, *et., seq.*	D.P.U. 20-120

PREFILED DIRECT TESTIMONY AND EXHIBITS OF

DAVID J. GARRETT

ON BEHALF OF THE

MASSACHUSETTS OFFICE OF THE ATTORNEY GENERAL

OFFICE OF RATEPAYER ADVOCACY

MARCH 26, 2021

TABLE OF CONTENTS

APPENDICES

LIST OF EXHIBITS

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. I focus my practice on the primary capital recovery mechanisms for public utility companies: cost of capital and depreciation.

Q. SUMMARIZE YOUR EDUCATIONAL BACKGROUND AND PROFESSIONAL EXPERIENCE.

A. I received a B.B.A. degree with a major in Finance, an M.B.A. degree, and a Juris Doctor degree 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, where 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. In 2016 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]

[1] Exh. AG-DJG-2.

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

A. I am testifying on behalf of the Massachusetts Office of the Attorney General, Office of Ratepayer Advocacy ("AGO") regarding the depreciation study and proposed depreciation rates of Boston Gas Company d/b/a National Grid (the "Company"). I am responding to the Testimony and Exhibits of Ned W. Allis, who sponsored the Company's depreciation study, which proposes annual depreciation accrual rates by account as of December 31, 2019.

II. EXECUTIVE SUMMARY

Q. PLEASE SUMMARIZE THE COMPANY'S PROPOSED DEPRECIATION RATES AND ACCRUAL.

A. In this case, the Company proposes a substantial increase in the annual depreciation accrual in the amount of $29.4 million, or about 15%. This increase is primarily driven by the Company's proposal to significantly reduce the currently-approved service lives of several of its depreciable accounts. The Company claims that the decrease in service lives is necessary to comport with the Commonwealth's decarbonization goals (generally referred to hereinafter as "Net Zero by 2050"). The Company's proposal is based on admitted uncertainties regarding the future of the natural gas industry. What is certain, however, is that if the Company's proposed depreciation rates are adopted, it will have a significant and immediate negative financial impact to customers, with a corresponding increase to the Company's cash flows.

Q. PLEASE SUMMARIZE YOUR PROPOSED DEPRECIATION ADJUSTMENT.

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 to statistically analyze the Company's depreciable assets to develop reasonable depreciation rates in this case. I applied my estimates of average service life and salvage to the Company's plant and reserve balances as of December 31, 2019. The table below compares my proposed depreciation accrual by plant function to the Company's proposal.[2]

Figure 1:
Depreciation Accrual Comparison by Plant Function

Plant Function	Plant Balance 12/31/2019	Company Proposal	AG Proposal	AG Adjustment
Production	199,916,533	5,832,544	5,052,617	(779,927)
Storage	131,283,017	2,774,479	2,390,533	(383,946)
Distribution	5,178,859,057	203,470,702	153,034,361	(50,436,341)
General	100,298,408	5,178,921	5,188,504	9,583
Leak Prone Pipe Program	154,343,262	7,114,661	7,114,660	(1)
Total	$ 5,764,700,277	$ 224,550,439	$ 172,959,807	**$ (51,590,632)**

The original cost and accrual amounts correspond to plant balances as of the depreciation study date—December 31, 2019. As shown in this table, accepting the AGO's proposed

[2] Exh. AG-DJG-3.

depreciation rates would result in an adjustment reducing the Company's proposed depreciation accrual by approximately $51.6 million.

Q. SUMMARIZE THE PRIMARY FACTORS DRIVING AGO'S PROPOSED ADJUSTMENT.

A. I am proposing adjustments to 13 of the Company's accounts. These adjustments include proposing longer average service life estimates than those proposed by Mr. Allis. My service life proposals are based on the observed retirements rates of the Company's plant accounts as indicated by the Company's own historical retirement data. The following table compares my proposed service lives, depreciation rates, and accrual amounts with those proposed by Mr. Allis for the accounts at issue.

Figure 2:
Depreciation Accrual Comparison by Plant Function

		Company's Position				AG's Position			
Account		Iowa Curve		Depr	Annual	Iowa Curve		Depr	Annual
No.	Description	Type	AL	Rate	Accrual	Type	AL	Rate	Accrual
	PRODUCTION PLANT								
320.17	OTHER EQUIPMENT - LNG	S2.5 -	35	3.23%	2,993,048	R2.5 -	44	2.48%	2,295,467
320.18	OTHER EQUIPMENT	S2.5 -	35	2.70%	385,052	R2.5 -	44	2.13%	303,844
	STORAGE PLANT								
361.03	STRUCTURES AND IMPROVEMENTS	S1.5 -	45	4.04%	38,023	S1.5 -	54	2.73%	25,690
361.07	STRUCTURES AND IMPROVEMENTS - LNG	S1.5 -	45	2.16%	2,348,433	S1.5 -	54	1.82%	1,983,773
361.08	STRUCTURES AND IMPROVEMENTS - LNG TANKS	S1.5 -	45	2.53%	37,185	S1.5 -	54	2.03%	29,894
	DISTRIBUTION PLANT								
367.12	MAINS - PLASTIC	R3 -	55	3.52%	87,311,826	S1.5 -	70	2.63%	65,227,703
367.13	MAINS - DISCONNECTED AND RECONNECTED	R3 -	55	3.30%	109,929	S1.5 -	70	2.59%	86,161
367.14	MAINS - STEEL	R3 -	55	3.86%	24,082,804	S1.5 -	70	2.68%	16,712,751
367.15	MAINS - CAST IRON	R3 -	55	12.54%	663,956	S1.5 -	70	2.78%	147,444
369.00	MEASURING AND REGULATING STATION EQUIPMENT	R3 -	45	4.04%	4,648,308	R3 -	55	2.88%	3,307,519
369.07	M&R STATION EQUIPMENT - COMMERCIAL POINT	R3 -	45	3.87%	213,452	R3 -	55	2.96%	163,263
380.02	SERVICES - PLASTIC	R3 -	35	4.54%	67,788,210	S1 -	45	3.29%	49,135,878
380.04	SERVICES - STEEL	R3 -	35	2.91%	2,513,567	S1 -	45	2.42%	2,090,580

For each of these accounts, I propose a longer service life than Mr. Allis proposes, which results in adjustments reducing the Company's proposed depreciation rates. These adjustments will be discussed in more detail later in my testimony.[3]

Q. WHY ARE YOUR PROPOSED ADJUSTMENTS IMPORTANT?

A. Average service lives that are too short result in depreciation rates that overestimate the Company's actual depreciation expense. 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 lives of the utility's assets. If depreciation rates are overestimated (i.e., service lives are underestimated), they encourage 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, it provides an incentive for the utility to unnecessarily replace the asset in order to increase rate base, which results in economic waste. Thus, from a public policy perspective, regulators should ensure that assets are not depreciated before the end of their economic useful lives.

[3] *See* Exh. AG-DJG-4.

III. LEGAL STANDARDS

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

A. In *Lindheimer v. Illinois Bell Telephone Co.*, 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."[4] 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.[5] 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.[6]

Thus, the Department of Public Utilities ("Department") 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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[4] *Lindheimer v. Illinois Bell Tel. Co.*, 292 U.S. 151, 167 (1934).

[5] *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."

[6] *Id*., at 169.

Q. CAN YOU DISCUSS WHAT DEPRECIATION SHOULD REPRESENT?

A. Yes. Depreciation should represent an allocated cost of capital to operation, rather than a mechanism to determine loss of value. Although 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.[7] Adoption of this "value concept" would require annual appraisals of extensive utility plant and is thus 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.[8] 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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[7] *See* Frank K. Wolf & W. Chester Fitch, *Depreciation Systems* 71 (Iowa State University Press 1994).

[8] 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.[9]

Thus, the concept of depreciation as "the allocation of cost has proven to be the most useful and most widely used concept."[10]

IV. ANALYTIC METHODS

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

A. I obtained and reviewed all the data that was used to conduct the Company's depreciation study. The depreciation rates that Mr. Allis proposed were developed based on depreciable property recorded as of December 31, 2019. I used the same plant balances to develop my proposed depreciation rates. In developing my proposed service lives, I used the Company's historical plant data to develop observed life tables for each account. I then used empirical survivor curves known as "Iowa curves" to develop remaining life estimates for each adjusted account. The details of this process are further discussed later in my testimony.

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

[10] Wolf *supra* n. 7, at 73.

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

A. The legal standards set forth above do not mandate a specific procedure for conducting 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 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.[11] 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 is 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 Appendix A.

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[11] *See* Wolf *supra* n.7, at 70, 140.

V. SERVICE LIFE ANALYSIS

Q. DESCRIBE THE ACTUARIAL PROCESS THAT 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 to predict how long a group of people will live, depreciation analysts study historical plant data to estimate the average lives of property groups. The most common actuarial method depreciation analysts use 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.[12] 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 OLT, however, must be fitted and smoothed with a complete curve in order to determine the ultimate average life of the group.[13] 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

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[12] 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).

[13] *See* Appendix C for a more detailed discussion of the actuarial analysis used to determine the average lives of grouped industrial property.

"Iowa curves."[14] A more detailed explanation of how the Iowa curves is used in the actuarial analysis of depreciable property is set forth in Appendix C.

I used the aged property data provided by the Company 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 required. 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 curve fitting 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 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

[14] *See* Appendix B for a more detailed discussion of the Iowa curves.

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. Although mathematical curve fitting is important, it may not always yield the optimum result. For example, if there is insufficient historical data in a particular account and the OLT curve derived from that data is relatively short and flat, the mathematically "best" curve may be one with a very long average life, which may not provide the most accurate estimate of service life. However, when there are sufficient data available, mathematical curve fitting can be used as part of an objective service life 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."[15] In accordance with this standard, an analyst may

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[15] Wolf *supra* n.7, at 46.

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 also conducted further analyses that involved fitting Iowa curves to the 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 percent of the "exposures" (i.e., dollars exposed to retirement) and to eliminate the tail end of the curve representing the bottom 1 percent of exposures for some accounts, if necessary. 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. 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. Allis and I primarily rely 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).

Q. DO YOU AGREE WITH THE COMPANY'S PROPOSAL TO ACCELERATE DEPRECIATION RATES IN THIS CASE?

A. No. In this case, the Company essentially requests accelerated depreciation rates for several significant accounts to purportedly account for the Net Zero by 2050 goals. In my experience, utilities often seek to accelerate depreciation rates under a variety of different justifications, often under the pretext of benefiting future customers. The more likely motivation, however, is the desire to increase cash flow and reduce risk for the benefit of shareholders. With those dynamics in mind, the Company's request is not surprising; however, it is also not appropriate. There is no need to drastically accelerate depreciation expense today based on uncertainties in the gas industry ranging several decades in the future. What is not uncertain, however, is that the Company's request would cause a sudden and substantial increase in the rates of current customers, who are suffering from an unprecedented global pandemic. The Company's request to accelerate depreciation rates is premature, is based on unknown and unmeasurable changes ranging decades into the future, and is entirely unfair to current customers.

A. Account 320 – Other Equipment

Q. DESCRIBE YOUR SERVICE LIFE ESTIMATE FOR ACCOUNT 320, OTHER EQUIPMENT, AND COMPARE IT WITH THE COMPANY'S ESTIMATE.

A. The OLT curve for these accounts is shown in the graph below.[16] The graph also shows the Iowa curves that Mr. Allis 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. Allis selected the S2.5-35 Iowa curve, and I selected the R2.5-44 Iowa curve. The average lives resulting from each curve are indicated by the numbers after the dashes (35 and 44 in this case). Both Iowa curves are shown with the OLT curve in the graph below.

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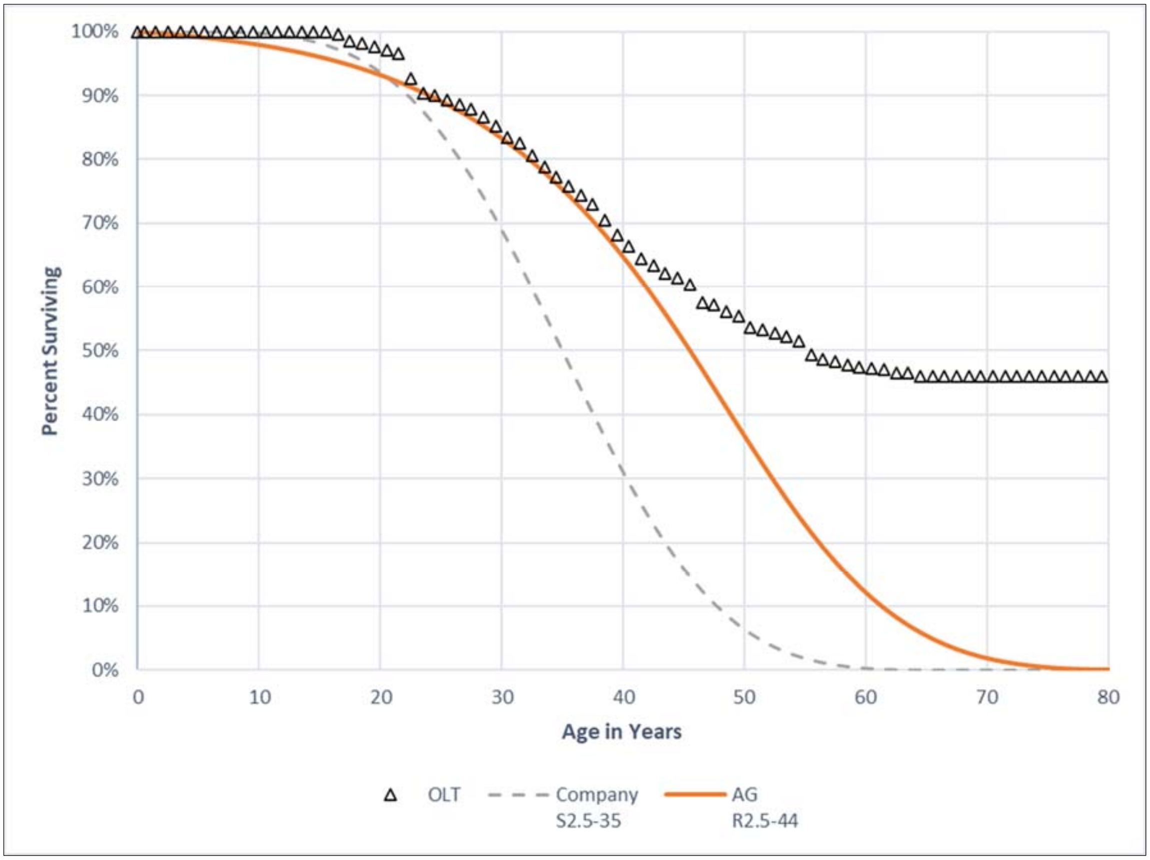
[16] For service life analysis, the depreciation study combined Account 320.17 – Other Equipment – LNG and Account 320.18 – Other Equipment.

Figure 3:
Accounts 320 – Other Equipment

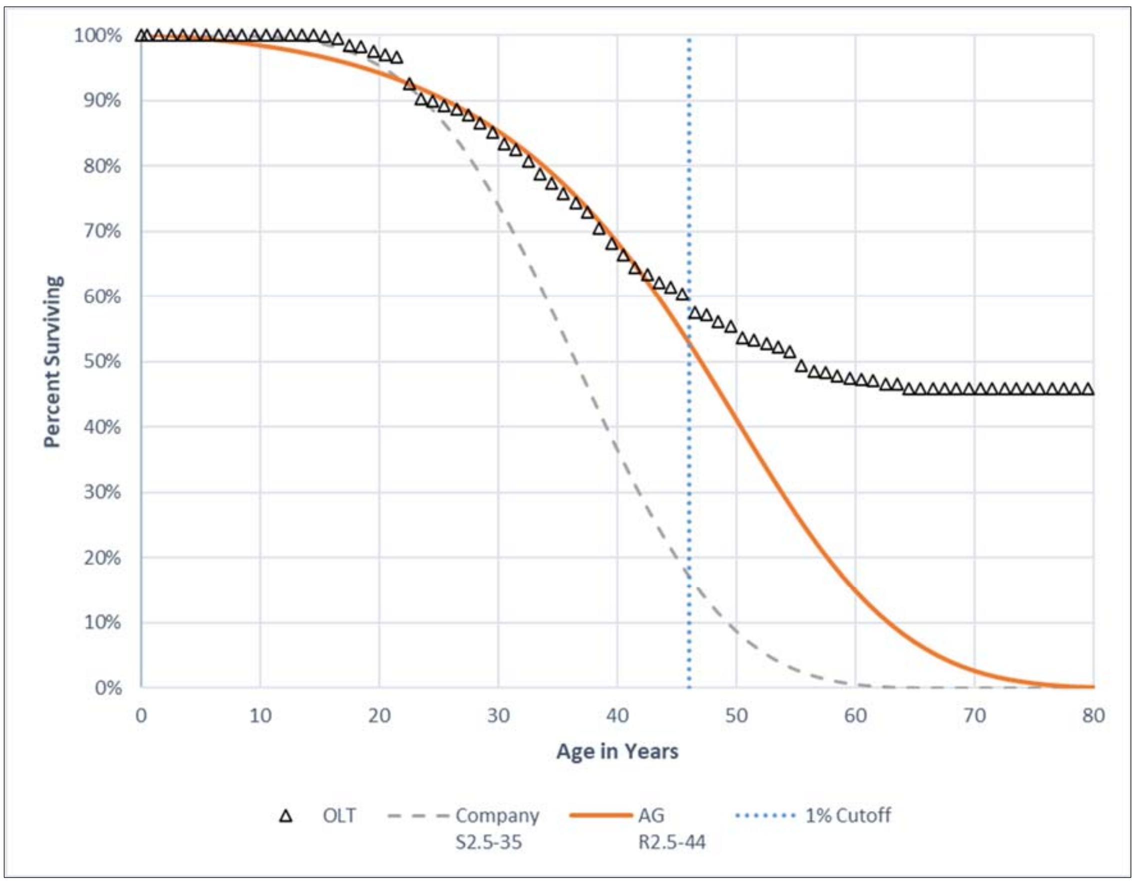


One of the primary purposes of visual and mathematical Iowa curve fitting is to select an Iowa curve that provides a relatively close fit to the historical retirement pattern, as displayed through the OLT curve. As discussed above, the tail-end of some OLT curves may be properly ignored during the curve-fitting process, which is the case for this account. However, the S2.5-35 curve selected by Mr. Allis simply ignores too much of the relevant historical data in this account. As shown in the graph, the S2.5-35 is far too short to provide an accurate fit to the OLT curve. The R2.5-44 curve I selected provides a much closer fit to the observed data, especially when the most relevant portion of the OLT curve is considered, as further discussed below.

Q. PLEASE ILLUSTRATE THE 1% TRUNCATION BENCHMARK FOR THE TAIL END OF THE OLT CURVE FOR THIS ACCOUNT.

A. The graph below is the same as the one shown above, but with the inclusion of the 1% truncation line.

Figure 4:
Accounts 320 – Other Equipment – with 1% Truncation



Based on the 1% truncation benchmark, the data points to the right of the vertical dotted line are statistically much less relevant than the preceding data points on the OLT curve.

With this benchmark in mind, the R2.5-44 curve I selected provides an even better fit to the historical data.

Q. DOES THE IOWA CURVE THAT YOU SELECTED PROVIDE A BETTER MATHEMATICAL FIT TO THE 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. In this account, it is clear from a mere visual inspection that the R2.5-44 curve that I selected provides the closer fit to the historical data. However, we can also confirm this fact mathematically. For this account, the total SSD, or "distance" between the Company's R2.5-35 curve and the relevant portion of the OLT curve is 1.8451. The total SSD between the R2.5-44 curve that I selected and the same portion of the OLT curve is only 0.0465.[17] Thus, the R2.5-44 curve is a better mathematical fit and provides a more reasonable service life estimate and depreciation rate for this account.

[17] Exh. AG-DJG-7.

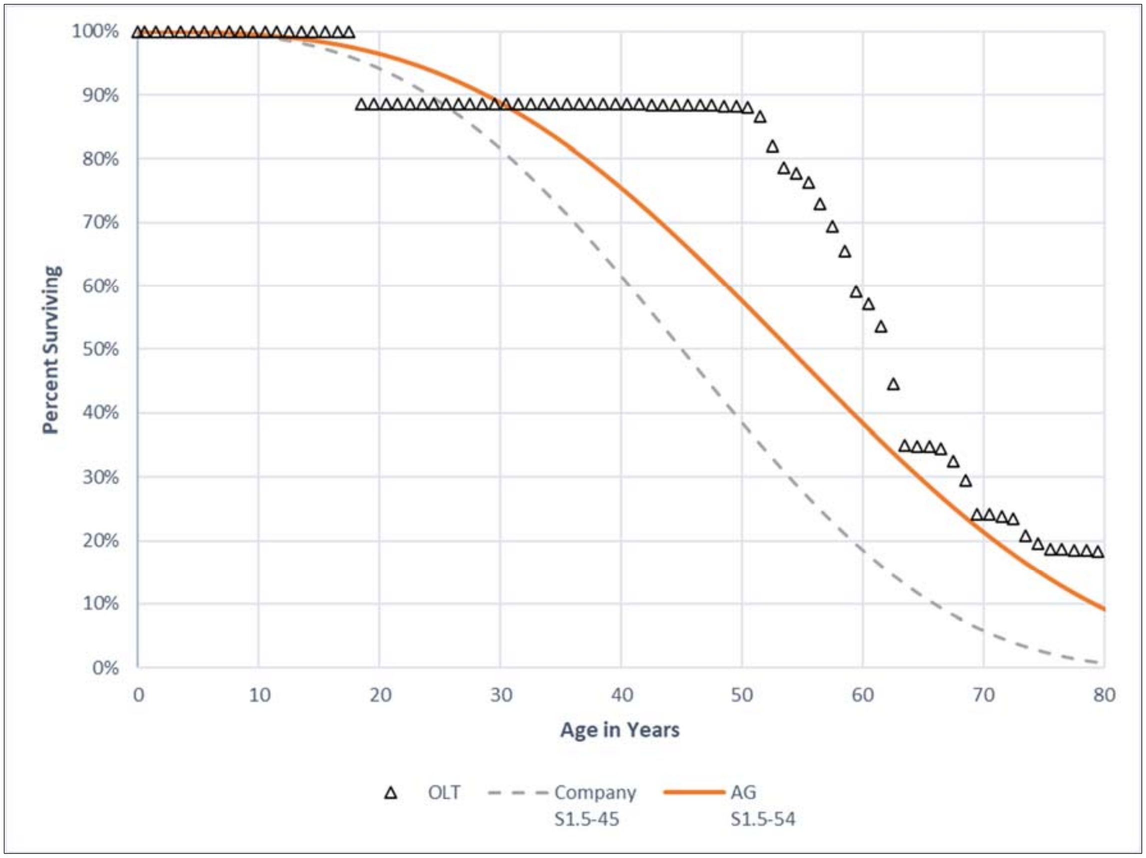
B. Account 361 – Structures and Improvements

Q. DESCRIBE YOUR SERVICE LIFE ESTIMATE FOR ACCOUNT 361, STRUCTURES AND IMPROVEMENTS, AND COMPARE IT WITH THE COMPANY'S ESTIMATE.

A. For this account, Mr. Allis selected the S1.5-45 curve, and I selected the S1.5-54 curve.[18] Thus, both selected Iowa curves have the same shape, but with a nine-year difference in average service life. The graph below shows both Iowa curves juxtaposed with the OLT curve.

[18] For service life analysis, the depreciation study combined Accounts 361.03 – Structures and Improvements, Account 361.07 – Structures and Improvements – LNG, and Account 361.08 – Structures and Improvements – LNG Tanks.

Figure 5:
Account 361 – Structures and Improvements



As with the account discussed above, the Iowa curve chosen by Mr. Allis for this account declines to sharply relative to the relevant data presented in the OLT curve. The S1.5-54 clearly provides a more reasonable fit to the observed data and thus will result in a more reasonable depreciation rate.

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

A. Yes. While it is visually clear in the graph above that the Iowa curve that I selected for this account provides a closer fit to the historical retirement pattern, we can also confirm this fact mathematically. Specifically, the SSD for the Company's curve is 5.2770, and the

SSD for the S1.5-54 curve that I selected is only 1.5025, which means it provides the closer fit to the Company's historical retirement data for this account.[19]

C. <u>Account 367 – Mains</u>

Q. DESCRIBE YOUR SERVICE LIFE ESTIMATE FOR ACCOUNT 367, MAINS, AND COMPARE IT WITH THE COMPANY'S ESTIMATE.

A. For this account, Mr. Allis selected the R3-55 curve, and I selected the S1.5-70 curve.[20] Both curves are shown in the graph below along with the OLT curve.

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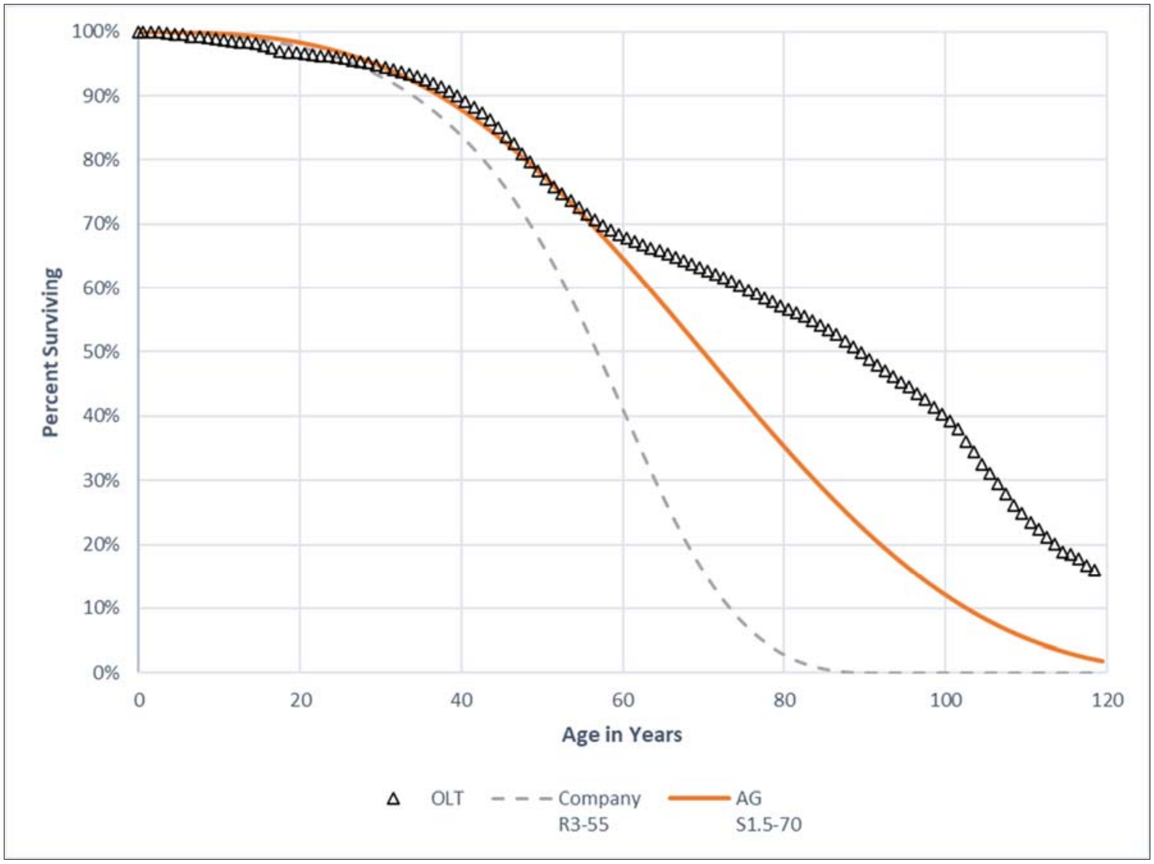
[19] Exh. AG-DJG-8.

