COMMONWEALTH OF MASSACHUSETTS
DEPARTMENT OF PUBLIC UTILITIES

Petition of Massachusetts Electric Company and Nantucket Electric Company each d/b/a National Grid	D.P.U. 18-150

PREFILED DIRECT TESTIMONY AND EXHIBITS OF

DAVID J. GARRETT

ON BEHALF OF THE

MASSACHUSETTS OFFICE OF THE ATTORNEY GENERAL

OFFICE OF RATEPAYER ADVOCACY

MARCH 22, 2019

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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]

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[1] Exhibit 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 ("AG") regarding the depreciation study and proposed depreciation rates of Massachusetts Electric Company and Nantucket Electric Company (collectively, "National Grid" or the "Company"). I am responding to the Testimony and Exhibits of Dr. Kimbugwe A. Kateregga who sponsored the Company's depreciation study.

II. EXECUTIVE SUMMARY

Q. SUMMARIZE THE KEY POINTS OF YOUR TESTIMONY.

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, 2017. The table below compares my proposed depreciation accrual by plant function to that proposed by the Company.[2]

[2] Exhibit AG-DJG-3.

Figure 1:
Depreciation Accrual Comparison by Plant Function

Plant Function	Plant Balance 12/31/2017	Company Proposal	AG Proposal	AG Adjustment
Transmission	74,489,396	2,450,191	1,968,281	(481,910)
Distribution	4,209,885,632	128,747,462	117,509,998	(11,237,464)
General	173,383,584	4,944,384	4,806,059	(138,325)
Total	$ 4,457,758,612	$ 136,142,037	$ 124,284,338	**$ (11,857,699)**

The original cost and accrual amounts correspond to plant balances as of the depreciation study date – December 31, 2017. As shown in this table, accepting the AG's proposed depreciation rates would result in an adjustment reducing the Company's proposed depreciation accrual by $11.8 million.

Q. SUMMARIZE THE PRIMARY FACTORS DRIVING AG'S ADJUSTMENT.

A. I am proposing adjustments to several transmission and distribution accounts. These adjustments include proposing longer average service life estimates and higher (i.e., less negative) net salvage estimates for several accounts. The following table compares my proposed service lives, depreciation rates, and accrual amounts with those proposed by Dr. Kateregga for the accounts at issue.

Figure 2:
Depreciation Accrual Comparison by Plant Function

		Company's Position				AG's Position			
		Iowa Curve		Depr	Annual	Iowa Curve		Depr	Annual
Account No.	Description	Type	AL	Rate	Accrual	Type	AL	Rate	Accrual
	TRANSMISSION PLANT								
355.00	Poles and Fixtures	S1	45	3.73%	1,190,951	R2	57	2.76%	882,784
356.00	OH Conductors and Devices	R2	55	2.99%	971,897	R1.5	63	2.63%	854,039
	DISTRIBUTION PLANT								
362.00	Station Equipment	L1.5	45	2.67%	16,974,768	S0	49	2.74%	17,424,482
364.00	Poles, Towers and Fixtures	S1.5	45	3.15%	21,957,160	L2	50	2.92%	20,334,878
365.00	OH Conductors and Devices	SC	45	3.17%	27,086,938	O1	48	2.75%	23,524,639
366.00	UG Conduit	S4	50	2.21%	4,822,102	R4	55	1.73%	3,782,914
367.10	UG Conductors and Devices	R0.5	50	2.74%	20,155,093	L0	53	2.49%	18,345,789
368.20	Line Transformers - Bare Cost	R4	40	3.24%	10,334,601	R5	44	2.91%	9,271,198

For each of these accounts, I propose a longer average service life and/or higher net salvage rate than Dr. Kateregga, 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. DESCRIBE WHY IT IS IMPORTANT NOT TO OVERESTIMATE DEPRECIATION RATES.

A. Under the rate base rate of return model, the utility is allowed to recover the original cost of its prudent investments required to provide service. Depreciation systems are designed to allocate those costs in a systematic and rational manner – specifically, over the service lives of the utility's assets. If depreciation rates are overestimated (i.e., service lives are underestimated), economic inefficiency is encouraged. Unlike competitive firms, regulated utility companies are not always incentivized by natural market forces to make

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

the most economically efficient decisions. If a utility is allowed to recover the cost of an asset before the end of its useful life, this could incentivize the utility to unnecessarily replace the asset in order to increase rate base, which results in economic waste. Thus, from a public policy perspective, it is preferable for regulators to ensure that assets are not depreciated before the end of their economic useful lives.

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:

[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."

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

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

A. Yes. While the *Lindheimer* case and other early literature recognized depreciation as a necessary expense, the language indicated that depreciation was primarily a mechanism to determine loss of value.[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

[6] *Id*. at 169.

[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).

definition of "depreciation accounting" published by the American Institute of Certified Public Accountants ("AICPA") properly reflects the cost allocation concept:

> 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 proposed by Dr. Kateregga were developed based on depreciable property recorded as of December 31, 2017. 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 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 would be denoted as an "SL-AL-RL-BG" system. This depreciation system conforms to the legal standards set forth above and is commonly used by depreciation analysts in regulatory proceedings. I provide a more detailed discussion of depreciation system parameters, theories, and equations in Appendix A.

Q. DESCRIBE HOW THE BOOK RESERVE IS INCORPORATED INTO THE REMAINING LIFE DEPRECIATION RATE CALCULATION.

A. Under the remaining life technique, the book depreciation reserve is subtracted from the gross plant balance of each account and allocated over the remaining life of plant, as

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

estimated through Iowa curve analysis. This feature of the remaining life technique is important because it highlights the purpose for which the remaining life technique was created. Over time, imbalances between the book reserve and the "theoretical reserve" can develop. Essentially, the theoretical reserve is the balance the book reserve "should be" if the current depreciation parameters (i.e., life and net salvage estimates) had been applied to the account from the beginning. If the "whole life" technique is used instead of the remaining life technique, then a manual rebalancing of the depreciation reserve should be conducted, which adds complexities to a regulatory proceeding. For this reason, the majority of depreciation analysts and regulatory jurisdictions rely on the remaining life technique in depreciation rate development. Under the remaining life technique, there is no need to make a separate adjustment to rebalance or reallocate the theoretical reserve to bring it closer to the book reserve.

The authoritative texts are clear that, when using the remaining life technique, no separate reallocation of the theoretical reserve (or "Calculated Accumulated Depreciation" or "CAD") is required or even necessary. According to Wolf:

> Users of remaining life depreciation often do not explicitly calculate the CAD. As previously discussed, calculation of the CAD is implicit in the use of the remaining life method of adjustment, because the variation between the CAD and the accumulated provision for depreciation is automatically amortized over the remaining life.[12]

The NARUC manual also agrees that no separate reallocation of the theoretical reserve is required when using the remaining life technique:

[12] Wolf *supra* n. 7, at 178 (emphasis added).

> The desirability of using the remaining life technique is that any necessary adjustments of depreciation reserves, because of changes to the estimates of life on net salvage, are accrued automatically over the remaining life of the property.[13]

Thus, the primary purpose of the remaining life technique is the fact that a separate adjustment to the theoretical reserve is not required.

Q. DESPITE THE AUTOMATIC REBALANCING FEATURE INHERENT IN THE REMAINING LIFE TECHNIQUE, DID DR. KATEREGGA PROPOSE A MANUAL REBALANCING OF THE DEPRECIATION RESERVE?

A. Yes. According to Dr. Kateregga, it is appropriate to "periodically redistribute or rebalance recorded reserves among primary accounts based on the most recent estimates of service lives, retirement dispersion and net salvage rates."[14] In my opinion, Dr. Kateregga's approach with regard to manual reserve rebalancing is not in conformance with authoritative depreciation texts or the approach utilized by the majority of depreciation analysts. Moreover, as discussed above, Dr. Kateregga's manual rebalancing of the reserve is simply not necessary.

Q. DID DR. KATEREGGA'S MANUAL REBALANCING OF THE DEPRECIATION RESERVE HAVE AN INCREASING EFFECT ON DEPRECIATION RATES AND EXPENSE?

A. Yes. All else held constant, Dr. Kateregga's manual rebalancing of the depreciation reserve had an increasing effect on the depreciation accrual of about $1 million.

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[13] NARUC *supra* n. 8, at 65 (emphasis added).

[14] Direct Testimony of Dr. Kimbugwe A. Kateregga, p. 9, lines 11-14.

Q. IN DEVELOPING YOUR PROPOSED DEPRECIATION RATES, DID YOU UTILIZE THE BOOK RESERVE?

A. Yes. In conformance with the depreciation texts cited above, I used the book reserve, rather than a rebalanced reserve, when calculating my proposed depreciation rates under the remaining life technique. This accounted for about $1 million of the $11.8 million adjustment I propose.

Q. IN ADDITION TO THE REASONS DISCUSSED ABOVE, ARE THERE OTHER PRACTICAL BENEFITS OBTAINED BY USING THE BOOK RESERVE INSTEAD OF A REBALANCED RESERVE AS PROPOSED BY DR. KATEREGGA?

A. Yes. Dr. Kateregga's rebalanced reserve is mathematically influenced by each one of his service life and net salvage estimates. Thus, if the Commission were to adopt even one adjustment proposed by any party to either service life or net salvage, Dr. Kateregga's rebalanced reserve estimates could not prudently be considered in the determination of depreciation rates approved by the Commission. On the other hand, if the book reserve is used to calculate depreciation rates, in conformance with the authoritative depreciation texts cited above, then the Commission could freely adjust service life and net salvage without having to also consider a further rebalancing of the depreciation reserve to maintain technical accuracy. Thus, using the book reserve instead of rebalanced reserve is not only in conformance with depreciation texts and standard practice in the industry, but it is also more practical and efficient in the context of a regulatory proceeding.

V. SERVICE LIFE ANALYSIS

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

A. The study of retirement patterns of industrial property is derived from the actuarial process used to study human mortality. Just as actuarial analysts study historical human mortality data 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 used by depreciation analysts is called the "retirement rate method." In the retirement rate method, original property data, including additions, retirements, transfers, and other transactions, are organized by vintage and transaction year.[15] The retirement rate method is ultimately used to develop an "observed life table," ("OLT") which shows the percentage of property surviving at each age interval. This pattern of property retirement is described as a "survivor curve." The survivor curve derived from the observed life table, however, must be fitted and smoothed with a complete curve in order to determine the ultimate average life of the group.[16] The most widely used survivor curves for this curve fitting process were developed at Iowa State University in the early 1900s and are commonly known as the "Iowa curves."[17] A more detailed explanation of how the Iowa curves are used in the actuarial analysis of depreciable property is set forth in Appendix C.

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[15] 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).

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

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

I used the aged property data provided by the Company to create an observed life table ("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 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 Iowa curve on the same graph to determine how well the curve fits. I may repeat this process several times for any given account to ensure that the most reasonable Iowa curve is selected.

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

A. Not necessarily. Mathematical fitting is an important part of the curve-fitting process because it promotes objective, unbiased results. While mathematical curve fitting is important, it may not always yield the optimum result. For example, if there is insufficient historical data in a particular account and OLT curve derived from that data is relatively short and flat, the mathematically "best" curve may be one with a very long average 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."[18] In accordance with this standard, an analyst may decide to truncate the tail end of the OLT curve at a certain percent of initial exposures, such as one percent. Using this approach puts a greater emphasis on the most valuable portions of the curve. For my analysis in this case, I not only considered the entirety of the OLT curve, but 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

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

accuracy of my curve selection, I narrowed the focus of my additional calculation to consider the top 99% of the "exposures" (i.e., dollars exposed to retirement) and to eliminate the tail end of the curve representing the bottom 1% of exposures 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 most of the accounts in which I propose a longer service life, such proposal is based on the objective approach of choosing an Iowa curve that provides a better mathematical and/or visual fit to the observed historical retirement pattern derived from the Company's plant data.

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

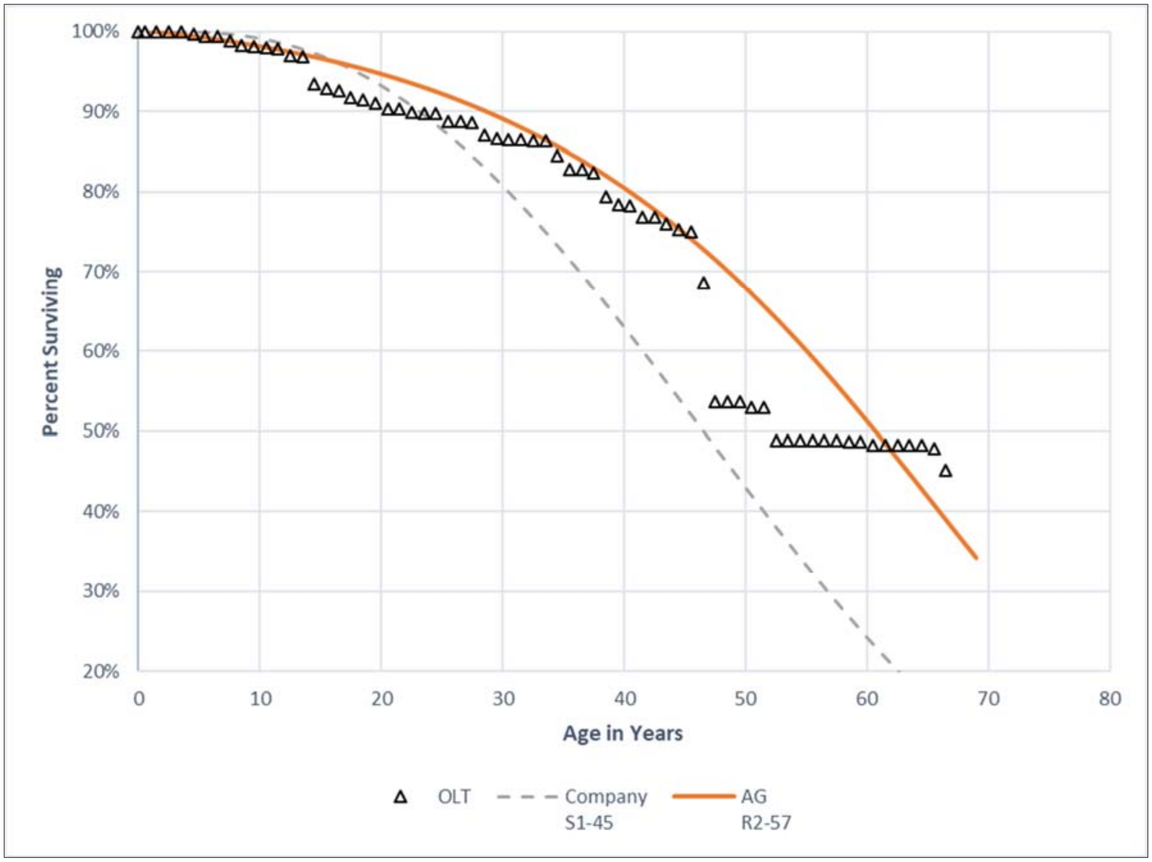
A. No, not in my opinion. As stated in the legal standards discussed above, the Company has the burden to make a convincing showing that its proposed depreciation rates are not excessive. Necessarily, this standard must include making convincing showings that service life and net salvage estimates are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

A. Account 355 – Transmission Poles and Fixtures

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

A. The observed survivor curve ("OLT curve") derived from the Company's data for this account is relatively well-suited for Iowa curve fitting. This is because the OLT curve is relatively smooth and follows the typical pattern of a survivor curve for industrial property, at least through the most relevant age intervals comprising the upper and middle portions of the curve. The OLT curve for this account is shown in the graph below. The graph also shows the Iowa curves that Dr. Kateregga 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. For this account, Dr. Kateregga selected the S1-45 Iowa curve and I selected the R2-57 curve. The average lives resulting from each curve are indicated by the numbers after the dashes (45 and 57 in this case).

Figure 3:
Account 355 – Transmission Poles and Fixtures



As shown in the graph, the OLT curve declines from age zero to 45 in a fairly smooth and consistent pattern. The type of sharp drop in the OLT curve observed around age-interval 47 in this account typically indicates that the data points occurring after this point are statistically irrelevant. Examination of the observed life table for this account, however, indicates that most of the data points after age-interval 47 and shown in the graph are still well above the "1%" exposure cut-off discussed above, which means they are arguably statistically relevant. Regardless, the S1-45 curve selected by Dr. Kateregga for this account clearly fails to provide a good an accurate fit to the historical retirement pattern observed in the OLT curve for this account. Specifically, the S1-45 curve declines at a much greater rate than the OLT curve beginning around age-interval 25. As a result, the average life derived from Dr. Kateregga's curve is too short to accurately describe the observed retirement pattern in this account. As a result, the depreciation rate and accrual proposed by Dr. Kateregga for this account is excessive in my opinion.

Q. DOES THE IOWA CURVE 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 R2-57 curve 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 curve and the OLT curve is 1.6844, and the total SSD between the R2-57 curve and the OLT curve is only 0.1848.[19] Thus, the R2-57 curve is a better mathematical

[19] Exhibit AG-DJG-7.

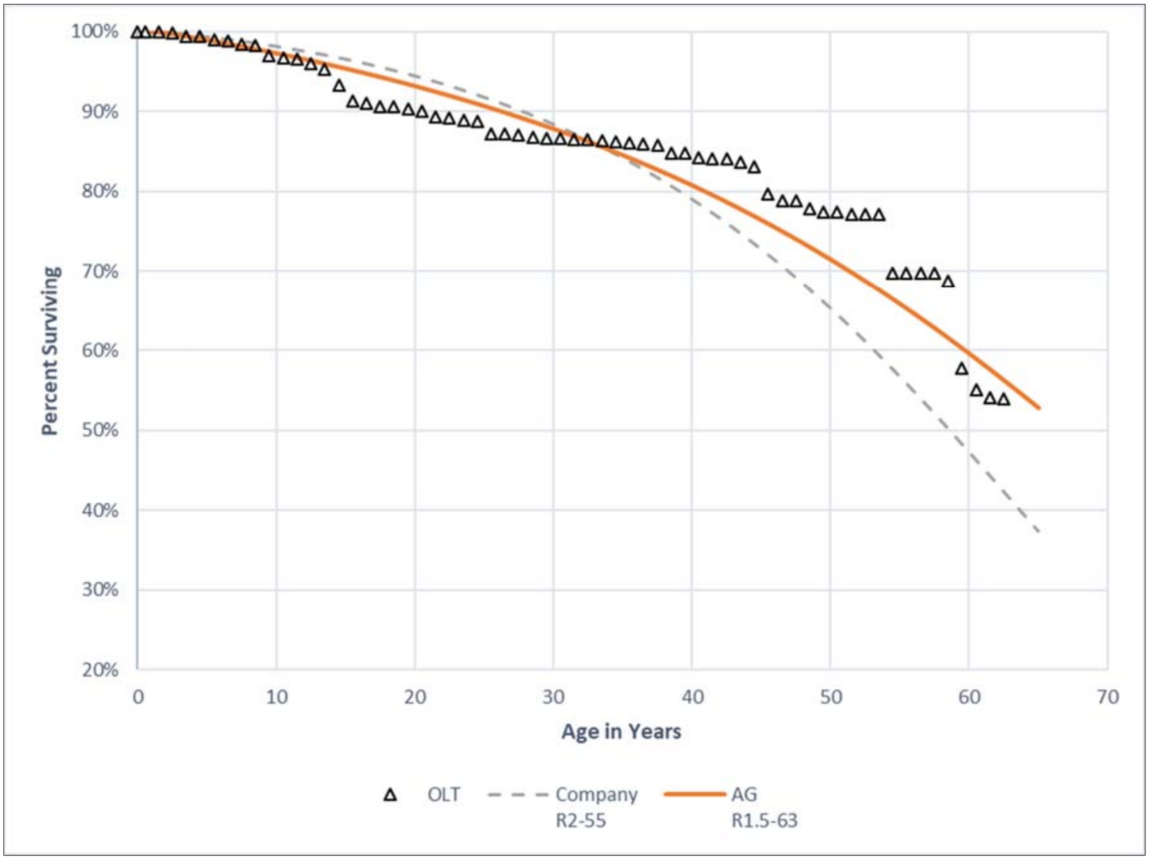
fit and provides a more reasonable service life estimate and depreciation rate for this account.

B. <u>Account 356 – Transmission Overhead Conductors and Devices</u>

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

A. The OLT curve for this account is well-suited for conventional Iowa curve-fitting techniques. The OLT curve for this account is smooth, has adequate retirement history, and reflects a typical survivor curve pattern for utility property. For this account, Dr. Kateregga selected the R2-55 curve and I selected the R1.5-63 curve. The graph below shows both Iowa curves juxtaposed with the OLT curve.

Figure 4:
Account 356 – Transmission Overhead Conductors and Devices



As with the account discussed above, the Iowa curve chosen by Dr. Kateregga for this account declines to sharply relative to the OLT curve, starting around age-interval 35. Both Dr. Kateregga and I selected curves in the same modal family – the "R" curves. However, the R1.5 curve I selected as a lower mode and flatter trajectory than the R2 curve Dr. Kateregga selected. As shown in the graph above, the flatter trajectory and longer average life presented by the R1.5-63 curve provides a more accurate representation of the historical retirement pattern in this account (the OLT curve) and in my opinion results in a more accurate and reasonable projection of remaining life.

Q. DOES THE IOWA CURVE 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 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 0.5172 and the SSD for the R1.5-63 curve I selected is only 0.1250, which means it provides the closer fit to the Company's historical retirement data for this account.[20] Thus, the average life and depreciation rate derived from the Iowa curve I selected will result in a more reasonable and accurate depreciation rate estimate in my opinion.

C. Account 362 – Station Equipment

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

A. As with the accounts discussed above, the OLT curve for Account 362 is well suited for Iowa curve fitting. For this account, Dr. Kateregga selected the L1.5-45 curve and I selected the S0-49 curve.

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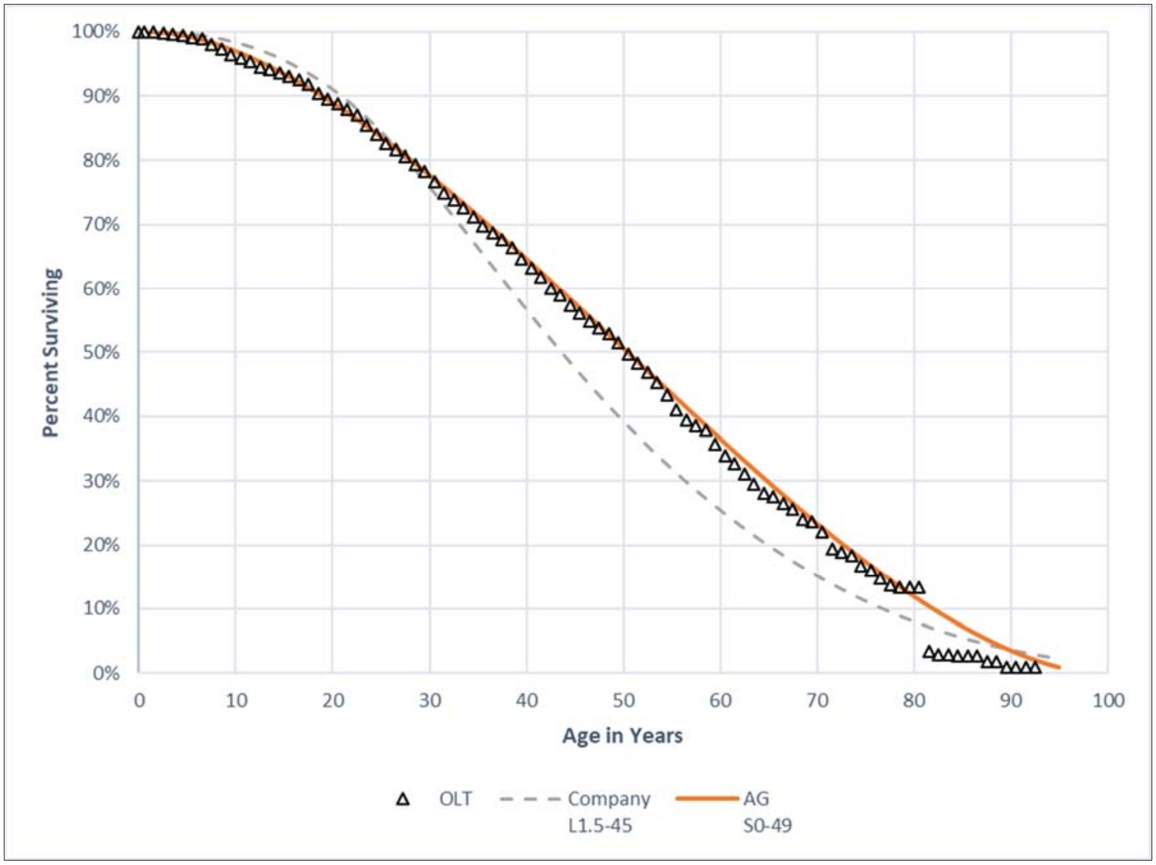
[20] Exhibit AG-DJG-8.

Figure 5:
Account 362 – Station Equipment



The primary purpose of using Iowa curves to estimate the average lives of grouped property is that the OLT curves derived from historical property data are often not smooth and are incomplete. However, the OLT curve for Account 362 is relatively smooth and nearly complete (i.e., reaches zero percent surviving). In this case, it is prudent to simply select the Iowa curve that provides the best mathematical fit to the observed data. This curve is the S0-49 curve that I selected. Unless there is a convincing reason to deviate from the historical retirement pattern in this account, the mathematically superior curve should be selected, especially considering the adequate retirement history presented in Account 362.

Q. HAS DR. KATEREGGA MADE A CONVINCING SHOWING THAT HIS PROPOSED SERVICE LIFE ESTIMATE FOR THIS ACCOUNT IS NOT EXCESSIVE?

A. No, not in my opinion. As stated in the legal standards discussed above, the Company has the burden to make a convincing showing that its proposed depreciation rates are not excessive. Necessarily, this standard must include making convincing showings that service life and net salvage estimates are not excessive. For this account, we have a smooth, and nearly complete OLT curve that follows almost exactly the patter of the S0-49 Iowa curve. Since the Company has not presented a convincing reason, if any to deviate from this patter, the S0-49 curve should be selected to calculate the depreciation rate for this account.

Q. DOES THE IOWA CURVE 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 0.5137 while the SSD for the S0-49 curve I selected is only 0.0251. Thus, the S0-49 curve results in the closer fit to the observed retirement pattern in this account.[21]

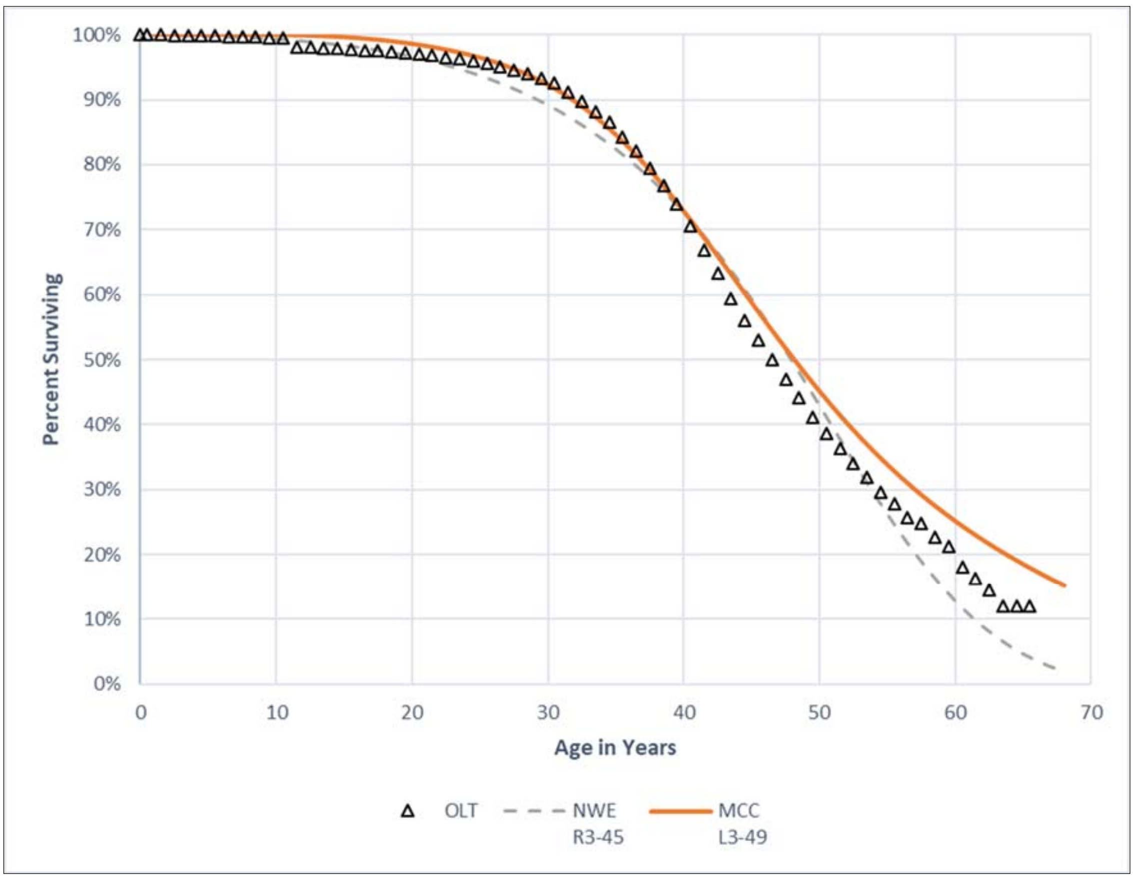
[21] Exhibit AG-DJG-9.

D. Account 364 – Poles, Towers and Fixtures

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

A. For this account, Dr. Kateregga selected the S1.5-45 curve and I selected the L2-50 curve. Both Iowa curves are shown in the graph below along with the OLT curve.

Figure 6:
Account 364 – Poles, Towers and Fixtures



As with the OLT curve for Account 362, the OLT curve for Account 364 is also relatively smooth and mostly complete. In this case, we should give more weight to mathematical curve fitting. As shown in the graph, both Iowa curves provide relatively close fits to the OLT curve, and thus it is difficult to tell which curve provides a better fit through mere visual inspection. Mathematical curve fitting techniques are especially useful in situations like this.

Q. DOES THE IOWA CURVE YOU SELECTED PROVIDE A BETTER MATHEMATICAL FIT TO THE OBSERVED DATA THAN THE COMPANY'S CURVE?

A. Yes. Specifically, the total SSD for the Company's curve is 0.0677 and the SSD for the L2-50 curve I selected is only 0.0349.[22]

E. Account 365 – Overhead Conductors and Devices

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

A. The OLT curve shape for Account 365 is fairly unique for utility property in that it is somewhat linear. There are, however, several Iowa curve shapes that reflect this pattern. For this account, Dr. Kateregga selected the SC-45 curve and I selected the O1-48 curve. Both Iowa curves are displayed with the OLT curve in the following graph.

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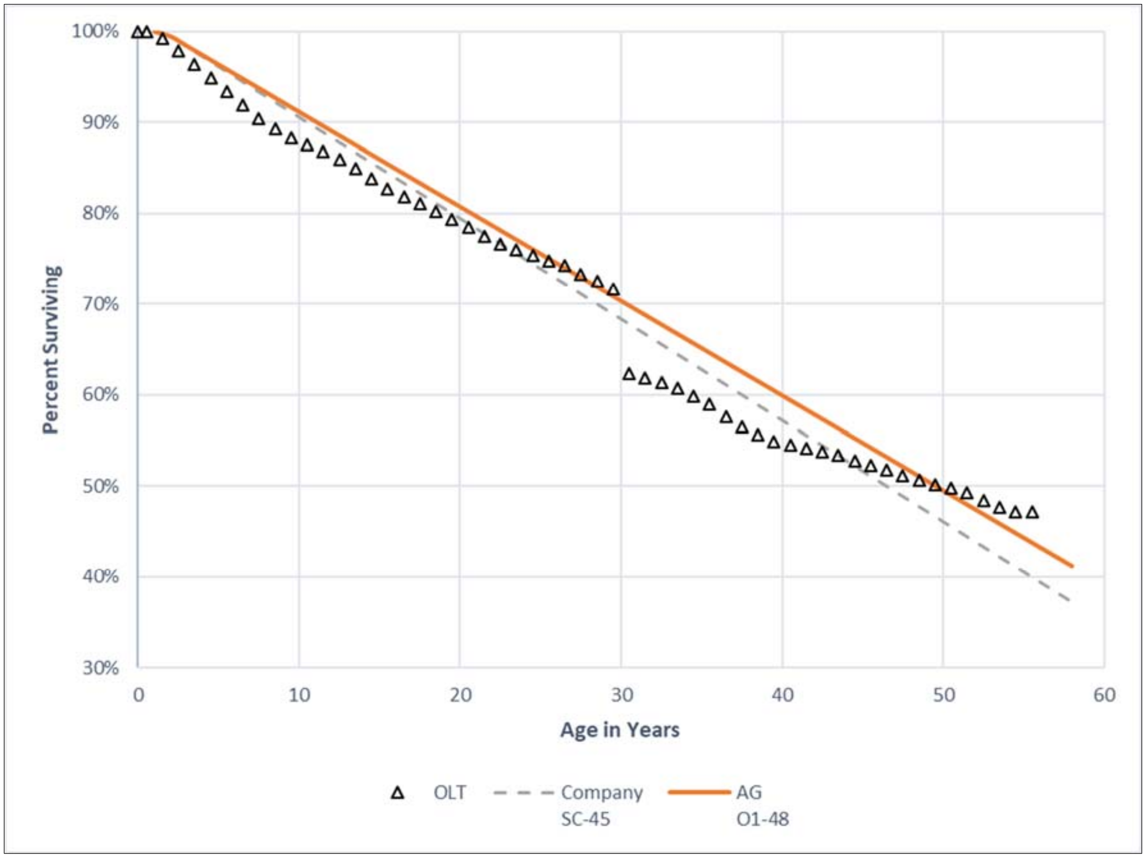
[22] Exhibit AG-DJG-10.

Figure 7:
Account 365 – Overhead Conductors and Devices



As with the previous account, both Iowa curves provide relatively close fits to the observed data and both are within a range of reasonableness for this account in my opinion. As discussed above, however, the Company bears the burden to make a convincing showing that its proposed depreciation rates are not excessive. Since both Dr. Kateregga and I are relying primarily on the statistical analysis of the Company's historical data when developing our service life recommendations, it is prudent to select the Iowa curve that provides the better mathematical fit when there is sufficient and reliable historical data in the account, as is the case here. In other words, there is no convincing evidence provided by the Company outside of its historical retirement data, and that data indicates that the average life of the assets in this account is 48 years.

Q. DOES THE IOWA CURVE YOU SELECTED PROVIDE A BETTER MATHEMATICAL FIT TO THE OBSERVED DATA THAN THE COMPANY'S CURVE?

A. Yes. Specifically, the total SSD for the Company's curve is 0.0556 and the SSD for the O1-48 curve I selected is 0.0363.[23] The fact that the O1-48 curve provides a better mathematical fit to the historical observed data suggests that it also provides a more reasonable estimate of the average remaining life of the assets in this account and ultimately a more reasonable depreciation rate.

F. Account 366 – Underground Conduit

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

A. Unlike each account discussed above, the OLT curve for this account does not have sufficient retirement history to conduct conventional Iowa curve fitting techniques in order to develop reasonable estimates for average service life. Nonetheless, we must ultimately choose an Iowa curve for this account so that average and remaining life can be calculated. For this account, Dr. Kateregga selected the S4-50 curve, and I selected the R4-55 curve. Both Iowa curves are displayed with the OLT curve in the following graph.

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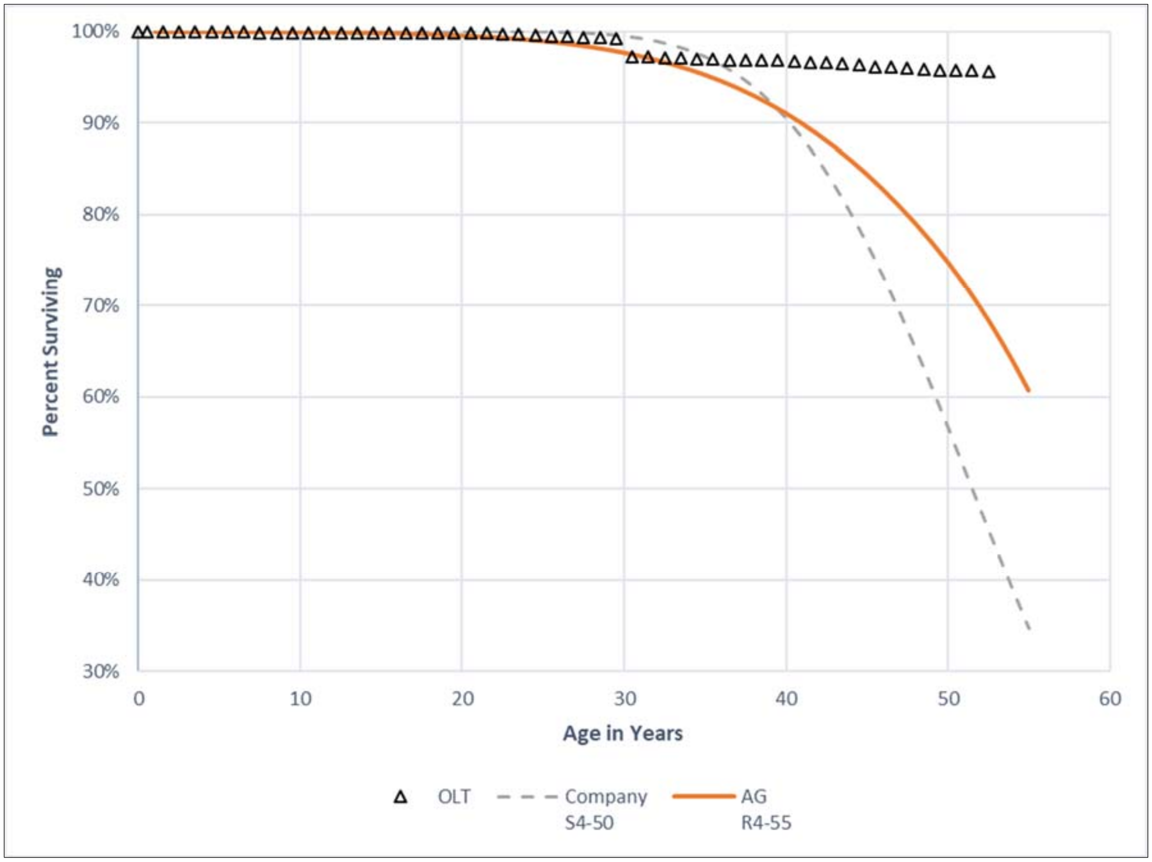
[23] Exhibit AG-DJG-11.

Figure 8:
Account 366 – Underground Conduit



As shown in the graph, the OLT curve for this account has not had enough retirement history to display a sufficient retirement pattern for Iowa curve fitting. Under these circumstances, it is appropriate to consider the approved service lives of other utilities for this account. Based on my experience in other cases, Dr. Kateregga's service life estimate of only 50 years for Account 366 is markedly low.

Q. PLEASE COMPARE DR. KATEREGGA'S SERVICE LIFE ESTIMATE FOR ACCOUNT 366 WITH THE APPROVED SERVICE LIFE ESTIMATES FOR OTHER UTILITIES.

A. In Southwestern Electric Power Company's 2017 rate case, the company's witness proposed a 70-year service life for Account 366. I also testified in that case, and I agreed with the utility's position on that account. The Public Utility Commission of Texas ultimately ordered a 70-year average service life for Account 366. Similarly, in Public Service Company of Oklahoma's 2017 rate case, the Oklahoma Commission order a 72-year average service life for Account 366. Based on my experience, the average service life typically recommended for this account by utility witnesses is about 60 years.

Q. WHAT IS YOUR RECOMMENDATION FOR THIS ACCOUNT?

A. While service life estimates for this account are typically around 60 years and can range into the 70s, I am recommending a service life estimate of only 55 years in the interest of reasonableness. The Company has not made a convincing showing supporting its service life estimate of only 50 years for this account, which is markedly shorter than service life estimates for other utilities for the same account.

Q. DOES THE IOWA CURVE YOU SELECTED PROVIDE A BETTER MATHEMATICAL FIT TO THE OBSERVED DATA THAN THE COMPANY'S CURVE?

A. Yes. Although, as discussed above, the mathematical analysis for an account with insufficient retirement history should be given relatively less weight, the Iowa curve I selected for this account nonetheless provides a better mathematical fit to the observed data than the Iowa curve selected by Dr. Kateregga. Specifically, the Company's S4-50 curve results in an SSD of 1.6218 while the SSD for the R4-55 curve I selected results in an SSD of only 0.5109.[24]

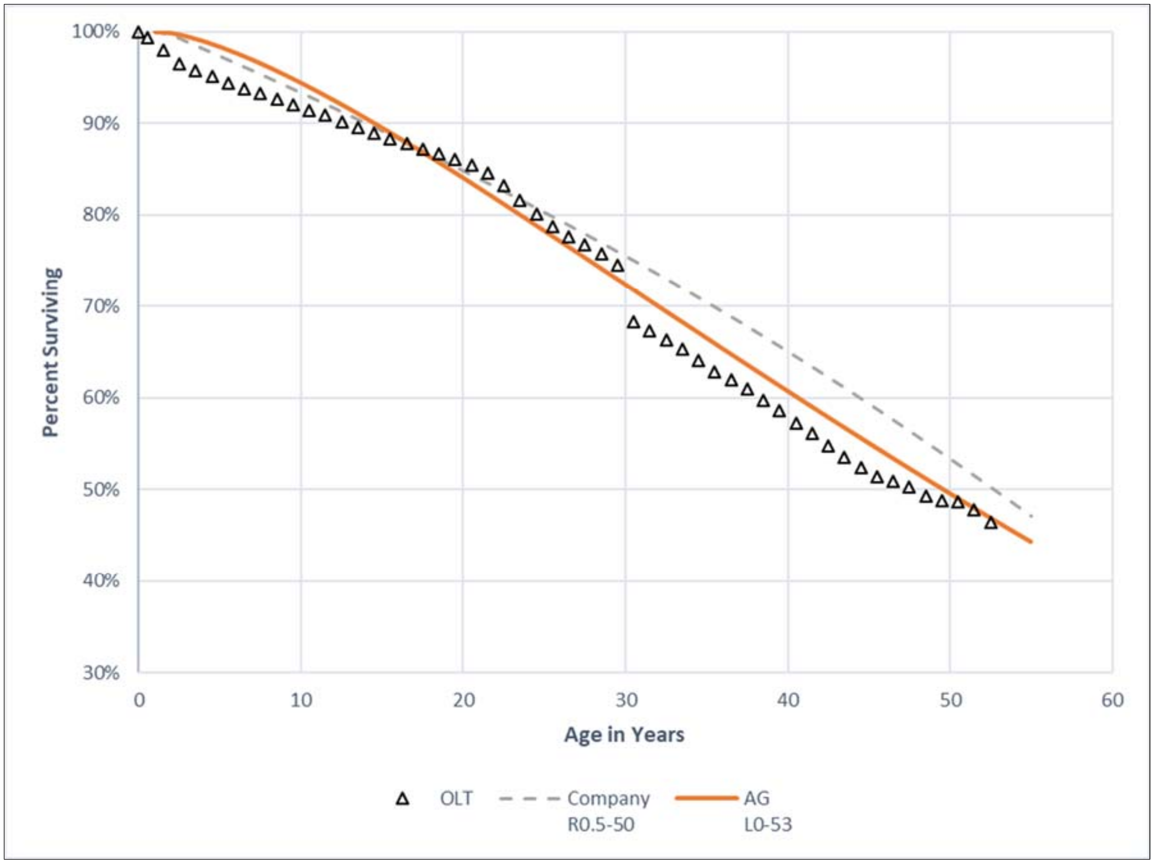
G. Account 367.10 – Underground Conductors and Devices

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

A. For this account, Dr. Kateregga selected the R0.5-50 curve and I selected the L0-53 curve. Both Iowa curves are displayed with the OLT curve in the following graph.

[24] Exhibit AG-DJG-12.

Figure 9:
Account 367.10 – Underground Conductors and Devices



Other than an unusual drop in the percent surviving at age-interval 30, this OLT curve is fairly consistent. The OLT curve for Account 367.10 also has adequate retirement history. The Iowa curve selected by Dr. Kateregga provides a fairly good fit to the observed data up to age interval 30, but it does not provide a good fit after that point. In contrast, the L0-53 curve I selected provides better fits to the observed data through nearly all portions of the OLT curve.

Q. DOES THE IOWA CURVE YOU SELECTED PROVIDE A BETTER MATHEMATICAL FIT TO THE OBSERVED DATA THAN THE COMPANY'S CURVE?

A. Yes. Specifically, the total SSD for the Company's curve is 0.0591 and the SSD for the L0-53 curve I selected is 0.0217.[25]

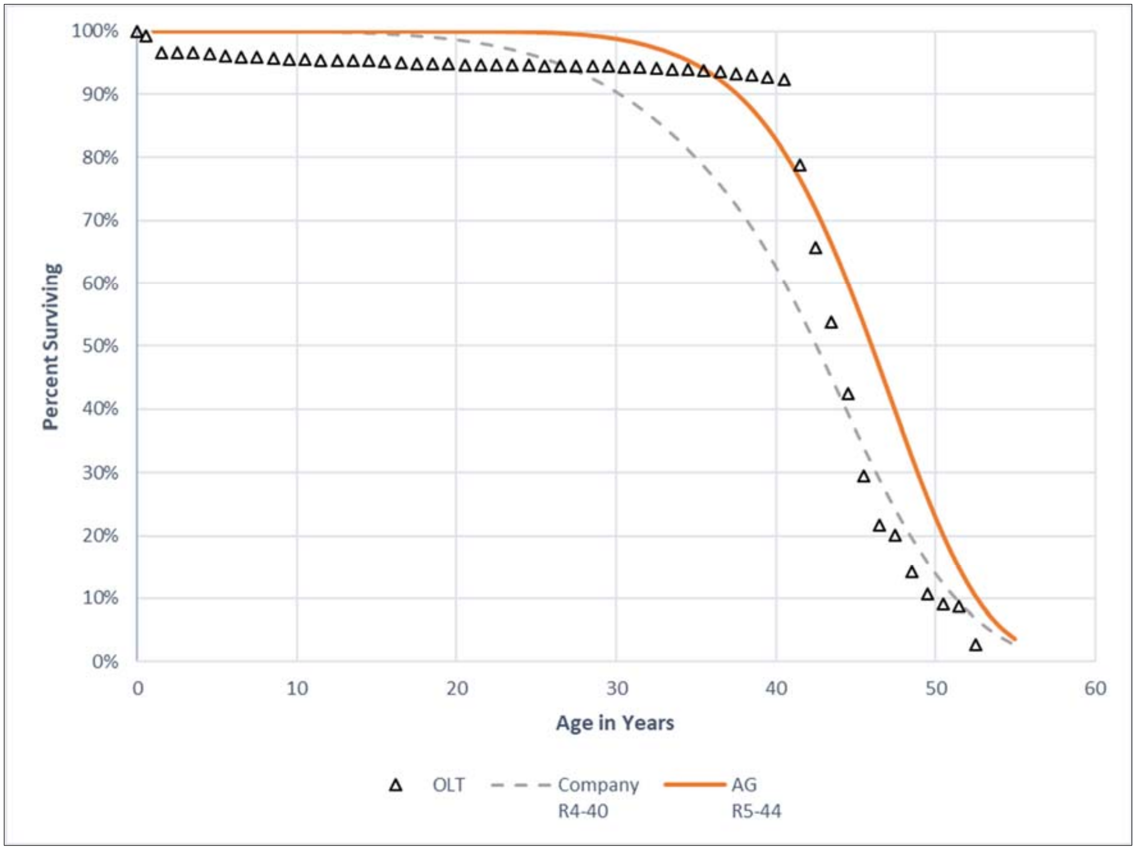
H. Account 368.20 – Line Transformers – Bare Cost

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

A. For this account, Dr. Kateregga selected the R4-40 curve and I selected the R5-44 curve. Both Iowa curves are displayed with the OLT curve in the following graph.

[25] Exhibit AG-DJG-13.

Figure 10:
Account 368.20 – Line Transformers – Bare Cost



The retirement pattern presented in the OLT curve for Account 368.20 declines very slightly until age-interval 41, upon which it declines rapidly. This type of retirement pattern is best described by higher-modal Iowa curves. Both Dr. Kateregga and I selected high modal curves in the "R" family of Iowa curves. However, the R4 curve shape selected by Dr. Kateregga declines to early relative to the OLT curve for this account. If one were to look only at the R4-40 curve selected by Dr. Kateregga to assess the historical retirement rate for the assets in this account, one could be led to believe that only 58% of the assets survive when they reach 40 years. However, the <u>actual</u> historical retirement data in this account, as displayed in the OLT curve, show that 93% of the assets survive when they reach 40 years. The primary purpose of using Iowa curves to estimate average and remaining life is to use historical retirement patterns to predict future retirement patterns. However, the R4-40 curve selected by Dr. Kateregga does not even accurately describe information we already know, and severely understates the actual percent surviving observed between age intervals 30 – 40 for this account. Instead, a higher-modal "R" curve (the R5 curve) and a slightly longer average life of 44 years provide a more accurate reflection of the significant data points through this middle portion of the OLT curve.

Q. DOES THE IOWA CURVE YOU SELECTED PROVIDE A BETTER MATHEMATICAL FIT TO THE OBSERVED DATA THAN THE COMPANY'S CURVE?

A. Yes. Specifically, the total SSD for the Company's curve is 0.8442 and the SSD for the R5-44 curve I selected is 0.2140.[26] Because the OLT curve for this account follows a typical, higher-modal survivor curve patter and reaches nearly zero percent surviving (a complete curve), more deference should be given to the mathematical analysis, which favors the R5-44 Iowa curve for this account.