[20] For service life analysis, the depreciation study combined Account 367.12 – Mains – Plastic, Account 367.13 – Mains – Disconnected and Reconnected, Account 367.14 – Mains – Steel, and Account 367.15 – Mains – Cast Iron.

Figure 6:
Account 367 – Mains



For this account, the OLT curve is relatively smooth and complete (approaches 0% surviving), which makes it relatively ideal for Iowa curve fitting. As with the accounts discussed above, it is immediately clear from a visual perspective that the Company's selected Iowa curve is far too short given the historical retirement pattern observed in the OLT curve. Accordingly, the Company's selected Iowa curve results in an unreasonable and excessively high depreciation rate proposal. Given the nature and pattern of Iowa curves, there is no Iowa curve that could perfectly match this particular OLT curve, and even if there were, it would run the risk of having an average life that is too long given those observed in the industry. Specifically, around the 55-year age interval, the OLT curve in this account decreases at a lesser rate than the preceding age intervals. It is around this point in which the S1.5-70 curve I selected begins to deviate more notably from the OLT curve. However, the 1% truncation benchmark for this OLT curve indicates that data points up to the 95-year age interval are statistically relevant. With this in mind, the S1.5-70 curve that I selected is quite reasonable and conservative. The S1.5-curve represents a good balance between mathematical curve fitting and professional judgement, especially considering the fact that longer Iowa curves would provide an even closer fit from a pure mathematical perspective. In addition, a 70-year average life is currently approved for this account.

Q. DOES THE IOWA CURVE THAT YOU SELECTED FOR THIS ACCOUNT RESULT IN A BETTER MATHEMATICAL FIT TO THE OLT CURVE THAN THE IOWA CURVE SELECTED BY THE COMPANY?

A. Yes. The SSD for the Company's curve is 10.7677, while the SSD for the S1.5-70 curve I selected is only 2.5957.[21]

[21] Exh. AG-DJG-9.

D. Account 369 – Measuring and Regulating Station Equipment

Q. DESCRIBE THE COMPANY'S SERVICE LIFE ESTIMATE FOR ACCOUNT 369, MEASURING AND REGULATING STATION EQUIPMENT, AND COMPARE IT WITH THE COMPANY'S ESTIMATE.

A. For Account 369, Measuring and Regulating Station Equipment, Mr. Allis proposes an R3-45 curve, and I propose an R3-55 curve.[22] Both curves are shown in the graph below along with the OLT curve, including the 1% truncation line.

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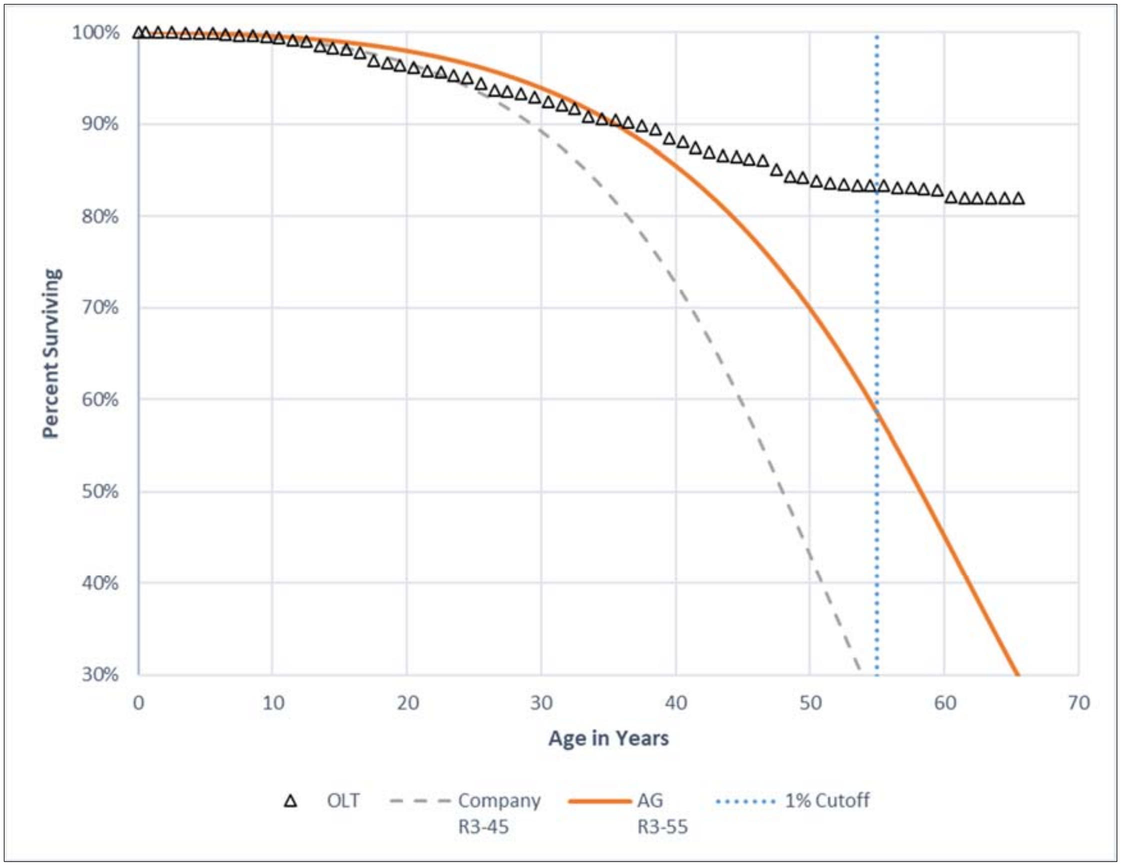
[22] For service life analysis, the depreciation study combined Account 369 – Measuring and Regulating Station Equipment and Account 369.07 – Measuring and Regulating Station Equipment – Commercial Point.

Figure 7:
Account 369 – Measuring and Regulating Station Equipment



As with the accounts discussed above, the Company's Iowa curve is far too short given the historical retirement pattern presented in the OLT curve. As with Account 367 discussed above, even the curve that I selected for Account 369 is not the mathematically best fitting curve. Instead, I used a combination of mathematical curve fitting techniques along with professional judgment to arrive at the R3-55 Iowa curve. As illustrated in the graph, the R3-55 curve provides a very good fit throughout the majority of the OLT curve. While a longer, flatter curve might provide a better mathematical fit, such curve might run the risk of being too long to be considered reasonable, especially given the fact that the OLT curve for this account does not have a substantial amount of retirement history (i.e., a curve that approaches lower percentages surviving). In addition, a 55-year average life is equal to the currently-approved life for this account. Again, there is some evidence to support a longer curve than 55 years, but no convincing evidence to support a curve that is shorter than 55-years, especially one as short as the R3-45 curve that the Company proposes.

Q. DOES THE IOWA CURVE THAT YOU SELECTED FOR THIS ACCOUNT RESULT IN A BETTER MATHEMATICAL FIT TO THE OLT CURVE THAN THE IOWA CURVE SELECTED BY THE COMPANY?

A. Yes. The SSD for the Company's curve is 8.4985, while the SSD for the R3-55 curve that I selected is only 2.4826.[23]

E. Account 380 – Services

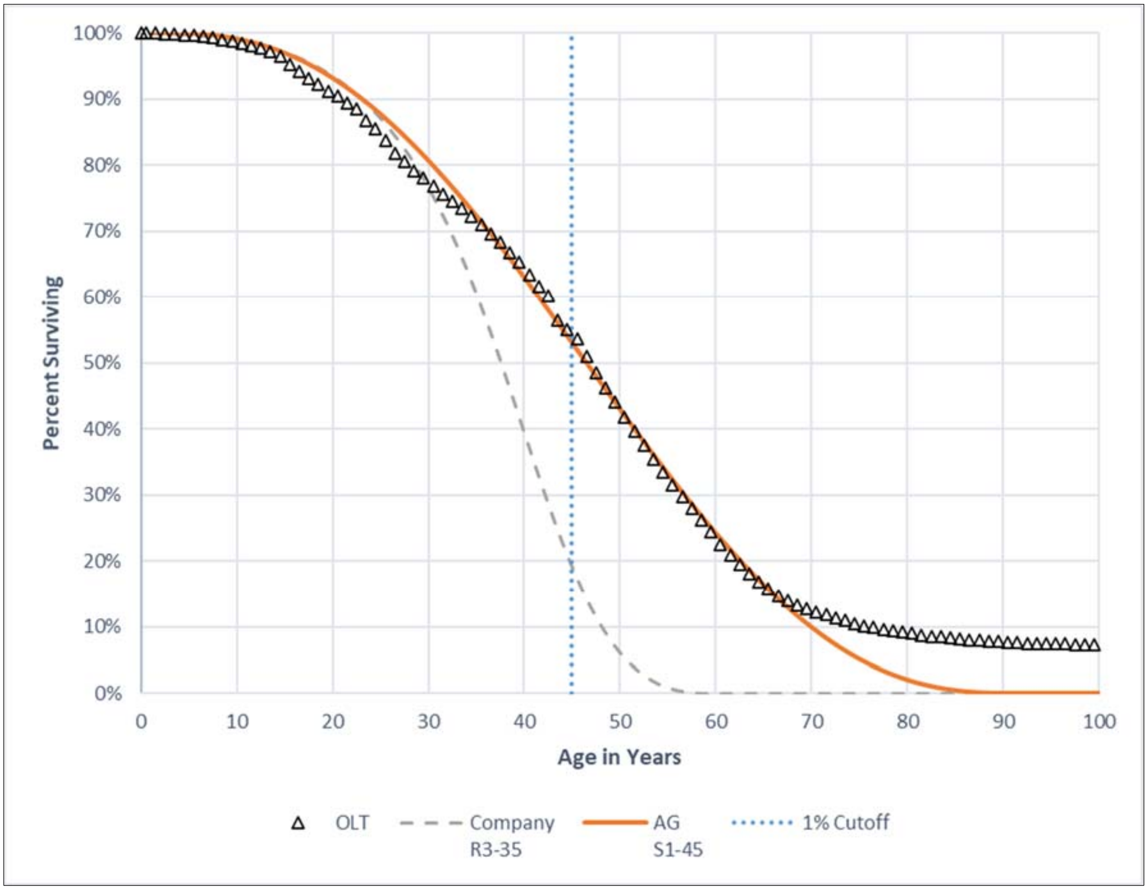
Q. DESCRIBE THE COMPANY'S SERVICE LIFE ESTIMATE FOR ACCOUNT 380, SERVICES, AND COMPARE IT WITH THE COMPANY'S ESTIMATE.

A. For Account 380, Services, Mr. Allis proposes the R3-35 curve, and I propose the S1-45 curve.[24] Both curves are shown in the graph below along with the OLT curve, including the 1% truncation line.

[23] Exh. AG-DJG-10.

[24] For service life analysis, the depreciation study combined Account 380.02 – Services – Plastic and Account 380.04 – Services – Steel.

Figure 8:
Account 380 – Services



As with the accounts discussed above, the Company's Iowa curve is far too short given the historical retirement pattern presented in the OLT curve. By contrast, the S1-45 curve that I selected clearly provides a close fit throughout the relevant portions of the OLT curve. As a result, the corresponding depreciation rate for the S1-45 curve is much more reasonable and accurate than the rate that the Company proposes.

Q. DOES THE IOWA CURVE THAT YOU SELECTED FOR THIS ACCOUNT RESULT IN A BETTER MATHEMATICAL FIT TO THE OLT CURVE THAN THE IOWA CURVE SELECTED BY THE COMPANY?

A. Yes. The SSD for the Company's curve is 3.4853, while the SSD for the S1-45 curve I selected is only 0.2738.[25]

Q. DOES THIS CONCLUDE YOUR TESTIMONY?

A. Yes.

[25] Exhibit AG-DJG-11.

APPENDIX A:

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.[26] 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 <u>method</u> of allocation; 2) a <u>procedure</u> for applying the method of allocation to a group of property; 3) a <u>technique</u> for applying the depreciation rate; and 4) a <u>model</u> for analyzing the characteristics of vintage groups comprising a continuous property group.[27] The figure below illustrates the basic concept of a depreciation system and includes some of the available parameters.[28]

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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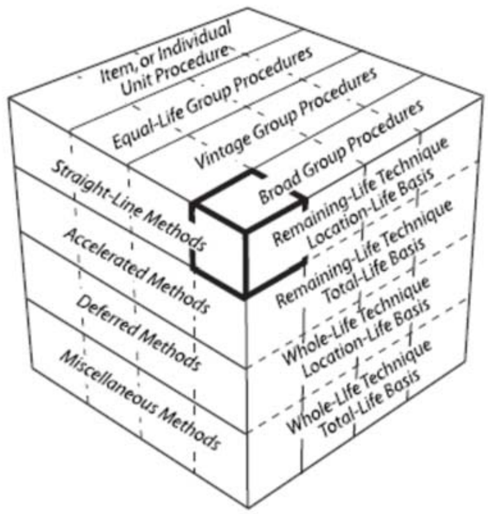
[26] Wolf *supra* n.7, at 69–70.

[27] *Id.* at 70, 139–40.

[28] 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 because depreciation analysis is a relatively small and fragmented field. This diagram simply illustrates some of the available parameters of a depreciation system.

Figure 9:
The Depreciation System Cube



1. <u>Allocation Methods</u>

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.[29] 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.[30] The basic formula for the straight-line method is as follows:[31]

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[29] NARUC *supra* n.8, at 56.

[30] *Id*.

[31] *Id*.

Equation 1:
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 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.[32] In practice, the annual accrual is expressed as a rate which is applied to the original cost of plant to determine the annual accrual in dollars. The formula for determining the straight-line rate is as follows:[33]

Equation 2:
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.[34] While single units may be analyzed for depreciation, a group plan of depreciation is particularly adaptable to utility property. Employing a grouping procedure allows

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[32] *Id*. at 57.

[33] *Id*. at 56.

[34] Wolf *supra* n.7, at 74–75.

for a composite application of depreciation rates to groups of similar property, rather than 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.[35] 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.[36]

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.[37] 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.[38] Under the equal life procedure the property is divided into subgroups that each has a common life.[39]

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[35] *Id*. at 74.

[36] NARUC *supra* n.8, at 61–62.

[37] *See* Wolf *supr*a n.7, at 74–75.

[38] *Id*. at 75.

[39] *Id*.

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 remaining life technique seeks to recover undepreciated costs over the remaining life of the plant.[40]

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.[41] 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.[42] 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.

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[40] NARUC *supra* n.8, at 63–64.

[41] Wolf *supra* n.7, at 83.

[42] NARUC *supra* n.8, at 325.

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 in the annual accrual.[43] 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:[44]

Equation 3:
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.[45]

4. <u>Analysis Model</u>

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[43] NARUC *supra* n. 8, 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.").

[44] *Id*. at 64.

[45] Wolf *supra* n.7, at 178.

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.[46] 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 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 form a continuous property group.

The broad group model views the continuous property group as a collection of vintage groups that each have 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.

[46] *See* Wolf *supra* n.7, at 139 (I added the term "model" to distinguish this fourth depreciation system parameter from the other three parameters).

APPENDIX B:

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.[47] This history 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.[48] 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. <u>Development</u>

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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[47] Wolf *supra* n.7, at 276.

[48] *Id*. at 23.

representing the life characteristics of each group of property.[49] 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.[50] This research 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."[51] 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 Appendix C.)

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

[49] *Id*. at 34.

[50] *Id*.

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

intervals.[52] Rather than using the original formulas, analysts typically rely on the published tables containing the percentages surviving. This reliance is necessary because, absent knowledge of the integration 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:[53]

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

[52] 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.7, at 305–38 (publishing the percent surviving for each Iowa curve, including "O" type curve, at one percent intervals).

[53] *See* Wolf *supra* n.7, at 37.

time, the underlying patterns of retirements remain constant and can be adequately described by the Iowa curves.[54]

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 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.

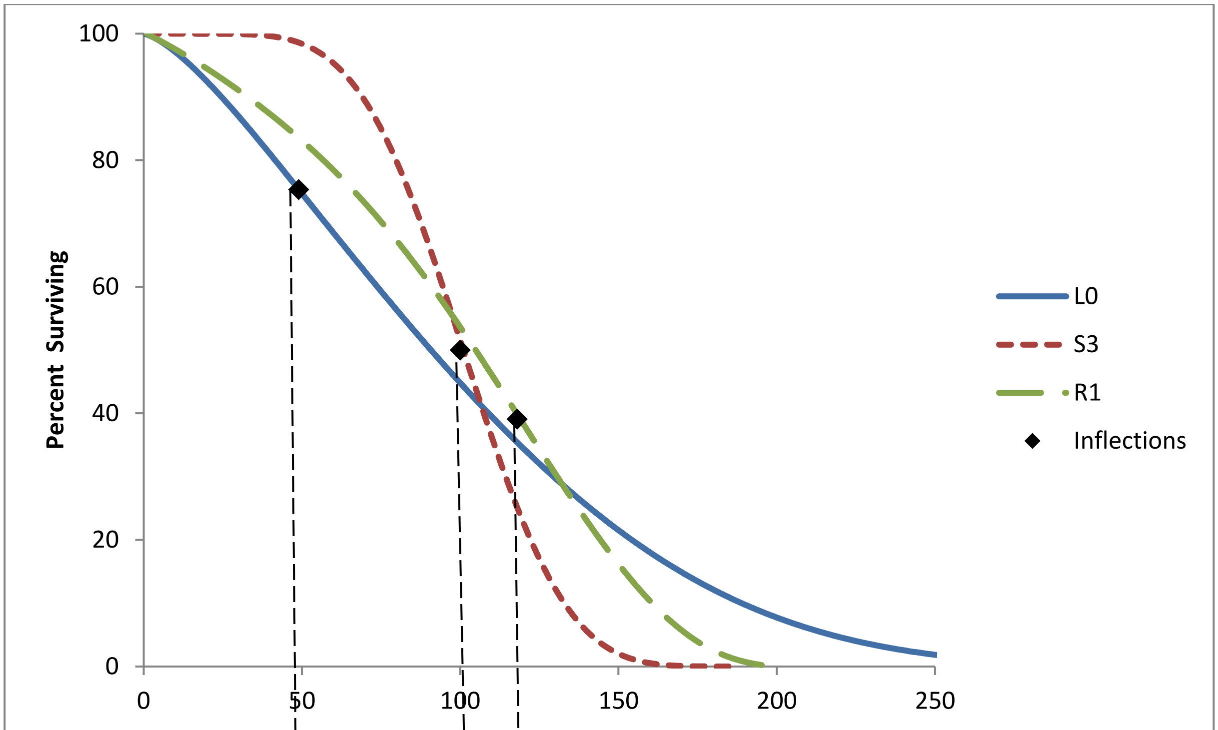
The classification of the survivor curves was made according to whether the mode of the retirement frequency curves was to the left, to the right, or coincident with average service life. There are three modal "families" of curves: six left modal curves (L0, L1, L2, L3, L4, L5); five right modal curves (R1, R2, R3, R4, R5); and seven symmetrical curves (S0, S1, S2, S3, S4, S5,

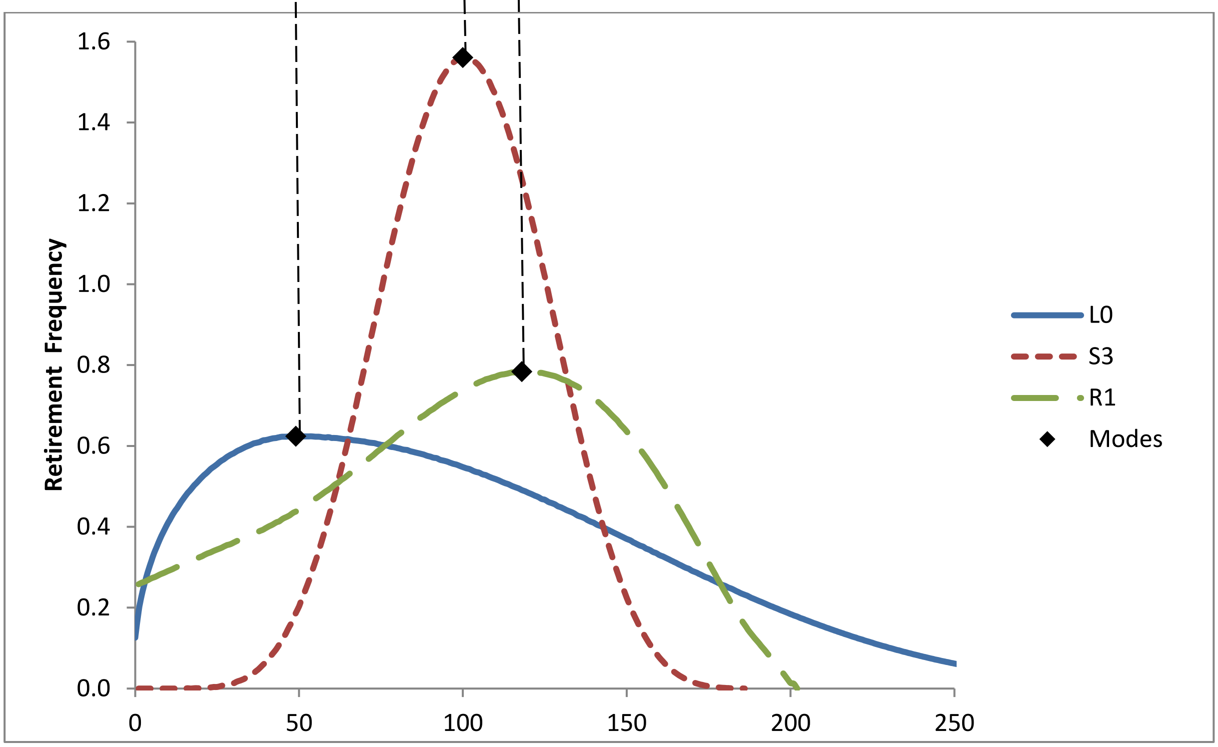
[54] *Id*.

S6).[55] 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.

[55] 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.8, at 68).

Figure 10:
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 design was necessary 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."[56]

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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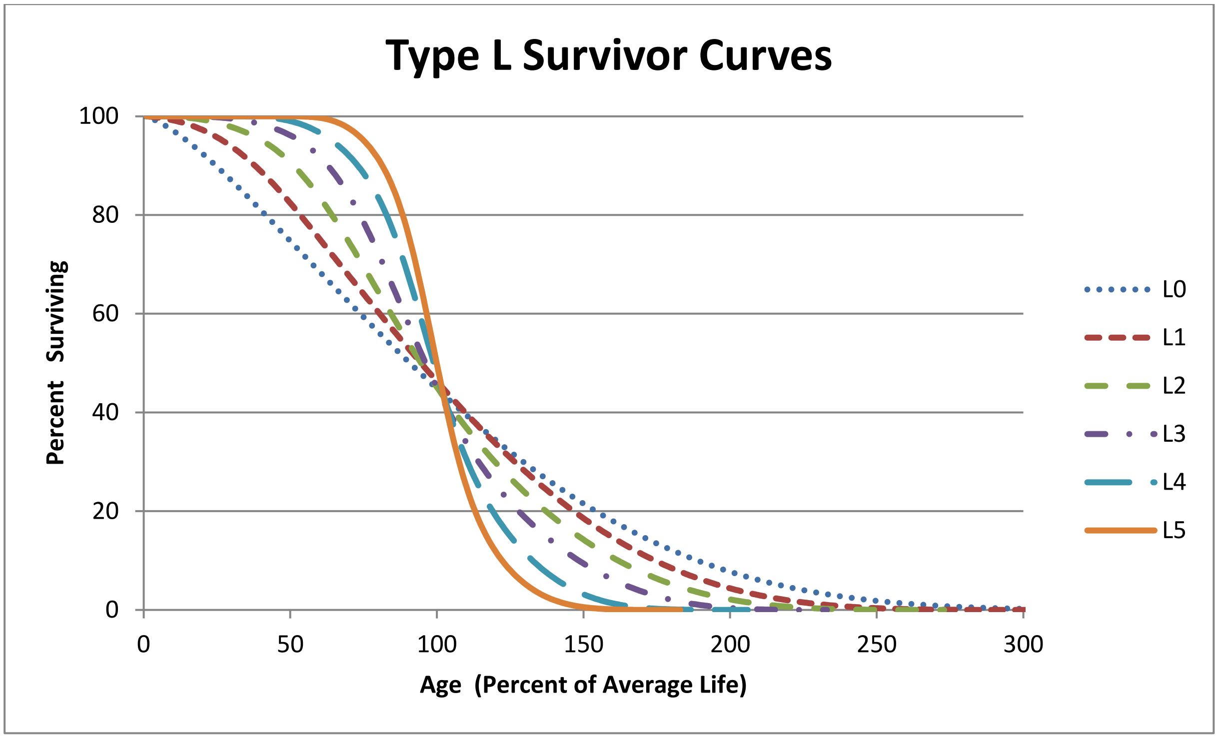
[56] Winfrey *supra* n. 75, at 60.