[26] Exhibit AG-DJG-14.

VI. NET SALVAGE ANALYSIS

Q. DESCRIBE THE CONCEPT OF NET SALVAGE.

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

Q. DESCRIBE HOW YOU ANALYZED THE COMPANY'S NET SALVAGE RATES.

A. In this case, I examined the Company's historical net salvage data over different periods of time.

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

A. No. In my opinion, the net salvage rates proposed by Dr. Kateregga are reasonable.

VII. CONCLUSION AND RECOMMENDATION

Q. SUMMARIZE THE KEY POINTS OF YOUR TESTIMONY.

A. I employed a well-established depreciation system and used actuarial analysis to statistically analyze the Company's depreciable assets in order to develop reasonable depreciation rates in this case. I recommended adjustments to the Company's proposed service lives for several of its transmission and distribution accounts. For these accounts, the Company did not meet its burden to make a convincing showing that its proposed depreciation rates are not excessive. I used a combination of visual and mathematical Iowa curve fitting techniques along with professional judgment to arrive at reasonable and accurate service life estimates for these accounts. I also recommend the Commission adopt use of book reserve balances when calculating depreciation rates under the remaining life technique rather than rebalanced or redistributed reserve balances, which are influenced by estimated service lives and net salvage rates.

Q. DOES THIS CONCLUDE YOUR TESTIMONY?

A. Yes.

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.[27] The primary objective of the depreciation system is the timely recovery of capital. The process for calculating the annual accruals is determined by the factors required to define the system. A depreciation system should be defined by four primary factors: 1) a method of allocation; 2) a procedure for applying the method of allocation to a group of property; 3) a technique for applying the depreciation rate; and 4) a model for analyzing the characteristics of vintage groups comprising a continuous property group.[28] The figure below illustrates the basic concept of a depreciation system and includes some of the available parameters.[29]

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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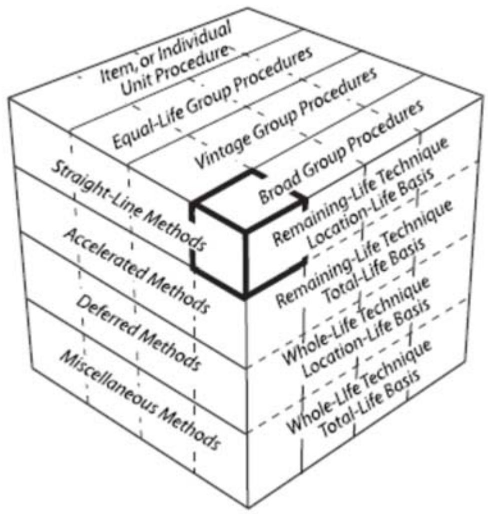
[27] Wolf *supra* n. 7, at 69-70.

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

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

Figure 11:
The Depreciation System Cube



1. Allocation Methods

The "method" refers to the pattern of depreciation in relation to the accounting periods. The method most commonly used in the regulatory context is the "straight-line method" – a type of age-life method in which the depreciable cost of plant is charged in equal amounts to each accounting period over the service life of plant.[30] 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.[31] The basic formula for the straight-line method is as follows:[32]

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

[31] *Id*.

[32] *Id*.

Equation 1:
Straight-Line Accrual

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

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.[33] 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:[34]

Equation 2:
Straight-Line Rate

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

2. <u>Grouping Procedures</u>

The "procedure" refers to the way the allocation method is applied through subdividing the total property into groups.[35] 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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[33] *Id*. at 57.

[34] *Id*. at 56.

[35] 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.[36] 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.[37]

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.[38] 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.[39] Under the equal life procedure the property is divided into subgroups that each has a common life.[40]

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[36] *Id*. at 74.

[37] NARUC *supra* n. 8, at 61-62.

[38] *See* Wolf *supra* n. 7, at 74-75.

[39] *Id*. at 75.

[40] *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.[41]

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.[42] 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.[43] An imbalance exists when the actual accumulated depreciation account does not equal the CAD. The choice of application technique will affect how the imbalance is dealt with.

Use of the whole life technique requires that an adjustment be made to accumulated depreciation after calculation of the CAD. The adjustment can be made in a lump sum or over a

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[41] NARUC *supra* n. 8, at 63-64.

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

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

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.[44] 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:[45]

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.[46]

4. Analysis Model

The fourth parameter of a depreciation system, the "model," relates to the way of viewing the life and salvage characteristics of the vintage groups that have been combined to form a

[44] 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.").

[45] *Id*. at 64.

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

continuous property group for depreciation purposes.[47] 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.

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[47] *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.[48] This explains why the word "mortality" is often used in the context of depreciation analysis. In fact, a group of property installed during the same accounting period is analogous to a group of humans born during the same calendar year. Each period the group will incur a certain fraction of deaths / retirements until there are no survivors. Describing this pattern of mortality is part of actuarial analysis and is regularly used by insurance companies to determine life insurance premiums. The pattern of mortality may be described by several mathematical functions, particularly the survivor curve and frequency curve. Each curve may be derived from the other so that if one curve is known, the other may be obtained. A survivor curve is a graph of the percent of units remaining in service expressed as a function of age.[49] 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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[48] Wolf *supra* n. 7, at 276.

[49] *Id*. at 23.

representing the life characteristics of each group of property.[50] 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.[51] This resulted in 5 additional survivor curve types for a total of 18 curves. In 1935, Winfrey published *Bulletin 125: Statistical Analysis of Industrial Property Retirements*. According to Winfrey, "[t]he 18 type curves are expected to represent quite well all survivor curves commonly encountered in utility and industrial practices."[52] 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 intervals.[53] Rather than using the original formulas, analysts typically rely on the published tables containing the percentages surviving. This is because absent knowledge of the integration

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[50] *Id*. at 34.

[51] *Id*.

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

[53] 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).

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:[54]

1. No evidence was found to conclude that the Iowa curve set, as it stands, is not a valid system of standard curves;
2. No evidence was found to conclude that new curve shapes could be produced at this time that would add to the validity of the Iowa curve set; and
3. No evidence was found to suggest that the number of curves within the Iowa curve set should be reduced.

Prior to Russo's study, some had criticized the Iowa curves as being potentially obsolete because their development was rooted in the study of industrial property in existence during the early 1900s. Russo's research, however, negated this criticism by confirming that the Iowa curves represent a sufficiently wide range of life patterns, and that though technology will change over time, the underlying patterns of retirements remain constant and can be adequately described by the Iowa curves.[55]

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

[55] *Id*.

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.

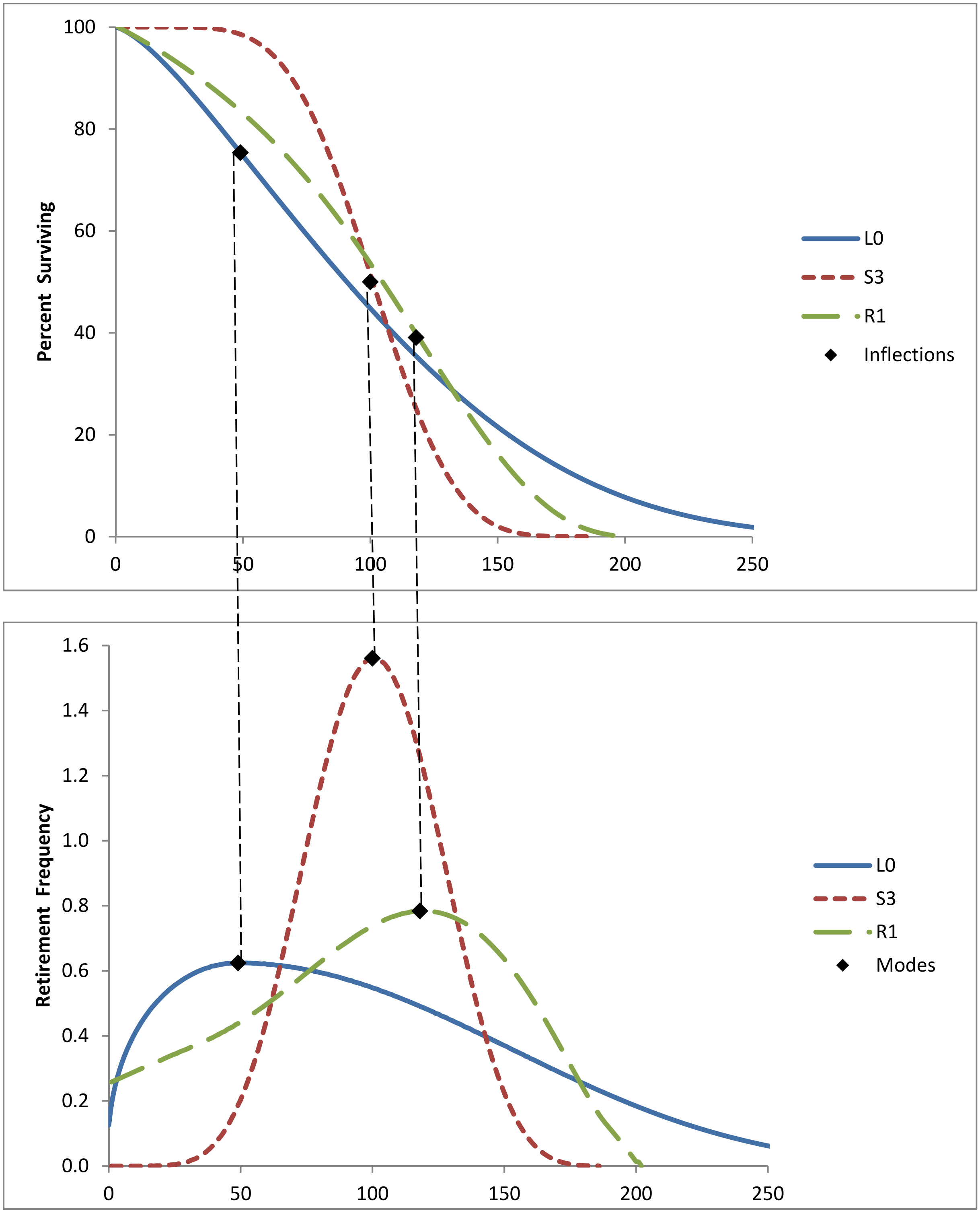
2. Classification

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, S6).[56] 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.

[56] 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 12:
Modal Age Illustration



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

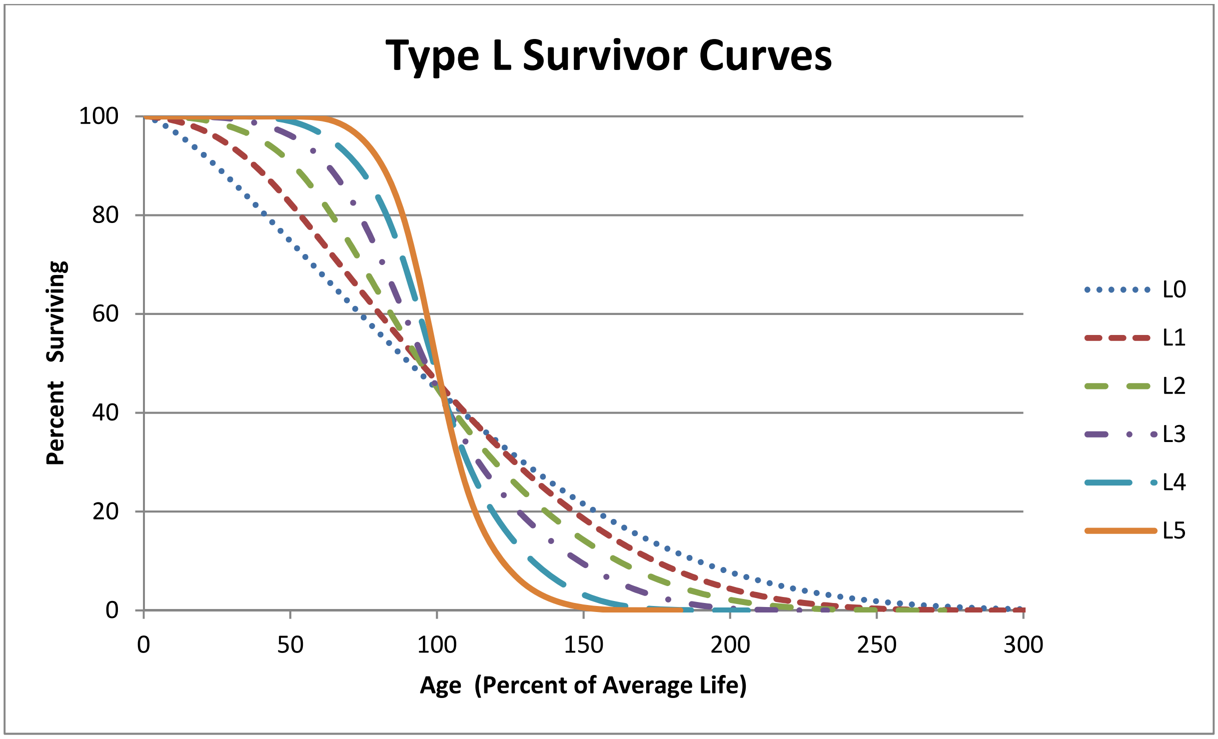
> Since the location of a particular survivor on a graph is affected by both its span in years and the shape of the curve, it is difficult to classify a group of curves unless one of these variables can be controlled. This is easily done by expressing the age in percent of average life."[57]

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.

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

Figure 13:
Type L Survivor and Frequency Curves



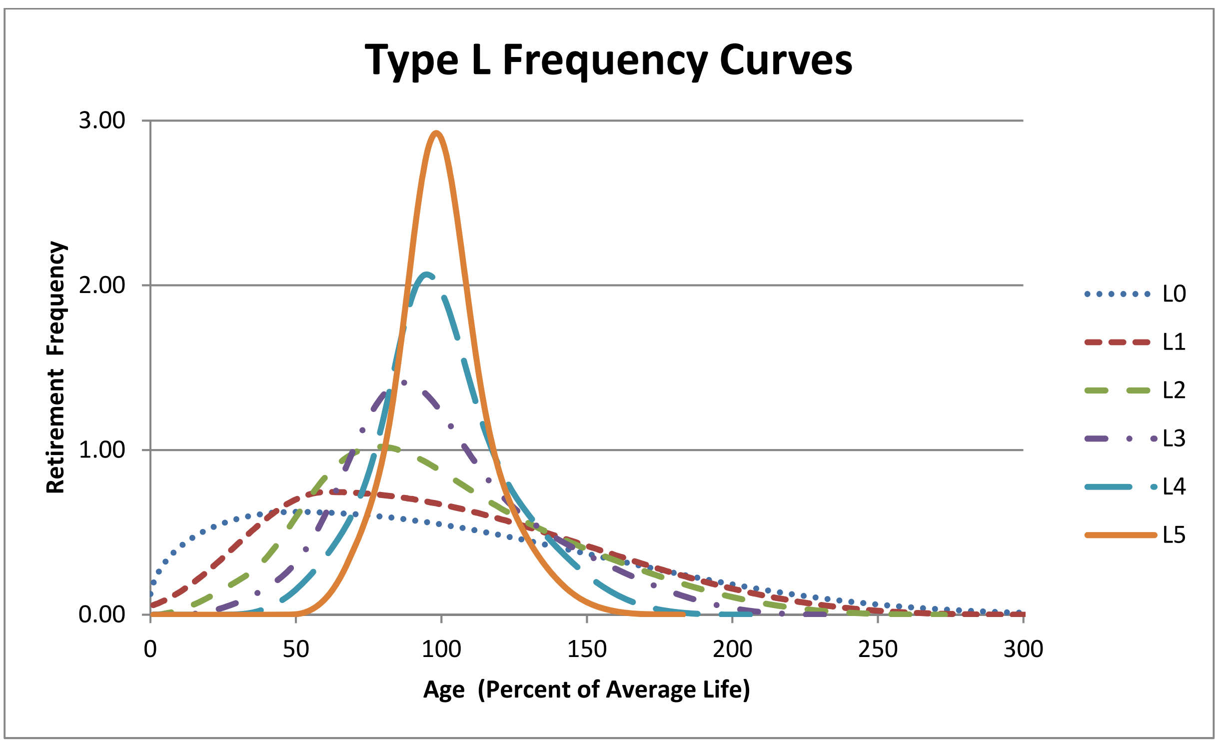
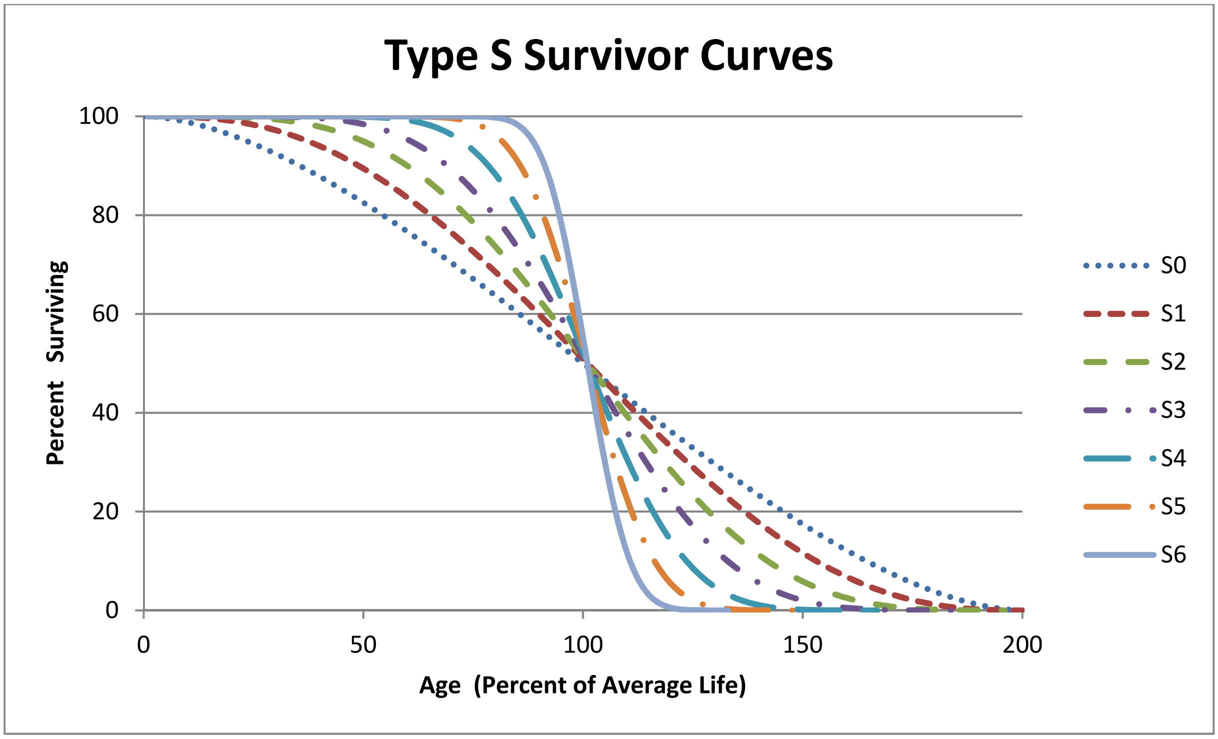


Figure 14:
Type S Survivor and Frequency Curves



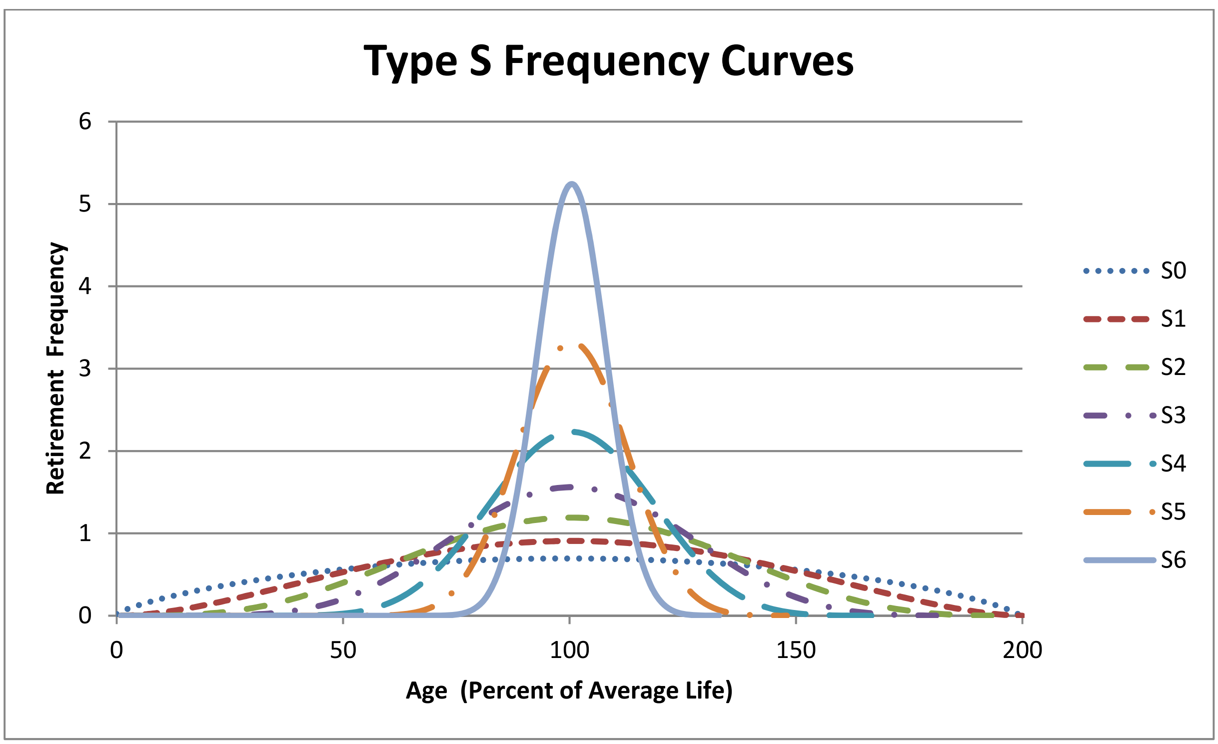
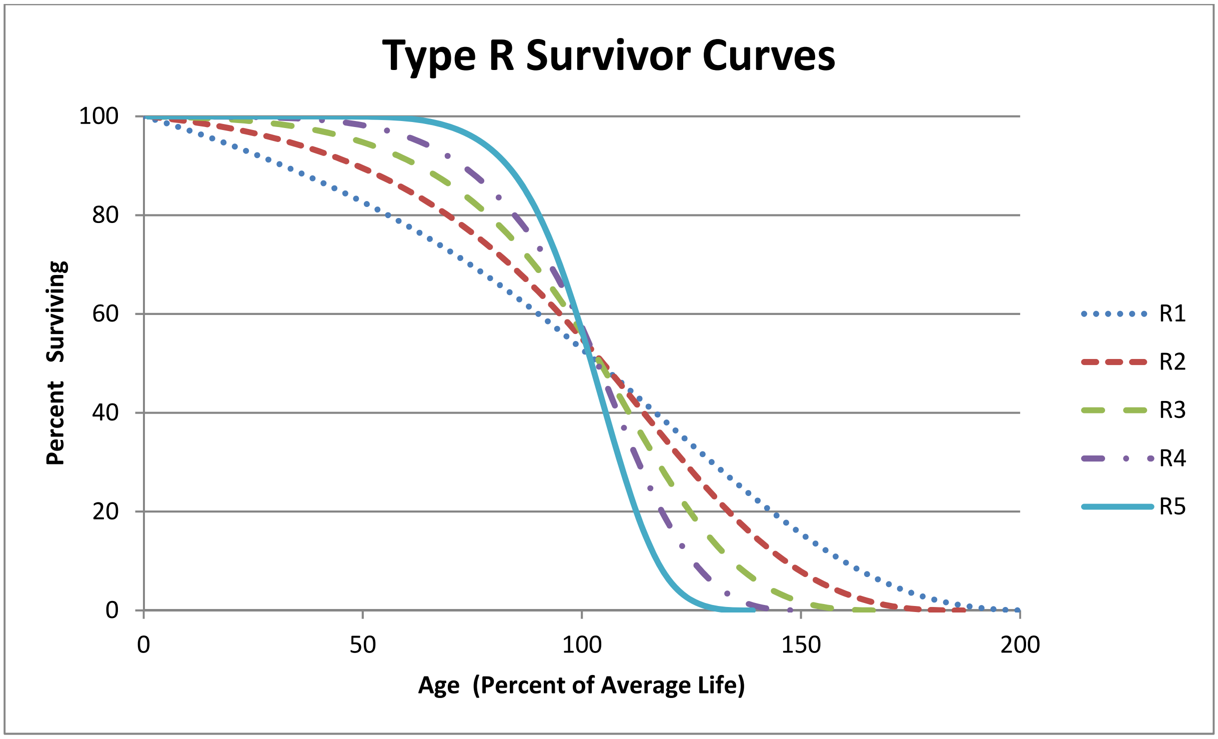
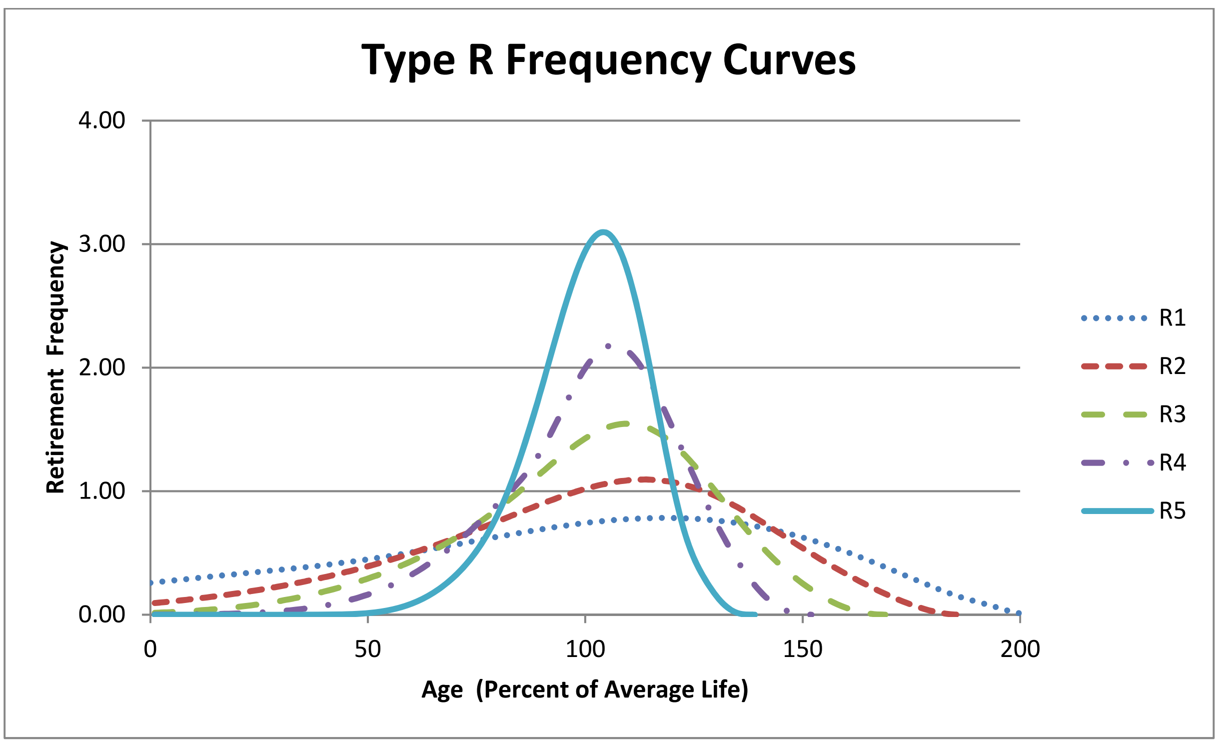


Figure 15:
Type R Survivor and Frequency Curves





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.[58]

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:[59]

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 results in a "stub" survivor

[58] 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.

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

curve. Iowa curves are used to extend stub curves to maximum life in order for the average life calculation to be made (see 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.[60] 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.[61] 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

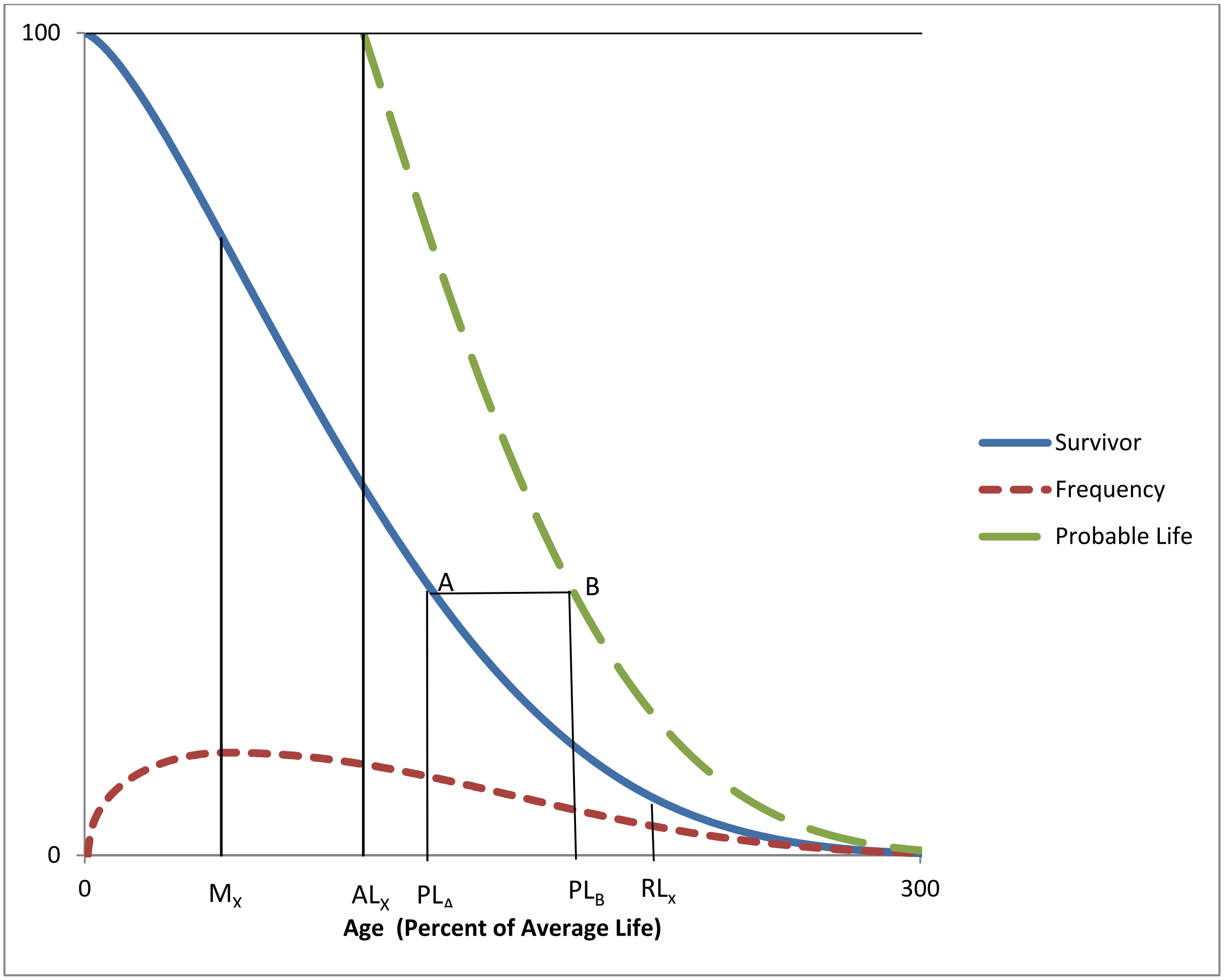
$$Average\ Remaining\ Life = \frac{Area\ Under\ Survivor\ Curve\ from\ Age\ x\ to\ Max\ Life}{S_X}$$

It is necessary to determine average remaining life to calculate the annual accrual under the remaining life technique.

[60] *Id*. at 73.

[61] *Id*. at 74.

Figure 16:
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.[62] The probable life is also illustrated in this figure. The

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[62] 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 is 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.[63]

Figure 17:
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 the average lives of property groups. A utility's historical data is often contained in the Continuing

[63] NARUC *supra* n. 8, at 14-15.

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.[64] Historical data is used in the retirement rate actuarial method, which is discussed further below.

<u>The Retirement Rate Method</u>

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.[65] 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 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

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[64] *Id*. at 112-13.

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

method may not be employed. The first matrix is the exposure matrix, which shows the exposures at the beginning of each year.[66] 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.

Figure 18:
Exposure Matrix

	Experience Years Exposures at January 1 of Each Year (Dollars in 000's)									
Placement Years	2008	2009	2010	2011	2012	2013	2014	2015	Total at Start of Age Interval	Age Interval
2003	261	245	228	211	**192**	173	152	131	131	11.5 - 12.5
2004	267	252	236	220	202	**184**	165	145	297	10.5 - 11.5
2005	304	291	277	263	248	232	**216**	198	536	9.5 - 10.5
2006	345	334	322	310	298	284	270	**255**	**847**	8.5 - 9.5
2007	367	357	347	335	324	312	299	286	1,201	7.5 - 8.5
2008	375	366	357	347	336	325	314	302	1,581	6.5 - 7.5
2009		377	366	356	346	336	327	319	1,986	5.5 - 6.5
2010			381	369	358	347	336	327	2,404	4.5 - 5.5
2011				386	372	359	346	334	2,559	3.5 - 4.5
2012					395	380	366	352	2,722	2.5 - 3.5
2013						401	385	370	2,866	1.5 - 2.5
2014							410	393	2,998	0.5 - 1.5
2015								416	3,141	0.0 - 0.5
Total	1919	2222	2514	2796	3070	3333	3586	3827	23,268	

[66] 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 19:
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.[67] 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

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[67] 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 20:
Observed Life Table

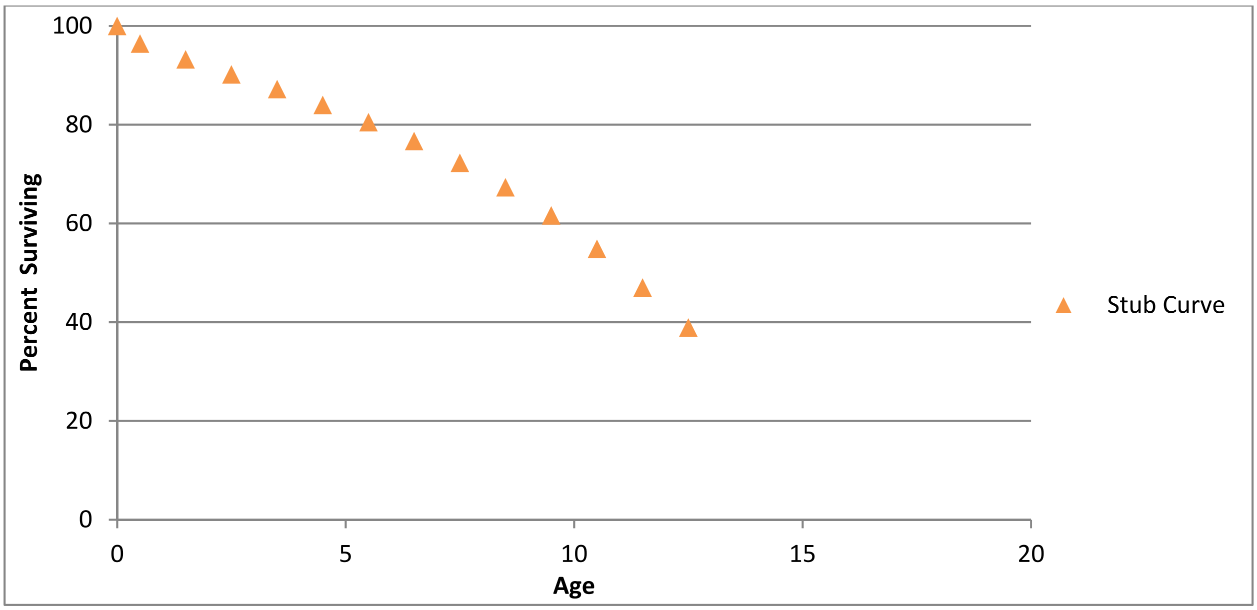
Age at Start of Interval	Exposures at Start of Age Interval	Retirements During Age Interval	Retirement Ratio	Survivor Ratio	Percent Surviving at Start of Age Interval
A	B	C	D = C / B	E = 1 - D	F
0.0	3,141	112	0.036	0.964	**100.00**
0.5	2,998	100	0.033	0.967	**96.43**
1.5	2,866	93	0.032	0.968	**93.21**
2.5	2,722	91	0.033	0.967	**90.19**
3.5	2,559	93	0.037	0.963	**87.19**
4.5	2,404	100	0.042	0.958	**84.01**
5.5	1,986	95	0.048	0.952	**80.50**
6.5	1,581	91	0.058	0.942	**76.67**
7.5	1,201	82	0.068	0.932	**72.26**
8.5	847	71	0.084	0.916	**67.31**
9.5	536	59	0.110	0.890	**61.63**
10.5	297	43	0.143	0.857	**54.87**
11.5	131	23	0.172	0.828	**47.01**
					38.91
Total	23,268	1,052			

Column F on the right shows the percentages surviving at the beginning of each age interval. This column starts at 100% surviving. Each consecutive number below is calculated by multiplying the percent surviving from the previous age interval by the corresponding survivor ratio for that age interval. For example, the percent surviving at the start of age interval 1.5 is 93.21%, which was calculated by multiplying the percent surviving for age interval 0.5 (96.43%) by the survivor ratio for age interval 0.5 (0.967)[68].

[68] 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% surviving and ends at 38.91% 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 21:
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.[69] 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.[70]

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.

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

[70] *Id*.

Figure 22:
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 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.[71] 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

[71] 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.[72]

Analysts also use "experience bands." Experience bands show the composite retirement history for all vintages during a select set of activity years. The figure below shows the same data presented in the previous exposure matrices, except that the experience band from 2011 – 2013 is isolated, resulting in different interval totals.

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

Figure 23:
Experience Bands

Placement Years	Experience Years Exposures at January 1 of Each Year (Dollars in 000's)								Total at Start of Age Interval	Age Interval
	2008	2009	2010	2011	2012	2013	2014	2015		
2003	261	245	228	211	192	173	152	131		11.5 - 12.5
2004	267	252	236	220	202	184	165	145		10.5 - 11.5
2005	304	291	277	263	248	232	216	198	173	9.5 - 10.5
2006	345	334	322	310	298	284	270	255	376	8.5 - 9.5
2007	367	357	347	335	324	312	299	286	645	7.5 - 8.5
2008	375	366	357	347	336	325	314	302	752	6.5 - 7.5
2009		377	366	356	346	336	327	319	872	5.5 - 6.5
2010			381	369	358	347	336	327	959	4.5 - 5.5
2011				386	372	359	346	334	1,008	3.5 - 4.5
2012					395	380	366	352	1,039	2.5 - 3.5
2013						401	385	370	1,072	1.5 - 2.5
2014							410	393	1,121	0.5 - 1.5
2015								416	1,182	0.0 - 0.5
Total	1919	2222	2514	2796	3070	3333	3586	3827	9,199	

The shaded cells within the experience band equal the total exposures at the beginning of age interval 4.5–5.5 ($1,237). The same experience band would be used for the retirement matrix covering the same experience years of 2011 – 2013. This of course would result in a different OLT and original stub survivor than if the band had not been used. Analysts often use experience bands to isolate and analyze the effects of an operating environment over time.[73] 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

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[73] *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. This is because, as seen in the OLT above, relatively newer vintage groups have not yet been fully retired at the time the property is studied. An analyst could confine the analysis to older, fully retired vintage groups 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.

<u>Curve Fitting</u>

Depreciation analysts typically use the survivor curve rather than the frequency curve to fit the observed stub curves. The most commonly used generalized survivor curves 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."[74]

Curve fitting may be done through visual matching or mathematical matching. In visual curve fitting, the analyst visually examines the plotted data to make an initial judgment about the Iowa curves that may be a good fit. The figure below illustrates the stub survivor curve shown above. It also shows three different Iowa curves: the 10-L4, the 10.5-R1, and the 10-S0. Visually, it is clear that the 10.5-R1 curve is a better fit than the other two curves.

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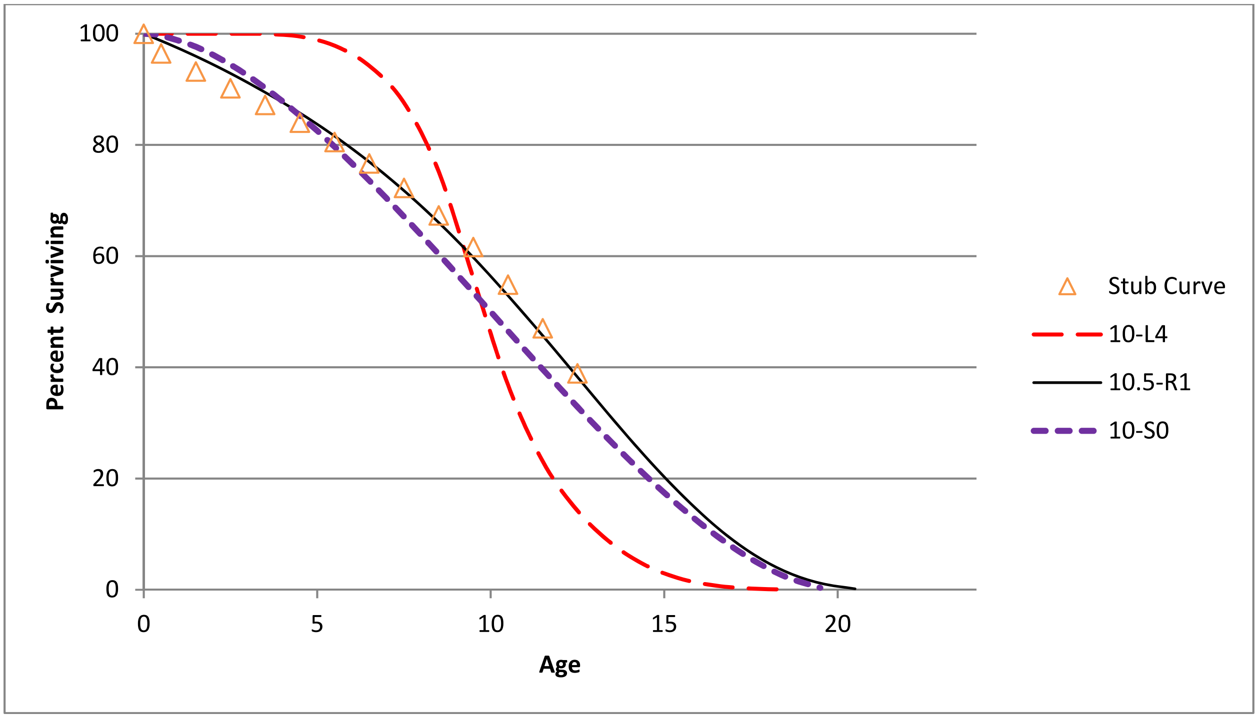
[74] Wolf *supra* n. 7, at 46 (22 curves includes Winfrey's 18 original curves plus Cowles's four "O" type curves).

Figure 24:
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.[75]

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."[76]

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.

---

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

[76] *Id*. at 48.

Figure 25:
Mathematical Fitting

Age	Stub	Iowa Curves			Squared Differences		
Interval	Curve	10-L4	10-S0	10.5-R1	10-L4	10-S0	10.5-R1
0.0	100.0	100.0	100.0	100.0	0.0	0.0	0.0
0.5	96.4	100.0	99.7	98.7	12.7	10.3	5.3
1.5	93.2	100.0	97.7	96.0	46.1	19.8	7.6
2.5	90.2	100.0	94.4	92.9	96.2	18.0	7.2
3.5	87.2	100.0	90.2	89.5	162.9	9.3	5.2
4.5	84.0	99.5	85.3	85.7	239.9	1.6	2.9
5.5	80.5	97.9	79.7	81.6	301.1	0.7	1.2
6.5	76.7	94.2	73.6	77.0	308.5	9.5	0.1
7.5	72.3	87.6	67.1	71.8	235.2	26.5	0.2
8.5	67.3	75.2	60.4	66.1	62.7	48.2	1.6
9.5	61.6	56.0	53.5	59.7	31.4	66.6	3.6
10.5	54.9	36.8	46.5	52.9	325.4	69.6	3.9
11.5	47.0	23.1	39.6	45.7	572.6	54.4	1.8
12.5	38.9	14.2	32.9	38.2	609.6	36.2	0.4
SUM					**3004.2**	**371.0**	**41.0**

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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 – Present
Participate in management of operations, attend meetings, review performance, compensation, and financial records. Assist in fundraising events.

Group Facilitator & Fundraiser — 2014 – Present
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
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
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

Utility Regulatory Proceedings

Regulatory Agency	Utility Applicant	Docket Number	Issues Addressed	Parties Represented
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
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

Utility Regulatory Proceedings

Regulatory Agency	Utility Applicant	Docket Number	Issues Addressed	Parties Represented
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 12/31/2017	Company Proposal	AG Proposal	AG Adjustment
Transmission	74,489,396	2,450,191	1,968,281	(481,910)
Distribution	4,209,885,632	128,747,462	117,509,998	(11,237,464)
General	173,383,584	4,944,384	4,806,059	(138,325)
Total	$ 4,457,758,612	$ 136,142,037	$ 124,284,338	**$ (11,857,699)**

Depreciation Parameter Comparison

Account No.	Description	Company's Position: Iowa Curve Type	Iowa Curve AL	Depr Rate	Annual Accrual	AG's Position: Iowa Curve Type	Iowa Curve AL	Depr Rate	Annual Accrual
	TRANSMISSION PLANT								
355.00	Poles and Fixtures	S1	45	3.73%	1,190,951	R2	57	2.76%	882,784
356.00	OH Conductors and Devices	R2	55	2.99%	971,897	R1.5	63	2.63%	854,039
	DISTRIBUTION PLANT								
362.00	Station Equipment	L1.5	45	2.67%	16,974,768	S0	49	2.74%	17,424,482
364.00	Poles, Towers and Fixtures	S1.5	45	3.15%	21,957,160	L2	50	2.92%	20,334,878
365.00	OH Conductors and Devices	SC	45	3.17%	27,086,938	O1	48	2.75%	23,524,639
366.00	UG Conduit	S4	50	2.21%	4,822,102	R4	55	1.73%	3,782,914
367.10	UG Conductors and Devices	R0.5	50	2.74%	20,155,093	L0	53	2.49%	18,345,789
368.20	Line Transformers - Bare Cost	R4	40	3.24%	10,334,601	R5	44	2.91%	9,271,198