Figure 11:
Type L Survivor and Frequency Curves



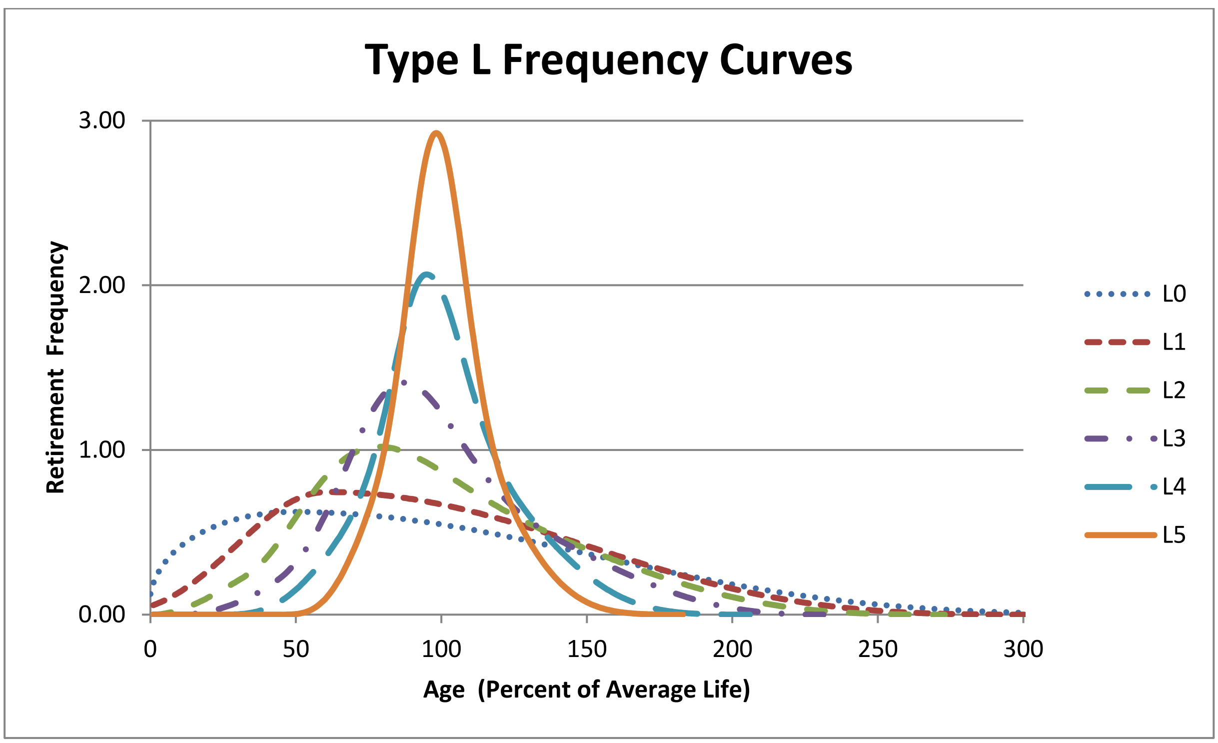
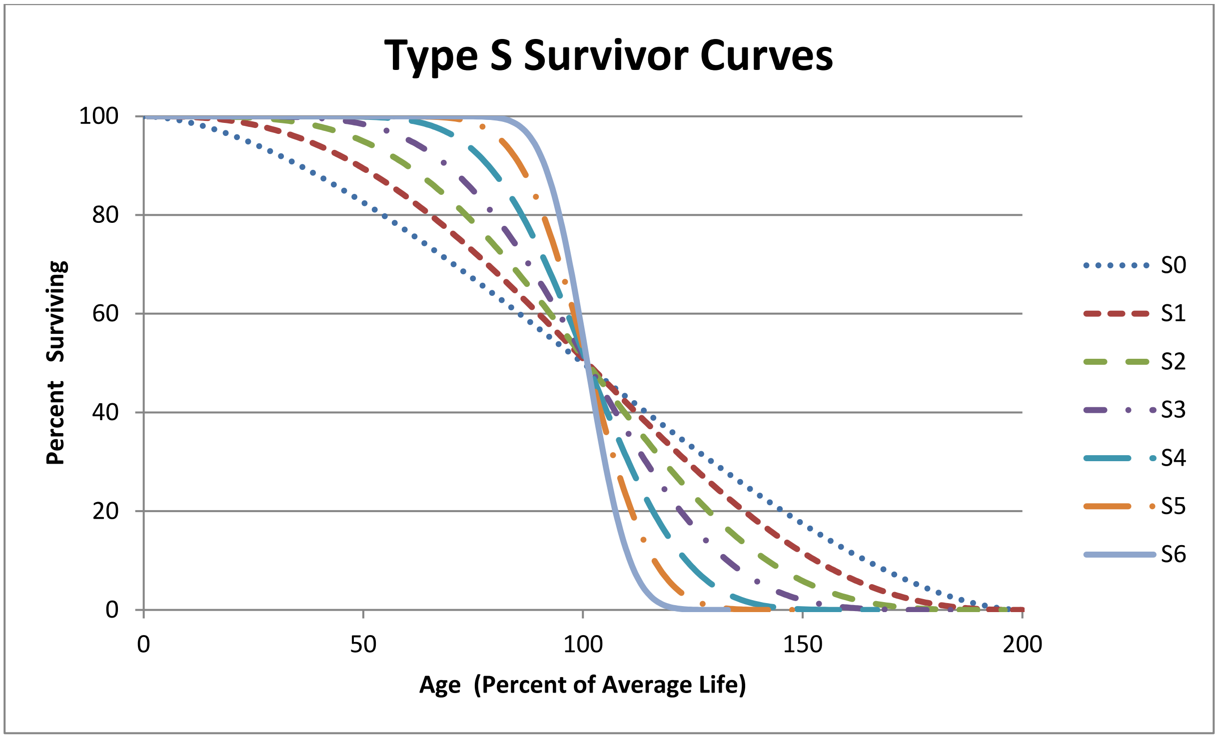


Figure 12:
Type S Survivor and Frequency Curves



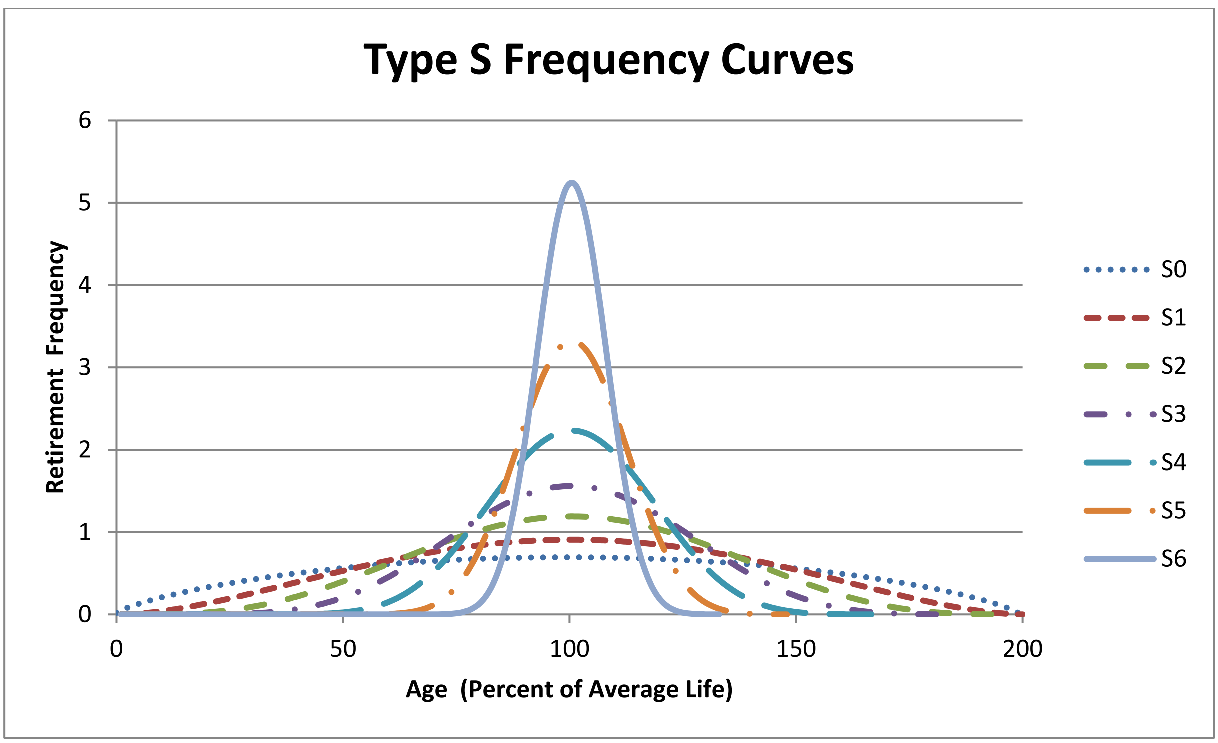
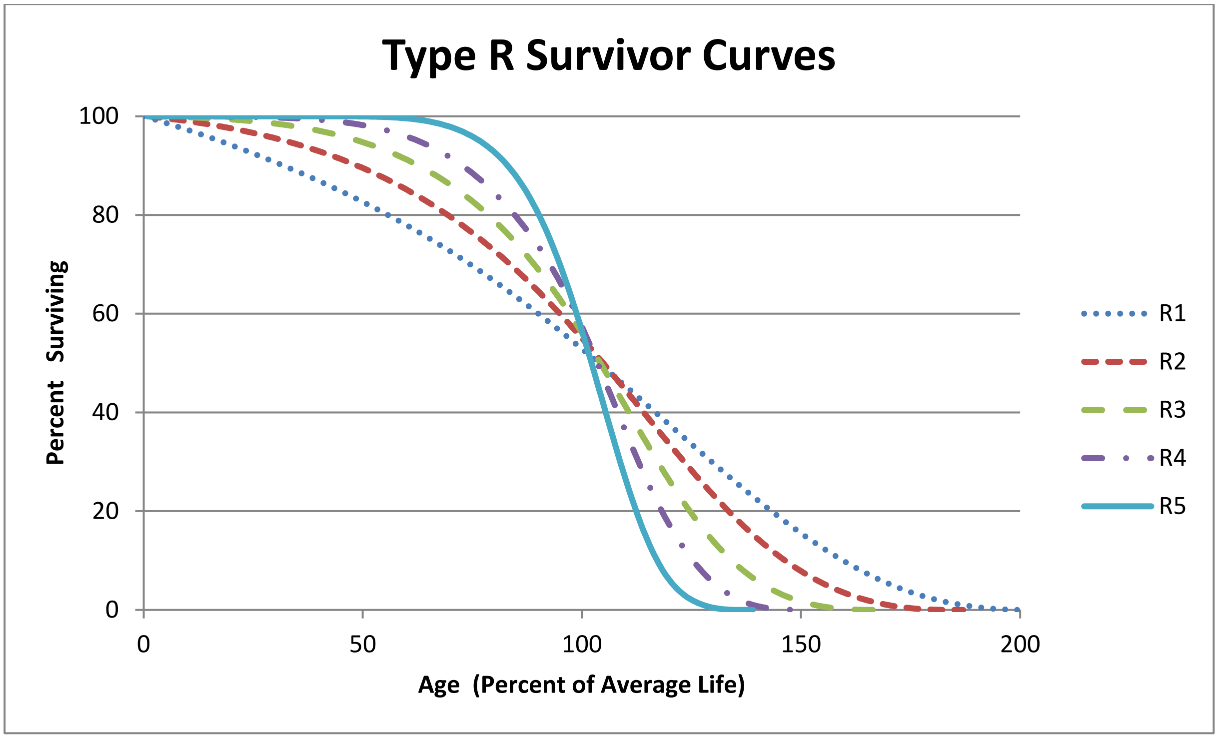
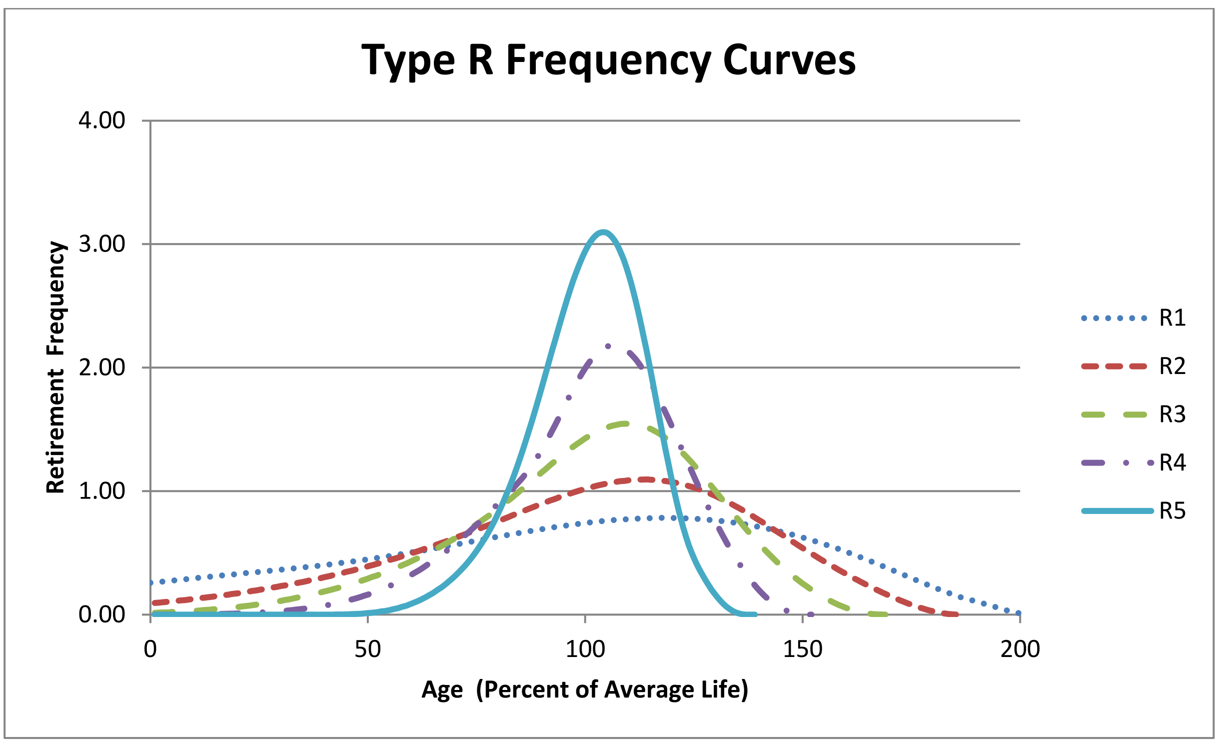


Figure 13:
Type R Survivor and Frequency Curves





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.[57]

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:[58]

Equation 4:
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 dynamic results in a "stub"

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[57] 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.

[58] *See* NARUC *supra* n.8, at 71.

survivor curve. Iowa curves are used to extend stub curves to maximum life in order to make the average life calculation (see Appendix C).

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.[59] 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.[60] 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 portion of the survivor curve is divided by the percent surviving at age x (denoted S_X). Thus, the average remaining life formula is:

Equation 5:
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 to calculate the annual accrual under the remaining life technique.

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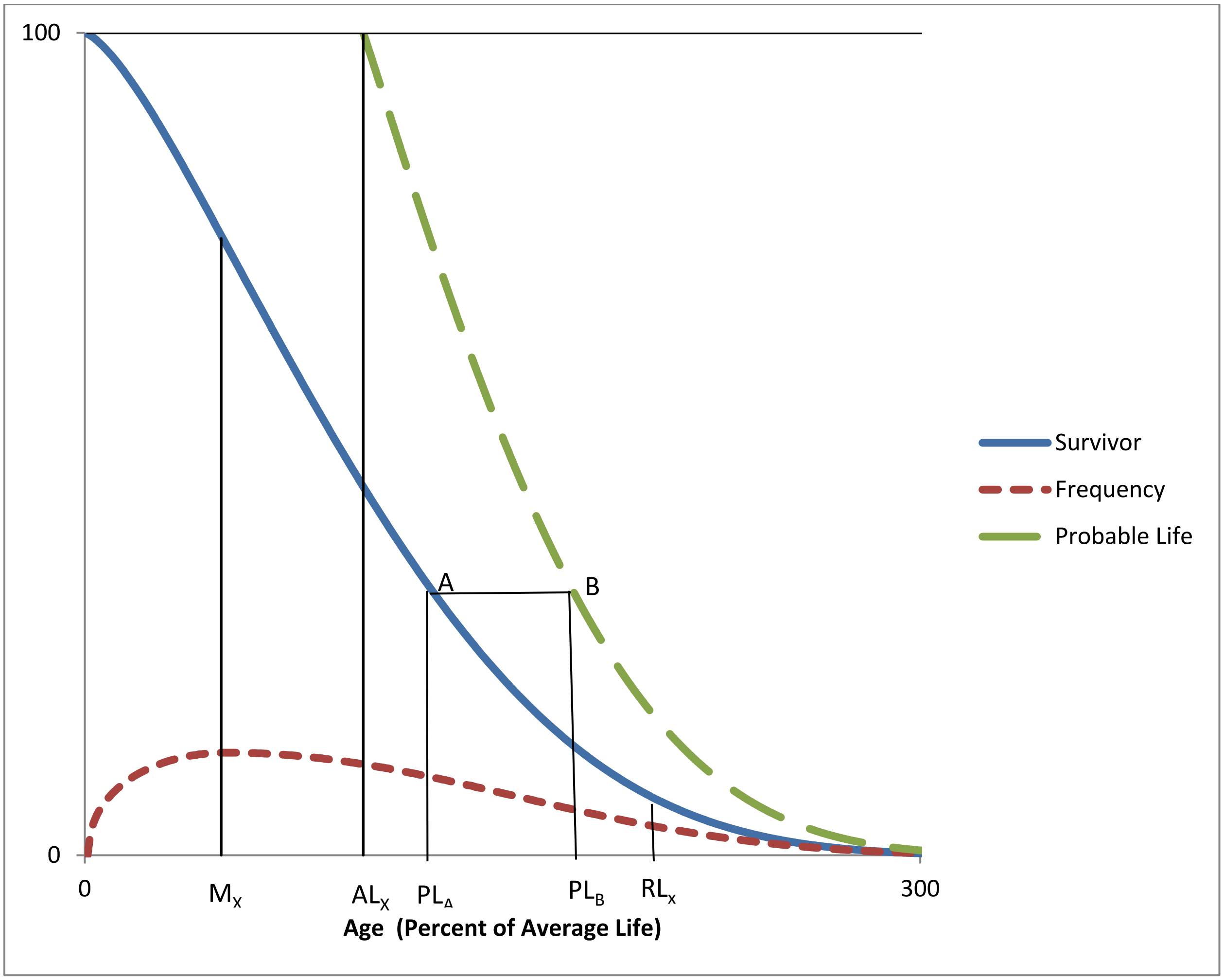
[59] *Id*. at 73.

[60] *Id*. at 74.

Figure 14:
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.[61] The probable life is also illustrated in this figure. The

[61] Wolf *supra* n.7, at 28.

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 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 connection occurs because at age zero, probable life equals average life.

APPENDIX C:

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 today will live. Insurance companies rely on 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.[62]

Figure 15:
Forces of Retirement

Physical Factors	Functional Factors	Contingent Factors
Wear and tear Decay or deterioration Action of the elements	Inadequacy Obsolescence Changes in technology Regulations Managerial discretion	Casualties or disasters 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

[62] NARUC *supra* n.8, at 14–15.

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 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.[63] 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 to calculate observed survivor curves for property groups. Of these methods, the retirement rate method is superior, and is widely employed by depreciation analysts.[64] The retirement rate method is ultimately used to develop an observed survivor curve, which can be fitted with an Iowa curve discussed in Appendix B 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 into service 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

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[63] *Id*. at 112–13.

[64] Anson Marston, Robley Winfrey & Jean C. Hempstead, *Engineering Valuation and Depreciation* 154 (2nd ed., McGraw-Hill Book Company, Inc. 1953).

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, which shows the exposures at the beginning of each year.[65] 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 2012 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 were retired during 2012.

[65] 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 accounting period is called an "exposure" rather than an addition.

Figure 16:
Exposure Matrix

Placement Years	Experience Years Exposures at January 1 of Each Year (Dollars in 000's) 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	

Figure 17:
Retirement Matrix

Placement Years	Experience Years Retirments During the Year (Dollars in 000's) 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.[66] 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

[66] Wolf *supra* n.7, at 22.

was calculated by adding the numbers shown on the “stairs” to the left (192+184+216+255=847). 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 at the beginning of 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 18:
Observed Life Table

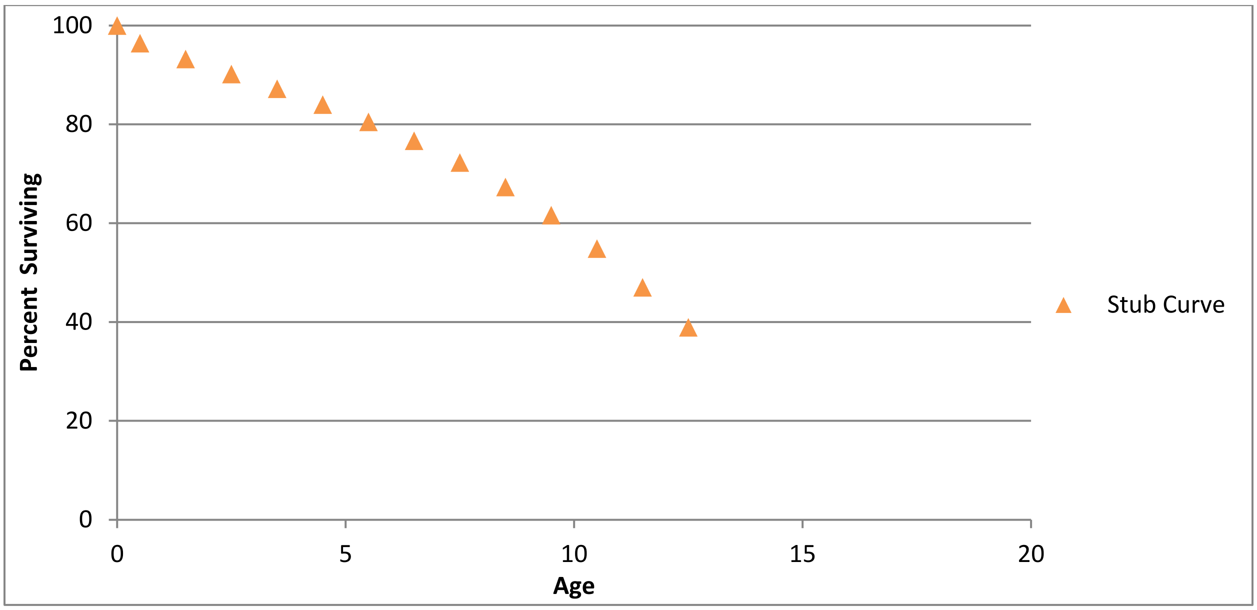
Age at Start of Interval	Exposures at Start of Age Interval	Retirements During Age Interval	Retirement Ratio	Survivor Ratio	Percent Surviving at Start of Age Interval
A	B	C	D = C / B	E = 1 - D	F
0.0	3,141	112	0.036	0.964	**100.00**
0.5	2,998	100	0.033	0.967	**96.43**
1.5	2,866	93	0.032	0.968	**93.21**
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 percent 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 percent, which was calculated by multiplying the percent surviving for age interval 0.5 (96.43 percent) by the survivor ratio for age interval 0.5 (0.967)[67].

[67] Multiplying 96.43 by 0.967 does not equal 93.21 exactly due to rounding.

The percentages surviving in Column F are the numbers that are used to form the original survivor curve. This particular curve starts at 100 percent surviving and ends at 38.91 percent surviving. An 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 above.

Figure 19:
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.[68] 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.[69]

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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[68] NARUC *supra* n.8, at 113.

[69] *Id*.

Figure 20:
Placement Bands

	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		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 use 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.[70] 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 into service with a special chemical treatment that extended the service lives of those poles, an analyst could use placement bands to

[70] Wolf *supra* n.7, at 182.

isolate and analyze the effect of that change in the property group's physical characteristics. While placement 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.[71]

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.

[71] NARUC *supra* n.8, at 114.

Figure 21:
Experience Bands

Placement Years	Experience Years Exposures at January 1 of Each Year (Dollars in 000's) 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 use 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.[72] 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

[72] *Id.*

experience year from the analysis. In contrast, a placement band would not effectively isolate the 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. They rarely reach zero percent 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 to get complete survivor curves, but such analysis would ignore some of 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.

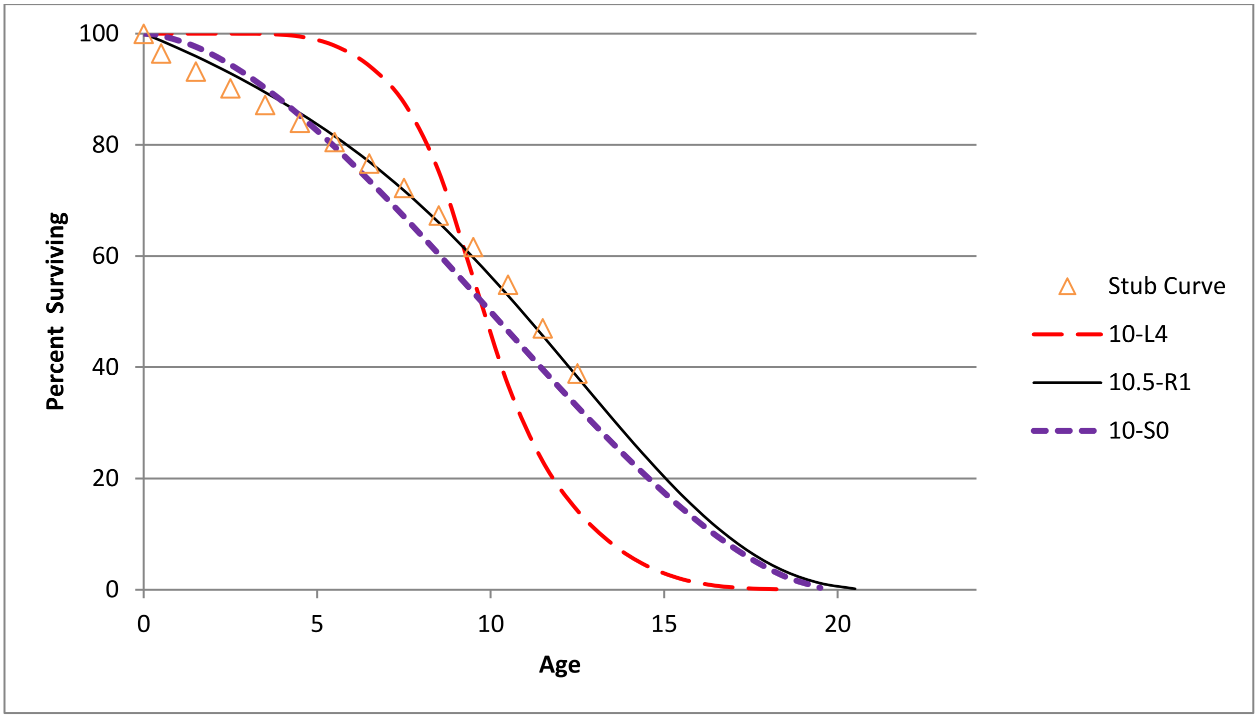
Curve Fitting

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 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."[73]

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, the 10.5-R1 curve is clearly a better fit than the other two curves.

[73] Wolf *supra* n.7, at 46 (22 curves includes Winfrey's 18 original curves plus Cowles's four "O" type curves).

Figure 22:
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 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.[74]

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."[75]

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 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 for the other two curves. Curve 10-L4 is the worst fit, which was also confirmed visually.

---

[74] Wolf *supra* n.7, at 47.

[75] *Id*. at 48.

Figure 23:
Mathematical Fitting

Age Interval	Stub Curve	Iowa Curves 10-L4	Iowa Curves 10-S0	Iowa Curves 10.5-R1	Squared Differences 10-L4	Squared Differences 10-S0	Squared Differences 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**

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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
Maryland Public Service Commission	Washington Gas Light Company	9651	Cost of capital and authorized rate of return	Maryland Office of People's Counsel
Florida Public Service Commission	Utilities, Inc. of Florida	20200139-WS	Cost of capital and authorized rate of return	Florida Office of Public Counsel
New Mexico Public Regulatory Commission	El Paso Electric Company	20-00104-UT	Cost of capital, depreciation rates, net salvage	City of Las Cruces and Doña Ana County
Public Utilities Commission of Nevada	Nevada Power Company	20-06003	Cost of capital, awarded rate of return, capital structure, earnings sharing	MGM Resorts International, Caesars Enterprise Services, LLC, Wynn Las Vegas, LLC, Smart Energy Alliance, and Circus Circus Las Vegas, LLC
Wyoming Public Service Commission	Rocky Mountain Power	20000-578-ER-20	Cost of capital and authorized rate of return	Wyoming Industrial Energy Consumers
Florida Public Service Commission	Peoples Gas System	20200051-GU 20200166-GU	Cost of capital, depreciation rates, net salvage	Florida Office of Public Counsel
Wyoming Public Service Commission	Rocky Mountain Power	20000-539-EA-18	Depreciation rates, service lives, net salvage	Wyoming Industrial Energy Consumers
Public Service Commission of South Carolina	Dominion Energy South Carolina	2020-125-E	Depreciation rates, service lives, net salvage	South Carolina Office of Regulatory Staff
Pennsylvania Public Utility Commission	The City of Bethlehem	2020-3020256	Cost of capital, awarded rate of return, capital structure	Pennsylvania Office of Consumer Advocate
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-El 20190156-El 20190174-El	Depreciation rates, service lives, net salvage	Florida Office of Public Counsel

Utility Regulatory Proceedings

Regulatory Agency	Utility Applicant	Docket Number	Issues Addressed	Parties Represented
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
Public Service Commission of South Carolina	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
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

Utility Regulatory Proceedings

Regulatory Agency	Utility Applicant	Docket Number	Issues Addressed	Parties Represented
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
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

Utility Regulatory Proceedings

Regulatory Agency	Utility Applicant	Docket Number	Issues Addressed	Parties Represented
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
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

Utility Regulatory Proceedings

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

Summary Accrual Adjustment

Plant Function	Plant Balance 12/31/2019	Company Proposal	AG Proposal	AG Adjustment
Production	199,916,533	5,832,544	5,052,617	(779,927)
Storage	131,283,017	2,774,479	2,390,533	(383,946)
Distribution	5,178,859,057	203,470,702	153,034,361	(50,436,341)
General	100,298,408	5,178,921	5,188,504	9,583
Leak Prone Pipe Program	154,343,262	7,114,661	7,114,660	(1)
Total	$ 5,764,700,277	$ 224,550,439	$ 172,959,807	**$ (51,590,632)**

Depreciation Parameter Comparison

Account No.	Description	Company's Position: Iowa Curve Type	AL	Depr Rate	Annual Accrual	AG's Position: Iowa Curve Type	AL	Depr Rate	Annual Accrual
	PRODUCTION PLANT								
320.17	OTHER EQUIPMENT - LNG	S2.5	35	3.23%	2,993,048	R2.5	44	2.48%	2,295,467
320.18	OTHER EQUIPMENT	S2.5	35	2.70%	385,052	R2.5	44	2.13%	303,844
	STORAGE PLANT								
361.03	STRUCTURES AND IMPROVEMENTS	S1.5	45	4.04%	38,023	S1.5	54	2.73%	25,690
361.07	STRUCTURES AND IMPROVEMENTS - LNG	S1.5	45	2.16%	2,348,433	S1.5	54	1.82%	1,983,773
361.08	STRUCTURES AND IMPROVEMENTS - LNG TANKS	S1.5	45	2.53%	37,185	S1.5	54	2.03%	29,894
	DISTRIBUTION PLANT								
367.12	MAINS - PLASTIC	R3	55	3.52%	87,311,826	S1.5	70	2.63%	65,227,703
367.13	MAINS - DISCONNECTED AND RECONNECTED	R3	55	3.30%	109,929	S1.5	70	2.59%	86,161
367.14	MAINS - STEEL	R3	55	3.86%	24,082,804	S1.5	70	2.68%	16,712,751
367.15	MAINS - CAST IRON	R3	55	12.54%	663,956	S1.5	70	2.78%	147,444
369.00	MEASURING AND REGULATING STATION EQUIPMENT	R3	45	4.04%	4,648,308	R3	55	2.88%	3,307,519
369.07	M&R STATION EQUIPMENT - COMMERCIAL POINT	R3	45	3.87%	213,452	R3	55	2.96%	163,263
380.02	SERVICES - PLASTIC	R3	35	4.54%	67,788,210	S1	45	3.29%	49,135,878
380.04	SERVICES - STEEL	R3	35	2.91%	2,513,567	S1	45	2.42%	2,090,580

Detailed Rate Comparison

Account No.	Description	[1] Original Cost	[3] Company Proposal Rate	[3] Company Proposal Annual Accrual	[4] AG Proposal Rate	[4] AG Proposal Annual Accrual	[6] AG Adjustment Rate	[6] AG Adjustment Annual Accrual
	PRODUCTION PLANT							
305.00	STRUCTURES AND IMPROVEMENTS	36,561,706	1.91%	698,600	1.91%	698,894	0.00%	294
306.00	BOILER PLANT EQUIPMENT	605,282	2.59%	15,648	2.58%	15,636	-0.01%	-12
307.00	OTHER POWER EQUIPMENT	3,270,573	2.17%	71,061	2.17%	71,112	0.00%	51
307.01	OTHER POWER EQUIPMENT - LNG	1,732,741	1.66%	28,681	1.65%	28,666	-0.01%	-15
311.00	STRUCTURES AND IMPROVEMENTS	9,839,012	1.91%	188,284	1.92%	188,803	0.01%	519
313.00	LNG EQUIPMENT	32,529,018	3.55%	1,153,783	3.54%	1,151,548	-0.01%	-2,235
316.00	REFORMING EQUIPMENT - SALEM	301,376	3.01%	9,067	3.01%	9,065	0.00%	-2
316.07	REFORMING EQUIPMENT - COMMERCIAL POINT	6,895,082	3.91%	269,415	3.91%	269,680	0.00%	265
319.00	GAS MIXING EQUIPMENT	1,259,211	1.58%	19,905	1.58%	19,901	0.00%	-4
320.17	OTHER EQUIPMENT - LNG	92,646,594	3.23%	2,993,048	2.48%	2,295,467	-0.75%	-697,581
320.18	OTHER EQUIPMENT	14,275,938	2.70%	385,052	2.13%	303,844	-0.57%	-81,208
	Total Production Plant	199,916,533	2.92%	5,832,544	2.53%	5,052,617	-0.39%	-779,927
	STORAGE PLANT							
361.03	STRUCTURES AND IMPROVEMENTS	940,896	4.04%	38,023	2.73%	25,690	-1.31%	-12,333
361.07	STRUCTURES AND IMPROVEMENTS - LNG	108,929,311	2.16%	2,348,433	1.82%	1,983,773	-0.34%	-364,660
361.08	STRUCTURES AND IMPROVEMENTS - LNG TANKS	1,471,805	2.53%	37,185	2.03%	29,894	-0.50%	-7,291
362.04	GAS HOLDERS	4,130,354	0.76%	31,545	0.76%	31,575	0.00%	30
362.07	GAS HOLDERS - LNG	11,250,695	0.92%	102,992	0.91%	102,926	-0.01%	-66
363.05	OTHER EQUIPMENT	3,914,555	4.41%	172,736	4.41%	172,641	0.00%	-95
363.07	OTHER EQUIPMENT - LNG	645,402	6.75%	43,565	6.82%	44,035	0.07%	470
	Total Storage Plant	131,283,017	2.11%	2,774,479	1.82%	2,390,533	-0.29%	-383,946
	DISTRIBUTION PLANT							
366.01	STRUCTURES - COMPRESSOR STATION	4,587,714	0.16%	7,519	0.16%	7,525	0.00%	6
366.02	STRUCTURES - M&R STATION EQUIPMENT	5,995,057	0.73%	43,987	0.73%	43,972	0.00%	-15
366.03	STRUCTURES AND IMPROVEMENTS - OTHER	1,124,622	0.36%	4,100	0.36%	4,098	0.00%	-2
	ACCOUNT 367							
367.12	MAINS - PLASTIC	2,477,912,698	3.52%	87,311,826	2.63%	65,227,703	-0.89%	-22,084,123
367.13	MAINS - DISCONNECTED AND RECONNECTED	3,329,658	3.30%	109,929	2.59%	86,161	-0.71%	-23,768
367.14	MAINS - STEEL	623,975,125	3.86%	24,082,804	2.68%	16,712,751	-1.18%	-7,370,053
367.15	MAINS - CAST IRON	5,294,207	12.54%	663,956	2.78%	147,444	-9.76%	-516,512
	TOTAL ACCOUNT 367	3,110,511,689	3.61%	112,168,515	2.64%	82,174,058	-0.96%	-29,994,457

Detailed Rate Comparison

Account No.	Description	[1] Original Cost	[3] Company Proposal Rate	[3] Company Proposal Annual Accrual	[4] AG Proposal Rate	[4] AG Proposal Annual Accrual	[6] AG Adjustment Rate	[6] AG Adjustment Annual Accrual
369.00	MEASURING AND REGULATING STATION EQUIPMENT	114,980,169	4.04%	4,648,308	2.88%	3,307,519	-1.16%	-1,340,789
369.07	M&R STATION EQUIPMENT - COMMERCIAL POINT	5,519,032	3.87%	213,452	2.96%	163,263	-0.91%	-50,189
	ACCOUNT 380							
380.02	SERVICES - PLASTIC	1,494,354,194	4.54%	67,788,210	3.29%	49,135,878	-1.25%	-18,652,332
380.04	SERVICES - STEEL	86,286,044	2.91%	2,513,567	2.42%	2,090,580	-0.49%	-422,987
	TOTAL ACCOUNT 380	1,580,640,239	4.45%	70,301,777	3.24%	51,226,458	-1.21%	-19,075,319
381.00	METERS	139,835,160	5.30%	7,413,082	5.31%	7,426,644	0.01%	13,562
381.02	METERS - ERTS	60,437,663	5.66%	3,418,948	5.66%	3,423,390	0.00%	4,442
382.02	METER INSTALLATIONS	128,546,845	3.61%	4,637,567	3.61%	4,644,559	0.00%	6,992
383.00	HOUSE REGULATORS	4,314,511	4.36%	187,951	4.36%	188,084	0.00%	133
387.01	OTHER EQUIPMENT	22,366,356	1.90%	425,496	1.90%	424,791	0.00%	-705
	Total Distribution Plant	5,178,859,057	3.93%	203,470,702	2.95%	153,034,361	-0.97%	-50,436,341

Detailed Rate Comparison

		[1]	[3]		[4]		[6]	
			Company Proposal		AG Proposal		AG Adjustment	
Account No.	Description	Original Cost	Rate	Annual Accrual	Rate	Annual Accrual	Rate	Annual Accrual
	GENERAL PLANT							
390.00	STRUCTURES AND IMPROVEMENTS	49,988,473	3.27%	1,636,474	3.27%	1,634,083	0.00%	-2,391
391.00	OFFICE FURNITURE AND EQUIPMENT							
	FULLY ACCRUED	1,491,651		0	0.00%	0	0.00%	0
	AMORTIZED	4,207,009	5.00%	210,332	4.98%	209,701	-0.02%	-631
	TOTAL ACCOUNT 391.00	5,698,660	3.69%	210,332	3.68%	209,701	-0.01%	-631
391.03	OFFICE FURNITURE AND EQUIPMENT - COMPUTERS							
	FULLY ACCRUED	46,099		0	0.00%	0	0.00%	0
	AMORTIZED	8,008,539	20.00%	1,601,907	20.15%	1,613,702	0.15%	11,795
	TOTAL ACCOUNT 391.03	8,054,638	19.89%	1,601,907	20.03%	1,613,702	0.15%	11,795
392.01	TRANSPORTATION EQUIPMENT - TRAILERS	24,997	5.10%	1,275	5.10%	1,275	0.00%	0
392.04	TRANSPORTATION EQUIPMENT	343,427	2.92%	10,026	2.91%	9,987	-0.01%	-39
393.00	STORES EQUIPMENT							
	FULLY ACCRUED	6,717		0	0.00%	0	0.00%	0
	AMORTIZED	645,645	4.00%	25,818	4.02%	25,934	0.02%	116
	TOTAL ACCOUNT 393.00	652,362	3.96%	25,818	3.98%	25,934	0.02%	116
394.00	TOOLS, SHOP AND GARAGE EQUIPMENT							
	FULLY ACCRUED	1,404,030		0	0.00%	0	0.00%	0
	AMORTIZED	26,043,765	5.00%	1,302,188	5.01%	1,303,988	0.01%	1,800
	TOTAL ACCOUNT 394.00	27,447,794	4.74%	1,302,188	4.75%	1,303,988	0.01%	1,800
395.00	LABORATORY EQUIPMENT	4,320	4.00%	173	4.00%	173	0.00%	0
397.00	COMMUNICATION EQUIPMENT	142,319	6.67%	9,487	6.67%	9,497	0.00%	10
398.00	MISCELLANEOUS EQUIPMENT							
	FULLY ACCRUED	317,940		0	0.00%	0	0.00%	0
	AMORTIZED	7,623,477	5.00%	381,241	4.99%	380,165	-0.01%	-1,076
	TOTAL ACCOUNT 398.00	7,941,417	4.80%	381,241	4.79%	380,165	-0.01%	-1,076
	Total General Plant	100,298,408	5.16%	5,178,921	5.17%	5,188,504	0.01%	9,583
	LEAK PRONE PIPE PROGRAM							
	BOSTON GAS COMPANY							

Detailed Rate Comparison

		[1]	[3]		[4]		[6]	
			Company Proposal		AG Proposal		AG Adjustment	
Account No.	Description	Original Cost	Rate	Annual Accrual	Rate	Annual Accrual	Rate	Annual Accrual
367.03	MAINS - CLAMPING	23,319,782	5.88%	1,371,948	5.88%	1,371,946	0.00%	-2
367.12	MAINS - PLASTIC	18,000,646	4.90%	882,439	4.90%	882,439	0.00%	0
367.14	MAINS - STEEL	21,235,210	4.07%	863,883	4.07%	863,879	0.00%	-4
367.15	MAINS - CAST IRON	31,058,408	4.10%	1,272,781	4.10%	1,272,783	0.00%	2
380.02	SERVICES - PLASTIC	34,954,160	4.00%	1,398,164	4.00%	1,398,166	0.00%	2
380.04	SERVICES - STEEL	12,915,672	4.00%	516,625	4.00%	516,627	0.00%	2
380.05	SERVICES - CAST IRON	57,402	4.02%	2,305	4.02%	2,305	0.00%	0
	TOTAL BOSTON GAS COMPANY	141,541,280	4.46%	6,308,145	4.46%	6,308,145	0.00%	0
	COLONIAL GAS COMPANY							
367.12	MAINS - PLASTIC	3,018,814	6.82%	205,769	6.82%	205,769	0.00%	0
367.14	MAINS - STEEL	4,622,195	6.82%	315,060	6.82%	315,060	0.00%	0
367.15	MAINS - CAST IRON	33,263	11.28%	3,752	11.28%	3,752	0.00%	0
380.04	SERVICES - STEEL	5,127,710	5.50%	281,935	5.50%	281,935	0.00%	0
	TOTAL COLONIAL GAS COMPANY	12,801,983	6.30%	806,516	6.30%	806,515	0.00%	-1
	TOTAL LEAK PRONE PIPE PROGRAM	154,343,262	4.61%	7,114,661	4.61%	7,114,660	0.00%	-1
	RESERVE ADJUSTMENT FOR AMORTIZATION							
391.00	OFFICE FURNITURE AND EQUIPMENT			72,888	0.00%	72,888	0.00%	0
391.03	OFFICE FURNITURE AND EQUIPMENT - COMPUTERS			-492,146	0.00%	-492,146	0.00%	0
394.00	TOOLS, SHOP AND GARAGE EQUIPMENT			395,416	0.00%	395,416	0.00%	0
395.00	LABORATORY EQUIPMENT			-1,278	0.00%	-1,278	0.00%	0
397.00	COMMUNICATION EQUIPMENT			-225	0.00%	-225	0.00%	0
398.00	MISCELLANEOUS EQUIPMENT			204,478	0.00%	204,478	0.00%	0
	TOTAL RESERVE ADJUSTMENT FOR AMORTIZATION			179,132	0.00%	179,132	0.00%	0
	TOTAL PLANT STUDIED	**5,764,700,277**	**3.90%**	**224,550,439**	**3.00%**	**172,959,807**	**-0.89%**	**-51,590,632**

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

Detailed Rate Comparison

		[1]	[3]		[4]		[6]	
			Company Proposal		AG Proposal		AG Adjustment	
Account No.	Description	Original Cost	Rate	Annual Accrual	Rate	Annual Accrual	Rate	Annual Accrual

Depreciation Rate Development

D.P.U. 20-120
Exh. AG-DJG-6
March 26, 2021
H.O. Tassone

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
	PRODUCTION PLANT														
305.00	STRUCTURES AND IMPROVEMENTS	36,561,706	S1.5	45	-10%	40,217,877	13,939,479	26,278,398	37.60	601,655	1.65%	97,239	0.27%	698,894	**1.91%**
306.00	BOILER PLANT EQUIPMENT	605,282	S3	45	-10%	665,810	231,121	434,689	27.80	13,459	2.22%	2,177	0.36%	15,636	**2.58%**
307.00	OTHER POWER EQUIPMENT	3,270,573	S2.5	45	-10%	3,597,630	1,030,470	2,567,160	36.10	62,053	1.90%	9,060	0.28%	71,112	**2.17%**
307.01	OTHER POWER EQUIPMENT - LNG	1,732,741	S2.5	45	-10%	1,906,015	822,431	1,083,584	37.80	24,082	1.39%	4,584	0.26%	28,666	**1.65%**
311.00	STRUCTURES AND IMPROVEMENTS	9,839,012	S1.5	35	-10%	10,822,913	7,518,856	3,304,057	17.50	132,580	1.35%	56,223	0.57%	188,803	**1.92%**
313.00	LNG EQUIPMENT	32,529,018	S3	35	-10%	35,781,920	7,108,367	28,673,553	24.90	1,020,910	3.14%	130,639	0.40%	1,151,548	**3.54%**
316.00	REFORMING EQUIPMENT - SALEM	301,376	S1.5	30	-10%	331,514	136,612	194,902	21.50	7,663	2.54%	1,402	0.47%	9,065	**3.01%**
316.07	REFORMING EQUIPMENT - COMMERCIAL POINT	6,895,082	S1.5	30	-10%	7,584,590	4,402,368	3,182,222	11.80	211,247	3.06%	58,433	0.85%	269,680	**3.91%**
319.00	GAS MIXING EQUIPMENT	1,259,211	S2.5	35	-10%	1,385,133	1,210,000	175,133	8.80	5,592	0.44%	14,309	1.14%	19,901	**1.58%**
320.17	OTHER EQUIPMENT - LNG	92,646,594	R2.5	44	-10%	101,911,253	8,738,261	93,172,992	40.59	2,067,217	2.23%	228,250	0.25%	2,295,467	**2.48%**
320.18	OTHER EQUIPMENT	14,275,938	R2.5	44	-10%	15,703,531	6,135,492	9,568,039	31.49	258,509	1.81%	45,335	0.32%	303,844	**2.13%**
	Total Production Plant	199,916,533			-10%	219,908,186	51,273,457	168,634,729	33.38	4,404,967	2.20%	647,650	0.32%	5,052,617	**2.53%**
	STORAGE PLANT														
361.03	STRUCTURES AND IMPROVEMENTS	940,896	S1.5	54	-10%	1,034,985	34,377	1,000,608	38.95	23,274	2.47%	2,416	0.26%	25,690	**2.73%**
361.07	STRUCTURES AND IMPROVEMENTS - LNG	108,929,311	S1.5	54	-10%	119,822,242	18,848,201	100,974,041	50.90	1,769,766	1.62%	214,007	0.20%	1,983,773	**1.82%**
361.08	STRUCTURES AND IMPROVEMENTS - LNG TANKS	1,471,805	S1.5	54	-10%	1,618,985	231,010	1,387,975	46.43	26,724	1.82%	3,170	0.22%	29,894	**2.03%**
362.04	GAS HOLDERS	4,130,354	R2	45	-10%	4,543,390	3,757,184	786,206	24.90	14,987	0.36%	16,588	0.40%	31,575	**0.76%**
362.07	GAS HOLDERS - LNG	11,250,695	R2	45	-10%	12,375,764	8,248,430	4,127,334	40.10	74,869	0.67%	28,057	0.25%	102,926	**0.91%**
363.05	OTHER EQUIPMENT	3,914,555	S0	25	-10%	4,306,010	162,628	4,143,382	24.00	156,330	3.99%	16,311	0.42%	172,641	**4.41%**
363.07	OTHER EQUIPMENT - LNG	645,402	S0	25	-10%	709,942	582,241	127,701	2.90	21,780	3.37%	22,255	3.45%	44,035	**6.82%**
	Total Storage Plant	131,283,017			-10%	144,411,318	31,864,071	112,547,247	47.08	2,087,730	1.59%	302,802	0.23%	2,390,533	**1.82%**
	DISTRIBUTION PLANT														
366.01	STRUCTURES - COMPRESSOR STATION	4,587,714	R3	60	-5%	4,817,099	4,495,023	322,076	42.80	2,166	0.05%	5,359	0.12%	7,525	**0.16%**
366.02	STRUCTURES - M&R STATION EQUIPMENT	5,995,057	R3	60	-5%	6,294,810	4,395,236	1,899,574	43.20	37,033	0.62%	6,939	0.12%	43,972	**0.73%**
366.03	STRUCTURES AND IMPROVEMENTS - OTHER	1,124,622	R3	60	-5%	1,180,853	1,012,001	168,852	41.20	2,734	0.24%	1,365	0.12%	4,098	**0.36%**
	ACCOUNT 367														
367.12	MAINS - PLASTIC	2,477,912,698	S1.5	70	-80%	4,460,242,857	450,695,969	4,009,546,887	61.47	32,978,961	1.33%	32,248,742	1.30%	65,227,703	**2.63%**
367.13	MAINS - DISCONNECTED AND RECONNECTED	3,329,658	S1.5	70	-80%	5,993,385	21,580	5,971,805	69.31	47,729	1.43%	38,432	1.15%	86,161	**2.59%**
367.14	MAINS - STEEL	623,975,125	S1.5	70	-80%	1,123,155,226	189,413,823	933,741,403	55.87	7,778,080	1.25%	8,934,672	1.43%	16,712,751	**2.68%**
367.15	MAINS - CAST IRON	5,294,207	S1.5	70	-80%	9,529,573	2,020,275	7,509,298	50.93	64,283	1.21%	83,161	1.57%	147,444	**2.78%**
	TOTAL ACCOUNT 367	3,110,511,689			-80%	5,598,921,040	642,151,647	4,956,769,393	60.32	40,869,052	1.31%	41,305,006	1.33%	82,174,058	**2.64%**
369.00	MEASURING AND REGULATING STATION EQUIPMENT	114,980,169	R3	55	-50%	172,470,253	24,392,631	148,077,622	44.77	2,023,398	1.76%	1,284,121	1.12%	3,307,519	**2.88%**
369.07	M&R STATION EQUIPMENT - COMMERCIAL POINT	5,519,032	R3	55	-50%	8,278,548	-13,581	8,292,129	50.79	108,931	1.97%	54,332	0.98%	163,263	**2.96%**
	ACCOUNT 380														
380.02	SERVICES - PLASTIC	1,494,354,194	S1	45	-80%	2,689,837,549	996,615,179	1,693,222,370	34.46	14,443,964	0.97%	34,691,914	2.32%	49,135,878	**3.29%**
380.04	SERVICES - STEEL	86,286,044	S1	45	-80%	155,314,880	98,785,604	56,529,276	27.04	-462,262	-0.54%	2,552,842	2.96%	2,090,580	**2.42%**
	TOTAL ACCOUNT 380	1,580,640,239			-80%	2,845,152,429	1,095,400,783	1,749,751,646	34.16	13,981,703	0.88%	37,244,756	2.36%	51,226,458	**3.24%**
381.00	METERS	139,835,160	R1	25	-25%	174,793,950	29,231,730	145,562,220	19.60	5,643,032	4.04%	1,783,612	1.28%	7,426,644	**5.31%**
381.02	METERS - ERTS	60,437,663	SQ	14	0%	60,437,663	29,969,493	30,468,170	8.90	3,423,390	5.66%	0	0.00%	3,423,390	**5.66%**
382.02	METER INSTALLATIONS	128,546,845	R2.5	35	-25%	160,683,557	24,133,528	136,550,029	29.40	3,551,473	2.76%	1,093,085	0.85%	4,644,559	**3.61%**
383.00	HOUSE REGULATORS	4,314,511	R2.5	35	-25%	5,393,139	465,347	4,927,792	26.20	146,915	3.41%	41,169	0.95%	188,084	**4.36%**
387.01	OTHER EQUIPMENT	22,366,356	S2.5	30	0%	22,366,356	11,619,138	10,747,218	25.30	424,791	1.90%	0	0.00%	424,791	**1.90%**
	Total Distribution Plant	5,178,859,057			-75%	9,060,789,698	1,867,252,976	7,193,536,722	47.01	70,214,618	1.36%	82,819,743	1.60%	153,034,361	**2.95%**
	GENERAL PLANT														
390.00	STRUCTURES AND IMPROVEMENTS	49,988,473	S0.5	35	-10%	54,987,321	10,867,081	44,120,240	27.00	1,448,940	2.90%	185,142	0.37%	1,634,083	**3.27%**
391.00	OFFICE FURNITURE AND EQUIPMENT														
	FULLY ACCRUED	1,491,651				1,491,651	1,491,651	0							
	AMORTIZED	4,207,009	SQ	20	0%	4,207,009	1,732,541	2,474,468	11.80	209,701	4.98%	0	0.00%	209,701	**4.98%**
	TOTAL ACCOUNT 391.00	5,698,660			0%	5,698,660	3,224,192	2,474,468	11.80	209,701	3.68%	0	0.00%	209,701	**3.68%**
391.03	OFFICE FURNITURE AND EQUIPMENT - COMPUTERS														
	FULLY ACCRUED	46,099				46,099	46,099	0							
	AMORTIZED	8,008,539	SQ	5	0%	8,008,539	4,135,654	3,872,885	2.40	1,613,702	20.15%	0	0.00%	1,613,702	**20.15%**
	TOTAL ACCOUNT 391.03	8,054,638			0%	8,054,638	4,181,753	3,872,885	2.40	1,613,702	20.03%	0	0.00%	1,613,702	**20.03%**