Detailed Rate Comparison

D.P.U. 18-150
Exhibit AG-DJG-5
March 22, 2019
H.O. Carol Pieper

		[1]	[2]		[3]		[4]		[5]		[6]	
			Current Parameters		Company Proposal		AG Proposal		AG Adjustment from Current Parameters		AG Adjustment to Company Proposal	
Account No.	Description	Original Cost	Rate	Annual Accrual	Rate	Annual Accrual	Rate	Annual Accrual	Rate	Annual Accrual	Rate	Annual Accrual
	TRANSMISSION PLANT											
352.00	Structures and Improvements	248,719	1.56%	3,880	2.56%	6,367	1.51%	3,761	-0.05%	-119	-1.05%	-2,606
353.00	Station Equipment	7,678,898	1.79%	137,452	2.92%	224,224	2.80%	214,851	1.01%	77,399	-0.12%	-9,373
354.00	Towers and Fixtures	720,064	1.54%	11,089	2.19%	15,769	-0.85%	-6,114	-2.39%	-17,203	-3.04%	-21,883
355.00	Poles and Fixtures	31,928,978	3.04%	970,641	3.73%	1,190,951	2.76%	882,784	-0.28%	-87,857	-0.97%	-308,167
356.00	Overhead Conductors and Devices	32,504,929	2.49%	809,373	2.99%	971,897	2.63%	854,039	0.14%	44,666	-0.36%	-117,858
357.00	Underground Conduit	1,033,869	1.97%	20,367	2.57%	26,570	1.97%	20,354	0.00%	-13	-0.60%	-6,216
358.00	Underground Conductors and Devices	241,585	-1.33%	-3,213	4.12%	9,953	-0.20%	-486	1.13%	2,727	-4.32%	-10,439
359.00	Roads and Trails	132,354	0.27%	357	3.37%	4,460	-0.69%	-908	-0.96%	-1,265	-4.06%	-5,368
	Total Transmission Plant	74,489,396	2.62%	1,949,946	3.29%	2,450,191	2.64%	1,968,281	0.02%	18,335	-0.65%	-481,910
	DISTRIBUTION PLANT											
361.00	Structures and Improvements	27,756,943	2.44%	677,269	2.12%	588,447	2.17%	602,697	-0.27%	-74,572	0.05%	14,250
362.00	Station Equipment	635,759,089	2.07%	13,160,213	2.67%	16,974,768	2.74%	17,424,482	0.67%	4,264,269	0.07%	449,714
364.00	Poles, Towers and Fixtures	697,052,709	3.41%	23,769,497	3.15%	21,957,160	2.92%	20,334,878	-0.49%	-3,434,619	-0.23%	-1,622,282
365.00	Overhead Conductors and Devices	854,477,531	3.19%	27,257,833	3.17%	27,086,938	2.75%	23,524,639	-0.44%	-3,733,194	-0.42%	-3,562,299
366.00	Underground Conduit	218,194,682	2.56%	5,585,784	2.21%	4,822,102	1.73%	3,782,914	-0.83%	-1,802,870	-0.48%	-1,039,188
367.10	Underground Conductors and Devices	735,587,354	2.90%	21,332,033	2.74%	20,155,093	2.49%	18,345,789	-0.41%	-2,986,244	-0.25%	-1,809,304
368.10	Line Transformer Stations	12,555,678	3.50%	439,449	3.84%	482,138	3.99%	501,592	0.49%	62,143	0.15%	19,454
368.20	Line Transformers - Bare Cost	318,969,174	3.77%	12,025,138	3.24%	10,334,601	2.91%	9,271,198	-0.86%	-2,753,940	-0.33%	-1,063,403
368.30	Line Transformers - Install Cost	204,623,493	3.87%	7,918,929	3.72%	7,611,994	3.58%	7,320,138	-0.29%	-598,791	-0.14%	-291,856
369.10	Overhead Services	196,419,229	3.53%	6,933,599	3.97%	7,797,843	4.27%	8,388,032	0.74%	1,454,433	0.30%	590,189
369.22	Underground Services	73,529,381	2.90%	2,132,352	3.64%	2,676,469	3.84%	2,823,897	0.94%	691,545	0.20%	147,428
370.10	Meters - Bare Cost - Domestic	64,191,181	4.23%	2,715,287	4.18%	2,683,191	3.64%	2,337,955	-0.59%	-377,332	-0.54%	-345,236
370.20	Meters - Install Cost - Domestic	29,588,090	4.49%	1,328,505	4.52%	1,337,382	2.93%	866,681	-1.56%	-461,824	-1.59%	-470,701
370.30	Large Meters - Bare Coss - Domestic	24,133,674	4.10%	989,481	3.55%	856,745	4.56%	1,100,146	0.46%	110,665	1.01%	243,401
370.35	Large Meters - Install Cost - Domestic	21,645,767	3.65%	790,070	2.94%	636,386	5.43%	1,176,117	1.78%	386,047	2.49%	539,731
373.10	OH Street Lighting and Signal Systems	62,244,001	5.44%	3,386,074	2.74%	1,705,486	-0.29%	-178,873	-5.73%	-3,564,947	-3.03%	-1,884,359
373.20	UG Street Lighting and Signal Systems	33,088,481	5.41%	1,790,087	3.13%	1,035,669	-0.36%	-117,500	-5.77%	-1,907,587	-3.49%	-1,153,169
373.30	UG Street Lighting - LED	69,175	5.41%	3,742	7.30%	5,050	7.54%	5,217	2.13%	1,475	0.24%	167
	Total Distribution Plant	4,209,885,632	3.14%	132,235,342	3.06%	128,747,462	2.79%	117,509,998	-0.35%	-14,725,345	-0.27%	-11,237,464
	GENERAL PLANT											
390.00	Structures and Improvements	134,489,799	2.05%	2,757,041	2.34%	3,147,061	2.37%	3,188,432	0.32%	431,391	0.03%	41,371
397.10	Communication Equipment - Site Specific	7,620,116	3.83%	291,850	5.31%	404,628	3.63%	276,442	-0.20%	-15,409	-1.68%	-128,186
391.00	Office Furniture and Equipment	7,800,363	6.66%	519,323	6.66%	519,323	7.91%	616,825	1.25%	97,502	1.25%	97,502
393.00	Stores Equipment	745,166	0.00%	0	0.00%	0	-7.47%	-55,659	-7.47%	-55,659	-7.47%	-55,659
394.00	Tools, Shop and Garage Equipment	7,836,936	6.62%	518,884	6.62%	518,884	6.05%	474,170	-0.57%	-44,714	-0.57%	-44,714
395.00	Laboratory Equipment	3,958,740	6.33%	250,550	6.33%	250,550	5.18%	205,192	-1.15%	-45,358	-1.15%	-45,358
397.00	Communication Equipment	10,311,026	0.61%	62,509	0.61%	62,509	0.62%	64,080	0.02%	1,571	0.02%	1,571
398.00	Miscellaneous Equipment	621,438	6.67%	41,429	6.67%	41,429	5.89%	36,577	-0.78%	-4,852	-0.78%	-4,852
	Total General Plant	173,383,584	2.56%	4,441,586	2.85%	4,944,384	2.77%	4,806,059	0.21%	364,473	-0.08%	-138,325
	TOTAL PLANT STUDIED	**4,457,758,612**	**3.11%**	**138,626,875**	**3.05%**	**136,142,037**	**2.79%**	**124,284,338**	**-0.32%**	**-14,342,536**	**-0.27%**	**-11,857,699**

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

Depreciation Rate Development

		[1]	[2]		[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]	[13]
			Iowa Curve							Service Life		Net Salvage		Total	
Account No.	Description	Original Cost	Type	AL	Net Salvage	Depreciable Base	Book Reserve	Future Accruals	Remaining Life	Accrual	Rate	Accrual	Rate	Accrual	Rate
	TRANSMISSION PLANT														
352.00	Structures and Improvements	248,719	S4	55	-10%	273,591	172,371	101,219	26.91	2,837	1.14%	924	0.37%	3,761	**1.51%**
353.00	Station Equipment	7,678,898	L2	40	-10%	8,446,788	1,721,958	6,724,830	31.30	190,318	2.48%	24,533	0.32%	214,851	**2.80%**
354.00	Towers and Fixtures	720,064	R4	50	-10%	792,070	1,006,608	-214,538	35.09	-8,166	-1.13%	2,052	0.28%	-6,114	**-0.85%**
355.00	Poles and Fixtures	31,928,978	R2	57	-50%	47,893,467	8,309,429	39,584,038	44.84	526,752	1.65%	356,032	1.12%	882,784	**2.76%**
356.00	Overhead Conductors and Devices	32,504,929	R1.5	63	-50%	48,757,394	2,417,237	46,340,156	54.26	554,510	1.71%	299,529	0.92%	854,039	**2.63%**
357.00	Underground Conduit	1,033,869	S5	50	-10%	1,137,256	510,354	626,902	30.80	16,997	1.64%	3,357	0.32%	20,354	**1.97%**
358.00	Underground Conductors and Devices	241,585	S1	42	-10%	265,744	271,256	-5,513	11.35	-2,614	-1.08%	2,129	0.88%	-486	**-0.20%**
359.00	Roads and Trails	132,354	S6	60	0%	132,354	143,445	-11,091	12.21	-908	-0.69%	0	0.00%	-908	**-0.69%**
	Total Transmission Plant	74,489,396			-45%	107,698,663	14,552,659	93,146,004	47.32	1,279,725	1.72%	688,556	0.92%	1,968,281	**2.64%**
	DISTRIBUTION PLANT														
361.00	Structures and Improvements	27,756,943	R1	65	-40%	38,859,720	7,772,586	31,087,134	51.58	387,444	1.40%	215,254	0.78%	602,697	**2.17%**
362.00	Station Equipment	635,759,089	S0	49	-25%	794,698,861	103,643,917	691,054,944	39.66	13,416,923	2.11%	4,007,559	0.63%	17,424,482	**2.74%**
364.00	Poles, Towers and Fixtures	697,052,709	L2	50	-50%	1,045,579,064	306,609,614	738,969,449	36.34	10,744,169	1.54%	9,590,709	1.38%	20,334,878	**2.92%**
365.00	Overhead Conductors and Devices	854,477,531	O1	48	-50%	1,281,716,297	360,020,953	921,695,344	39.18	12,620,127	1.48%	10,904,512	1.28%	23,524,639	**2.75%**
366.00	Underground Conduit	218,194,682	R4	55	-20%	261,833,618	132,949,726	128,883,892	34.07	2,502,053	1.15%	1,280,861	0.59%	3,782,914	**1.73%**
367.10	Underground Conductors and Devices	735,587,354	L0	53	-40%	1,029,822,296	182,246,859	847,575,437	46.20	11,977,067	1.63%	6,368,722	0.87%	18,345,789	**2.49%**
368.10	Line Transformer Stations	12,555,678	S1.5	32	-40%	17,577,949	7,651,447	9,926,502	19.79	247,814	1.97%	253,778	2.02%	501,592	**3.99%**
368.20	Line Transformers - Bare Cost	318,969,174	R5	44	-40%	446,556,844	194,380,253	252,176,590	27.20	4,580,475	1.44%	4,690,723	1.47%	9,271,198	**2.91%**
368.30	Line Transformers - Install Cost	204,623,493	R3	35	-40%	286,472,890	124,697,838	161,775,052	22.10	3,616,545	1.77%	3,703,593	1.81%	7,320,138	**3.58%**
369.10	Overhead Services	196,419,229	S1.5	55	-100%	392,838,458	62,433,861	330,404,597	39.39	3,401,507	1.73%	4,986,525	2.54%	8,388,032	**4.27%**
369.22	Underground Services	73,529,381	S1.5	55	-100%	147,058,762	23,372,066	123,686,696	43.80	1,145,144	1.56%	1,678,753	2.28%	2,823,897	**3.84%**
370.10	Meters - Bare Cost - Domestic	64,191,181	R2	25	-20%	77,029,417	45,046,195	31,983,222	13.68	1,399,487	2.18%	938,468	1.46%	2,337,955	**3.64%**
370.20	Meters - Install Cost - Domestic	29,588,090	R2	25	-20%	35,505,708	20,763,458	14,742,250	17.01	518,791	1.75%	347,891	1.18%	866,681	**2.93%**
370.30	Large Meters - Bare Coss - Domestic	24,133,674	R2	25	-20%	28,960,409	16,935,818	12,024,590	10.93	658,541	2.73%	441,604	1.83%	1,100,146	**4.56%**
370.35	Large Meters - Install Cost - Domestic	21,645,767	R2	25	-20%	25,974,920	15,189,928	10,784,992	9.17	704,017	3.25%	472,100	2.18%	1,176,117	**5.43%**
373.10	OH Street Lighting and Signal Systems	62,244,001	SC	35	-10%	68,468,401	72,913,407	-4,445,006	24.85	-429,352	-0.69%	250,479	0.40%	-178,873	**-0.29%**
373.20	UG Street Lighting and Signal Systems	33,088,481	SC	30	-10%	36,397,329	38,760,264	-2,362,935	20.11	-282,038	-0.85%	164,537	0.50%	-117,500	**-0.36%**
373.30	UG Street Lighting - LED	69,175	S3	15	-10%	76,093	449	75,643	14.50	4,740	6.85%	477	0.69%	5,217	**7.54%**
	Total Distribution Plant	4,209,885,632			-43%	6,015,427,036	1,715,388,640	4,300,038,396	36.59	67,213,455	1.60%	50,296,543	1.19%	117,509,998	**2.79%**
	GENERAL PLANT														
390.00	Structures and Improvements	134,489,799	L0.5	50	-15%	154,663,269	21,801,324	132,861,945	41.67	2,704,307	2.01%	484,125	0.36%	3,188,432	**2.37%**
397.10	Communication Equipment - Site Specific	7,620,116	R4	20	-5%	8,001,122	4,155,820	3,845,302	13.91	249,051	3.27%	27,391	0.36%	276,442	**3.63%**
391.00	Office Furniture and Equipment	7,800,363	SQ	15	0%	7,800,363	2,705,387	5,094,976	8.26	616,825	7.91%	0	0.00%	616,825	**7.91%**
393.00	Stores Equipment	745,166	SQ	15	0%	745,166	800,825	-55,659	1.00	-55,659	-7.47%	0	0.00%	-55,659	**-7.47%**
394.00	Tools, Shop and Garage Equipment	7,836,936	SQ	15	0%	7,836,936	2,834,438	5,002,498	10.55	474,170	6.05%	0	0.00%	474,170	**6.05%**
395.00	Laboratory Equipment	3,958,740	SQ	15	0%	3,958,740	2,785,043	1,173,697	5.72	205,192	5.18%	0	0.00%	205,192	**5.18%**
397.00	Communication Equipment	10,311,026	SQ	15	0%	10,311,026	9,726,614	584,412	9.12	64,080	0.62%	0	0.00%	64,080	**0.62%**
398.00	Miscellaneous Equipment	621,438	SQ	15	0%	621,438	258,956	362,482	9.91	36,577	5.89%	0	0.00%	36,577	**5.89%**
	Total General Plant	173,383,584			-12%	193,938,060	45,068,408	148,869,652	30.98	4,294,544	2.48%	511,515	0.30%	4,806,059	**2.77%**
	TOTAL PLANT STUDIED	**4,457,758,612**			**-42%**	**6,317,063,758**	**1,775,009,707**	**4,542,054,051**	**36.55**	**72,787,724**	**1.63%**	**51,496,615**	**1.16%**	**124,284,338**	**2.79%**

[1] Company depreciation study
[2] Average life and Iowa curve shape developed through actuarial analysis and professional judgment
[3] Net salvage estimates developed through statistical analysis and professional judgment
[4] = [1]*(1-[3])
[5] From depreciation study
[6] = [4] - [5]
[7] Composite remaining life based on Iowa 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 355 Curve Fitting

[1] Age (Years)	[2] Exposures (Dollars)	[3] Observed Life Table (OLT)	[4] Company S1-45	[5] AG R2-57	[6] Company SSD	[7] AG SSD
0.0	28,303,599	100.00%	100.00%	100.00%	0.0000	0.0000
0.5	26,273,688	100.00%	100.00%	99.92%	0.0000	0.0000
1.5	24,877,782	99.99%	99.99%	99.74%	0.0000	0.0000
2.5	24,104,523	99.95%	99.97%	99.56%	0.0000	0.0000
3.5	23,452,562	99.93%	99.92%	99.36%	0.0000	0.0000
4.5	19,596,101	99.68%	99.84%	99.16%	0.0000	0.0000
5.5	19,262,330	99.37%	99.72%	98.94%	0.0000	0.0000
6.5	18,866,435	99.33%	99.57%	98.71%	0.0000	0.0000
7.5	18,481,392	98.89%	99.36%	98.46%	0.0000	0.0000
8.5	18,514,988	98.26%	99.10%	98.21%	0.0001	0.0000
9.5	18,485,887	98.08%	98.79%	97.93%	0.0001	0.0000
10.5	21,005,053	97.98%	98.42%	97.64%	0.0000	0.0000
11.5	19,789,006	97.82%	97.99%	97.34%	0.0000	0.0000
12.5	17,494,241	96.92%	97.50%	97.02%	0.0000	0.0000
13.5	14,271,157	96.86%	96.94%	96.69%	0.0000	0.0000
14.5	11,699,344	93.46%	96.32%	96.33%	0.0008	0.0008
15.5	8,308,113	92.93%	95.63%	95.96%	0.0007	0.0009
16.5	6,195,373	92.52%	94.88%	95.57%	0.0006	0.0009
17.5	5,186,222	91.67%	94.05%	95.16%	0.0006	0.0012
18.5	5,111,601	91.50%	93.16%	94.73%	0.0003	0.0010
19.5	5,853,322	90.98%	92.20%	94.28%	0.0001	0.0011
20.5	5,343,493	90.34%	91.17%	93.81%	0.0001	0.0012
21.5	5,254,229	90.29%	90.08%	93.31%	0.0000	0.0009
22.5	5,151,812	89.84%	88.92%	92.79%	0.0001	0.0009
23.5	5,137,585	89.74%	87.69%	92.25%	0.0004	0.0006
24.5	5,085,724	89.68%	86.40%	91.68%	0.0011	0.0004
25.5	4,967,206	88.79%	85.06%	91.08%	0.0014	0.0005
26.5	4,965,270	88.73%	83.65%	90.46%	0.0026	0.0003
27.5	4,959,955	88.63%	82.18%	89.81%	0.0042	0.0001
28.5	4,860,504	86.99%	80.66%	89.13%	0.0040	0.0005
29.5	4,805,407	86.68%	79.08%	88.41%	0.0058	0.0003
30.5	4,828,373	86.53%	77.45%	87.67%	0.0082	0.0001
31.5	4,827,030	86.49%	75.78%	86.90%	0.0115	0.0000
32.5	4,714,956	86.39%	74.06%	86.10%	0.0152	0.0000
33.5	4,717,270	86.38%	72.30%	85.25%	0.0198	0.0001
34.5	4,678,122	84.54%	70.49%	84.38%	0.0197	0.0000
35.5	3,832,404	82.84%	68.65%	83.47%	0.0201	0.0000
36.5	3,595,356	82.76%	66.78%	82.52%	0.0255	0.0000
37.5	3,578,518	82.33%	64.88%	81.53%	0.0305	0.0001
38.5	3,453,411	79.39%	62.95%	80.51%	0.0270	0.0001
39.5	3,344,727	78.44%	61.00%	79.45%	0.0304	0.0001
40.5	3,263,095	78.25%	59.03%	78.34%	0.0370	0.0000
41.5	3,204,098	76.79%	57.04%	77.20%	0.0390	0.0000
42.5	3,074,129	76.77%	55.03%	76.01%	0.0472	0.0001
43.5	2,965,945	75.95%	53.03%	74.78%	0.0526	0.0001
44.5	2,801,248	75.21%	51.01%	73.51%	0.0586	0.0003

Account 355 Curve Fitting

[1] Age (Years)	[2] Exposures (Dollars)	[3] Observed Life Table (OLT)	[4] Company S1-45	[5] AG R2-57	[6] Company SSD	[7] AG SSD
45.5	2,415,081	74.97%	48.99%	72.19%	0.0675	0.0008
46.5	2,239,141	68.53%	46.98%	70.83%	0.0465	0.0005
47.5	1,725,849	53.65%	44.97%	69.43%	0.0075	0.0249
48.5	1,680,639	53.64%	42.96%	67.98%	0.0114	0.0206
49.5	1,676,948	53.62%	40.98%	66.49%	0.0160	0.0166
50.5	1,561,125	52.96%	39.00%	64.95%	0.0195	0.0144
51.5	1,478,251	52.95%	37.05%	63.38%	0.0253	0.0109
52.5	1,328,071	48.80%	35.12%	61.76%	0.0187	0.0168
53.5	1,327,943	48.79%	33.22%	60.11%	0.0242	0.0128
54.5	1,323,399	48.79%	31.35%	58.41%	0.0304	0.0093
55.5	1,323,399	48.79%	29.51%	56.68%	0.0372	0.0062
56.5	1,303,240	48.79%	27.70%	54.92%	0.0445	0.0038
57.5	1,257,297	48.79%	25.94%	53.12%	0.0522	0.0019
58.5	1,251,917	48.66%	24.22%	51.30%	0.0597	0.0007
59.5	1,251,917	48.66%	22.55%	49.45%	0.0682	0.0001
60.5	1,227,286	48.31%	20.92%	47.57%	0.0750	0.0001
61.5	1,098,470	48.31%	19.34%	45.68%	0.0839	0.0007
62.5	843,684	48.31%	17.82%	43.78%	0.0930	0.0021
63.5	843,684	48.31%	16.35%	41.86%	0.1021	0.0042
64.5	843,684	48.31%	14.94%	39.94%	0.1113	0.0070
65.5	835,170	47.82%	13.60%	38.03%	0.1171	0.0096
66.5	788,355	45.14%	12.31%	36.11%	0.1078	0.0081
67.5	51,228	45.14%	11.08%	34.21%		

Sum of Squared Differences	[8]	1.6844	0.1848
Up to 1% of Beginning Exposures	[9]	1.6844	0.1848

[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 356 Curve Fitting

[1]	[2]	[3]	[4]	[5]	[6]	[7]
Age (Years)	**Exposures (Dollars)**	**Observed Life Table (OLT)**	**Company R2-55**	**AG R1.5-63**	**Company SSD**	**AG SSD**
0.0	29,509,356	100.00%	100.00%	100.00%	0.0000	0.0000
0.5	24,675,109	99.97%	99.91%	99.86%	0.0000	0.0000
1.5	24,356,625	99.95%	99.73%	99.57%	0.0000	0.0000
2.5	17,919,426	99.76%	99.54%	99.28%	0.0000	0.0000
3.5	17,713,438	99.37%	99.34%	98.97%	0.0000	0.0000
4.5	14,807,509	99.36%	99.12%	98.66%	0.0000	0.0000
5.5	14,700,919	98.95%	98.89%	98.34%	0.0000	0.0000
6.5	12,906,119	98.84%	98.65%	98.01%	0.0000	0.0001
7.5	12,571,225	98.33%	98.39%	97.67%	0.0000	0.0000
8.5	12,611,595	98.20%	98.12%	97.31%	0.0000	0.0001
9.5	10,043,341	96.97%	97.83%	96.95%	0.0001	0.0000
10.5	11,609,893	96.75%	97.53%	96.58%	0.0001	0.0000
11.5	11,330,428	96.54%	97.21%	96.20%	0.0000	0.0000
12.5	10,771,504	96.02%	96.87%	95.80%	0.0001	0.0000
13.5	8,937,948	95.23%	96.52%	95.40%	0.0002	0.0000
14.5	9,190,431	93.33%	96.14%	94.98%	0.0008	0.0003
15.5	5,567,208	91.30%	95.75%	94.55%	0.0020	0.0011
16.5	5,195,563	90.97%	95.33%	94.11%	0.0019	0.0010
17.5	4,762,929	90.60%	94.89%	93.66%	0.0018	0.0009
18.5	4,686,304	90.53%	94.43%	93.20%	0.0015	0.0007
19.5	4,561,270	90.29%	93.95%	92.72%	0.0013	0.0006
20.5	4,447,501	90.00%	93.44%	92.24%	0.0012	0.0005
21.5	4,415,795	89.35%	92.91%	91.73%	0.0013	0.0006
22.5	4,401,633	89.15%	92.35%	91.22%	0.0010	0.0004
23.5	4,302,080	88.92%	91.76%	90.69%	0.0008	0.0003
24.5	4,283,280	88.78%	91.15%	90.15%	0.0006	0.0002
25.5	4,182,658	87.21%	90.50%	89.59%	0.0011	0.0006
26.5	4,177,316	87.14%	89.83%	89.01%	0.0007	0.0004
27.5	4,152,278	87.00%	89.13%	88.42%	0.0005	0.0002
28.5	4,105,288	86.72%	88.39%	87.82%	0.0003	0.0001
29.5	4,034,657	86.61%	87.62%	87.20%	0.0001	0.0000
30.5	4,030,607	86.55%	86.81%	86.55%	0.0000	0.0000
31.5	4,014,868	86.53%	85.97%	85.90%	0.0000	0.0000
32.5	3,965,190	86.41%	85.10%	85.22%	0.0002	0.0001
33.5	3,964,348	86.40%	84.18%	84.52%	0.0005	0.0004
34.5	3,949,405	86.21%	83.23%	83.80%	0.0009	0.0006
35.5	3,380,334	86.03%	82.24%	83.07%	0.0014	0.0009
36.5	3,322,818	85.97%	81.20%	82.31%	0.0023	0.0013
37.5	3,315,080	85.78%	80.13%	81.53%	0.0032	0.0018
38.5	3,276,537	84.80%	79.01%	80.73%	0.0034	0.0017
39.5	3,264,190	84.76%	77.85%	79.90%	0.0048	0.0024
40.5	3,206,111	84.24%	76.64%	79.06%	0.0058	0.0027
41.5	3,191,365	84.02%	75.39%	78.19%	0.0075	0.0034
42.5	3,081,949	84.01%	74.09%	77.29%	0.0098	0.0045
43.5	2,785,195	83.69%	72.75%	76.38%	0.0120	0.0054
44.5	2,367,393	83.11%	71.36%	75.43%	0.0138	0.0059

Account 356 Curve Fitting

[1]	[2]	[3]	[4]	[5]	[6]	[7]
Age (Years)	**Exposures (Dollars)**	**Observed Life Table (OLT)**	**Company R2-55**	**AG R1.5-63**	**Company SSD**	**AG SSD**
45.5	2,141,051	79.61%	69.92%	74.46%	0.0094	0.0026
46.5	2,111,183	78.87%	68.43%	73.47%	0.0109	0.0029
47.5	2,038,177	78.83%	66.90%	72.45%	0.0142	0.0041
48.5	1,955,205	77.86%	65.32%	71.41%	0.0157	0.0042
49.5	1,930,207	77.37%	63.70%	70.34%	0.0187	0.0049
50.5	1,825,531	77.32%	62.03%	69.24%	0.0234	0.0065
51.5	1,239,754	77.16%	60.32%	68.12%	0.0284	0.0082
52.5	1,126,580	77.15%	58.57%	66.97%	0.0345	0.0104
53.5	1,126,563	77.15%	56.78%	65.80%	0.0415	0.0129
54.5	1,006,129	69.72%	54.95%	64.60%	0.0218	0.0026
55.5	1,006,068	69.72%	53.09%	63.38%	0.0277	0.0040
56.5	1,005,972	69.72%	51.20%	62.13%	0.0343	0.0058
57.5	931,516	69.72%	49.28%	60.86%	0.0418	0.0079
58.5	917,916	68.70%	47.33%	59.56%	0.0457	0.0084
59.5	772,703	57.83%	45.37%	58.24%	0.0155	0.0000
60.5	712,824	55.07%	43.40%	56.90%	0.0136	0.0003
61.5	575,079	54.10%	41.41%	55.54%	0.0161	0.0002
62.5	75,111	53.98%	39.42%	54.16%	0.0212	0.0000
63.5	75,111	53.98%	37.43%	52.76%		
Sum of Squared Differences				[8]	0.5172	0.1250
Up to 1% of Beginning Exposures				[9]	0.4960	0.1250

[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 362 Curve Fitting

[1] Age (Years)	[2] Exposures (Dollars)	[3] Observed Life Table (OLT)	[4] Company L1.5-45	[5] AG S0-49	[6] Company SSD	[7] AG SSD
0.0	648,581,417	100.00%	100.00%	100.00%	0.0000	0.0000
0.5	603,305,477	99.99%	99.97%	99.98%	0.0000	0.0000
1.5	540,827,410	99.88%	99.89%	99.85%	0.0000	0.0000
2.5	490,497,174	99.82%	99.78%	99.64%	0.0000	0.0000
3.5	460,388,415	99.68%	99.65%	99.35%	0.0000	0.0000
4.5	441,797,436	99.46%	99.47%	98.99%	0.0000	0.0000
5.5	417,932,746	99.03%	99.26%	98.58%	0.0000	0.0000
6.5	392,062,430	98.82%	98.99%	98.11%	0.0000	0.0001
7.5	356,977,751	97.94%	98.68%	97.58%	0.0001	0.0000
8.5	330,381,946	97.22%	98.31%	97.01%	0.0001	0.0000
9.5	312,807,898	96.41%	97.88%	96.38%	0.0002	0.0000
10.5	316,955,503	95.82%	97.38%	95.71%	0.0002	0.0000
11.5	276,739,701	95.37%	96.83%	95.00%	0.0002	0.0000
12.5	263,456,251	94.40%	96.21%	94.25%	0.0003	0.0000
13.5	243,193,743	94.09%	95.52%	93.45%	0.0002	0.0000
14.5	226,993,159	93.59%	94.76%	92.62%	0.0001	0.0001
15.5	207,573,353	93.05%	93.94%	91.75%	0.0001	0.0002
16.5	201,816,207	92.58%	93.05%	90.85%	0.0000	0.0003
17.5	193,490,202	91.75%	92.07%	89.92%	0.0000	0.0003
18.5	176,562,285	90.44%	91.01%	88.95%	0.0000	0.0002
19.5	164,845,387	89.52%	89.87%	87.95%	0.0000	0.0002
20.5	157,656,371	88.76%	88.63%	86.92%	0.0000	0.0003
21.5	152,264,362	87.88%	87.31%	85.87%	0.0000	0.0004
22.5	144,921,254	86.93%	85.90%	84.79%	0.0001	0.0005
23.5	131,354,098	85.36%	84.40%	83.68%	0.0001	0.0003
24.5	118,400,402	84.05%	82.82%	82.55%	0.0002	0.0002
25.5	108,242,407	82.56%	81.18%	81.39%	0.0002	0.0001
26.5	98,952,683	81.61%	79.47%	80.21%	0.0005	0.0002
27.5	96,092,253	80.60%	77.70%	79.02%	0.0008	0.0003
28.5	94,012,118	79.38%	75.89%	77.80%	0.0012	0.0003
29.5	91,017,889	78.22%	74.04%	76.56%	0.0017	0.0003
30.5	89,001,407	76.63%	72.16%	75.30%	0.0020	0.0002
31.5	84,139,566	74.89%	70.25%	74.03%	0.0022	0.0001
32.5	81,319,655	73.81%	68.32%	72.74%	0.0030	0.0001
33.5	79,298,876	72.66%	66.38%	71.44%	0.0039	0.0001
34.5	76,326,186	71.28%	64.44%	70.12%	0.0047	0.0001
35.5	73,618,295	69.71%	62.50%	68.79%	0.0052	0.0001
36.5	71,490,548	68.80%	60.56%	67.45%	0.0068	0.0002
37.5	68,718,624	67.69%	58.63%	66.09%	0.0082	0.0003
38.5	66,716,786	66.41%	56.72%	64.73%	0.0094	0.0003
39.5	63,384,690	64.67%	54.83%	63.35%	0.0097	0.0002
40.5	59,972,467	63.18%	52.97%	61.97%	0.0104	0.0001
41.5	57,372,096	61.85%	51.13%	60.58%	0.0115	0.0002
42.5	54,917,656	60.08%	49.33%	59.18%	0.0116	0.0001
43.5	49,312,124	58.88%	47.56%	57.78%	0.0128	0.0001
44.5	46,155,185	57.29%	45.82%	56.37%	0.0132	0.0001
45.5	42,972,493	56.09%	44.11%	54.96%	0.0143	0.0001
46.5	40,524,864	54.89%	42.45%	53.54%	0.0155	0.0002
47.5	37,678,940	53.80%	40.82%	52.13%	0.0168	0.0003
48.5	36,523,021	52.97%	39.23%	50.71%	0.0189	0.0005
49.5	34,460,782	51.44%	37.68%	49.29%	0.0189	0.0005
50.5	32,536,862	49.78%	36.17%	47.87%	0.0185	0.0004
51.5	30,464,431	48.24%	34.69%	46.46%	0.0183	0.0003
52.5	28,637,640	46.89%	33.26%	45.04%	0.0186	0.0003
53.5	26,541,107	45.31%	31.86%	43.63%	0.0181	0.0003
54.5	24,970,389	43.37%	30.50%	42.22%	0.0166	0.0001
55.5	21,497,860	41.12%	29.18%	40.82%	0.0143	0.0000
56.5	19,242,074	39.45%	27.89%	39.42%	0.0134	0.0000
57.5	14,681,873	38.49%	26.64%	38.03%	0.0140	0.0000

Account 362 Curve Fitting

[1]	[2]	[3]	[4]	[5]	[6]	[7]
Age (Years)	**Exposures (Dollars)**	**Observed Life Table (OLT)**	**Company L1.5-45**	**AG S0-49**	**Company SSD**	**AG SSD**
58.5	12,662,591	37.85%	25.42%	36.65%	0.0154	0.0001
59.5	11,505,915	35.67%	24.24%	35.27%	0.0131	0.0000
60.5	10,532,156	33.89%	23.09%	33.91%	0.0117	0.0000
61.5	9,643,379	32.78%	21.98%	32.55%	0.0117	0.0000
62.5	7,462,970	31.12%	20.90%	31.21%	0.0104	0.0000
63.5	5,697,557	29.58%	19.86%	29.88%	0.0095	0.0000
64.5	5,061,327	28.06%	18.85%	28.56%	0.0085	0.0000
65.5	3,723,002	27.60%	17.87%	27.26%	0.0095	0.0000
66.5	3,394,821	26.48%	16.92%	25.97%	0.0091	0.0000
67.5	2,620,754	25.68%	16.00%	24.70%	0.0094	0.0001
68.5	2,104,376	23.93%	15.12%	23.44%	0.0078	0.0000
69.5	1,767,715	23.59%	14.27%	22.20%	0.0087	0.0002
70.5	1,608,409	22.05%	13.45%	20.98%	0.0074	0.0001
71.5	1,132,631	19.45%	12.66%	19.79%	0.0046	0.0000
72.5	1,084,367	18.90%	11.90%	18.61%	0.0049	0.0000
73.5	1,052,709	18.35%	11.17%	17.45%	0.0051	0.0001
74.5	952,287	16.79%	10.48%	16.32%	0.0040	0.0000
75.5	851,654	15.93%	9.81%	15.21%	0.0037	0.0001
76.5	697,621	14.68%	9.17%	14.13%	0.0030	0.0000
77.5	517,545	13.64%	8.56%	13.08%	0.0026	0.0000
78.5	424,251	13.34%	7.98%	12.05%	0.0029	0.0002
79.5	423,836	13.33%	7.42%	11.05%	0.0035	0.0005
80.5	422,212	13.28%	6.90%	10.08%	0.0041	0.0010
81.5	109,667	3.45%	6.40%	9.15%	0.0009	0.0032
82.5	88,810	2.79%	5.92%	8.25%	0.0010	0.0030
83.5	88,810	2.79%	5.47%	7.38%	0.0007	0.0021
84.5	88,135	2.78%	5.05%	6.55%	0.0005	0.0014
85.5	36,157	2.78%	4.65%	5.75%	0.0003	0.0009
86.5	29,021	2.78%	4.27%	5.00%	0.0002	0.0005
87.5	18,385	1.80%	3.92%	4.29%	0.0004	0.0006
88.5	18,385	1.80%	3.59%	3.62%	0.0003	0.0003
89.5	9,811	0.96%	3.28%	2.99%	0.0005	0.0004
90.5	8,863	0.87%	2.99%	2.42%	0.0004	0.0002
91.5	8,863	0.87%	2.72%	1.89%	0.0003	0.0001
92.5	8,584	0.87%	2.46%	1.42%	0.0003	0.0000
93.5	6,636	0.87%	2.23%	1.01%		
Sum of Squared Differences				[8]	0.5137	0.0251
Up to 1% of Beginning Exposures				[9]	0.3995	0.0098

[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 364 Curve Fitting

[1] Age (Years)	[2] Exposures (Dollars)	[3] Observed Life Table (OLT)	[4] Company S1.5-45	[5] AG L2-50	[6] Company SSD	[7] AG SSD
0.0	517,356,342	100.00%	100.00%	100.00%	0.0000	0.0000
0.5	495,444,018	99.92%	100.00%	100.00%	0.0000	0.0000
1.5	490,904,401	99.57%	100.00%	100.00%	0.0000	0.0000
2.5	465,233,866	99.23%	99.98%	99.99%	0.0001	0.0001
3.5	446,988,562	98.85%	99.96%	99.96%	0.0001	0.0001
4.5	436,655,674	98.65%	99.92%	99.92%	0.0002	0.0002
5.5	422,299,787	98.49%	99.86%	99.86%	0.0002	0.0002
6.5	409,609,623	98.36%	99.77%	99.77%	0.0002	0.0002
7.5	395,143,447	98.19%	99.65%	99.65%	0.0002	0.0002
8.5	380,681,230	98.10%	99.50%	99.50%	0.0002	0.0002
9.5	364,377,565	97.97%	99.32%	99.32%	0.0002	0.0002
10.5	354,276,105	97.84%	99.09%	99.10%	0.0002	0.0002
11.5	340,777,484	97.74%	98.82%	98.84%	0.0001	0.0001
12.5	334,482,405	97.61%	98.49%	98.54%	0.0001	0.0001
13.5	328,951,361	97.47%	98.12%	98.20%	0.0000	0.0001
14.5	315,550,213	97.29%	97.68%	97.82%	0.0000	0.0000
15.5	303,246,575	97.11%	97.19%	97.40%	0.0000	0.0000
16.5	293,724,222	96.92%	96.63%	96.93%	0.0000	0.0000
17.5	280,536,999	96.73%	96.00%	96.42%	0.0001	0.0000
18.5	269,747,210	96.52%	95.30%	95.85%	0.0001	0.0000
19.5	261,496,108	96.24%	94.53%	95.21%	0.0003	0.0001
20.5	248,764,107	95.86%	93.67%	94.49%	0.0005	0.0002
21.5	237,006,497	95.55%	92.74%	93.68%	0.0008	0.0003
22.5	218,439,245	95.26%	91.73%	92.78%	0.0012	0.0006
23.5	201,287,705	94.92%	90.64%	91.78%	0.0018	0.0010
24.5	183,177,625	94.50%	89.46%	90.67%	0.0025	0.0015
25.5	166,809,611	94.09%	88.20%	89.46%	0.0035	0.0021
26.5	141,975,707	93.60%	86.85%	88.15%	0.0046	0.0030
27.5	126,711,158	92.90%	85.43%	86.73%	0.0056	0.0038
28.5	115,853,829	92.13%	83.92%	85.22%	0.0067	0.0048
29.5	134,448,487	91.27%	82.33%	83.62%	0.0080	0.0059
30.5	106,312,798	78.30%	80.66%	81.93%	0.0006	0.0013
31.5	96,407,583	76.68%	78.91%	80.17%	0.0005	0.0012
32.5	86,444,675	75.26%	77.09%	78.34%	0.0003	0.0009
33.5	77,429,065	73.67%	75.20%	76.45%	0.0002	0.0008
34.5	70,245,364	71.73%	73.25%	74.52%	0.0002	0.0008
35.5	61,227,283	70.19%	71.23%	72.55%	0.0001	0.0006
36.5	54,013,638	68.59%	69.16%	70.54%	0.0000	0.0004
37.5	47,234,546	66.36%	67.03%	68.52%	0.0000	0.0005
38.5	41,767,797	63.85%	64.86%	66.48%	0.0001	0.0007
39.5	36,801,710	61.58%	62.64%	64.44%	0.0001	0.0008
40.5	32,651,164	59.93%	60.40%	62.40%	0.0000	0.0006
41.5	28,149,716	58.03%	58.12%	60.38%	0.0000	0.0006
42.5	25,434,567	56.58%	55.81%	58.37%	0.0001	0.0003
43.5	22,096,133	55.25%	53.49%	56.38%	0.0003	0.0001
44.5	19,194,818	53.80%	51.17%	54.42%	0.0007	0.0000

Account 364 Curve Fitting

[1] Age (Years)	[2] Exposures (Dollars)	[3] Observed Life Table (OLT)	[4] Company S1.5-45	[5] AG L2-50	[6] Company SSD	[7] AG SSD
45.5	16,405,815	52.26%	48.83%	52.49%	0.0012	0.0000
46.5	13,939,480	50.53%	46.51%	50.59%	0.0016	0.0000
47.5	12,195,189	49.01%	44.19%	48.74%	0.0023	0.0000
48.5	10,444,722	47.16%	41.88%	46.92%	0.0028	0.0000
49.5	8,934,244	45.17%	39.61%	45.15%	0.0031	0.0000
50.5	7,747,203	44.39%	37.36%	43.42%	0.0049	0.0001
51.5	6,432,943	42.75%	35.14%	41.73%	0.0058	0.0001
52.5	5,296,683	40.15%	32.97%	40.09%	0.0052	0.0000
53.5	4,049,045	37.96%	30.84%	38.50%		
Sum of Squared Differences				[8]	0.0677	0.0349
Up to 1% of Beginning Exposures				[9]	0.0677	0.0349

[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 365 Curve Fitting

[1]	[2]	[3]	[4]	[5]	[6]	[7]
Age (Years)	**Exposures (Dollars)**	**Observed Life Table (OLT)**	**Company SC-45**	**AG O1-48**	**Company SSD**	**AG SSD**
0.0	676,941,943	100.00%	100.00%	100.00%	0.0000	0.0000
0.5	663,539,570	99.91%	99.44%	99.48%	0.0000	0.0000
1.5	664,521,705	99.19%	98.33%	98.44%	0.0001	0.0001
2.5	624,446,680	97.85%	97.22%	97.40%	0.0000	0.0000
3.5	593,843,270	96.40%	96.11%	96.35%	0.0000	0.0000
4.5	577,140,242	94.84%	95.00%	95.31%	0.0000	0.0000
5.5	561,634,571	93.40%	93.89%	94.27%	0.0000	0.0001
6.5	534,987,914	91.88%	92.78%	93.23%	0.0001	0.0002
7.5	505,976,699	90.46%	91.67%	92.19%	0.0001	0.0003
8.5	473,502,214	89.26%	90.56%	91.15%	0.0002	0.0004
9.5	444,794,621	88.33%	89.44%	90.10%	0.0001	0.0003
10.5	424,389,885	87.53%	88.33%	89.06%	0.0001	0.0002
11.5	400,318,377	86.84%	87.22%	88.02%	0.0000	0.0001
12.5	384,001,924	85.95%	86.11%	86.98%	0.0000	0.0001
13.5	375,516,338	84.96%	85.00%	85.94%	0.0000	0.0001
14.5	357,665,832	83.85%	83.89%	84.90%	0.0000	0.0001
15.5	351,312,340	82.74%	82.78%	83.85%	0.0000	0.0001
16.5	344,575,496	81.88%	81.67%	82.81%	0.0000	0.0001
17.5	333,139,624	81.04%	80.56%	81.77%	0.0000	0.0001
18.5	328,918,727	80.22%	79.44%	80.73%	0.0001	0.0000
19.5	321,848,670	79.34%	78.33%	79.69%	0.0001	0.0000
20.5	312,457,116	78.48%	77.22%	78.65%	0.0002	0.0000
21.5	304,926,258	77.54%	76.11%	77.60%	0.0002	0.0000
22.5	285,819,498	76.60%	75.00%	76.56%	0.0003	0.0000
23.5	275,755,525	75.93%	73.89%	75.52%	0.0004	0.0000
24.5	258,876,997	75.31%	72.78%	74.48%	0.0006	0.0001
25.5	236,720,508	74.75%	71.67%	73.44%	0.0010	0.0002
26.5	206,963,337	74.20%	70.56%	72.40%	0.0013	0.0003
27.5	187,101,119	73.26%	69.44%	71.35%	0.0015	0.0004
28.5	175,484,639	72.52%	68.33%	70.31%	0.0018	0.0005
29.5	199,008,552	71.70%	67.22%	69.27%	0.0020	0.0006
30.5	160,488,392	62.35%	66.11%	68.23%	0.0014	0.0035
31.5	149,418,327	61.87%	65.00%	67.19%	0.0010	0.0028
32.5	139,219,504	61.37%	63.89%	66.15%	0.0006	0.0023
33.5	129,960,167	60.72%	62.78%	65.10%	0.0004	0.0019
34.5	121,696,999	59.81%	61.67%	64.06%	0.0003	0.0018
35.5	112,265,977	58.92%	60.56%	63.02%	0.0003	0.0017
36.5	102,174,351	57.57%	59.44%	61.98%	0.0004	0.0019
37.5	93,600,137	56.51%	58.33%	60.94%	0.0003	0.0020
38.5	85,288,506	55.59%	57.22%	59.90%	0.0003	0.0019
39.5	78,610,504	54.82%	56.11%	58.85%	0.0002	0.0016
40.5	70,911,651	54.50%	55.00%	57.81%	0.0000	0.0011
41.5	63,496,724	54.09%	53.89%	56.77%	0.0000	0.0007
42.5	58,757,053	53.73%	52.78%	55.73%	0.0001	0.0004
43.5	50,992,453	53.33%	51.67%	54.69%	0.0003	0.0002
44.5	44,363,184	52.80%	50.56%	53.65%	0.0005	0.0001

Account 365 Curve Fitting

[1] Age (Years)	[2] Exposures (Dollars)	[3] Observed Life Table (OLT)	[4] Company SC-45	[5] AG O1-48	[6] Company SSD	[7] AG SSD
45.5	37,896,053	52.24%	49.44%	52.60%	0.0008	0.0000
46.5	32,289,254	51.75%	48.33%	51.56%	0.0012	0.0000
47.5	27,427,005	51.18%	47.22%	50.52%	0.0016	0.0000
48.5	23,402,178	50.62%	46.11%	49.48%	0.0020	0.0001
49.5	19,508,059	50.12%	45.00%	48.44%	0.0026	0.0003
50.5	16,637,895	49.83%	43.89%	47.40%	0.0035	0.0006
51.5	14,082,829	49.22%	42.78%	46.35%	0.0042	0.0008
52.5	11,961,819	48.46%	41.67%	45.31%	0.0046	0.0010
53.5	9,635,764	47.65%	40.56%	44.27%	0.0050	0.0011
54.5	471,377	47.23%	39.44%	43.23%	0.0061	0.0016
55.5	470,974	47.19%	38.33%	42.19%	0.0078	0.0025
56.5	470,905	47.18%	37.22%	41.15%		
Sum of Squared Differences				[8]	0.0556	0.0363
Up to 1% of Beginning Exposures				[9]	0.0417	0.0322

[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 366 Curve Fitting

[1]	[2]	[3]	[4]	[5]	[6]	[7]
Age (Years)	**Exposures (Dollars)**	**Observed Life Table (OLT)**	**Company S4-50**	**AG R4-55**	**Company SSD**	**AG SSD**
0.0	148,820,170	100.00%	100.00%	100.00%	0.0000	0.0000
0.5	147,459,370	100.00%	100.00%	100.00%	0.0000	0.0000
1.5	147,166,893	99.95%	100.00%	100.00%	0.0000	0.0000
2.5	148,176,911	99.94%	100.00%	99.99%	0.0000	0.0000
3.5	148,098,288	99.94%	100.00%	99.99%	0.0000	0.0000
4.5	148,318,888	99.94%	100.00%	99.99%	0.0000	0.0000
5.5	149,776,935	99.92%	100.00%	99.98%	0.0000	0.0000
6.5	135,164,052	99.92%	100.00%	99.98%	0.0000	0.0000
7.5	134,197,161	99.90%	100.00%	99.97%	0.0000	0.0000
8.5	134,133,573	99.90%	100.00%	99.96%	0.0000	0.0000
9.5	131,727,435	99.90%	100.00%	99.95%	0.0000	0.0000
10.5	130,043,812	99.90%	100.00%	99.93%	0.0000	0.0000
11.5	124,866,523	99.89%	100.00%	99.91%	0.0000	0.0000
12.5	123,787,611	99.89%	100.00%	99.89%	0.0000	0.0000
13.5	109,586,959	99.86%	100.00%	99.86%	0.0000	0.0000
14.5	106,646,528	99.86%	100.00%	99.82%	0.0000	0.0000
15.5	106,554,208	99.85%	100.00%	99.78%	0.0000	0.0000
16.5	103,835,605	99.84%	100.00%	99.73%	0.0000	0.0000
17.5	98,772,848	99.84%	100.00%	99.67%	0.0000	0.0000
18.5	90,334,580	99.84%	100.00%	99.60%	0.0000	0.0000
19.5	85,032,671	99.83%	100.00%	99.51%	0.0000	0.0000
20.5	77,145,980	99.82%	99.99%	99.41%	0.0000	0.0000
21.5	68,701,713	99.81%	99.99%	99.29%	0.0000	0.0000
22.5	60,014,808	99.71%	99.97%	99.15%	0.0000	0.0000
23.5	54,621,106	99.68%	99.95%	98.99%	0.0000	0.0000
24.5	49,607,979	99.62%	99.91%	98.80%	0.0000	0.0001
25.5	43,976,782	99.53%	99.86%	98.58%	0.0000	0.0001
26.5	39,040,064	99.44%	99.78%	98.33%	0.0000	0.0001
27.5	37,169,030	99.38%	99.66%	98.04%	0.0000	0.0002
28.5	36,204,650	99.33%	99.48%	97.71%	0.0000	0.0003
29.5	49,510,975	99.28%	99.25%	97.33%	0.0000	0.0004
30.5	45,628,777	97.29%	98.92%	96.91%	0.0003	0.0000
31.5	44,345,603	97.21%	98.49%	96.43%	0.0002	0.0001
32.5	43,454,142	97.15%	97.93%	95.89%	0.0001	0.0002
33.5	42,122,173	97.10%	97.22%	95.28%	0.0000	0.0003
34.5	40,837,693	97.01%	96.33%	94.60%	0.0000	0.0006
35.5	38,166,695	96.96%	95.23%	93.85%	0.0003	0.0010
36.5	37,818,475	96.90%	93.91%	93.01%	0.0009	0.0015
37.5	36,156,156	96.84%	92.33%	92.09%	0.0020	0.0023
38.5	34,439,250	96.82%	90.48%	91.07%	0.0040	0.0033
39.5	32,491,444	96.80%	88.34%	89.96%	0.0072	0.0047
40.5	29,647,000	96.68%	85.90%	88.74%	0.0116	0.0063
41.5	27,141,450	96.65%	83.15%	87.41%	0.0182	0.0085
42.5	26,493,333	96.61%	80.11%	85.97%	0.0272	0.0113
43.5	24,903,646	96.55%	76.78%	84.42%	0.0391	0.0147
44.5	22,601,083	96.37%	73.17%	82.75%	0.0538	0.0185

Account 366 Curve Fitting

[1]	[2]	[3]	[4]	[5]	[6]	[7]
Age (Years)	**Exposures (Dollars)**	**Observed Life Table (OLT)**	**Company S4-50**	**AG R4-55**	**Company SSD**	**AG SSD**
45.5	19,856,995	96.12%	69.32%	80.96%	0.0718	0.0230
46.5	18,614,663	96.07%	65.26%	79.05%	0.0949	0.0290
47.5	17,966,510	95.95%	61.03%	77.00%	0.1219	0.0359
48.5	17,098,531	95.84%	56.67%	74.80%	0.1534	0.0443
49.5	16,373,516	95.75%	52.23%	72.42%	0.1894	0.0544
50.5	15,914,426	95.75%	47.77%	69.82%	0.2302	0.0672
51.5	15,485,436	95.71%	43.33%	67.00%	0.2744	0.0824
52.5	15,122,697	95.60%	38.97%	63.96%	0.3207	0.1001
53.5	14,704,283	95.52%	34.74%	60.68%		
Sum of Squared Differences				[8]	1.6218	0.5109
Up to 1% of Beginning Exposures				[9]	1.6218	0.5109