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
392.01	TRANSPORTATION EQUIPMENT - TRAILERS	24,997	S2	10	10%	22,497	21,222	1,275	1.00	3,775	15.10%	-2,500	-10.00%	1,275	**5.10%**
392.04	TRANSPORTATION EQUIPMENT	343,427	L1	20	10%	309,085	234,180	74,905	7.50	14,566	4.24%	-4,579	-1.33%	9,987	**2.91%**
393.00	STORES EQUIPMENT														
	FULLY ACCRUED	6,717				6,717	6,717	0							
	AMORTIZED	645,645	SQ	25	0%	645,645	487,449	158,196	6.10	25,934	4.02%	0	0.00%	25,934	**4.02%**
	TOTAL ACCOUNT 393.00	652,362			0%	652,362	494,166	158,196	6.10	25,934	3.98%	0	0.00%	25,934	**3.98%**
394.00	TOOLS, SHOP AND GARAGE EQUIPMENT														
	FULLY ACCRUED	1,404,030	SQ	25		1,404,030	1,404,030	0							
	AMORTIZED	26,043,765	SQ	15	0%	26,043,765	7,657,538	18,386,227	14.10	1,303,988	5.01%	0	0.00%	1,303,988	**5.01%**
	TOTAL ACCOUNT 394.00	27,447,794			0%	27,447,794	9,061,568	18,386,226	14.10	1,303,988	4.75%	0	0.00%	1,303,988	**4.75%**
395.00	LABORATORY EQUIPMENT	4,320	R1.5	70	0%	4,320	2,333	1,987	11.50	173	4.00%	0	0.00%	173	**4.00%**
397.00	COMMUNICATION EQUIPMENT	142,319	R1.6	70	0%	142,319	56,844	85,475	9.00	9,497	6.67%	0	0.00%	9,497	**6.67%**
398.00	MISCELLANEOUS EQUIPMENT														
	FULLY ACCRUED	317,940				317,940	317,940	0							
	AMORTIZED	7,623,477	SQ	20	0%	7,623,477	4,810,258	2,813,219	7.40	380,165	4.99%	0	0.00%	380,165	**4.99%**
	TOTAL ACCOUNT 398.00	7,941,417			0%	7,941,417	5,128,198	2,813,219	7.40	380,165	4.79%	0	0.00%	380,165	**4.79%**
	Total General Plant	100,298,408			-5%	105,260,413	33,271,537	71,988,876	13.87	5,010,440	5.00%	178,064	0.18%	5,188,504	**5.17%**
	LEAK PRONE PIPE PROGRAM														
	BOSTON GAS COMPANY														
367.03	MAINS - CLAMPING	23,319,782	SQ		-80%	41,975,607	14,536,690	27,438,917	20.00	439,155	1.88%	932,791	4.00%	1,371,946	**5.88%**
367.12	MAINS - PLASTIC	18,000,646	SQ		-80%	32,401,163	14,752,379	17,648,784	20.00	162,413	0.90%	720,026	4.00%	882,439	**4.90%**
367.14	MAINS - STEEL	21,235,210	SQ		-80%	38,223,378	20,945,804	17,277,574	20.00	14,470	0.07%	849,408	4.00%	863,879	**4.07%**
367.15	MAINS - CAST IRON	31,058,408	SQ		-80%	55,905,134	30,449,483	25,455,651	20.00	30,446	0.10%	1,242,336	4.00%	1,272,783	**4.10%**
380.02	SERVICES - PLASTIC	34,954,160	SQ		-80%	62,917,488	34,954,160	27,963,328	20.00	0	0.00%	1,398,166	4.00%	1,398,166	**4.00%**
380.04	SERVICES - STEEL	12,915,672	SQ		-80%	23,248,210	12,915,672	10,332,538	20.00	0	0.00%	516,627	4.00%	516,627	**4.00%**
380.05	SERVICES - CAST IRON	57,402	SQ		-80%	103,324	57,218	46,106	20.00	9	0.02%	2,296	4.00%	2,305	**4.02%**
	TOTAL BOSTON GAS COMPANY	141,541,280			-80%	254,774,303	128,611,406	126,162,897	20.00	646,494	0.46%	5,661,651	4.00%	6,308,145	**4.46%**
	COLONIAL GAS COMPANY														
367.12	MAINS - PLASTIC	3,018,814	SQ		-80%	5,433,866	2,347,325	3,086,541	15.00	44,766	1.48%	161,003	5.33%	205,769	**6.82%**
367.14	MAINS - STEEL	4,622,195	SQ		-80%	8,319,951	3,594,058	4,725,893	15.00	68,542	1.48%	246,517	5.33%	315,060	**6.82%**
367.15	MAINS - CAST IRON	33,263	SQ		-80%	59,874	3,600	56,274	15.00	1,978	5.95%	1,774	5.33%	3,752	**11.28%**
380.04	SERVICES - STEEL	5,127,710	SQ		-80%	9,229,879	5,000,856	4,229,023	15.00	8,457	0.16%	273,478	5.33%	281,935	**5.50%**
	TOTAL COLONIAL GAS COMPANY	12,801,983			-80%	23,043,569	10,945,839	12,097,730	15.00	123,743	0.97%	682,772	5.33%	806,515	**6.30%**
	TOTAL LEAK PRONE PIPE PROGRAM	154,343,262			-80%	277,817,872	139,557,245	138,260,627	19.43	770,237	0.50%	6,344,424	4.11%	7,114,660	**4.61%**
	RESERVE ADJUSTMENT FOR AMORTIZATION														
391.00	OFFICE FURNITURE AND EQUIPMENT						-364,439							72,888	
391.03	OFFICE FURNITURE AND EQUIPMENT - COMPUTERS						2,460,731							-492,146	
394.00	TOOLS, SHOP AND GARAGE EQUIPMENT						-1,977,079							395,416	
395.00	LABORATORY EQUIPMENT						6,391							-1,278	
397.00	COMMUNICATION EQUIPMENT						1,125							-225	
398.00	MISCELLANEOUS EQUIPMENT						-1,022,391							204,478	
	TOTAL RESERVE ADJUSTMENT FOR AMORTIZATION	0				0	-895,662	0						179,132	
	TOTAL PLANT STUDIED	**5,764,700,277**			**-70%**	**9,808,187,488**	**2,122,323,625**	**7,684,968,201**	**44.43**	**82,487,992**	**1.43%**	**90,292,683**	**1.57%**	**172,959,807**	**3.00%**

[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]

Depreciation Rate Development

		[1]	[2]		[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]	[13]
Account		Original	Iowa Curve		Net	Depreciable	Book	Future	Remaining	Service Life		Net Salvage		Total	
No.	Description	Cost	Type	AL	Salvage	Base	Reserve	Accruals	Life	Accrual	Rate	Accrual	Rate	Accrual	Rate

[7] Composite remaining life based on Iowa cuve 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 320 Curve Fitting

[1] Age (Years)	[2] Exposures (Dollars)	[3] Observed Life Table (OLT)	[4] Company S2.5-35	[5] AG R2.5-44	[6] Company SSD	[7] AG SSD
0.0	94,788,832	100.00%	100.00%	100.00%	0.0000	0.0000
0.5	91,775,393	100.00%	100.00%	99.94%	0.0000	0.0000
1.5	24,865,428	100.00%	100.00%	99.80%	0.0000	0.0000
2.5	26,783,602	100.00%	100.00%	99.65%	0.0000	0.0000
3.5	27,283,562	100.00%	100.00%	99.49%	0.0000	0.0000
4.5	24,818,360	100.00%	99.99%	99.31%	0.0000	0.0000
5.5	24,913,620	100.00%	99.98%	99.12%	0.0000	0.0001
6.5	24,780,714	99.98%	99.95%	98.91%	0.0000	0.0001
7.5	20,511,090	99.98%	99.91%	98.67%	0.0000	0.0002
8.5	17,485,228	99.97%	99.85%	98.42%	0.0000	0.0002
9.5	17,521,482	99.97%	99.75%	98.14%	0.0000	0.0003
10.5	13,568,277	99.97%	99.61%	97.83%	0.0000	0.0005
11.5	12,991,940	99.97%	99.42%	97.50%	0.0000	0.0006
12.5	11,108,631	99.97%	99.17%	97.14%	0.0001	0.0008
13.5	11,351,036	99.95%	98.83%	96.75%	0.0001	0.0010
14.5	9,140,473	99.95%	98.40%	96.32%	0.0002	0.0013
15.5	8,802,278	99.93%	97.86%	95.86%	0.0004	0.0017
16.5	7,854,829	99.58%	97.19%	95.36%	0.0006	0.0018
17.5	7,477,946	98.51%	96.38%	94.82%	0.0005	0.0014
18.5	7,117,329	98.20%	95.40%	94.23%	0.0008	0.0016
19.5	7,041,451	97.58%	94.24%	93.60%	0.0011	0.0016
20.5	7,009,572	97.06%	92.89%	92.92%	0.0017	0.0017
21.5	6,800,232	96.60%	91.33%	92.18%	0.0028	0.0020
22.5	6,526,226	92.65%	89.54%	91.39%	0.0010	0.0002
23.5	6,355,249	90.35%	87.53%	90.54%	0.0008	0.0000
24.5	6,247,408	90.03%	85.29%	89.63%	0.0022	0.0000
25.5	6,081,731	89.25%	82.81%	88.66%	0.0042	0.0000
26.5	5,763,192	88.67%	80.09%	87.61%	0.0074	0.0001
27.5	4,176,870	87.86%	77.16%	86.50%	0.0115	0.0002
28.5	4,068,130	86.66%	74.01%	85.30%	0.0160	0.0002
29.5	3,966,511	85.16%	70.68%	84.03%	0.0210	0.0001
30.5	3,800,988	83.43%	67.17%	82.67%	0.0264	0.0001
31.5	3,477,965	82.51%	63.51%	81.23%	0.0361	0.0002
32.5	3,383,537	80.66%	59.74%	79.69%	0.0438	0.0001
33.5	3,263,035	78.77%	55.88%	78.06%	0.0524	0.0001
34.5	2,906,656	77.31%	51.96%	76.32%	0.0642	0.0001
35.5	2,436,653	75.83%	48.04%	74.48%	0.0773	0.0002
36.5	2,351,929	74.36%	44.12%	72.53%	0.0914	0.0003
37.5	1,561,476	73.01%	40.26%	70.47%	0.1072	0.0006
38.5	1,353,567	70.42%	36.49%	68.29%	0.1151	0.0005
39.5	1,301,201	68.19%	32.83%	66.00%	0.1250	0.0005
40.5	1,227,984	66.34%	29.32%	63.61%	0.1370	0.0007
41.5	1,187,579	64.52%	25.99%	61.10%	0.1485	0.0012
42.5	1,103,529	63.44%	22.84%	58.48%	0.1648	0.0025
43.5	1,061,118	62.22%	19.91%	55.77%	0.1790	0.0042
44.5	1,021,029	61.46%	17.19%	52.97%	0.1959	0.0072
45.5	977,337	60.37%	14.71%	50.10%	0.2085	0.0105
46.5	852,562	57.51%	12.47%	47.17%	0.2029	0.0107
47.5	749,298	57.21%	10.46%	44.20%	0.2186	0.0169
48.5	710,729	56.19%	8.67%	41.21%	0.2258	0.0224
49.5	492,001	55.43%	7.11%	38.22%	0.2335	0.0296
50.5	401,395	53.63%	5.76%	35.25%	0.2292	0.0338
51.5	404,214	53.36%	4.60%	32.33%	0.2378	0.0442
52.5	291,224	52.78%	3.62%	29.49%	0.2417	0.0543
53.5	254,481	52.26%	2.81%	26.73%	0.2446	0.0652
54.5	190,414	51.46%	2.14%	24.08%	0.2433	0.0749
55.5	169,782	49.46%	1.60%	21.57%	0.2291	0.0778
56.5	164,259	48.59%	1.17%	19.20%	0.2249	0.0864
57.5	159,215	48.38%	0.83%	16.97%	0.2261	0.0986
58.5	137,733	47.74%	0.58%	14.91%	0.2224	0.1078
59.5	133,287	47.42%	0.39%	13.01%	0.2212	0.1184
60.5	111,862	47.31%	0.25%	11.27%	0.2215	0.1299
61.5	113,343	47.15%	0.15%	9.69%	0.2209	0.1403
62.5	111,075	46.60%	0.09%	8.26%	0.2163	0.1470
63.5	92,904	46.53%	0.05%	6.99%	0.2161	0.1564
64.5	72,467	45.95%	0.02%	5.85%	0.2109	0.1608
65.5	39,663	45.95%	0.01%	4.85%	0.2111	0.1689
66.5	38,051	45.95%	0.00%	3.98%	0.2111	0.1762

Account 320 Curve Fitting

[1] Age (Years)	[2] Exposures (Dollars)	[3] Observed Life Table (OLT)	[4] Company S2.5-35	[5] AG R2.5-44	[6] Company SSD	[7] AG SSD
67.5	38,051	45.95%	0.00%	3.23%	0.2111	0.1825
68.5	36,929	45.95%	0.00%	2.58%	0.2111	0.1881
69.5	35,753	45.95%	0.00%	2.04%	0.2111	0.1928
70.5	27,699	45.95%	0.00%	1.59%	0.2111	0.1968
71.5	27,699	45.95%	0.00%	1.21%	0.2111	0.2001
72.5	10,423	45.95%	0.00%	0.91%	0.2111	0.2029
73.5	10,423	45.95%	0.00%	0.66%	0.2111	0.2051
74.5	10,423	45.95%	0.00%	0.46%	0.2111	0.2069
75.5	10,423	45.95%	0.00%	0.31%	0.2111	0.2083
76.5	10,423	45.95%	0.00%	0.19%	0.2111	0.2094
77.5	10,423	45.95%	0.00%	0.10%	0.2111	0.2102
78.5	10,423	45.95%	0.00%	0.05%	0.2111	0.2107
79.5	10,423	45.95%	0.00%	0.02%	0.2111	0.2110
80.5	10,423	45.95%	0.00%	0.00%	0.2111	0.2111
81.5	10,423	45.95%	0.00%	0.00%	0.2111	0.2111
82.5	10,423	45.95%	0.00%	0.00%	0.2111	0.2111
83.5	10,423	45.95%	0.00%	0.00%	0.2111	0.2111
84.5	10,423	45.95%	0.00%	0.00%	0.2111	0.2111
85.5	5,783	45.95%	0.00%	0.00%	0.2111	0.2111
86.5	5,783	45.95%	0.00%	0.00%	0.2111	0.2111
87.5	5,783	45.95%	0.00%	0.00%	0.2111	0.2111
88.5	5,783	45.95%	0.00%	0.00%	0.2111	0.2111
89.5	5,783	45.95%	0.00%	0.00%	0.2111	0.2111
90.5	5,783	45.95%	0.00%	0.00%	0.2111	0.2111
91.5	5,783	45.95%	0.00%	0.00%	0.2111	0.2111
92.5	5,783	45.95%	0.00%	0.00%	0.2111	0.2111
93.5	5,783	45.95%	0.00%	0.00%	0.2111	0.2111
94.5	5,783	45.95%	0.00%	0.00%	0.2111	0.2111
95.5	5,783	45.95%	0.00%	0.00%	0.2111	0.2111
96.5	5,783	45.95%	0.00%	0.00%	0.2111	0.2111
97.5	5,783	45.95%	0.00%	0.00%	0.2111	0.2111
98.5	5,783	45.95%	0.00%	0.00%	0.2111	0.2111
99.5	5,783	45.95%	0.00%	0.00%	0.2111	0.2111
100.5	5,783	45.95%	0.00%	0.00%	0.2111	0.2111
101.5	5,783	45.95%	0.00%	0.00%	0.2111	0.2111
102.5	5,783	45.95%	0.00%	0.00%	0.2111	0.2111
103.5	5,783	45.95%	0.00%	0.00%	0.2111	0.2111
104.5	5,783	45.95%	0.00%	0.00%	0.2111	0.2111
105.5	5,783	45.95%	0.00%	0.00%	0.2111	0.2111
106.5	5,783	45.95%	0.00%	0.00%	0.2111	0.2111
107.5	5,783	45.95%	0.00%	0.00%	0.2111	0.2111
108.5	5,783	45.95%	0.00%	0.00%	0.2111	0.2111
109.5	5,783	45.95%	0.00%	0.00%	0.2111	0.2111
110.5			0.00%	0.00%		
Sum of Squared Differences				[8]	15.6329	10.9261
Up to 1% of Beginning Exposures				[9]	1.8451	0.0465

[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 361 Curve Fitting

[1] Age (Years)	[2] Exposures (Dollars)	[3] Observed Life Table (OLT)	[4] Company S1.5-45	[5] AG S1.5-54	[6] Company SSD	[7] AG SSD
0.0	111,845,084	100.00%	100.00%	100.00%	0.0000	0.0000
0.5	111,845,431	100.00%	100.00%	100.00%	0.0000	0.0000
1.5	21,196,564	100.00%	100.00%	100.00%	0.0000	0.0000
2.5	19,709,555	100.00%	99.98%	99.99%	0.0000	0.0000
3.5	19,709,571	100.00%	99.96%	99.98%	0.0000	0.0000
4.5	19,528,470	100.00%	99.92%	99.95%	0.0000	0.0000
5.5	18,162,061	100.00%	99.86%	99.91%	0.0000	0.0000
6.5	5,334,615	100.00%	99.77%	99.86%	0.0000	0.0000
7.5	5,261,994	100.00%	99.65%	99.79%	0.0000	0.0000
8.5	5,099,757	100.00%	99.50%	99.70%	0.0000	0.0000
9.5	5,031,135	100.00%	99.32%	99.59%	0.0000	0.0000
10.5	4,813,359	100.00%	99.09%	99.46%	0.0001	0.0000
11.5	4,763,022	100.00%	98.82%	99.30%	0.0001	0.0000
12.5	4,616,837	100.00%	98.49%	99.11%	0.0002	0.0001
13.5	4,489,475	100.00%	98.12%	98.89%	0.0004	0.0001
14.5	4,474,349	99.99%	97.68%	98.63%	0.0005	0.0002
15.5	4,472,996	99.96%	97.19%	98.34%	0.0008	0.0003
16.5	4,469,425	99.89%	96.63%	98.01%	0.0011	0.0004
17.5	4,469,418	99.89%	96.00%	97.65%	0.0015	0.0005
18.5	3,847,033	88.63%	95.30%	97.23%	0.0045	0.0074
19.5	3,847,100	88.63%	94.53%	96.78%	0.0035	0.0066
20.5	3,833,388	88.63%	93.67%	96.27%	0.0025	0.0058
21.5	3,789,145	88.63%	92.74%	95.72%	0.0017	0.0050
22.5	3,789,132	88.63%	91.73%	95.11%	0.0010	0.0042
23.5	3,683,243	88.63%	90.64%	94.46%	0.0004	0.0034
24.5	3,605,645	88.63%	89.46%	93.75%	0.0001	0.0026
25.5	3,605,817	88.63%	88.20%	92.98%	0.0000	0.0019
26.5	3,589,531	88.63%	86.86%	92.16%	0.0003	0.0012
27.5	2,810,831	88.63%	85.43%	91.29%	0.0010	0.0007
28.5	2,655,087	88.62%	83.92%	90.35%	0.0022	0.0003
29.5	2,640,061	88.62%	82.33%	89.36%	0.0040	0.0001
30.5	2,553,054	88.62%	80.66%	88.31%	0.0063	0.0000
31.5	2,509,415	88.62%	78.91%	87.20%	0.0094	0.0002
32.5	2,515,933	88.62%	77.09%	86.03%	0.0133	0.0007
33.5	2,515,995	88.61%	75.20%	84.81%	0.0180	0.0014
34.5	2,350,801	88.61%	73.25%	83.53%	0.0236	0.0026
35.5	2,350,723	88.61%	71.23%	82.19%	0.0302	0.0041
36.5	2,316,840	88.60%	69.16%	80.80%	0.0378	0.0061
37.5	2,307,159	88.58%	67.03%	79.35%	0.0464	0.0085
38.5	2,306,922	88.57%	64.86%	77.86%	0.0562	0.0115
39.5	2,255,123	88.56%	62.64%	76.31%	0.0672	0.0150
40.5	2,138,520	88.55%	60.40%	74.72%	0.0793	0.0191
41.5	2,047,276	88.53%	58.12%	73.08%	0.0925	0.0239
42.5	2,046,830	88.50%	55.81%	71.40%	0.1068	0.0292
43.5	2,016,926	88.46%	53.49%	69.68%	0.1223	0.0353
44.5	2,003,409	88.43%	51.17%	67.92%	0.1389	0.0420
45.5	1,931,353	88.43%	48.83%	66.13%	0.1568	0.0497
46.5	1,899,753	88.40%	46.51%	64.31%	0.1755	0.0580
47.5	1,808,707	88.38%	44.19%	62.46%	0.1953	0.0672
48.5	1,663,628	88.27%	41.88%	60.58%	0.2152	0.0767
49.5	625,768	88.24%	39.60%	58.69%	0.2365	0.0873
50.5	23,202	88.08%	37.36%	56.77%	0.2573	0.0980
51.5	22,863	86.59%	35.14%	54.85%	0.2647	0.1008
52.5	22,483	82.10%	32.97%	52.91%	0.2414	0.0852
53.5	23,692	78.71%	30.84%	50.97%	0.2291	0.0769
54.5	22,727	77.82%	28.77%	49.03%	0.2406	0.0829
55.5	22,279	76.29%	26.75%	47.09%	0.2454	0.0853
56.5	21,326	73.03%	24.80%	45.15%	0.2327	0.0777
57.5	21,206	69.47%	22.91%	43.23%	0.2168	0.0689
58.5	19,979	65.45%	21.09%	41.31%	0.1968	0.0583
59.5	20,538	59.22%	19.34%	39.42%	0.1590	0.0392
60.5	19,814	57.13%	17.67%	37.54%	0.1557	0.0384
61.5	18,865	53.70%	16.08%	35.69%	0.1415	0.0324
62.5	15,665	44.59%	14.57%	33.87%	0.0901	0.0115
63.5	12,275	34.94%	13.14%	32.08%	0.0475	0.0008
64.5	12,233	34.82%	11.80%	30.32%	0.0530	0.0020
65.5	12,226	34.80%	10.54%	28.60%	0.0589	0.0038
66.5	12,076	34.38%	9.36%	26.92%	0.0626	0.0056
67.5	11,445	32.58%	8.27%	25.28%	0.0591	0.0053
68.5	16,464	29.50%	7.26%	23.69%	0.0495	0.0034
69.5	13,509	24.21%	6.33%	22.14%	0.0320	0.0004
70.5	13,449	24.10%	5.47%	20.65%	0.0347	0.0012
71.5	13,245	23.74%	4.70%	19.20%	0.0363	0.0021

Account 361 Curve Fitting

[1] Age (Years)	[2] Exposures (Dollars)	[3] Observed Life Table (OLT)	[4] Company S1.5-45	[5] AG S1.5-54	[6] Company SSD	[7] AG SSD
72.5	13,140	23.55%	4.00%	17.81%	0.0382	0.0033
73.5	11,649	20.88%	3.37%	16.47%	0.0307	0.0019
74.5	10,910	19.55%	2.81%	15.19%	0.0280	0.0019
75.5	112,432	18.64%	2.32%	13.97%	0.0266	0.0022
76.5	112,491	18.63%	1.88%	12.80%	0.0281	0.0034
77.5	111,804	18.51%	1.51%	11.69%	0.0289	0.0046
78.5	111,229	18.42%	1.18%	10.64%	0.0297	0.0061
79.5	110,755	18.34%	0.91%	9.65%	0.0304	0.0076
80.5	83,497	13.83%	0.68%	8.71%	0.0173	0.0026
81.5	70,445	11.67%	0.50%	7.84%	0.0125	0.0015
82.5	64,596	10.70%	0.35%	7.02%	0.0107	0.0014
83.5	63,780	10.56%	0.23%	6.25%	0.0107	0.0019
84.5	50,361	8.34%	0.14%	5.54%	0.0067	0.0008
85.5	38,981	6.44%	0.08%	4.89%	0.0040	0.0002
86.5	38,978	6.44%	0.04%	4.28%	0.0041	0.0005
87.5	38,383	6.44%	0.02%	3.73%	0.0041	0.0007
88.5	38,383	6.44%	0.00%	3.22%	0.0041	0.0010
89.5	31,395	5.27%	0.00%	2.77%	0.0028	0.0006
90.5	10,664	1.45%	0.00%	2.35%	0.0002	0.0001
91.5	4,459	1.00%	0.00%	1.99%	0.0001	0.0001
92.5	4,459	1.00%	0.00%	1.66%	0.0001	0.0000
93.5	4,459	1.00%	0.00%	1.37%	0.0001	0.0000
94.5	4,444	1.00%	0.00%	1.11%	0.0001	0.0000
95.5	2,459	0.55%	0.00%	0.89%	0.0000	0.0000
96.5	2,459	0.55%	0.00%	0.70%	0.0000	0.0000
97.5	2,459	0.55%	0.00%	0.54%	0.0000	0.0000
98.5	2,459	0.55%	0.00%	0.41%	0.0000	0.0000
99.5	2,459	0.55%	0.00%	0.30%	0.0000	0.0000
100.5	2,459	0.55%	0.00%	0.21%	0.0000	0.0000
101.5	2,459	0.55%	0.00%	0.14%	0.0000	0.0000
102.5	2,459	0.55%	0.00%	0.09%	0.0000	0.0000
103.5	2,459	0.55%	0.00%	0.05%	0.0000	0.0000
104.5	2,459	0.55%	0.00%	0.02%	0.0000	0.0000
105.5	2,459	0.55%	0.00%	0.01%	0.0000	0.0000
106.5	2,459	0.55%	0.00%	0.00%	0.0000	0.0000
107.5	2,459	0.55%	0.00%	0.00%	0.0000	0.0000
108.5	2,459	0.55%	0.00%	0.00%	0.0000	0.0000
109.5	2,459	0.55%	0.00%	0.00%	0.0000	0.0000
110.5	2,459	0.55%	0.00%	0.00%	0.0000	0.0000
111.5	2,459	0.55%	0.00%	0.00%	0.0000	0.0000
112.5	2,459	0.55%	0.00%	0.00%	0.0000	0.0000
113.5	2,459	0.55%	0.00%	0.00%	0.0000	0.0000
114.5	2,459	0.55%	0.00%	0.00%	0.0000	0.0000
115.5	2,459	0.55%	0.00%	0.00%	0.0000	0.0000
116.5	2,459	0.55%	0.00%	0.00%	0.0000	0.0000
117.5	2,459	0.55%	0.00%	0.00%	0.0000	0.0000
118.5			0.00%	0.00%		
Sum of Squared Differences				[8]	5.2770	1.5025
Up to 1% of Beginning Exposures				[9]	1.6168	0.4921