[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 367.10 Curve Fitting

[1]	[2]	[3]	[4]	[5]	[6]	[7]
Age (Years)	**Exposures (Dollars)**	**Observed Life Table (OLT)**	**Company R0.5-50**	**AG L0-53**	**Company SSD**	**AG SSD**
0.0	689,924,599	100.00%	100.00%	100.00%	0.0000	0.0000
0.5	629,570,267	99.35%	99.62%	99.88%	0.0000	0.0000
1.5	569,396,144	98.00%	98.86%	99.49%	0.0001	0.0002
2.5	521,674,511	96.44%	98.09%	98.98%	0.0003	0.0006
3.5	487,839,238	95.70%	97.31%	98.37%	0.0003	0.0007
4.5	444,709,116	95.06%	96.52%	97.69%	0.0002	0.0007
5.5	412,341,328	94.34%	95.73%	96.95%	0.0002	0.0007
6.5	377,762,826	93.80%	94.93%	96.16%	0.0001	0.0006
7.5	354,954,968	93.27%	94.12%	95.31%	0.0001	0.0004
8.5	332,494,207	92.60%	93.31%	94.43%	0.0001	0.0003
9.5	308,755,963	91.99%	92.49%	93.51%	0.0000	0.0002
10.5	281,700,504	91.37%	91.66%	92.55%	0.0000	0.0001
11.5	258,995,032	90.88%	90.82%	91.57%	0.0000	0.0000
12.5	236,622,042	90.21%	89.98%	90.56%	0.0000	0.0000
13.5	223,864,878	89.53%	89.13%	89.52%	0.0000	0.0000
14.5	202,176,603	88.91%	88.28%	88.46%	0.0000	0.0000
15.5	190,052,367	88.27%	87.41%	87.38%	0.0001	0.0001
16.5	181,411,917	87.77%	86.54%	86.29%	0.0002	0.0002
17.5	172,478,255	87.21%	85.67%	85.18%	0.0002	0.0004
18.5	161,359,587	86.69%	84.78%	84.05%	0.0004	0.0007
19.5	152,888,847	86.05%	83.89%	82.91%	0.0005	0.0010
20.5	142,116,757	85.38%	82.99%	81.76%	0.0006	0.0013
21.5	123,063,178	84.53%	82.08%	80.61%	0.0006	0.0015
22.5	109,439,215	83.24%	81.17%	79.44%	0.0004	0.0014
23.5	100,024,986	81.53%	80.24%	78.27%	0.0002	0.0011
24.5	88,146,656	80.14%	79.30%	77.10%	0.0001	0.0009
25.5	78,382,604	78.67%	78.36%	75.92%	0.0000	0.0008
26.5	67,801,518	77.59%	77.40%	74.74%	0.0000	0.0008
27.5	60,668,936	76.78%	76.44%	73.56%	0.0000	0.0010
28.5	56,502,293	75.80%	75.46%	72.39%	0.0000	0.0012
29.5	74,522,104	74.52%	74.47%	71.21%	0.0000	0.0011
30.5	63,742,396	68.24%	73.47%	70.04%	0.0027	0.0003
31.5	59,555,767	67.29%	72.45%	68.86%	0.0027	0.0002
32.5	55,839,860	66.32%	71.43%	67.69%	0.0026	0.0002
33.5	52,298,867	65.31%	70.39%	66.53%	0.0026	0.0001
34.5	49,032,728	64.01%	69.34%	65.36%	0.0028	0.0002
35.5	45,738,259	62.79%	68.27%	64.20%	0.0030	0.0002
36.5	42,600,858	61.96%	67.20%	63.04%	0.0027	0.0001
37.5	39,461,377	60.91%	66.11%	61.89%	0.0027	0.0001
38.5	36,551,893	59.71%	65.01%	60.74%	0.0028	0.0001
39.5	33,570,713	58.57%	63.89%	59.59%	0.0028	0.0001
40.5	30,987,565	57.24%	62.76%	58.45%	0.0030	0.0001
41.5	28,050,048	56.06%	61.62%	57.32%	0.0031	0.0002
42.5	26,417,328	54.80%	60.47%	56.19%	0.0032	0.0002
43.5	24,002,186	53.53%	59.30%	55.07%	0.0033	0.0002
44.5	21,487,086	52.41%	58.12%	53.96%	0.0033	0.0002

Account 367.10 Curve Fitting

[1] Age (Years)	[2] Exposures (Dollars)	[3] Observed Life Table (OLT)	[4] Company R0.5-50	[5] AG L0-53	[6] Company SSD	[7] AG SSD
45.5	17,982,278	51.44%	56.93%	52.85%	0.0030	0.0002
46.5	16,910,018	50.85%	55.73%	51.75%	0.0024	0.0001
47.5	16,162,230	50.26%	54.52%	50.66%	0.0018	0.0000
48.5	15,152,998	49.31%	53.30%	49.58%	0.0016	0.0000
49.5	14,328,855	48.80%	52.07%	48.51%	0.0011	0.0000
50.5	13,673,200	48.63%	50.83%	47.44%	0.0005	0.0001
51.5	12,837,707	47.73%	49.58%	46.39%	0.0003	0.0002
52.5	12,026,613	46.37%	48.32%	45.34%	0.0004	0.0001
53.5	10,736,547	45.31%	47.06%	44.30%		
Sum of Squared Differences				[8]	0.0591	0.0217
Up to 1% of Beginning Exposures				[9]	0.0591	0.0217

[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 368.20 Curve Fitting

[1] Age (Years)	[2] Exposures (Dollars)	[3] Observed Life Table (OLT)	[4] Company R4-40	[5] AG R5-44	[6] Company SSD	[7] AG SSD
0.0	163,241,194	100.00%	100.00%	100.00%	0.0000	0.0000
0.5	157,393,488	99.31%	100.00%	100.00%	0.0000	0.0000
1.5	150,089,138	96.60%	100.00%	100.00%	0.0012	0.0012
2.5	144,704,386	96.58%	99.99%	100.00%	0.0012	0.0012
3.5	138,666,651	96.50%	99.99%	100.00%	0.0012	0.0012
4.5	127,490,309	96.32%	99.98%	100.00%	0.0013	0.0014
5.5	120,669,906	95.99%	99.97%	100.00%	0.0016	0.0016
6.5	115,657,135	95.84%	99.95%	100.00%	0.0017	0.0017
7.5	112,493,472	95.80%	99.93%	100.00%	0.0017	0.0018
8.5	105,703,530	95.67%	99.91%	100.00%	0.0018	0.0019
9.5	98,088,559	95.59%	99.87%	100.00%	0.0018	0.0019
10.5	89,801,713	95.54%	99.82%	100.00%	0.0018	0.0020
11.5	83,886,470	95.37%	99.77%	100.00%	0.0019	0.0021
12.5	76,758,557	95.30%	99.69%	100.00%	0.0019	0.0022
13.5	77,252,756	95.28%	99.59%	100.00%	0.0019	0.0022
14.5	84,986,001	95.27%	99.47%	100.00%	0.0018	0.0022
15.5	88,682,561	95.17%	99.31%	100.00%	0.0017	0.0023
16.5	90,575,973	94.98%	99.12%	100.00%	0.0017	0.0025
17.5	96,017,663	94.89%	98.88%	100.00%	0.0016	0.0026
18.5	96,731,816	94.82%	98.59%	100.00%	0.0014	0.0027
19.5	98,882,343	94.77%	98.24%	99.99%	0.0012	0.0027
20.5	97,521,891	94.70%	97.82%	99.98%	0.0010	0.0028
21.5	95,076,179	94.68%	97.31%	99.97%	0.0007	0.0028
22.5	94,736,057	94.62%	96.71%	99.93%	0.0004	0.0028
23.5	94,318,034	94.59%	95.99%	99.88%	0.0002	0.0028
24.5	90,344,030	94.57%	95.16%	99.79%	0.0000	0.0027
25.5	87,438,917	94.49%	94.19%	99.66%	0.0000	0.0027
26.5	85,861,729	94.46%	93.07%	99.47%	0.0002	0.0025
27.5	82,489,140	94.41%	91.78%	99.20%	0.0007	0.0023
28.5	70,817,916	94.40%	90.32%	98.84%	0.0017	0.0020
29.5	64,481,845	94.39%	88.66%	98.37%	0.0033	0.0016
30.5	59,100,498	94.36%	86.80%	97.75%	0.0057	0.0011
31.5	48,854,699	94.21%	84.72%	96.96%	0.0090	0.0008
32.5	42,434,456	94.07%	82.42%	95.97%	0.0136	0.0004
33.5	37,362,268	93.94%	79.90%	94.74%	0.0197	0.0001
34.5	33,326,323	93.83%	77.13%	93.21%	0.0279	0.0000
35.5	29,640,567	93.69%	74.07%	91.33%	0.0385	0.0006
36.5	25,934,257	93.50%	70.65%	89.04%	0.0522	0.0020
37.5	22,295,986	93.28%	66.82%	86.24%	0.0700	0.0050
38.5	20,454,031	93.01%	62.55%	82.90%	0.0928	0.0102
39.5	18,280,484	92.61%	57.86%	78.95%	0.1208	0.0186
40.5	18,112,542	92.38%	52.81%	74.38%	0.1566	0.0324
41.5	14,534,228	78.83%	47.50%	69.14%	0.0982	0.0094
42.5	10,843,118	65.78%	42.06%	63.31%	0.0563	0.0006
43.5	8,281,212	53.83%	36.64%	56.95%	0.0295	0.0010
44.5	6,411,604	42.37%	31.37%	50.19%	0.0121	0.0061

Account 368.20 Curve Fitting

[1] Age (Years)	[2] Exposures (Dollars)	[3] Observed Life Table (OLT)	[4] Company R4-40	[5] AG R5-44	[6] Company SSD	[7] AG SSD
45.5	4,381,624	29.42%	26.37%	43.20%	0.0009	0.0190
46.5	3,141,502	21.63%	21.75%	36.19%	0.0000	0.0212
47.5	2,860,294	20.02%	17.58%	29.39%	0.0006	0.0088
48.5	2,019,813	14.27%	13.88%	23.05%	0.0000	0.0077
49.5	1,483,739	10.70%	10.69%	17.38%	0.0000	0.0045
50.5	1,224,236	9.11%	7.99%	12.54%	0.0001	0.0012
51.5	1,158,626	8.71%	5.76%	8.63%	0.0009	0.0000
52.5	342,908	2.69%	3.97%	5.69%	0.0002	0.0009
53.5	299,953	2.69%	2.59%	3.59%		
Sum of Squared Differences				[8]	0.8442	0.2140
Up to 1% of Beginning Exposures				[9]	0.8430	0.2074

[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.

MEC
Electric Division
355.00 Poles and Fixtures

Observed Life Table
Retirement Expr. 1970 TO 2017
Placement Years 1912 TO 2017

Age Interval	$ Surviving At Beginning of Age Interval	$ Retired During The Age Interval	Retirement Ratio	% Surviving At Beginning of Age Interval
0.0 - 0.5	$28,303,599.18	$111.00	0.00000	100.00
0.5 - 1.5	$26,273,688.04	$3,221.00	0.00012	100.00
1.5 - 2.5	$24,877,782.04	$9,619.00	0.00039	99.99
2.5 - 3.5	$24,104,523.04	$5,643.00	0.00023	99.95
3.5 - 4.5	$23,452,562.41	$57,799.23	0.00246	99.93
4.5 - 5.5	$19,596,100.85	$60,493.46	0.00309	99.68
5.5 - 6.5	$19,262,330.39	$7,653.91	0.00040	99.37
6.5 - 7.5	$18,866,434.83	$84,866.04	0.00450	99.33
7.5 - 8.5	$18,481,391.79	$117,506.30	0.00636	98.89
8.5 - 9.5	$18,514,988.49	$34,113.20	0.00184	98.26
9.5 - 10.5	$18,485,887.29	$17,507.90	0.00095	98.08
10.5 - 11.5	$21,005,053.39	$34,617.60	0.00165	97.98
11.5 - 12.5	$19,789,005.79	$182,692.06	0.00923	97.82
12.5 - 13.5	$17,494,241.05	$11,042.09	0.00063	96.92
13.5 - 14.5	$14,271,157.43	$500,928.12	0.03510	96.86
14.5 - 15.5	$11,699,344.30	$65,386.90	0.00559	93.46
15.5 - 16.5	$8,308,113.40	$36,849.64	0.00444	92.93
16.5 - 17.5	$6,195,372.76	$56,790.38	0.00917	92.52
17.5 - 18.5	$5,186,222.38	$9,595.72	0.00185	91.67
18.5 - 19.5	$5,111,600.66	$29,139.76	0.00570	91.50
19.5 - 20.5	$5,853,322.00	$41,636.85	0.00711	90.98
20.5 - 21.5	$5,343,493.15	$2,929.00	0.00055	90.34
21.5 - 22.5	$5,254,229.15	$25,910.29	0.00493	90.29
22.5 - 23.5	$5,151,811.86	$6,071.31	0.00118	89.84
23.5 - 24.5	$5,137,584.55	$2,927.99	0.00057	89.74
24.5 - 25.5	$5,085,723.56	$50,553.70	0.00994	89.68
25.5 - 26.5	$4,967,205.86	$3,678.41	0.00074	88.79
26.5 - 27.5	$4,965,270.45	$5,490.84	0.00111	88.73
27.5 - 28.5	$4,959,954.61	$91,585.96	0.01847	88.63
28.5 - 29.5	$4,860,503.65	$17,365.67	0.00357	86.99
29.5 - 30.5	$4,805,406.98	$8,318.00	0.00173	86.68
30.5 - 31.5	$4,828,372.98	$2,190.10	0.00045	86.53
31.5 - 32.5	$4,827,029.88	$5,495.00	0.00114	86.49
32.5 - 33.5	$4,714,955.88	$962.69	0.00020	86.39
33.5 - 34.5	$4,717,270.19	$100,229.91	0.02125	86.38
34.5 - 35.5	$4,678,122.28	$93,947.67	0.02008	84.54
35.5 - 36.5	$3,832,403.61	$4,035.00	0.00105	82.84

MEC
Electric Division
355.00 Poles and Fixtures

Observed Life Table
Retirement Expr. 1970 TO 2017
Placement Years 1912 TO 2017

Age Interval	$ Surviving At Beginning of Age Interval	$ Retired During The Age Interval	Retirement Ratio	% Surviving At Beginning of Age Interval
36.5 - 37.5	$3,595,355.61	$18,628.74	0.00518	82.76
37.5 - 38.5	$3,578,517.87	$127,664.71	0.03568	82.33
38.5 - 39.5	$3,453,411.16	$41,393.86	0.01199	79.39
39.5 - 40.5	$3,344,727.30	$7,934.65	0.00237	78.44
40.5 - 41.5	$3,263,094.65	$61,019.53	0.01870	78.25
41.5 - 42.5	$3,204,098.12	$864.00	0.00027	76.79
42.5 - 43.5	$3,074,129.12	$32,696.90	0.01064	76.77
43.5 - 44.5	$2,965,945.22	$29,067.42	0.00980	75.95
44.5 - 45.5	$2,801,247.80	$8,722.93	0.00311	75.21
45.5 - 46.5	$2,415,080.87	$207,490.07	0.08591	74.97
46.5 - 47.5	$2,239,140.80	$486,349.98	0.21720	68.53
47.5 - 48.5	$1,725,848.82	$166.20	0.00010	53.65
48.5 - 49.5	$1,680,638.62	$540.00	0.00032	53.64
49.5 - 50.5	$1,676,947.62	$20,842.64	0.01243	53.62
50.5 - 51.5	$1,561,124.98	$94.00	0.00006	52.96
51.5 - 52.5	$1,478,250.98	$115,997.21	0.07847	52.95
52.5 - 53.5	$1,328,070.77	$128.00	0.00010	48.80
53.5 - 54.5	$1,327,942.77	$0.00	0.00000	48.79
54.5 - 55.5	$1,323,398.77	$0.00	0.00000	48.79
55.5 - 56.5	$1,323,398.77	$135.00	0.00010	48.79
56.5 - 57.5	$1,303,239.77	$0.00	0.00000	48.79
57.5 - 58.5	$1,257,296.77	$3,311.89	0.00263	48.79
58.5 - 59.5	$1,251,916.88	$0.00	0.00000	48.66
59.5 - 60.5	$1,251,916.88	$8,979.78	0.00717	48.66
60.5 - 61.5	$1,227,286.10	$0.00	0.00000	48.31
61.5 - 62.5	$1,098,470.10	$15.00	0.00001	48.31
62.5 - 63.5	$843,684.10	$0.00	0.00000	48.31
63.5 - 64.5	$843,684.10	$0.00	0.00000	48.31
64.5 - 65.5	$843,684.10	$8,514.44	0.01009	48.31
65.5 - 66.5	$835,169.66	$46,814.66	0.05605	47.82
66.5 - 67.5	$788,355.00	$0.00	0.00000	45.14
67.5 - 68.5	$51,228.00	$0.00	0.00000	45.14
68.5 - 69.5	$51,228.00	$0.00	0.00000	45.14
69.5 - 70.5	$51,228.00	$0.00	0.00000	45.14
70.5 - 71.5	$51,228.00	$0.00	0.00000	45.14
71.5 - 72.5	$51,228.00	$0.00	0.00000	45.14
72.5 - 73.5	$51,228.00	$0.00	0.00000	45.14

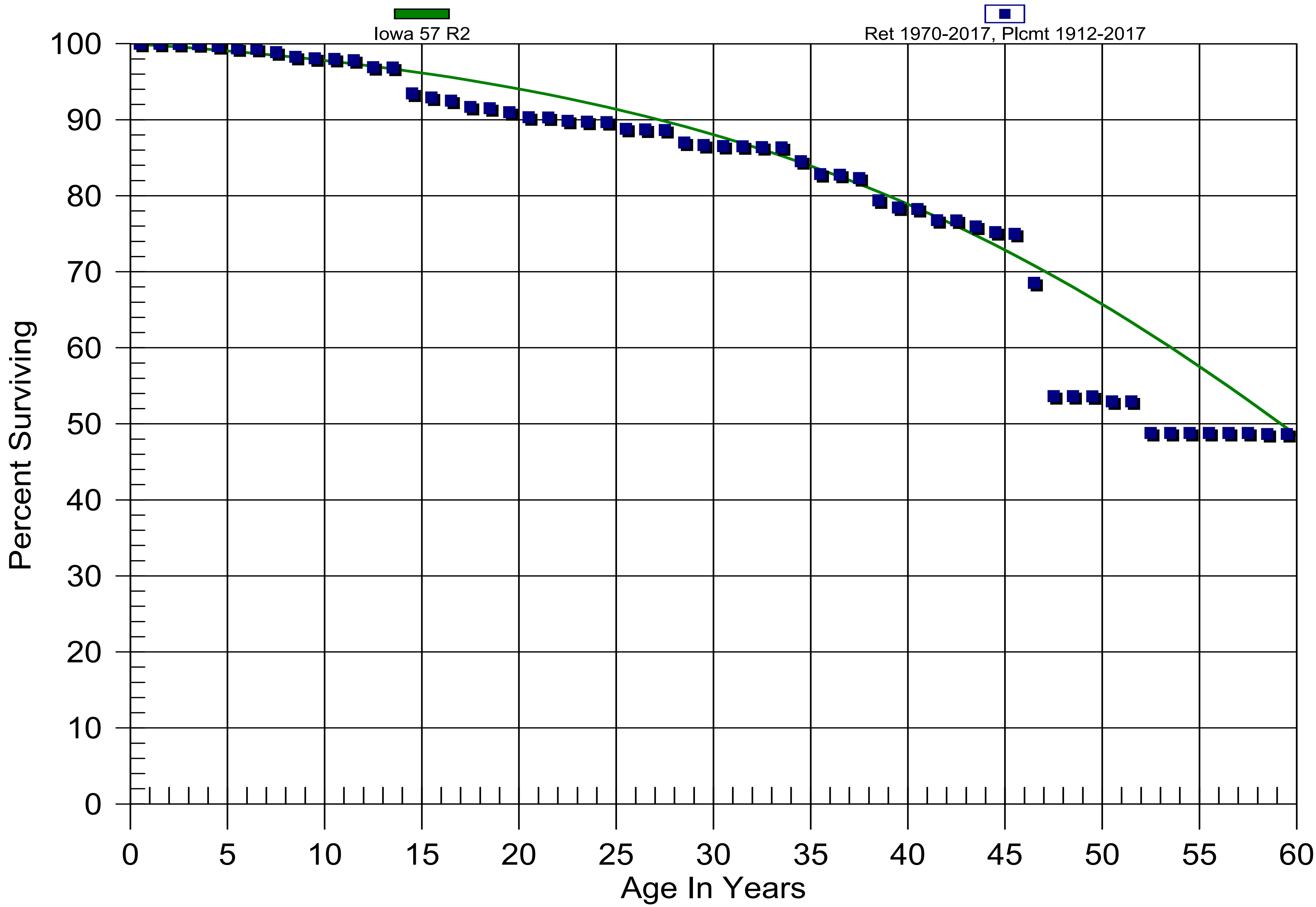
MEC
Electric Division
355.00 Poles and Fixtures

Observed Life Table
Retirement Expr. 1970 TO 2017
Placement Years 1912 TO 2017

Age Interval	$ Surviving At Beginning of Age Interval	$ Retired During The Age Interval	Retirement Ratio	% Surviving At Beginning of Age Interval
73.5 - 74.5	$51,228.00	$0.00	0.00000	45.14
74.5 - 75.5	$51,228.00	$0.00	0.00000	45.14
75.5 - 76.5	$51,228.00	$0.00	0.00000	45.14
76.5 - 77.5	$51,228.00	$0.00	0.00000	45.14
77.5 - 78.5	$51,228.00	$0.00	0.00000	45.14
78.5 - 79.5	$51,228.00	$0.00	0.00000	45.14
79.5 - 80.5	$51,228.00	$0.00	0.00000	45.14
80.5 - 81.5	$51,228.00	$0.00	0.00000	45.14
81.5 - 82.5	$51,228.00	$0.00	0.00000	45.14
82.5 - 83.5	$51,228.00	$0.00	0.00000	45.14
83.5 - 84.5	$51,228.00	$0.00	0.00000	45.14
84.5 - 85.5	$51,228.00	$0.00	0.00000	45.14
85.5 - 86.5	$51,228.00	$0.00	0.00000	45.14
86.5 - 87.5	$51,228.00	$0.00	0.00000	45.14
87.5 - 88.5	$51,228.00	$0.00	0.00000	45.14
88.5 - 89.5	$51,228.00	$0.00	0.00000	45.14
89.5 - 90.5	$51,228.00	$0.00	0.00000	45.14
90.5 - 91.5	$51,228.00	$0.00	0.00000	45.14
91.5 - 92.5	$51,228.00	$0.00	0.00000	45.14
92.5 - 93.5	$51,228.00	$0.00	0.00000	45.14
93.5 - 94.5	$51,228.00	$0.00	0.00000	45.14
94.5 - 95.5	$0.00	$0.00	0.00000	45.14
95.5 - 96.5	$0.00	$0.00	0.00000	45.14
96.5 - 97.5	$0.00	$0.00	0.00000	45.14
97.5 - 98.5	$0.00	$0.00	0.00000	45.14
98.5 - 99.5	$0.00	$0.00	0.00000	45.14
99.5 - 100.5	$0.00	$0.00	0.00000	45.14
100.5 - 101.5	$0.00	$0.00	0.00000	45.14
101.5 - 102.5	$0.00	$0.00	0.00000	45.14
102.5 - 103.5	$0.00	$0.00	0.00000	45.14
103.5 - 104.5	$0.00	$0.00	0.00000	45.14
104.5 - 105.5	$0.00	$0.00	0.00000	45.14

MEC

Electric Division
355.00 Poles and Fixtures
Original And Smooth Survivor Curves



MEC
Electric Division
356.00 Overhead Conductors and Devices
Observed Life Table
Retirement Expr. 1970 TO 2017
Placement Years 1912 TO 2017