[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 367 Curve Fitting

[1] Age (Years)	[2] Exposures (Dollars)	[3] Observed Life Table (OLT)	[4] Company R3-55	[5] AG S1.5-70	[6] Company SSD	[7] AG SSD
0.0	3,205,740,593	100.00%	100.00%	100.00%	0.0000	0.0000
0.5	2,943,490,689	100.00%	99.99%	100.00%	0.0000	0.0000
1.5	2,814,305,773	99.96%	99.95%	100.00%	0.0000	0.0000
2.5	2,535,571,825	99.88%	99.92%	100.00%	0.0000	0.0000
3.5	2,214,298,445	99.80%	99.88%	99.99%	0.0000	0.0000
4.5	1,991,559,812	99.67%	99.83%	99.98%	0.0000	0.0000
5.5	1,777,745,288	99.54%	99.77%	99.96%	0.0000	0.0000
6.5	1,577,962,898	99.30%	99.71%	99.93%	0.0000	0.0000
7.5	1,424,655,410	99.23%	99.64%	99.90%	0.0000	0.0000
8.5	1,316,104,925	99.07%	99.55%	99.86%	0.0000	0.0001
9.5	1,207,665,725	98.81%	99.46%	99.81%	0.0000	0.0001
10.5	1,083,686,368	98.71%	99.36%	99.74%	0.0000	0.0001
11.5	1,028,824,404	98.59%	99.24%	99.67%	0.0000	0.0001
12.5	968,385,705	98.41%	99.11%	99.58%	0.0000	0.0001
13.5	928,077,299	98.34%	98.96%	99.47%	0.0000	0.0001
14.5	870,016,448	98.17%	98.80%	99.35%	0.0000	0.0001
15.5	808,430,498	97.88%	98.62%	99.22%	0.0001	0.0002
16.5	742,463,130	97.43%	98.41%	99.06%	0.0001	0.0003
17.5	665,445,103	96.97%	98.19%	98.89%	0.0001	0.0004
18.5	587,148,617	96.84%	97.95%	98.70%	0.0001	0.0003
19.5	557,764,739	96.74%	97.68%	98.48%	0.0001	0.0003
20.5	526,570,620	96.61%	97.39%	98.24%	0.0001	0.0003
21.5	501,958,922	96.44%	97.07%	97.98%	0.0000	0.0002
22.5	475,150,149	96.29%	96.72%	97.70%	0.0000	0.0002
23.5	451,224,138	96.14%	96.33%	97.39%	0.0000	0.0002
24.5	406,881,487	95.98%	95.92%	97.06%	0.0000	0.0001
25.5	364,419,313	95.79%	95.47%	96.69%	0.0000	0.0001
26.5	344,128,665	95.60%	94.99%	96.30%	0.0000	0.0000
27.5	311,531,755	95.38%	94.47%	95.88%	0.0001	0.0000
28.5	286,649,800	95.08%	93.90%	95.43%	0.0001	0.0000
29.5	270,065,305	94.77%	93.29%	94.95%	0.0002	0.0000
30.5	254,372,861	94.44%	92.64%	94.44%	0.0003	0.0000
31.5	233,848,171	94.14%	91.94%	93.90%	0.0005	0.0000
32.5	215,706,922	93.72%	91.19%	93.32%	0.0006	0.0000
33.5	203,537,089	93.37%	90.39%	92.71%	0.0009	0.0000
34.5	189,504,124	92.95%	89.53%	92.07%	0.0012	0.0001
35.5	180,337,278	92.47%	88.62%	91.39%	0.0015	0.0001
36.5	173,824,587	91.95%	87.64%	90.68%	0.0019	0.0002
37.5	167,513,130	91.35%	86.60%	89.93%	0.0023	0.0002
38.5	158,813,797	90.67%	85.49%	89.15%	0.0027	0.0002
39.5	149,877,205	89.94%	84.31%	88.34%	0.0032	0.0003
40.5	141,290,551	89.14%	83.06%	87.49%	0.0037	0.0003
41.5	134,021,347	88.27%	81.72%	86.61%	0.0043	0.0003
42.5	128,796,756	87.28%	80.31%	85.69%	0.0049	0.0003
43.5	124,180,107	86.21%	78.81%	84.74%	0.0055	0.0002
44.5	120,243,276	84.98%	77.22%	83.75%	0.0060	0.0002
45.5	117,575,938	83.70%	75.54%	82.73%	0.0067	0.0001
46.5	115,142,095	82.48%	73.76%	81.68%	0.0076	0.0001
47.5	112,946,335	81.04%	71.89%	80.60%	0.0084	0.0000
48.5	110,784,671	79.66%	69.91%	79.48%	0.0095	0.0000
49.5	108,911,980	78.33%	67.84%	78.34%	0.0110	0.0000
50.5	107,267,516	77.07%	65.67%	77.16%	0.0130	0.0000
51.5	103,696,587	75.88%	63.40%	75.95%	0.0156	0.0000
52.5	101,462,133	74.72%	61.03%	74.72%	0.0187	0.0000
53.5	99,176,534	73.60%	58.58%	73.46%	0.0226	0.0000
54.5	96,147,022	72.56%	56.04%	72.18%	0.0273	0.0000
55.5	92,814,474	71.53%	53.42%	70.87%	0.0328	0.0000
56.5	91,553,430	70.59%	50.74%	69.53%	0.0394	0.0001
57.5	88,827,153	69.73%	48.01%	68.18%	0.0472	0.0002
58.5	85,991,173	69.02%	45.23%	66.80%	0.0566	0.0005
59.5	83,212,909	68.44%	42.43%	65.41%	0.0677	0.0009
60.5	81,064,462	67.89%	39.62%	63.99%	0.0799	0.0015
61.5	80,298,244	67.35%	36.81%	62.57%	0.0932	0.0023
62.5	78,181,005	66.80%	34.04%	61.12%	0.1073	0.0032
63.5	76,301,670	66.31%	31.31%	59.67%	0.1225	0.0044
64.5	74,739,097	65.79%	28.64%	58.20%	0.1380	0.0058
65.5	73,448,729	65.27%	26.04%	56.72%	0.1539	0.0073
66.5	73,636,271	64.77%	23.55%	55.24%	0.1699	0.0091
67.5	72,185,332	64.24%	21.16%	53.74%	0.1856	0.0110
68.5	71,023,786	63.74%	18.90%	52.25%	0.2011	0.0132
69.5	70,116,982	63.25%	16.77%	50.75%	0.2161	0.0156
70.5	68,981,572	62.71%	14.77%	49.25%	0.2298	0.0181
71.5	67,699,113	62.17%	12.92%	47.75%	0.2425	0.0208

Account 367 Curve Fitting

[1]	[2]	[3]	[4]	[5]	[6]	[7]
Age (Years)	**Exposures (Dollars)**	**Observed Life Table (OLT)**	**Company R3-55**	**AG S1.5-70**	**Company SSD**	**AG SSD**
72.5	66,533,690	61.58%	11.23%	46.26%	0.2535	0.0235
73.5	65,609,157	61.00%	9.67%	44.76%	0.2634	0.0264
74.5	64,921,593	60.40%	8.26%	43.28%	0.2718	0.0293
75.5	64,125,079	59.70%	6.99%	41.80%	0.2778	0.0320
76.5	63,372,937	59.07%	5.85%	40.33%	0.2832	0.0351
77.5	62,590,205	58.49%	4.85%	38.88%	0.2878	0.0385
78.5	61,457,999	57.88%	3.96%	37.43%	0.2907	0.0418
79.5	60,238,144	57.23%	3.19%	36.01%	0.2921	0.0450
80.5	59,166,312	56.64%	2.52%	34.59%	0.2929	0.0486
81.5	58,183,743	56.07%	1.95%	33.20%	0.2929	0.0523
82.5	57,112,722	55.50%	1.47%	31.82%	0.2919	0.0561
83.5	56,060,202	54.90%	1.08%	30.47%	0.2897	0.0597
84.5	55,002,962	54.22%	0.76%	29.13%	0.2858	0.0629
85.5	53,952,713	53.52%	0.51%	27.82%	0.2810	0.0660
86.5	52,758,492	52.66%	0.32%	26.54%	0.2739	0.0682
87.5	51,269,797	51.67%	0.19%	25.28%	0.2651	0.0697
88.5	49,515,134	50.84%	0.10%	24.05%	0.2575	0.0718
89.5	45,087,004	49.87%	0.04%	22.84%	0.2483	0.0731
90.5	42,262,345	48.86%	0.01%	21.66%	0.2386	0.0740
91.5	39,533,705	47.95%	0.00%	20.52%	0.2299	0.0752
92.5	36,914,937	47.08%	0.00%	19.40%	0.2217	0.0766
93.5	34,903,167	46.21%	0.00%	18.32%	0.2135	0.0778
94.5	32,811,727	45.30%	0.00%	17.27%	0.2052	0.0786
95.5	31,242,044	44.55%	0.00%	16.25%	0.1985	0.0801
96.5	29,597,539	43.55%	0.00%	15.26%	0.1897	0.0800
97.5	28,185,976	42.55%	0.00%	14.31%	0.1811	0.0797
98.5	26,911,762	41.43%	0.00%	13.39%	0.1716	0.0786
99.5	25,925,513	40.36%	0.00%	12.51%	0.1629	0.0776
100.5	24,868,591	39.30%	0.00%	11.66%	0.1544	0.0764
101.5	23,860,697	37.96%	0.00%	10.85%	0.1441	0.0735
102.5	22,223,446	36.06%	0.00%	10.07%	0.1300	0.0676
103.5	20,486,668	34.43%	0.00%	9.32%	0.1185	0.0630
104.5	18,191,999	32.59%	0.00%	8.61%	0.1062	0.0575
105.5	15,976,340	31.12%	0.00%	7.93%	0.0968	0.0538
106.5	13,689,772	29.53%	0.00%	7.29%	0.0872	0.0495
107.5	11,271,046	27.85%	0.00%	6.68%	0.0776	0.0448
108.5	8,687,578	26.13%	0.00%	6.10%	0.0683	0.0401
109.5	6,562,830	24.93%	0.00%	5.56%	0.0622	0.0375
110.5	5,175,539	23.50%	0.00%	5.05%	0.0552	0.0340
111.5	3,930,503	22.38%	0.00%	4.57%	0.0501	0.0317
112.5	2,962,088	21.20%	0.00%	4.12%	0.0449	0.0292
113.5	2,009,299	20.09%	0.00%	3.70%	0.0404	0.0269
114.5	1,332,722	18.92%	0.00%	3.31%	0.0358	0.0244
115.5	994,972	18.42%	0.00%	2.94%	0.0339	0.0240
116.5	595,606	17.79%	0.00%	2.61%	0.0316	0.0230
117.5	237,808	16.71%	0.00%	2.30%	0.0279	0.0208
118.5	207,995	16.08%	0.00%	2.02%	0.0259	0.0198
119.5			0.00%	1.76%		
Sum of Squared Differences				[8]	10.7677	2.5957
Up to 1% of Beginning Exposures				[9]	8.4728	1.4023

[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 369 Curve Fitting

[1] Age (Years)	[2] Exposures (Dollars)	[3] Observed Life Table (OLT)	[4] Company R3-45	[5] AG R3-55	[6] Company SSD	[7] AG SSD
0.0	120,573,192	100.00%	100.00%	100.00%	0.0000	0.0000
0.5	119,830,545	100.00%	99.98%	99.99%	0.0000	0.0000
1.5	112,291,694	99.99%	99.94%	99.95%	0.0000	0.0000
2.5	96,713,389	99.98%	99.90%	99.92%	0.0000	0.0000
3.5	84,674,207	99.94%	99.84%	99.88%	0.0000	0.0000
4.5	76,324,724	99.89%	99.77%	99.83%	0.0000	0.0000
5.5	65,344,930	99.86%	99.69%	99.77%	0.0000	0.0000
6.5	60,021,484	99.78%	99.60%	99.71%	0.0000	0.0000
7.5	53,919,600	99.71%	99.49%	99.64%	0.0000	0.0000
8.5	47,498,111	99.60%	99.37%	99.55%	0.0000	0.0000
9.5	43,145,848	99.53%	99.22%	99.46%	0.0000	0.0000
10.5	35,513,152	99.41%	99.06%	99.36%	0.0000	0.0000
11.5	32,486,786	99.20%	98.87%	99.24%	0.0000	0.0000
12.5	27,935,529	99.05%	98.66%	99.11%	0.0000	0.0000
13.5	26,101,956	98.56%	98.41%	98.96%	0.0000	0.0000
14.5	25,150,861	98.33%	98.14%	98.80%	0.0000	0.0000
15.5	24,439,650	98.11%	97.83%	98.62%	0.0000	0.0000
16.5	23,375,757	97.84%	97.49%	98.41%	0.0000	0.0000
17.5	21,905,263	96.93%	97.10%	98.19%	0.0000	0.0002
18.5	20,626,506	96.62%	96.68%	97.95%	0.0000	0.0002
19.5	19,090,465	96.40%	96.20%	97.68%	0.0000	0.0002
20.5	18,198,090	96.16%	95.68%	97.39%	0.0000	0.0002
21.5	17,255,813	95.82%	95.10%	97.07%	0.0001	0.0002
22.5	16,113,397	95.66%	94.47%	96.72%	0.0001	0.0001
23.5	15,226,545	95.24%	93.77%	96.33%	0.0002	0.0001
24.5	13,961,053	95.00%	93.01%	95.92%	0.0004	0.0001
25.5	13,463,221	94.41%	92.18%	95.47%	0.0005	0.0001
26.5	12,685,813	93.74%	91.28%	94.99%	0.0006	0.0002
27.5	10,809,274	93.52%	90.30%	94.47%	0.0010	0.0001
28.5	10,126,983	93.31%	89.23%	93.90%	0.0017	0.0000
29.5	9,717,797	92.92%	88.08%	93.29%	0.0023	0.0000
30.5	7,806,854	92.39%	86.84%	92.64%	0.0031	0.0000
31.5	7,572,047	92.04%	85.49%	91.94%	0.0043	0.0000
32.5	7,310,472	91.64%	84.04%	91.19%	0.0058	0.0000
33.5	6,665,927	90.85%	82.47%	90.39%	0.0070	0.0000
34.5	6,448,611	90.63%	80.79%	89.53%	0.0097	0.0001
35.5	6,113,670	90.43%	78.98%	88.62%	0.0131	0.0003
36.5	5,564,062	90.26%	77.04%	87.64%	0.0175	0.0007
37.5	5,119,891	89.87%	74.96%	86.60%	0.0222	0.0011
38.5	4,391,636	89.41%	72.73%	85.49%	0.0278	0.0015
39.5	4,285,369	88.47%	70.36%	84.31%	0.0328	0.0017
40.5	4,161,910	88.13%	67.84%	83.06%	0.0412	0.0026
41.5	3,981,329	87.52%	65.17%	81.72%	0.0499	0.0034
42.5	3,831,737	86.97%	62.36%	80.31%	0.0606	0.0044
43.5	3,697,115	86.58%	59.41%	78.81%	0.0738	0.0060
44.5	3,658,360	86.47%	56.33%	77.22%	0.0909	0.0086

Account 369 Curve Fitting

[1] Age (Years)	[2] Exposures (Dollars)	[3] Observed Life Table (OLT)	[4] Company R3-45	[5] AG R3-55	[6] Company SSD	[7] AG SSD
45.5	3,589,826	86.26%	53.13%	75.54%	0.1098	0.0115
46.5	3,466,098	86.13%	49.84%	73.76%	0.1317	0.0153
47.5	3,124,618	85.08%	46.47%	71.89%	0.1491	0.0174
48.5	2,988,992	84.41%	43.05%	69.91%	0.1710	0.0210
49.5	2,594,504	84.27%	39.62%	67.84%	0.1994	0.0270
50.5	2,411,739	83.86%	36.20%	65.67%	0.2272	0.0331
51.5	2,372,631	83.66%	32.82%	63.40%	0.2585	0.0411
52.5	2,063,878	83.50%	29.52%	61.03%	0.2914	0.0505
53.5	1,966,651	83.38%	26.33%	58.58%	0.3255	0.0615
54.5	1,766,682	83.33%	23.28%	56.04%	0.3606	0.0745
55.5	772,517	83.33%	20.39%	53.42%	0.3961	0.0894
56.5	741,976	83.17%	17.70%	50.74%	0.4286	0.1052
57.5	636,632	83.16%	15.21%	48.01%	0.4618	0.1236
58.5	611,914	82.97%	12.92%	45.23%	0.4906	0.1424
59.5	571,822	82.90%	10.87%	42.43%	0.5188	0.1638
60.5	542,077	82.18%	9.03%	39.62%	0.5351	0.1812
61.5	535,274	82.06%	7.40%	36.81%	0.5574	0.2047
62.5	506,140	82.06%	5.97%	34.04%	0.5789	0.2306
63.5	483,300	82.06%	4.74%	31.31%	0.5978	0.2576
64.5	387,934	82.06%	3.69%	28.64%	0.6142	0.2854
65.5	338,382	82.06%	2.80%	26.04%	0.6282	0.3138
66.5			2.07%	23.55%		
Sum of Squared Differences				[8]	8.4985	2.4826
Up to 1% of Beginning Exposures				[9]	2.6910	0.3849

[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 R3-35	[5] AG S1-45	[6] Company SSD	[7] AG SSD
0.0	1,759,511,151	100.00%	100.00%	100.00%	0.0000	0.0000
0.5	1,700,701,161	99.99%	99.98%	100.00%	0.0000	0.0000
1.5	1,642,097,929	99.95%	99.92%	99.99%	0.0000	0.0000
2.5	1,539,686,743	99.90%	99.86%	99.97%	0.0000	0.0000
3.5	1,480,707,342	99.83%	99.77%	99.92%	0.0000	0.0000
4.5	1,422,468,277	99.75%	99.67%	99.84%	0.0000	0.0000
5.5	1,355,200,297	99.61%	99.54%	99.73%	0.0000	0.0000
6.5	1,284,391,315	99.45%	99.39%	99.57%	0.0000	0.0000
7.5	1,204,249,557	99.24%	99.20%	99.36%	0.0000	0.0000
8.5	1,112,592,463	98.95%	98.98%	99.10%	0.0000	0.0000
9.5	1,017,620,768	98.72%	98.72%	98.79%	0.0000	0.0000
10.5	907,178,587	98.48%	98.41%	98.42%	0.0000	0.0000
11.5	834,609,467	98.06%	98.06%	97.99%	0.0000	0.0000
12.5	813,286,930	97.69%	97.64%	97.50%	0.0000	0.0000
13.5	712,349,245	97.16%	97.16%	96.94%	0.0000	0.0000
14.5	678,831,274	96.46%	96.61%	96.32%	0.0000	0.0000
15.5	619,557,121	95.33%	95.98%	95.63%	0.0000	0.0000
16.5	563,085,857	94.22%	95.27%	94.88%	0.0001	0.0000
17.5	521,744,084	93.20%	94.47%	94.05%	0.0002	0.0001
18.5	477,677,381	92.16%	93.56%	93.16%	0.0002	0.0001
19.5	441,582,599	91.15%	92.54%	92.20%	0.0002	0.0001
20.5	413,861,855	90.43%	91.41%	91.17%	0.0001	0.0001
21.5	363,414,655	89.42%	90.15%	90.08%	0.0001	0.0000
22.5	323,768,380	88.44%	88.75%	88.92%	0.0000	0.0000
23.5	279,833,556	86.82%	87.20%	87.69%	0.0000	0.0001
24.5	256,036,680	85.45%	85.49%	86.40%	0.0000	0.0001
25.5	227,170,676	83.67%	83.60%	85.06%	0.0000	0.0002
26.5	204,889,170	81.86%	81.53%	83.65%	0.0000	0.0003
27.5	177,278,299	80.60%	79.25%	82.18%	0.0002	0.0002
28.5	155,170,159	79.07%	76.75%	80.66%	0.0005	0.0003
29.5	142,290,698	78.02%	74.02%	79.08%	0.0016	0.0001
30.5	128,839,680	76.89%	71.05%	77.45%	0.0034	0.0000
31.5	118,450,296	75.60%	67.84%	75.78%	0.0060	0.0000
32.5	108,998,947	74.48%	64.38%	74.06%	0.0102	0.0000
33.5	101,706,511	73.41%	60.69%	72.30%	0.0162	0.0001
34.5	93,956,909	72.23%	56.77%	70.49%	0.0239	0.0003
35.5	87,609,157	70.96%	52.66%	68.65%	0.0335	0.0005
36.5	81,699,189	69.63%	48.40%	66.78%	0.0451	0.0008
37.5	76,406,733	68.35%	44.03%	64.88%	0.0591	0.0012
38.5	70,287,623	66.84%	39.62%	62.95%	0.0741	0.0015
39.5	63,821,742	65.38%	35.22%	61.00%	0.0909	0.0019
40.5	55,912,772	63.44%	30.92%	59.03%	0.1058	0.0019
41.5	50,786,181	61.71%	26.78%	57.04%	0.1220	0.0022
42.5	47,462,983	60.16%	22.86%	55.03%	0.1392	0.0026
43.5	43,379,750	56.45%	19.21%	53.02%	0.1386	0.0012
44.5	41,393,513	55.16%	15.90%	51.01%	0.1542	0.0017
45.5	7,733,787	53.62%	12.92%	48.99%	0.1656	0.0021
46.5	7,383,626	51.01%	10.32%	46.98%	0.1656	0.0016
47.5	7,139,646	48.55%	8.07%	44.97%	0.1638	0.0013
48.5	6,919,619	46.24%	6.17%	42.96%	0.1606	0.0011
49.5	6,647,478	44.04%	4.58%	40.97%	0.1557	0.0009
50.5	6,368,742	41.84%	3.29%	39.00%	0.1486	0.0008
51.5	6,007,706	39.64%	2.26%	37.05%	0.1397	0.0007
52.5	5,678,428	37.51%	1.47%	35.12%	0.1299	0.0006
53.5	5,352,114	35.45%	0.88%	33.22%	0.1195	0.0005
54.5	4,999,254	33.45%	0.48%	31.35%	0.1087	0.0004
55.5	4,646,014	31.60%	0.22%	29.51%	0.0985	0.0004
56.5	4,302,390	29.78%	0.08%	27.70%	0.0882	0.0004
57.5	3,997,033	27.96%	0.02%	25.94%	0.0781	0.0004
58.5	3,715,595	26.18%	0.00%	24.22%	0.0685	0.0004
59.5	3,413,061	24.40%	0.00%	22.55%	0.0595	0.0003
60.5	3,856,708	22.55%	0.00%	20.92%	0.0509	0.0003
61.5	3,532,837	20.86%	0.00%	19.34%	0.0435	0.0002
62.5	3,251,021	19.44%	0.00%	17.82%	0.0378	0.0003
63.5	2,973,848	18.07%	0.00%	16.35%	0.0327	0.0003
64.5	2,734,433	16.81%	0.00%	14.94%	0.0283	0.0003
65.5	2,529,786	15.74%	0.00%	13.60%	0.0248	0.0005
66.5	2,357,787	14.80%	0.00%	12.31%	0.0219	0.0006
67.5	2,220,426	14.00%	0.00%	11.08%	0.0196	0.0009
68.5	2,310,347	13.35%	0.00%	9.92%	0.0178	0.0012
69.5	2,201,570	12.79%	0.00%	8.83%	0.0164	0.0016
70.5	2,104,517	12.27%	0.00%	7.80%	0.0151	0.0020
71.5	2,014,262	11.81%	0.00%	6.84%	0.0139	0.0025

Account 380 Curve Fitting

[1] Age (Years)	[2] Exposures (Dollars)	[3] Observed Life Table (OLT)	[4] Company R3-35	[5] AG S1-45	[6] Company SSD	[7] AG SSD
72.5	1,936,858	11.40%	0.00%	5.95%	0.0130	0.0030
73.5	1,851,365	10.95%	0.00%	5.12%	0.0120	0.0034
74.5	1,777,873	10.55%	0.00%	4.37%	0.0111	0.0038
75.5	1,710,328	10.19%	0.00%	3.68%	0.0104	0.0042
76.5	1,658,430	9.90%	0.00%	3.06%	0.0098	0.0047
77.5	1,609,143	9.64%	0.00%	2.50%	0.0093	0.0051
78.5	1,550,569	9.34%	0.00%	2.01%	0.0087	0.0054
79.5	1,504,522	9.16%	0.00%	1.58%	0.0084	0.0057
80.5	1,457,765	9.00%	0.00%	1.21%	0.0081	0.0061
81.5	1,409,920	8.78%	0.00%	0.90%	0.0077	0.0062
82.5	1,363,065	8.59%	0.00%	0.64%	0.0074	0.0063
83.5	1,328,073	8.47%	0.00%	0.43%	0.0072	0.0065
84.5	1,293,678	8.38%	0.00%	0.27%	0.0070	0.0066
85.5	1,242,163	8.22%	0.00%	0.16%	0.0068	0.0065
86.5	1,211,664	8.08%	0.00%	0.08%	0.0065	0.0064
87.5	1,151,925	7.97%	0.00%	0.03%	0.0064	0.0063
88.5	1,100,178	7.88%	0.00%	0.01%	0.0062	0.0062
89.5	1,039,856	7.74%	0.00%	0.00%	0.0060	0.0060
90.5	983,706	7.66%	0.00%	0.00%	0.0059	0.0059
91.5	937,125	7.59%	0.00%	0.00%	0.0058	0.0058
92.5	902,067	7.54%	0.00%	0.00%	0.0057	0.0057
93.5	866,661	7.49%	0.00%	0.00%	0.0056	0.0056
94.5	840,082	7.46%	0.00%	0.00%	0.0056	0.0056
95.5	826,191	7.44%	0.00%	0.00%	0.0055	0.0055
96.5	811,836	7.42%	0.00%	0.00%	0.0055	0.0055
97.5	796,144	7.36%	0.00%	0.00%	0.0054	0.0054
98.5	784,261	7.31%	0.00%	0.00%	0.0053	0.0053
99.5	775,667	7.27%	0.00%	0.00%	0.0053	0.0053
100.5	763,654	7.22%	0.00%	0.00%	0.0052	0.0052
101.5	747,405	7.11%	0.00%	0.00%	0.0051	0.0051
102.5	719,452	7.01%	0.00%	0.00%	0.0049	0.0049
103.5	690,761	6.91%	0.00%	0.00%	0.0048	0.0048
104.5	653,632	6.85%	0.00%	0.00%	0.0047	0.0047
105.5	617,148	6.77%	0.00%	0.00%	0.0046	0.0046
106.5	585,132	6.66%	0.00%	0.00%	0.0044	0.0044
107.5	546,724	6.62%	0.00%	0.00%	0.0044	0.0044
108.5	522,447	6.59%	0.00%	0.00%	0.0043	0.0043
109.5	491,370	6.55%	0.00%	0.00%	0.0043	0.0043
110.5	488,947	6.52%	0.00%	0.00%	0.0043	0.0043
111.5	488,947	6.52%	0.00%	0.00%	0.0043	0.0043
112.5	488,540	6.52%	0.00%	0.00%	0.0043	0.0043
113.5	484,155	6.46%	0.00%	0.00%	0.0042	0.0042
114.5	462,521	6.17%	0.00%	0.00%	0.0038	0.0038
115.5	441,490	5.89%	0.00%	0.00%	0.0035	0.0035
116.5	424,015	5.66%	0.00%	0.00%	0.0032	0.0032
117.5	390,452	5.21%	0.00%	0.00%	0.0027	0.0027
118.5	379,752	5.07%	0.00%	0.00%	0.0026	0.0026
119.5			0.00%	0.00%		
Sum of Squared Differences				[8]	3.4853	0.2738
Up to 1% of Beginning Exposures				[9]	1.0254	0.0179

[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.

BGC
Gas Division
320.17 Other Equipment - LNG

Original Cost Of Utility Plant In Service
And Development Of Composite Remaining Life as of December 31, 2019
Based Upon Broad Group/Remaining Life Procedure and Technique

Average Service Life: 44 **Survivor Curve:** R2.5

Year (1)	Original Cost (2)	Avg. Service Life (3)	Avg. Annual Accrual (4)	Avg. Remaining Life (5)	Future Annual Accruals (6)
1970	63,609.69	44.00	1,445.67	8.29	11,986.01
1977	5,675.04	44.00	128.98	11.23	1,447.96
1983	2,728.57	44.00	62.01	14.50	899.12
1984	11,175.71	44.00	253.99	15.11	3,836.67
1985	209,522.65	44.00	4,761.87	15.73	74,905.54
1988	153,478.96	44.00	3,488.15	17.69	61,703.90
1989	12,382.83	44.00	281.43	18.37	5,170.68
1990	12,591.87	44.00	286.18	19.07	5,456.82
1991	31,265.15	44.00	710.57	19.78	14,051.77
1992	1,523,466.12	44.00	34,624.13	20.49	709,621.21
1993	294,366.77	44.00	6,690.14	21.23	142,025.22
1994	12,022.29	44.00	273.23	21.97	6,003.68
1995	6,835.67	44.00	155.36	22.73	3,530.86
1996	3,556.68	44.00	80.83	23.50	1,899.19
1997	5,298.45	44.00	120.42	24.27	2,922.82
2000	31,368.73	44.00	712.92	26.67	19,010.68
2001	194,401.58	44.00	4,418.21	27.48	121,426.22
2002	32,988.59	44.00	749.74	28.31	21,224.94
2003	763,718.14	44.00	17,357.18	29.15	505,903.70
2004	269,554.31	44.00	6,126.22	29.99	183,735.20
2005	14,086.00	44.00	320.14	30.85	9,874.59
2006	247,134.52	44.00	5,616.68	31.71	178,085.87
2007	1,704,389.17	44.00	38,736.01	32.58	1,261,914.87
2008	654,619.70	44.00	14,877.68	33.45	497,730.35
2009	3,489,046.44	44.00	79,296.29	34.34	2,723,005.15
2010	149,072.31	44.00	3,388.00	35.23	119,363.85
2011	2,475,085.31	44.00	56,251.78	36.13	2,032,430.32

BGC

Gas Division

320.17 Other Equipment - LNG

Original Cost Of Utility Plant In Service

And Development Of Composite Remaining Life as of December 31, 2019

Based Upon Broad Group/Remaining Life Procedure and Technique

Average Service Life: 44 **Survivor Curve:** R2.5

Year (1)	Original Cost (2)	Avg. Service Life (3)	Avg. Annual Accrual (4)	Avg. Remaining Life (5)	Future Annual Accruals (6)
2012	4,157,066.47	44.00	94,478.52	37.04	3,499,116.53
2013	209,295.86	44.00	4,756.71	37.95	180,504.27
2014	1,930,081.99	44.00	43,865.38	38.86	1,704,792.87
2015	2,072,981.18	44.00	47,113.08	39.79	1,874,516.50
2016	2,088,715.30	44.00	47,470.67	40.72	1,932,787.49
2017	1,754,369.38	44.00	39,871.92	41.65	1,660,587.77
2018	66,874,125.97	44.00	1,519,862.31	42.59	64,724,736.35
2019	1,186,516.51	44.00	26,966.21	43.53	1,173,777.21
Total	92,646,593.91	44.00	2,105,598.60	40.59	85,469,986.18

Composite Average Remaining Life ... 40.59 Years

BGC
Gas Division
320.18 Other Equipment

Original Cost Of Utility Plant In Service
And Development Of Composite Remaining Life as of December 31, 2019
Based Upon Broad Group/Remaining Life Procedure and Technique

Average Service Life: 44 **Survivor Curve:** R2.5

Year (1)	Original Cost (2)	Avg. Service Life (3)	Avg. Annual Accrual (4)	Avg. Remaining Life (5)	Future Annual Accruals (6)
1909	5,783.04	0.00	0.00	0.00	0.00
1934	4,640.43	0.00	0.00	0.00	0.00
1947	17,275.73	44.00	392.63	2.47	969.12
1949	8,053.40	44.00	183.03	2.96	541.06
1950	1,176.00	44.00	26.73	3.19	85.28
1951	1,122.54	44.00	25.51	3.42	87.19
1953	1,612.28	44.00	36.64	3.85	140.97
1954	32,803.74	44.00	745.54	4.07	3,032.55
1955	19,263.16	44.00	437.80	4.29	1,878.35
1956	18,014.09	44.00	409.41	4.51	1,844.64
1957	946.18	44.00	21.50	4.73	101.79
1958	41.51	44.00	0.94	4.97	4.68
1959	21,206.03	44.00	481.95	5.20	2,503.99
1960	4,207.88	44.00	95.63	5.43	519.72
1961	19,550.78	44.00	444.33	5.68	2,523.40
1962	4,320.70	44.00	98.20	5.93	582.29
1963	3,531.36	44.00	80.26	6.18	496.19
1964	14,173.50	44.00	322.12	6.45	2,076.93
1965	60,185.89	44.00	1,367.86	6.72	9,195.92
1966	35,466.65	44.00	806.06	7.01	5,649.94
1967	109,790.67	44.00	2,495.24	7.31	18,228.51
1968	1,203.06	44.00	27.34	7.62	208.30
1969	75,124.55	44.00	1,707.37	7.95	13,567.46
1970	151,344.55	44.00	3,439.64	8.29	28,517.93
1971	25,880.75	44.00	588.20	8.65	5,089.36
1972	98,770.89	44.00	2,244.79	9.03	20,276.96
1973	96,442.85	44.00	2,191.88	9.43	20,674.08

BGC

Gas Division

320.18 Other Equipment

Original Cost Of Utility Plant In Service

And Development Of Composite Remaining Life as of December 31, 2019

Based Upon Broad Group/Remaining Life Procedure and Technique

Average Service Life: **44** *Survivor Curve:* **R2.5**

Year (1)	Original Cost (2)	Avg. Service Life (3)	Avg. Annual Accrual (4)	Avg. Remaining Life (5)	Future Annual Accruals (6)
1974	29,065.18	44.00	660.57	9.85	6,507.73
1975	27,330.88	44.00	621.15	10.29	6,391.89
1976	21,899.26	44.00	497.71	10.75	5,349.68
1977	58,807.31	44.00	1,336.53	11.23	15,004.45
1978	9,939.41	44.00	225.90	11.73	2,648.89
1979	41,862.05	44.00	951.41	12.24	11,648.55
1980	27,251.17	44.00	619.34	12.78	7,914.90
1981	153,708.90	44.00	3,493.37	13.34	46,587.07
1982	757,483.54	44.00	17,215.49	13.91	239,447.16
1983	51,504.89	44.00	1,170.56	14.50	16,971.85
1984	415,905.05	44.00	9,452.36	15.11	142,782.02
1985	98,075.55	44.00	2,228.98	15.73	35,062.57
1986	51,058.67	44.00	1,160.42	16.37	18,994.87
1987	26,548.54	44.00	603.37	17.02	10,270.77
1988	136,527.89	44.00	3,102.90	17.69	54,888.98
1989	90,562.80	44.00	2,058.24	18.37	37,816.21
1990	34,201.16	44.00	777.30	19.07	14,821.44
1991	32,532.13	44.00	739.36	19.78	14,621.20
1992	13,978.62	44.00	317.70	20.49	6,511.16
1994	105,372.46	44.00	2,394.82	21.97	52,620.81
1995	104,363.16	44.00	2,371.88	22.73	53,907.16
1996	11,787.60	44.00	267.90	23.50	6,294.32
1998	214,520.27	44.00	4,875.45	25.06	122,175.82
2001	148,604.44	44.00	3,377.36	27.48	92,820.62
2002	268,550.64	44.00	6,103.41	28.31	172,786.14
2003	157,599.05	44.00	3,581.79	29.15	104,397.08
2004	95,260.97	44.00	2,165.02	29.99	64,932.34

BGC

Gas Division

320.18 Other Equipment

Original Cost Of Utility Plant In Service

And Development Of Composite Remaining Life as of December 31, 2019

Based Upon Broad Group/Remaining Life Procedure and Technique

Average Service Life: **44** *Survivor Curve:* **R2.5**

Year (1)	Original Cost (2)	Avg. Service Life (3)	Avg. Annual Accrual (4)	Avg. Remaining Life (5)	Future Annual Accruals (6)
2005	2,198,188.18	44.00	49,958.68	30.85	1,540,977.54
2006	15,213.46	44.00	345.76	31.71	10,962.86
2007	302,983.81	44.00	6,885.98	32.58	224,326.57
2008	290,183.39	44.00	6,595.06	33.45	220,636.62
2009	534,486.31	44.00	12,147.38	34.34	417,136.60
2010	551,501.92	44.00	12,534.10	35.23	441,593.68
2011	719,627.71	44.00	16,355.13	36.13	590,926.37
2012	180,497.30	44.00	4,102.20	37.04	151,929.51
2013	125,261.79	44.00	2,846.85	37.95	108,030.27
2014	1,525,182.56	44.00	34,663.14	38.86	1,347,155.39
2015	987,273.03	44.00	22,437.96	39.79	892,752.72
2016	291,412.22	44.00	6,622.99	40.72	269,657.57
2017	332,429.19	44.00	7,555.19	41.65	314,658.85
2018	279,099.33	44.00	6,343.15	42.59	270,128.85
2019	1,926,363.65	44.00	43,780.87	43.53	1,905,680.82
Total	14,275,937.65	42.72	324,215.34	31.49	10,209,526.52

Composite Average Remaining Life ... 31.49 Years

BGC

Gas Division

361.03 Structures and Improvements

Original Cost Of Utility Plant In Service

And Development Of Composite Remaining Life as of December 31, 2019

Based Upon Broad Group/Remaining Life Procedure and Technique

Average Service Life: 54 **Survivor Curve: S1.5**

Year (1)	Original Cost (2)	Avg. Service Life (3)	Avg. Annual Accrual (4)	Avg. Remaining Life (5)	Future Annual Accruals (6)
1901	2,459.48	0.00	0.00	0.00	0.00
1928	2,905.57	54.00	53.81	4.26	229.41
1932	595.00	54.00	11.02	5.27	58.10
1965	772.17	54.00	14.30	15.32	219.01
1966	4,223.53	54.00	78.21	15.71	1,228.94
1974	67,203.80	54.00	1,244.51	19.20	23,900.33
1975	12,818.17	54.00	237.37	19.68	4,672.64
1976	32,589.47	54.00	603.51	20.17	12,175.32
1983	8,286.94	54.00	153.46	23.93	3,672.72
1985	2,344.40	54.00	43.41	25.12	1,090.56
1989	72,000.65	54.00	1,333.35	27.66	36,874.49
1992	21,090.93	54.00	390.57	29.70	11,601.92
1993	16,270.26	54.00	301.30	30.42	9,164.91
1995	41,322.37	54.00	765.23	31.89	24,401.11
1996	3,259.72	54.00	60.37	32.64	1,970.41
1998	44,235.95	54.00	819.18	34.20	28,016.39
1999	13,703.11	54.00	253.76	35.00	8,882.01
2003	288.94	54.00	5.35	38.34	205.17
2005	14,073.44	54.00	260.62	40.10	10,450.39
2006	3,064.87	54.00	56.76	40.99	2,326.70
2007	37,436.15	54.00	693.26	41.90	29,049.07
2009	127,983.50	54.00	2,370.07	43.75	103,693.40
2011	148,143.48	54.00	2,743.40	45.64	125,211.29
2012	48,177.09	54.00	892.17	46.60	41,575.45
2013	11,475.00	54.00	212.50	47.57	10,108.23
2014	89,568.61	54.00	1,658.68	48.54	80,517.65
2015	99,422.96	54.00	1,841.17	49.53	91,183.83

BGC
Gas Division
361.03 Structures and Improvements

Original Cost Of Utility Plant In Service
And Development Of Composite Remaining Life as of December 31, 2019
Based Upon Broad Group/Remaining Life Procedure and Technique

Average Service Life: **54** *Survivor Curve:* **S1.5**

Year (1)	Original Cost (2)	Avg. Service Life (3)	Avg. Annual Accrual (4)	Avg. Remaining Life (5)	Future Annual Accruals (6)
2017	15,180.00	54.00	281.11	51.50	14,478.51
Total	940,895.56	52.07	17,378.45	38.95	676,957.95

Composite Average Remaining Life ... 38.95 Years

BGC

Gas Division

361.07 Structures and Improvements - LNG

Original Cost Of Utility Plant In Service

And Development Of Composite Remaining Life as of December 31, 2019

Based Upon Broad Group/Remaining Life Procedure and Technique

Average Service Life: 54 **Survivor Curve: S1.5**

Year (1)	Original Cost (2)	Avg. Service Life (3)	Avg. Annual Accrual (4)	Avg. Remaining Life (5)	Future Annual Accruals (6)
1969	601,408.97	54.00	11,137.20	16.95	188,810.25
1970	1,037,229.41	54.00	19,207.95	17.38	333,917.33
1971	142,994.61	54.00	2,648.05	17.82	47,200.99
1972	97,580.80	54.00	1,807.05	18.27	33,023.59
1973	34,947.16	54.00	647.17	18.73	12,124.50
1974	4,852.79	54.00	89.87	19.20	1,725.84
1978	90,714.22	54.00	1,679.89	21.19	35,596.43
1979	116,522.54	54.00	2,157.82	21.71	46,856.18
1980	51,458.37	54.00	952.93	22.25	21,203.86
1982	9,239.00	54.00	171.09	23.36	3,996.85
1983	25,419.63	54.00	470.73	23.93	11,265.82
1985	165,114.43	54.00	3,057.67	25.12	76,807.63
1988	43,679.00	54.00	808.87	27.00	21,840.21
1989	15,415.58	54.00	285.47	27.66	7,894.95
1990	14,997.49	54.00	277.73	28.32	7,866.05
1992	759,424.64	54.00	14,063.42	29.70	417,752.41
1995	36,258.19	54.00	671.45	31.89	21,410.68
1996	102,583.20	54.00	1,899.69	32.64	62,008.61
2001	118,548.75	54.00	2,195.35	36.65	80,450.98
2005	1,001.80	54.00	18.55	40.10	743.90
2006	124,349.57	54.00	2,302.77	40.99	94,400.18
2007	108,746.78	54.00	2,013.83	41.90	84,383.48
2008	50,373.81	54.00	932.85	42.82	39,945.70
2009	89,727.94	54.00	1,661.63	43.75	72,698.40
2010	68,652.15	54.00	1,271.34	44.69	56,816.47
2011	14,084.33	54.00	260.82	45.64	11,904.12
2013	12,801,652.44	54.00	237,067.66	47.57	11,276,865.62

BGC

Gas Division

361.07 Structures and Improvements - LNG

Original Cost Of Utility Plant In Service

And Development Of Composite Remaining Life as of December 31, 2019

Based Upon Broad Group/Remaining Life Procedure and Technique

***Average Service Life:* 54** ***Survivor Curve:* S1.5**

Year (1)	Original Cost (2)	Avg. Service Life (3)	Avg. Annual Accrual (4)	Avg. Remaining Life (5)	Future Annual Accruals (6)
2015	81,657.34	54.00	1,512.17	49.53	74,890.44
2017	1,471,821.04	54.00	27,255.95	51.50	1,403,805.61
2018	90,648,854.91	54.00	1,678,682.63	52.50	88,132,615.54
Total	108,929,310.89	54.00	2,017,209.62	50.90	102,680,822.61

Composite Average Remaining Life ...* 50.90 *Years

BGC
Gas Division
361.08 Structures and Improvements - LNG Tanks

Original Cost Of Utility Plant In Service
And Development Of Composite Remaining Life as of December 31, 2019
Based Upon Broad Group/Remaining Life Procedure and Technique

Average Service Life: 54 **Survivor Curve: S1.5**

Year (1)	Original Cost (2)	Avg. Service Life (3)	Avg. Annual Accrual (4)	Avg. Remaining Life (5)	Future Annual Accruals (6)
1991	156,269.10	54.00	2,893.87	29.01	83,941.13
2012	24,427.49	54.00	452.36	46.60	21,080.22
2013	14,299.55	54.00	264.81	47.57	12,596.35
2014	1,276,808.59	54.00	23,644.61	48.54	1,147,786.40
Total	1,471,804.73	54.00	27,255.65	46.43	1,265,404.10

Composite Average Remaining Life ... 46.43 Years

BGC

Gas Division

367.12 Mains - Plastic

Original Cost Of Utility Plant In Service

And Development Of Composite Remaining Life as of December 31, 2019

Based Upon Broad Group/Remaining Life Procedure and Technique

Average Service Life: 70 *Survivor Curve:* S1.5

Year (1)	Original Cost (2)	Avg. Service Life (3)	Avg. Annual Accrual (4)	Avg. Remaining Life (5)	Future Annual Accruals (6)
1975	193,024.01	70.00	2,757.49	32.70	90,156.56
1976	409,923.49	70.00	5,856.05	33.31	195,073.36
1977	413,623.36	70.00	5,908.91	33.93	200,514.16
1978	457,985.68	70.00	6,542.65	34.57	226,187.26
1979	399,507.46	70.00	5,707.25	35.22	200,985.25
1980	807,181.93	70.00	11,531.17	35.87	413,668.01
1981	922,735.49	70.00	13,181.94	36.54	481,677.93
1982	812,874.60	70.00	11,612.50	37.22	432,187.35
1983	950,236.25	70.00	13,574.80	37.91	514,621.05
1984	1,557,351.68	70.00	22,247.88	38.61	858,979.78
1985	4,394,148.44	70.00	62,773.55	39.32	2,468,509.86
1986	5,781,656.40	70.00	82,595.10	40.05	3,307,651.68
1987	9,139,739.34	70.00	130,567.71	40.78	5,324,974.86
1988	23,423,866.87	70.00	334,626.69	41.53	13,896,697.58
1989	16,103,943.18	70.00	230,056.35	42.28	9,727,884.71
1990	13,667,475.02	70.00	195,249.66	43.06	8,406,811.27
1991	20,020,080.50	70.00	286,001.17	43.84	12,537,054.31
1992	26,448,954.56	70.00	377,842.23	44.63	16,862,932.27
1993	15,839,877.82	70.00	226,283.98	45.43	10,280,399.77
1994	33,071,831.43	70.00	472,454.76	46.25	21,849,585.49
1995	38,968,878.14	70.00	556,698.29	47.07	26,204,495.43
1996	19,761,747.10	70.00	282,310.69	47.91	13,524,182.33
1997	22,796,292.97	70.00	325,661.35	48.75	15,877,405.92
1998	20,424,673.66	70.00	291,781.07	49.61	14,475,262.88
1999	23,948,963.65	70.00	342,128.07	50.48	17,270,354.90
2000	23,718,037.54	70.00	338,829.13	51.36	17,400,800.38
2001	56,999,529.81	70.00	814,279.05	52.24	42,541,355.30

BGC

Gas Division

367.12 Mains - Plastic

Original Cost Of Utility Plant In Service

And Development Of Composite Remaining Life as of December 31, 2019

Based Upon Broad Group/Remaining Life Procedure and Technique

Average Service Life: *70* *Survivor Curve:* *S1.5*

Year (1)	Original Cost (2)	Avg. Service Life (3)	Avg. Annual Accrual (4)	Avg. Remaining Life (5)	Future Annual Accruals (6)
2002	52,864,064.94	70.00	755,200.98	53.14	40,131,731.11
2003	47,819,109.43	70.00	683,130.18	54.05	36,919,858.25
2004	45,902,258.58	70.00	655,746.59	54.96	36,041,307.73
2005	41,322,588.47	70.00	590,322.73	55.88	32,990,163.36
2006	32,266,996.27	70.00	460,957.12	56.82	26,190,878.66
2007	44,672,440.50	70.00	638,177.76	57.76	36,859,758.65
2008	34,960,050.49	70.00	499,429.32	58.71	29,319,676.34
2009	79,327,308.02	70.00	1,133,247.33	59.66	67,610,392.24
2010	82,449,122.80	70.00	1,177,844.69	60.62	71,402,526.99
2011	82,664,227.08	70.00	1,180,917.60	61.59	72,733,370.41
2012	131,085,352.61	70.00	1,872,648.01	62.56	117,159,651.86
2013	169,945,331.78	70.00	2,427,790.61	63.54	154,270,565.07
2014	184,380,525.96	70.00	2,634,007.68	64.53	169,965,103.98
2015	183,680,249.47	70.00	2,624,003.73	65.52	171,914,160.99
2016	253,172,628.70	70.00	3,616,752.07	66.51	240,542,359.78
2017	254,428,077.57	70.00	3,634,687.05	67.50	245,351,053.46
2018	121,570,250.38	70.00	1,736,717.97	68.50	118,966,552.92
2019	253,967,974.65	70.00	3,628,114.15	69.50	252,153,706.40
Total	2,477,912,698.08	70.00	35,398,755.06	61.47	2,176,093,227.87

Composite Average Remaining Life ... 61.47 Years

BGC
Gas Division
367.13 Mains - Disconnected and Reconnected

Original Cost Of Utility Plant In Service
And Development Of Composite Remaining Life as of December 31, 2019
Based Upon Broad Group/Remaining Life Procedure and Technique

***Average Service Life:* 70** ***Survivor Curve:* S1.5**

Year (1)	Original Cost (2)	Avg. Service Life (3)	Avg. Annual Accrual (4)	Avg. Remaining Life (5)	Future Annual Accruals (6)
2018	618,363.02	70.00	8,833.76	68.50	605,119.40
2019	2,711,295.22	70.00	38,732.79	69.50	2,691,926.57
Total	3,329,658.24	70.00	47,566.55	69.31	3,297,045.97

Composite Average Remaining Life ... 69.31 Years

BGC

Gas Division

367.14 Mains - Steel

Original Cost Of Utility Plant In Service

And Development Of Composite Remaining Life as of December 31, 2019

Based Upon Broad Group/Remaining Life Procedure and Technique

Average Service Life: 70 **Survivor Curve: S1.5**

Year (1)	Original Cost (2)	Avg. Service Life (3)	Avg. Annual Accrual (4)	Avg. Remaining Life (5)	Future Annual Accruals (6)
1903	3,148.01	70.00	44.97	6.05	272.10
1905	8,883.69	70.00	126.91	6.57	833.45
1908	66.99	70.00	0.96	7.32	7.00
1912	12,530.59	70.00	179.01	8.35	1,495.60
1923	162.33	70.00	2.32	11.31	26.24
1926	12,464.50	70.00	178.06	12.18	2,168.06
1927	631.29	70.00	9.02	12.46	112.40
1928	18,696.71	70.00	267.10	12.76	3,408.54
1929	7,244.57	70.00	103.49	13.06	1,351.36
1930	23,443.26	70.00	334.90	13.36	4,474.64
1931	47,817.35	70.00	683.11	13.66	9,334.52
1932	372.53	70.00	5.32	13.97	74.37
1934	357.51	70.00	5.11	14.60	74.59
1935	1,019.52	70.00	14.56	14.93	217.39
1936	1,772.32	70.00	25.32	15.25	386.10
1937	297.92	70.00	4.26	15.58	66.31
1938	85.45	70.00	1.22	15.91	19.42
1947	24,370.67	70.00	348.15	19.13	6,661.79
1949	1,454.73	70.00	20.78	19.91	413.77
1950	922.55	70.00	13.18	20.31	267.64
1952	156,943.81	70.00	2,242.05	21.12	47,352.95
1953	3,731.66	70.00	53.31	21.54	1,148.10
1955	9,302.55	70.00	132.89	22.39	2,975.42
1956	11,306.23	70.00	161.52	22.83	3,686.79
1957	3,959.80	70.00	56.57	23.27	1,316.39
1958	7,145.42	70.00	102.08	23.72	2,421.46
1959	39,819.55	70.00	568.85	24.18	13,755.69

BGC
Gas Division
367.14 Mains - Steel

Original Cost Of Utility Plant In Service
And Development Of Composite Remaining Life as of December 31, 2019
Based Upon Broad Group/Remaining Life Procedure and Technique

Average Service Life: 70 **Survivor Curve:** S1.5

Year (1)	Original Cost (2)	Avg. Service Life (3)	Avg. Annual Accrual (4)	Avg. Remaining Life (5)	Future Annual Accruals (6)
1960	37,301.10	70.00	532.87	24.65	13,134.27
1961	12,662.20	70.00	180.89	25.12	4,544.25
1962	1,968,388.06	70.00	28,119.83	25.61	720,035.61
1963	1,885,926.12	70.00	26,941.80	26.10	703,077.51
1964	2,415,325.87	70.00	34,504.66	26.60	917,716.59
1965	2,319,509.88	70.00	33,135.86	27.10	898,122.93
1966	1,849,712.24	70.00	26,424.46	27.62	729,900.54
1967	1,768,078.95	70.00	25,258.27	28.15	710,956.32
1968	2,586,033.72	70.00	36,943.34	28.68	1,059,570.57
1969	1,711,047.49	70.00	24,443.54	29.23	714,415.94
1970	1,895,763.54	70.00	27,082.34	29.78	806,502.42
1971	1,557,018.09	70.00	22,243.12	30.34	674,959.72
1972	1,115,069.46	70.00	15,929.56	30.92	492,490.88
1973	783,380.61	70.00	11,191.15	31.50	352,534.01
1974	531,310.33	70.00	7,590.15	32.09	243,595.28
1975	1,136,204.13	70.00	16,231.49	32.70	530,691.76
1976	1,591,605.48	70.00	22,737.22	33.31	757,409.22
1977	1,124,486.32	70.00	16,064.09	33.93	545,122.57
1978	990,608.45	70.00	14,151.55	34.57	489,235.85
1979	2,291,676.89	70.00	32,738.24	35.22	1,152,902.74
1980	2,765,576.19	70.00	39,508.23	35.87	1,417,314.19
1981	2,529,691.99	70.00	36,138.46	36.54	1,320,526.64
1982	1,298,688.68	70.00	18,552.70	37.22	690,483.90
1983	1,673,452.22	70.00	23,906.46	37.91	906,294.34
1984	2,423,173.36	70.00	34,616.76	38.61	1,336,536.21
1985	4,960,909.83	70.00	70,870.14	39.32	2,786,900.58
1986	1,905,828.92	70.00	27,226.13	40.05	1,090,313.54

BGC
Gas Division
367.14 Mains - Steel

Original Cost Of Utility Plant In Service
And Development Of Composite Remaining Life as of December 31, 2019
Based Upon Broad Group/Remaining Life Procedure and Technique

Average Service Life: **70** *Survivor Curve:* **S1.5**

Year (1)	Original Cost (2)	Avg. Service Life (3)	Avg. Annual Accrual (4)	Avg. Remaining Life (5)	Future Annual Accruals (6)
1987	4,540,747.44	70.00	64,867.82	40.78	2,645,520.30
1988	58,602,235.77	70.00	837,174.85	41.53	34,766,998.66
1989	4,780,062.25	70.00	68,286.61	42.28	2,887,485.01
1990	4,009,832.33	70.00	57,283.32	43.06	2,466,432.43
1991	4,819,306.43	70.00	68,847.24	43.84	3,017,965.21
1992	5,962,809.98	70.00	85,183.01	44.63	3,801,679.97
1993	4,345,479.18	70.00	62,078.28	45.43	2,820,303.52
1994	9,144,102.73	70.00	130,630.05	46.25	6,041,239.50
1995	5,287,738.37	70.00	75,539.12	47.07	3,555,722.48
1996	4,242,416.76	70.00	60,605.96	47.91	2,903,347.44
1997	3,977,741.90	70.00	56,824.89	48.75	2,770,460.22
1998	3,901,657.63	70.00	55,737.97	49.61	2,765,161.43
1999	7,596,198.24	70.00	108,517.12	50.48	5,477,858.73
2000	5,712,515.79	70.00	81,607.37	51.36	4,191,002.18
2001	20,728,401.54	70.00	296,120.04	52.24	15,470,553.84
2002	20,788,141.01	70.00	296,973.46	53.14	15,781,307.89
2003	14,454,357.30	70.00	206,490.83	54.05	11,159,823.53
2004	13,229,733.46	70.00	188,996.20	54.96	10,387,656.50
2005	15,500,269.05	70.00	221,432.43	55.88	12,374,742.89
2006	8,120,454.63	70.00	116,006.50	56.82	6,591,312.07
2007	14,816,060.19	70.00	211,658.02	57.76	12,224,906.38
2008	19,580,288.24	70.00	279,718.42	58.71	16,421,249.56
2009	44,275,736.30	70.00	632,510.56	59.66	37,736,058.02
2010	23,812,474.60	70.00	340,178.23	60.62	20,622,061.25
2011	25,618,944.93	70.00	365,984.95	61.59	22,541,216.16
2012	22,291,064.42	70.00	318,443.80	62.56	19,922,998.98
2013	28,348,199.64	70.00	404,974.31	63.54	25,733,526.96

BGC

Gas Division

367.14 Mains - Steel

Original Cost Of Utility Plant In Service

And Development Of Composite Remaining Life as of December 31, 2019

Based Upon Broad Group/Remaining Life Procedure and Technique

Average Service Life: 70 **Survivor Curve: S1.5**

Year (1)	Original Cost (2)	Avg. Service Life (3)	Avg. Annual Accrual (4)	Avg. Remaining Life (5)	Future Annual Accruals (6)
2014	27,642,585.02	70.00	394,894.10	64.53	25,481,404.90
2015	36,736,671.27	70.00	524,809.62	65.52	34,383,413.77
2016	69,699,892.85	70.00	995,712.82	66.51	66,222,706.57
2017	24,818,106.67	70.00	354,544.40	67.50	23,932,691.21
2018	9,401,367.01	70.00	134,305.25	68.50	9,200,015.81
2019	9,663,150.77	70.00	138,045.02	69.50	9,594,120.23
Total	623,975,125.33	70.00	8,913,930.92	55.87	498,062,554.08

Composite Average Remaining Life ... 55.87 Years

BGC
Gas Division
367.15 Mains - Cast Iron

Original Cost Of Utility Plant In Service
And Development Of Composite Remaining Life as of December 31, 2019
Based Upon Broad Group/Remaining Life Procedure and Technique

Average Service Life: 70 *Survivor Curve:* S1.5

Year (1)	Original Cost (2)	Avg. Service Life (3)	Avg. Annual Accrual (4)	Avg. Remaining Life (5)	Future Annual Accruals (6)
1902	236.17	70.00	3.37	5.80	19.58
1903	22,791.50	70.00	325.59	6.05	1,970.02
1904	1,824.52	70.00	26.06	6.31	164.39
1905	64,087.24	70.00	915.53	6.57	6,012.54
1906	41,914.88	70.00	598.78	6.81	4,077.85
1907	70,302.64	70.00	1,004.32	7.07	7,100.68
1908	29,792.66	70.00	425.61	7.32	3,114.47
1909	43,585.93	70.00	622.66	7.58	4,718.24
1910	118,530.58	70.00	1,693.29	7.83	13,257.92
1911	75,002.47	70.00	1,071.46	8.09	8,668.36
1912	26,338.88	70.00	376.27	8.35	3,143.70
1913	11,020.46	70.00	157.44	8.61	1,355.14
1914	49,656.79	70.00	709.38	8.87	6,294.99
1915	20,870.90	70.00	298.16	9.13	2,722.78
1917	41,815.27	70.00	597.36	9.66	5,773.02
1918	84.64	70.00	1.21	9.94	12.01
1919	2,389.47	70.00	34.14	10.21	348.55
1920	5,415.46	70.00	77.36	10.48	810.66
1921	14,985.59	70.00	214.08	10.76	2,302.96
1922	24,373.90	70.00	348.20	11.03	3,841.25
1923	135,310.99	70.00	1,933.01	11.31	21,871.72
1924	35,760.52	70.00	510.86	11.60	5,923.89
1925	126,422.21	70.00	1,806.03	11.88	21,461.95
1926	44,784.60	70.00	639.78	12.18	7,789.76
1927	161,644.45	70.00	2,309.21	12.46	28,781.70
1928	61,756.47	70.00	882.24	12.76	11,258.64
1929	70,488.83	70.00	1,006.98	13.06	13,148.59

BGC

Gas Division

367.15 Mains - Cast Iron

Original Cost Of Utility Plant In Service

And Development Of Composite Remaining Life as of December 31, 2019

Based Upon Broad Group/Remaining Life Procedure and Technique

Average Service Life: 70 *Survivor Curve:* S1.5

Year (1)	Original Cost (2)	Avg. Service Life (3)	Avg. Annual Accrual (4)	Avg. Remaining Life (5)	Future Annual Accruals (6)
1930	18,192.99	70.00	259.90	13.36	3,472.52
1931	16,021.08	70.00	228.87	13.66	3,127.51
1932	20,315.20	70.00	290.22	13.97	4,055.77
1933	4,438.50	70.00	63.41	14.29	906.08
1934	108.58	70.00	1.55	14.60	22.65
1935	87.13	70.00	1.24	14.93	18.58
1938	80.70	70.00	1.15	15.91	18.34
1939	132.48	70.00	1.89	16.25	30.76
1941	8,116.30	70.00	115.95	16.94	1,964.24
1948	1,903.36	70.00	27.19	19.52	530.75
1959	1,356.23	70.00	19.37	24.18	468.51
2002	3,341.16	70.00	47.73	53.14	2,536.44
2007	306,239.76	70.00	4,374.85	57.76	252,682.05
2014	951,690.50	70.00	13,595.58	64.53	877,284.49
2015	1,711,819.48	70.00	24,454.57	65.52	1,602,164.69
2017	839,983.21	70.00	11,999.76	67.50	810,015.81
2018	109,192.50	70.00	1,559.89	68.50	106,853.90
Total	5,294,207.18	70.00	75,631.54	50.93	3,852,098.44

Composite Average Remaining Life ... 50.93 Years

BGC

Gas Division

369.00 M&R Station Equipment

Original Cost Of Utility Plant In Service

And Development Of Composite Remaining Life as of December 31, 2019

Based Upon Broad Group/Remaining Life Procedure and Technique

Average Service Life: 55 *Survivor Curve:* R3

Year (1)	Original Cost (2)	Avg. Service Life (3)	Avg. Annual Accrual (4)	Avg. Remaining Life (5)	Future Annual Accruals (6)
1953	338,381.69	55.00	6,152.39	6.76	41,590.59
1954	49,552.62	55.00	900.96	7.06	6,363.85
1955	95,365.31	55.00	1,733.91	7.38	12,793.89
1956	22,840.81	55.00	415.29	7.71	3,200.39
1957	29,134.06	55.00	529.71	8.05	4,263.55
1958	6,033.76	55.00	109.70	8.40	921.87
1959	24,743.39	55.00	449.88	8.77	3,946.76
1960	39,620.13	55.00	720.37	9.16	6,597.47
1961	23,274.85	55.00	423.18	9.56	4,045.70
1962	105,190.89	55.00	1,912.56	9.98	19,082.69
1963	29,139.78	55.00	529.81	10.41	5,516.91
1964	994,003.27	55.00	18,072.78	10.87	196,370.72
1965	198,954.35	55.00	3,617.35	11.34	41,004.46
1966	94,159.71	55.00	1,711.99	11.82	20,240.42
1967	304,277.85	55.00	5,532.32	12.33	68,197.62
1968	33,321.35	55.00	605.84	12.85	7,782.99
1969	114,144.65	55.00	2,075.36	13.39	27,780.65
1970	389,377.59	55.00	7,079.59	13.94	98,703.48
1971	111,078.83	55.00	2,019.61	14.51	29,313.17
1972	299,186.24	55.00	5,439.75	15.10	82,153.13
1973	118,234.62	55.00	2,149.72	15.70	33,757.50
1974	72,349.33	55.00	1,315.44	16.32	21,472.18
1975	34,240.29	55.00	622.55	16.96	10,556.99
1976	117,190.53	55.00	2,130.74	17.61	37,514.05
1977	124,472.02	55.00	2,263.13	18.27	41,343.36
1978	151,822.13	55.00	2,760.40	18.94	52,291.64
1979	123,219.10	55.00	2,240.35	19.63	43,976.74

BGC

Gas Division

369.00 M&R Station Equipment

Original Cost Of Utility Plant In Service

And Development Of Composite Remaining Life as of December 31, 2019

Based Upon Broad Group/Remaining Life Procedure and Technique

Average Service Life: **55** *Survivor Curve:* **R3**

Year (1)	Original Cost (2)	Avg. Service Life (3)	Avg. Annual Accrual (4)	Avg. Remaining Life (5)	Future Annual Accruals (6)
1980	60,280.58	55.00	1,096.01	20.33	22,282.79
1981	704,609.99	55.00	12,811.09	21.04	269,596.36
1982	428,069.48	55.00	7,783.08	21.77	169,426.63
1983	527,835.68	55.00	9,597.01	22.50	215,973.81
1984	346,134.29	55.00	6,293.35	23.25	146,311.47
1985	201,033.22	55.00	3,655.15	24.01	87,747.70
1986	580,902.89	55.00	10,561.87	24.77	261,667.92
1987	228,779.10	55.00	4,159.62	25.55	106,290.29
1988	208,353.06	55.00	3,788.24	26.34	99,784.94
1989	1,867,364.17	55.00	33,952.07	27.14	921,395.63
1990	366,298.47	55.00	6,659.97	27.94	186,102.29
1991	664,483.34	55.00	12,081.51	28.76	347,466.35
1992	1,849,250.03	55.00	33,622.72	29.59	994,757.93
1993	684,533.71	55.00	12,446.06	30.42	378,614.12
1994	425,320.44	55.00	7,733.10	31.26	241,763.84
1995	1,209,854.30	55.00	21,997.34	32.11	706,412.22
1996	782,066.79	55.00	14,219.39	32.97	468,871.94
1997	1,116,676.24	55.00	20,303.20	33.84	687,116.13
1998	878,878.38	55.00	15,979.60	34.72	554,799.46
1999	850,528.62	55.00	15,464.15	35.60	550,575.48
2000	1,493,954.97	55.00	27,162.81	36.49	991,303.62
2001	1,211,933.10	55.00	22,035.14	37.39	823,951.75
2002	1,253,224.00	55.00	22,785.88	38.30	872,674.38
2003	997,198.45	55.00	18,130.88	39.21	710,945.11
2004	657,589.29	55.00	11,956.17	40.13	479,815.20
2005	895,646.65	55.00	16,284.48	41.06	668,586.91
2006	1,726,825.52	55.00	31,396.82	41.99	1,318,261.40

BGC

Gas Division

369.00 M&R Station Equipment

Original Cost Of Utility Plant In Service

And Development Of Composite Remaining Life as of December 31, 2019

Based Upon Broad Group/Remaining Life Procedure and Technique

***Average Service Life:* 55** ***Survivor Curve:* R3**

Year (1)	Original Cost (2)	Avg. Service Life (3)	Avg. Annual Accrual (4)	Avg. Remaining Life (5)	Future Annual Accruals (6)
2007	4,446,674.02	55.00	80,848.59	42.92	3,470,389.56
2008	2,958,207.15	55.00	53,785.57	43.87	2,359,426.16
2009	7,665,799.09	55.00	139,378.12	44.81	6,246,228.72
2010	4,320,725.16	55.00	78,558.61	45.77	3,595,425.44
2011	6,808,289.75	55.00	123,787.05	46.72	5,783,863.20
2012	6,490,275.12	55.00	118,004.97	47.68	5,627,046.15
2013	5,348,078.98	55.00	97,237.77	48.65	4,730,623.27
2014	10,947,554.98	55.00	199,046.39	49.62	9,876,454.85
2015	7,525,833.52	55.00	136,833.29	50.59	6,922,530.08
2016	8,164,235.35	55.00	148,440.60	51.57	7,654,511.91
2017	16,117,950.34	55.00	293,053.55	52.54	15,398,133.25
2018	7,096,218.74	55.00	129,022.12	53.52	6,905,849.46
2019	829,392.69	55.00	15,079.86	54.51	821,967.94
Total	114,980,168.80	55.00	2,090,547.87	44.77	93,595,728.40

Composite Average Remaining Life ...* 44.77 *Years

BGC
Gas Division
369.07 M&R Station Equipment - Commercial Point

Original Cost Of Utility Plant In Service
And Development Of Composite Remaining Life as of December 31, 2019
Based Upon Broad Group/Remaining Life Procedure and Technique

Average Service Life: *55* *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	56,052.80	55.00	1,019.14	13.39	13,642.19
1983	11,720.16	55.00	213.09	22.50	4,795.52
1986	4,600.00	55.00	83.64	24.77	2,072.07
1995	18,731.50	55.00	340.57	32.11	10,936.99
1996	41,238.48	55.00	749.79	32.97	24,723.68
2007	58,257.72	55.00	1,059.23	42.92	45,467.01
2014	98,284.67	55.00	1,786.99	49.62	88,668.58
2015	825,889.68	55.00	15,016.17	50.59	759,682.78
2016	3,905,010.77	55.00	71,000.17	51.57	3,661,206.49
2018	499,246.33	55.00	9,077.20	53.52	485,853.12
Total	5,519,032.11	55.00	100,346.01	50.79	5,097,048.43

Composite Average Remaining Life ... ***50.79 Years***

BGC

Gas Division

380.02 Services - Plastic

Original Cost Of Utility Plant In Service

And Development Of Composite Remaining Life as of December 31, 2019

Based Upon Broad Group/Remaining Life Procedure and Technique

Average Service Life: 45 *Survivor Curve:* S1

Year (1)	Original Cost (2)	Avg. Service Life (3)	Avg. Annual Accrual (4)	Avg. Remaining Life (5)	Future Annual Accruals (6)
1974	3,845,160.40	45.00	85,448.01	14.24	1,216,965.88
1975	3,332.54	45.00	74.06	14.66	1,085.60
1976	89,329.78	45.00	1,985.11	15.08	29,940.74
1977	8,415.09	45.00	187.00	15.51	2,901.07
1978	57,787.37	45.00	1,284.16	15.95	20,484.57
1980	1,360.76	45.00	30.24	16.85	509.55
1982	5,463.82	45.00	121.42	17.78	2,159.21
1983	14,817.28	45.00	329.27	18.26	6,013.27
1984	155,449.26	45.00	3,454.43	18.75	64,771.72
1985	5,763,009.12	45.00	128,066.88	19.25	2,465,001.65
1986	5,656,798.43	45.00	125,706.64	19.76	2,483,467.72
1987	7,168,030.10	45.00	159,289.57	20.27	3,229,397.95
1988	7,584,735.81	45.00	168,549.69	20.80	3,506,155.28
1989	9,757,711.16	45.00	216,838.04	21.34	4,627,515.48
1990	9,233,569.42	45.00	205,190.44	21.89	4,491,841.09
1991	11,141,766.61	45.00	247,594.83	22.45	5,559,698.62
1992	18,384,623.89	45.00	408,547.22	23.03	9,408,575.23
1993	16,045,784.66	45.00	356,573.01	23.62	8,420,955.18
1994	18,849,714.86	45.00	418,882.58	24.22	10,143,779.07
1995	17,942,696.07	45.00	398,726.60	24.83	9,900,981.27
1996	37,178,878.06	45.00	826,197.34	25.46	21,034,481.80
1997	35,893,388.69	45.00	797,630.90	26.10	20,819,415.15
1998	46,047,663.42	45.00	1,023,281.47	26.76	27,381,464.35
1999	24,117,618.90	45.00	535,947.12	27.43	14,701,352.38
2000	29,847,214.12	45.00	663,271.46	28.12	18,651,918.84
2001	37,405,961.73	45.00	831,243.64	28.83	23,961,315.12
2002	33,972,134.18	45.00	754,936.36	29.55	22,306,236.18

BGC
Gas Division
380.02 Services - Plastic

Original Cost Of Utility Plant In Service
And Development Of Composite Remaining Life as of December 31, 2019
Based Upon Broad Group/Remaining Life Procedure and Technique

Average Service Life: 45 **Survivor Curve:** S1

Year (1)	Original Cost (2)	Avg. Service Life (3)	Avg. Annual Accrual (4)	Avg. Remaining Life (5)	Future Annual Accruals (6)
2003	48,306,428.20	45.00	1,073,476.24	30.29	32,510,692.33
2004	49,454,327.13	45.00	1,098,985.11	31.04	34,116,306.59
2005	27,442,830.08	45.00	609,840.70	31.82	19,403,722.98
2006	93,193,892.40	45.00	2,070,975.50	32.61	67,534,283.39
2007	17,520,641.53	45.00	389,347.61	33.42	13,012,119.74
2008	66,371,014.04	45.00	1,474,911.51	34.25	50,514,444.11
2009	104,889,849.88	45.00	2,330,885.68	35.10	81,812,524.74
2010	90,811,902.83	45.00	2,018,042.40	35.97	72,580,749.27
2011	86,062,795.27	45.00	1,912,506.67	36.85	70,477,288.90
2012	74,126,421.47	45.00	1,647,253.90	37.75	62,189,561.62
2013	68,513,599.14	45.00	1,522,524.51	38.68	58,884,697.13
2014	63,813,537.78	45.00	1,418,078.70	39.61	56,174,513.51
2015	57,370,334.92	45.00	1,274,896.40	40.57	51,717,500.33
2016	57,998,133.16	45.00	1,288,847.48	41.53	53,529,875.78
2017	72,760,324.57	45.00	1,616,896.19	42.51	68,738,510.06
2018	52,993,843.92	45.00	1,177,641.04	43.50	51,231,419.93
2019	86,551,902.17	45.00	1,923,375.71	44.50	85,590,574.00
Total	1,494,354,194.02	45.00	33,207,872.83	34.46	1,144,457,168.38

Composite Average Remaining Life ... 34.46 Years

BGC

Gas Division

380.04 Services - Steel

Original Cost Of Utility Plant In Service

And Development Of Composite Remaining Life as of December 31, 2019

Based Upon Broad Group/Remaining Life Procedure and Technique

Average Service Life: 45 *Survivor Curve:* S1

Year (1)	Original Cost (2)	Avg. Service Life (3)	Avg. Annual Accrual (4)	Avg. Remaining Life (5)	Future Annual Accruals (6)
1926	621.11	0.00	0.00	0.00	0.00
1927	414.08	0.00	0.00	0.00	0.00
1928	414.08	0.00	0.00	0.00	0.00
1943	549.34	45.00	12.21	3.71	45.29
1950	207.04	45.00	4.60	5.78	26.59
1954	207.04	45.00	4.60	7.03	32.35
1961	481.71	45.00	10.70	9.35	100.05
1962	1,863.34	45.00	41.41	9.69	401.40
1974	17,155,590.95	45.00	381,235.38	14.24	5,429,622.35
1975	312,557.27	45.00	6,945.72	14.66	101,817.57
1976	296,071.12	45.00	6,579.36	15.08	99,234.42
1977	269,361.60	45.00	5,985.81	15.51	92,861.38
1978	477,862.69	45.00	10,619.17	15.95	169,393.61
1979	601,129.60	45.00	13,358.44	16.40	219,042.86
1980	345,412.60	45.00	7,675.84	16.85	129,344.11
1981	587,088.92	45.00	13,046.42	17.31	225,864.69
1982	363,485.89	45.00	8,077.46	17.78	143,643.64
1983	223,034.34	45.00	4,956.32	18.26	90,513.69
1984	370,581.91	45.00	8,235.15	18.75	154,411.98
1985	739,529.83	45.00	16,434.00	19.25	316,317.78
1986	538,596.12	45.00	11,968.80	19.76	236,456.38
1987	994,276.12	45.00	22,095.03	20.27	447,949.19
1988	1,036,015.15	45.00	23,022.56	20.80	478,913.19
1989	179,645.51	45.00	3,992.12	21.34	85,195.43
1990	691,141.09	45.00	15,358.69	21.89	336,218.40
1991	6,063,181.28	45.00	134,737.37	22.45	3,025,504.11
1992	6,215,845.49	45.00	138,129.91	23.03	3,181,041.41

BGC
Gas Division
380.04 Services - Steel

Original Cost Of Utility Plant In Service
And Development Of Composite Remaining Life as of December 31, 2019
Based Upon Broad Group/Remaining Life Procedure and Technique

Average Service Life: 45 **Survivor Curve:** S1

Year (1)	Original Cost (2)	Avg. Service Life (3)	Avg. Annual Accrual (4)	Avg. Remaining Life (5)	Future Annual Accruals (6)
1993	1,551,104.74	45.00	34,469.00	23.62	814,032.08
1994	4,872,500.39	45.00	108,277.79	24.22	2,622,085.68
1995	1,660,868.93	45.00	36,908.20	24.83	916,486.13
1996	1,098,311.25	45.00	24,406.92	25.46	621,385.29
1997	18,333.88	45.00	407.42	26.10	10,634.29
1998	77,796.14	45.00	1,728.80	26.76	46,260.16
1999	434,844.69	45.00	9,663.22	27.43	265,067.83
2000	1,257,893.09	45.00	27,953.18	28.12	786,074.03
2001	992,654.81	45.00	22,059.00	28.83	635,869.62
2002	1,329,500.92	45.00	29,544.47	29.55	872,955.50
2003	988,606.99	45.00	21,969.05	30.29	665,342.04
2004	1,965,806.52	45.00	43,684.59	31.04	1,356,121.13
2005	1,253,135.90	45.00	27,847.47	31.82	886,042.07
2006	3,741,369.03	45.00	83,141.54	32.61	2,711,236.43
2007	1,096,718.23	45.00	24,371.52	33.42	814,503.79
2008	2,715,693.63	45.00	60,348.75	34.25	2,066,892.54
2009	3,547,071.44	45.00	78,823.81	35.10	2,766,663.03
2010	1,873,357.72	45.00	41,630.17	35.97	1,497,267.46
2011	2,418,474.32	45.00	53,743.88	36.85	1,980,501.71
2012	4,029,725.28	45.00	89,549.46	37.75	3,380,803.28
2013	664,375.89	45.00	14,763.91	38.68	571,004.49
2014	1,989,890.52	45.00	44,219.79	39.61	1,751,683.67
2015	257,323.61	45.00	5,718.30	40.57	231,968.91
2016	666,205.64	45.00	14,804.57	41.53	614,880.22
2017	2,146,400.15	45.00	47,697.78	42.51	2,027,758.25
2018	5,863,528.93	45.00	130,300.65	43.50	5,668,524.69
2019	309,386.63	45.00	6,875.26	44.50	305,950.29

BGC

Gas Division

380.04 Services - Steel

Original Cost Of Utility Plant In Service

And Development Of Composite Remaining Life as of December 31, 2019

Based Upon Broad Group/Remaining Life Procedure and Technique

Average Service Life: *45* *Survivor Curve:* *S1*

Year (1)	Original Cost (2)	Avg. Service Life (3)	Avg. Annual Accrual (4)	Avg. Remaining Life (5)	Future Annual Accruals (6)
Total	86,286,044.49	42.50	1,917,435.56	27.04	51,851,946.51

Composite Average Remaining Life ... 27.04 Years

COMMONWEALTH OF MASSACHUSETTS
DEPARTMENT OF PUBLIC UTILITIES

Boston Gas Company **d/b/a National Grid**	))))	**DPU 20-120**

AFFIDAVIT OF DAVID J. GARRETT

David J. Garrett does hereby depose and say as follows:

I, David J. Garrett, on behalf of the Massachusetts Attorney General's Office, certify that the testimony, including information responses, which bear my name was prepared by me or under my supervision and is true and accurate to the best of my knowledge and belief.

Signed under the pains and penalties of perjury this 23rd day of March, 2021.

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David J. Garrett