Age Interval	$ Surviving At Beginning of Age Interval	$ Retired During The Age Interval	Retirement Ratio	% Surviving At Beginning of Age Interval
0.0 - 0.5	$29,509,355.54	$9,575.49	0.00032	100.00
0.5 - 1.5	$24,675,108.86	$4,819.22	0.00020	99.97
1.5 - 2.5	$24,356,624.64	$46,159.48	0.00190	99.95
2.5 - 3.5	$17,919,426.33	$69,312.74	0.00387	99.76
3.5 - 4.5	$17,713,438.39	$2,907.36	0.00016	99.37
4.5 - 5.5	$14,807,508.97	$60,026.93	0.00405	99.36
5.5 - 6.5	$14,700,919.04	$16,717.40	0.00114	98.95
6.5 - 7.5	$12,906,119.10	$67,037.36	0.00519	98.84
7.5 - 8.5	$12,571,224.74	$16,487.82	0.00131	98.33
8.5 - 9.5	$12,611,594.66	$158,396.32	0.01256	98.20
9.5 - 10.5	$10,043,341.34	$21,974.76	0.00219	96.97
10.5 - 11.5	$11,609,892.58	$25,540.01	0.00220	96.75
11.5 - 12.5	$11,330,427.57	$60,995.43	0.00538	96.54
12.5 - 13.5	$10,771,503.85	$88,657.47	0.00823	96.02
13.5 - 14.5	$8,937,947.88	$178,474.07	0.01997	95.23
14.5 - 15.5	$9,190,431.06	$199,488.26	0.02171	93.33
15.5 - 16.5	$5,567,207.80	$20,016.06	0.00360	91.30
16.5 - 17.5	$5,195,562.74	$21,379.63	0.00411	90.97
17.5 - 18.5	$4,762,929.11	$3,464.79	0.00073	90.60
18.5 - 19.5	$4,686,304.32	$12,883.18	0.00275	90.53
19.5 - 20.5	$4,561,270.14	$14,584.99	0.00320	90.29
20.5 - 21.5	$4,447,501.15	$32,195.64	0.00724	90.00
21.5 - 22.5	$4,415,794.51	$9,780.79	0.00221	89.35
22.5 - 23.5	$4,401,632.72	$11,140.12	0.00253	89.15
23.5 - 24.5	$4,302,079.60	$6,948.11	0.00162	88.92
24.5 - 25.5	$4,283,280.49	$75,891.00	0.01772	88.78
25.5 - 26.5	$4,182,658.49	$3,082.21	0.00074	87.21
26.5 - 27.5	$4,177,316.28	$6,617.40	0.00158	87.14
27.5 - 28.5	$4,152,277.88	$13,744.06	0.00331	87.00
28.5 - 29.5	$4,105,287.82	$4,885.40	0.00119	86.72
29.5 - 30.5	$4,034,657.42	$2,868.22	0.00071	86.61
30.5 - 31.5	$4,030,607.20	$756.00	0.00019	86.55
31.5 - 32.5	$4,014,868.20	$5,554.52	0.00138	86.53
32.5 - 33.5	$3,965,189.68	$459.00	0.00012	86.41
33.5 - 34.5	$3,964,347.68	$9,099.94	0.00230	86.40
34.5 - 35.5	$3,949,404.74	$8,143.78	0.00206	86.21
35.5 - 36.5	$3,380,333.96	$2,116.00	0.00063	86.03

MEC
Electric Division
356.00 Overhead Conductors and Devices
Observed Life Table
Retirement Expr. 1970 TO 2017
Placement Years 1912 TO 2017

Age Interval	*$ Surviving At Beginning of Age Interval*	*$ Retired During The Age Interval*	*Retirement Ratio*	*% Surviving At Beginning of Age Interval*
36.5 - 37.5	$3,322,817.96	$7,585.56	0.00228	85.97
37.5 - 38.5	$3,315,080.40	$37,984.55	0.01146	85.78
38.5 - 39.5	$3,276,536.85	$1,518.00	0.00046	84.80
39.5 - 40.5	$3,264,189.85	$19,713.85	0.00604	84.76
40.5 - 41.5	$3,206,111.00	$8,686.00	0.00271	84.24
41.5 - 42.5	$3,191,365.00	$220.00	0.00007	84.02
42.5 - 43.5	$3,081,949.00	$11,591.96	0.00376	84.01
43.5 - 44.5	$2,785,195.04	$19,366.95	0.00695	83.69
44.5 - 45.5	$2,367,393.09	$99,821.39	0.04217	83.11
45.5 - 46.5	$2,141,050.70	$19,865.18	0.00928	79.61
46.5 - 47.5	$2,111,182.52	$1,051.80	0.00050	78.87
47.5 - 48.5	$2,038,176.72	$25,079.94	0.01231	78.83
48.5 - 49.5	$1,955,204.78	$12,246.04	0.00626	77.86
49.5 - 50.5	$1,930,206.74	$1,311.17	0.00068	77.37
50.5 - 51.5	$1,825,530.57	$3,738.03	0.00205	77.32
51.5 - 52.5	$1,239,753.54	$114.08	0.00009	77.16
52.5 - 53.5	$1,126,580.46	$17.00	0.00002	77.15
53.5 - 54.5	$1,126,563.46	$108,484.09	0.09630	77.15
54.5 - 55.5	$1,006,129.37	$0.00	0.00000	69.72
55.5 - 56.5	$1,006,068.37	$36.00	0.00004	69.72
56.5 - 57.5	$1,005,972.37	$0.00	0.00000	69.72
57.5 - 58.5	$931,516.37	$13,600.71	0.01460	69.72
58.5 - 59.5	$917,915.66	$145,212.46	0.15820	68.70
59.5 - 60.5	$772,703.20	$36,977.81	0.04786	57.83
60.5 - 61.5	$712,824.39	$12,499.00	0.01753	55.07
61.5 - 62.5	$575,079.39	$1,329.39	0.00231	54.10
62.5 - 63.5	$75,111.00	$0.00	0.00000	53.98
63.5 - 64.5	$75,111.00	$0.00	0.00000	53.98
64.5 - 65.5	$75,111.00	$0.00	0.00000	53.98
65.5 - 66.5	$75,111.00	$0.00	0.00000	53.98
66.5 - 67.5	$75,111.00	$0.00	0.00000	53.98
67.5 - 68.5	$75,111.00	$0.00	0.00000	53.98
68.5 - 69.5	$75,111.00	$0.00	0.00000	53.98
69.5 - 70.5	$75,111.00	$0.00	0.00000	53.98
70.5 - 71.5	$75,111.00	$0.00	0.00000	53.98
71.5 - 72.5	$75,111.00	$0.00	0.00000	53.98
72.5 - 73.5	$75,111.00	$0.00	0.00000	53.98

MEC

Electric Division

356.00 Overhead Conductors and Devices

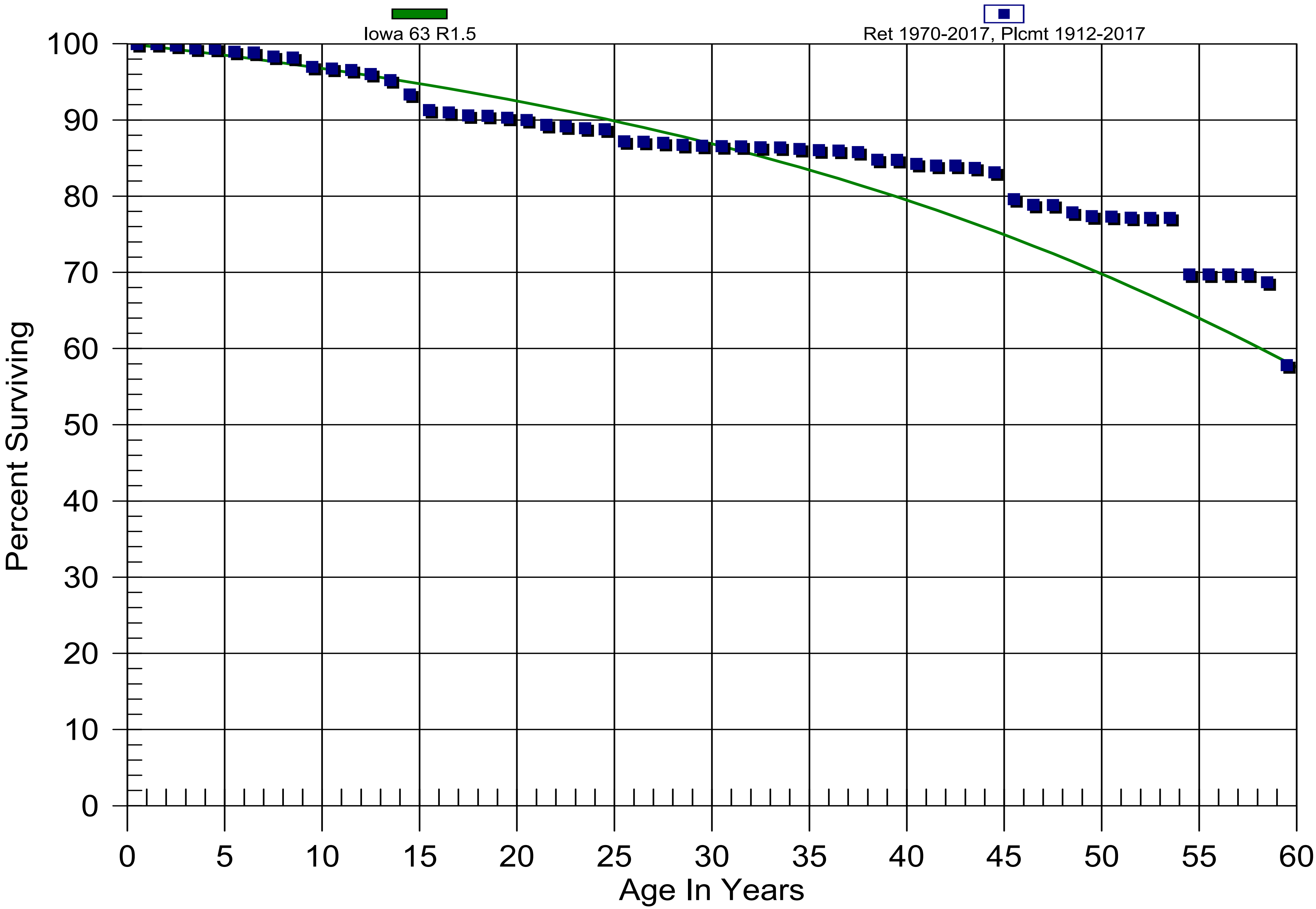
Observed Life Table

Retirement Expr. 1970 TO 2017
Placement Years 1912 TO 2017

Age Interval	$ Surviving At Beginning of Age Interval	$ Retired During The Age Interval	Retirement Ratio	% Surviving At Beginning of Age Interval
73.5 - 74.5	$75,111.00	$0.00	0.00000	53.98
74.5 - 75.5	$75,111.00	$0.00	0.00000	53.98
75.5 - 76.5	$75,111.00	$0.00	0.00000	53.98
76.5 - 77.5	$75,111.00	$0.00	0.00000	53.98
77.5 - 78.5	$75,111.00	$0.00	0.00000	53.98
78.5 - 79.5	$75,111.00	$0.00	0.00000	53.98
79.5 - 80.5	$75,111.00	$0.00	0.00000	53.98
80.5 - 81.5	$75,111.00	$0.00	0.00000	53.98
81.5 - 82.5	$75,111.00	$0.00	0.00000	53.98
82.5 - 83.5	$75,111.00	$0.00	0.00000	53.98
83.5 - 84.5	$75,111.00	$0.00	0.00000	53.98
84.5 - 85.5	$75,111.00	$0.00	0.00000	53.98
85.5 - 86.5	$75,111.00	$0.00	0.00000	53.98
86.5 - 87.5	$75,111.00	$0.00	0.00000	53.98
87.5 - 88.5	$75,111.00	$0.00	0.00000	53.98
88.5 - 89.5	$75,111.00	$0.00	0.00000	53.98
89.5 - 90.5	$75,111.00	$0.00	0.00000	53.98
90.5 - 91.5	$75,111.00	$0.00	0.00000	53.98
91.5 - 92.5	$75,111.00	$0.00	0.00000	53.98
92.5 - 93.5	$75,111.00	$0.00	0.00000	53.98
93.5 - 94.5	$75,111.00	$0.00	0.00000	53.98
94.5 - 95.5	$0.00	$0.00	0.00000	53.98
95.5 - 96.5	$0.00	$0.00	0.00000	53.98
96.5 - 97.5	$0.00	$0.00	0.00000	53.98
97.5 - 98.5	$0.00	$0.00	0.00000	53.98
98.5 - 99.5	$0.00	$0.00	0.00000	53.98
99.5 - 100.5	$0.00	$0.00	0.00000	53.98
100.5 - 101.5	$0.00	$0.00	0.00000	53.98
101.5 - 102.5	$0.00	$0.00	0.00000	53.98
102.5 - 103.5	$0.00	$0.00	0.00000	53.98
103.5 - 104.5	$0.00	$0.00	0.00000	53.98
104.5 - 105.5	$0.00	$0.00	0.00000	53.98

MEC

Electric Division
356.00 Overhead Conductors and Devices
Original And Smooth Survivor Curves



MEC
Electric Division
362.00 Station Equipment

Observed Life Table
Retirement Expr. 1970 TO 2017
Placement Years 1912 TO 2017

Age Interval	*$ Surviving At Beginning of Age Interval*	*$ Retired During The Age Interval*	*Retirement Ratio*	*% Surviving At Beginning of Age Interval*
0.0 - 0.5	$648,581,417.21	$41,069.00	0.00006	100.00
0.5 - 1.5	$603,305,477.25	$682,390.73	0.00113	99.99
1.5 - 2.5	$540,827,410.36	$303,242.49	0.00056	99.88
2.5 - 3.5	$490,497,173.82	$691,500.16	0.00141	99.82
3.5 - 4.5	$460,388,415.16	$1,024,012.88	0.00222	99.68
4.5 - 5.5	$441,797,436.23	$1,905,657.36	0.00431	99.46
5.5 - 6.5	$417,932,746.11	$882,118.04	0.00211	99.03
6.5 - 7.5	$392,062,429.81	$3,501,799.36	0.00893	98.82
7.5 - 8.5	$356,977,750.53	$2,626,712.53	0.00736	97.94
8.5 - 9.5	$330,381,945.71	$2,758,635.06	0.00835	97.22
9.5 - 10.5	$312,807,897.94	$1,925,619.17	0.00616	96.41
10.5 - 11.5	$316,955,503.29	$1,470,181.65	0.00464	95.82
11.5 - 12.5	$276,739,700.92	$2,813,242.09	0.01017	95.37
12.5 - 13.5	$263,456,251.12	$878,665.03	0.00334	94.40
13.5 - 14.5	$243,193,742.54	$1,283,382.09	0.00528	94.09
14.5 - 15.5	$226,993,158.88	$1,321,277.56	0.00582	93.59
15.5 - 16.5	$207,573,352.72	$1,048,610.33	0.00505	93.05
16.5 - 17.5	$201,816,207.40	$1,808,914.77	0.00896	92.58
17.5 - 18.5	$193,490,202.13	$2,743,915.77	0.01418	91.75
18.5 - 19.5	$176,562,285.16	$1,805,663.88	0.01023	90.44
19.5 - 20.5	$164,845,386.51	$1,407,032.01	0.00854	89.52
20.5 - 21.5	$157,656,370.64	$1,557,508.23	0.00988	88.76
21.5 - 22.5	$152,264,361.77	$1,645,234.65	0.01081	87.88
22.5 - 23.5	$144,921,253.59	$2,608,651.23	0.01800	86.93
23.5 - 24.5	$131,354,098.14	$2,021,616.63	0.01539	85.36
24.5 - 25.5	$118,400,402.49	$2,098,344.66	0.01772	84.05
25.5 - 26.5	$108,242,406.51	$1,246,583.25	0.01152	82.56
26.5 - 27.5	$98,952,682.78	$1,230,135.78	0.01243	81.61
27.5 - 28.5	$96,092,252.92	$1,454,876.69	0.01514	80.60
28.5 - 29.5	$94,012,117.92	$1,373,185.17	0.01461	79.38
29.5 - 30.5	$91,017,889.48	$1,846,659.49	0.02029	78.22
30.5 - 31.5	$89,001,407.31	$2,019,684.74	0.02269	76.63
31.5 - 32.5	$84,139,566.18	$1,219,113.70	0.01449	74.89
32.5 - 33.5	$81,319,654.76	$1,261,225.18	0.01551	73.81
33.5 - 34.5	$79,298,876.46	$1,501,309.64	0.01893	72.66
34.5 - 35.5	$76,326,185.82	$1,687,902.97	0.02211	71.28
35.5 - 36.5	$73,618,294.85	$960,394.41	0.01305	69.71

MEC

Electric Division

362.00 Station Equipment

Observed Life Table

Retirement Expr. 1970 TO 2017
Placement Years 1912 TO 2017

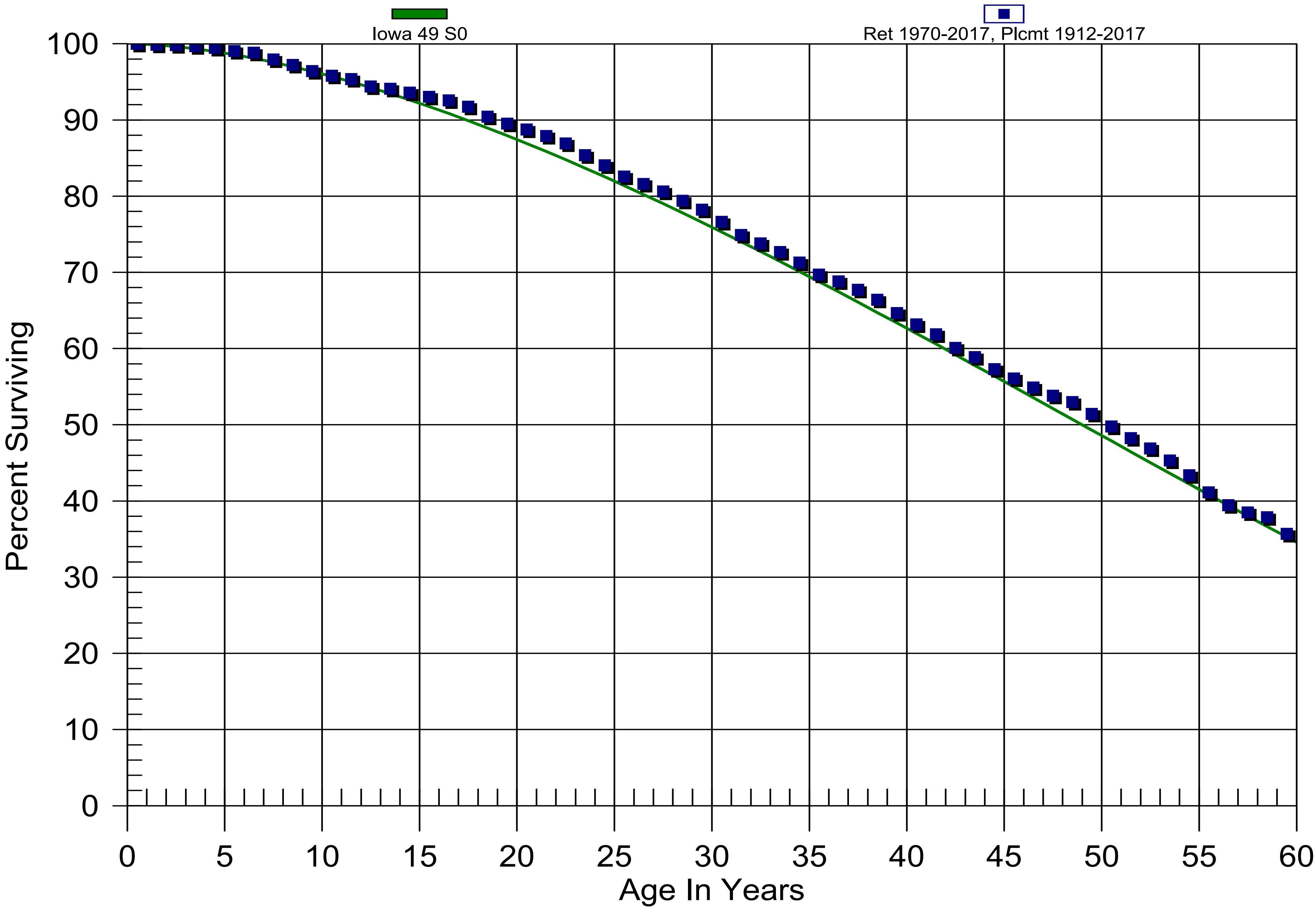
Age Interval	*$ Surviving At Beginning of Age Interval*	*$ Retired During The Age Interval*	*Retirement Ratio*	*% Surviving At Beginning of Age Interval*
36.5 - 37.5	$71,490,548.36	$1,147,856.34	0.01606	68.80
37.5 - 38.5	$68,718,623.86	$1,304,774.01	0.01899	67.69
38.5 - 39.5	$66,716,786.45	$1,744,556.68	0.02615	66.41
39.5 - 40.5	$63,384,690.45	$1,465,494.85	0.02312	64.67
40.5 - 41.5	$59,972,466.60	$1,255,879.90	0.02094	63.18
41.5 - 42.5	$57,372,095.70	$1,642,728.53	0.02863	61.85
42.5 - 43.5	$54,917,656.17	$1,097,610.01	0.01999	60.08
43.5 - 44.5	$49,312,124.16	$1,333,470.36	0.02704	58.88
44.5 - 45.5	$46,155,184.80	$967,924.06	0.02097	57.29
45.5 - 46.5	$42,972,493.21	$920,770.79	0.02143	56.09
46.5 - 47.5	$40,524,864.42	$802,662.65	0.01981	54.89
47.5 - 48.5	$37,678,939.77	$580,800.65	0.01541	53.80
48.5 - 49.5	$36,523,021.12	$1,056,054.62	0.02891	52.97
49.5 - 50.5	$34,460,781.50	$1,113,715.56	0.03232	51.44
50.5 - 51.5	$32,536,861.94	$1,006,345.18	0.03093	49.78
51.5 - 52.5	$30,464,430.76	$851,048.04	0.02794	48.24
52.5 - 53.5	$28,637,639.72	$967,060.98	0.03377	46.89
53.5 - 54.5	$26,541,106.74	$1,132,919.48	0.04269	45.31
54.5 - 55.5	$24,970,389.26	$1,297,737.61	0.05197	43.37
55.5 - 56.5	$21,497,859.65	$873,304.30	0.04062	41.12
56.5 - 57.5	$19,242,074.35	$469,127.26	0.02438	39.45
57.5 - 58.5	$14,681,873.09	$240,997.41	0.01641	38.49
58.5 - 59.5	$12,662,590.68	$732,018.70	0.05781	37.85
59.5 - 60.5	$11,505,914.98	$573,327.04	0.04983	35.67
60.5 - 61.5	$10,532,155.94	$345,202.79	0.03278	33.89
61.5 - 62.5	$9,643,379.15	$486,563.65	0.05046	32.78
62.5 - 63.5	$7,462,969.50	$370,465.52	0.04964	31.12
63.5 - 64.5	$5,697,556.98	$292,956.51	0.05142	29.58
64.5 - 65.5	$5,061,327.47	$82,161.99	0.01623	28.06
65.5 - 66.5	$3,723,002.48	$151,315.49	0.04064	27.60
66.5 - 67.5	$3,394,820.99	$102,969.82	0.03033	26.48
67.5 - 68.5	$2,620,754.17	$178,302.65	0.06803	25.68
68.5 - 69.5	$2,104,375.52	$30,000.68	0.01426	23.93
69.5 - 70.5	$1,767,714.84	$115,048.90	0.06508	23.59
70.5 - 71.5	$1,608,408.94	$189,849.66	0.11804	22.05
71.5 - 72.5	$1,132,631.28	$32,327.82	0.02854	19.45
72.5 - 73.5	$1,084,367.46	$31,133.03	0.02871	18.90

MEC
Electric Division
362.00 Station Equipment

Observed Life Table
Retirement Expr. 1970 TO 2017
Placement Years 1912 TO 2017

Age Interval	$ Surviving At Beginning of Age Interval	$ Retired During The Age Interval	Retirement Ratio	% Surviving At Beginning of Age Interval
73.5 - 74.5	$1,052,709.43	$89,914.48	0.08541	18.35
74.5 - 75.5	$952,286.95	$48,631.40	0.05107	16.79
75.5 - 76.5	$851,653.55	$66,518.46	0.07811	15.93
76.5 - 77.5	$697,621.09	$49,654.87	0.07118	14.68
77.5 - 78.5	$517,545.22	$11,162.60	0.02157	13.64
78.5 - 79.5	$424,250.62	$414.94	0.00098	13.34
79.5 - 80.5	$423,835.68	$1,623.28	0.00383	13.33
80.5 - 81.5	$422,212.40	$312,545.34	0.74026	13.28
81.5 - 82.5	$109,667.06	$20,856.60	0.19018	3.45
82.5 - 83.5	$88,810.46	$0.00	0.00000	2.79
83.5 - 84.5	$88,810.46	$296.92	0.00334	2.79
84.5 - 85.5	$88,134.54	$105.00	0.00119	2.78
85.5 - 86.5	$36,156.54	$0.00	0.00000	2.78
86.5 - 87.5	$29,020.54	$10,285.07	0.35441	2.78
87.5 - 88.5	$18,385.47	$0.00	0.00000	1.80
88.5 - 89.5	$18,385.47	$8,574.00	0.46635	1.80
89.5 - 90.5	$9,811.47	$948.47	0.09667	0.96
90.5 - 91.5	$8,863.00	$0.00	0.00000	0.87
91.5 - 92.5	$8,863.00	$0.00	0.00000	0.87
92.5 - 93.5	$8,584.00	$0.00	0.00000	0.87
93.5 - 94.5	$6,636.00	$4,241.00	0.63909	0.87

MEC
Electric Division
362.00 Station Equipment
Original And Smooth Survivor Curves



MEC
Electric Division
364.00 Poles, Towers, and Fixtures
Observed Life Table
Retirement Expr. 1993 TO 2017
Placement Years 1963 TO 2017

Age Interval	*$ Surviving At Beginning of Age Interval*	*$ Retired During The Age Interval*	*Retirement Ratio*	*% Surviving At Beginning of Age Interval*
0.0 - 0.5	$517,356,342.35	$417,150.68	0.00081	100.00
0.5 - 1.5	$495,444,018.31	$1,707,548.63	0.00345	99.92
1.5 - 2.5	$490,904,400.72	$1,718,744.70	0.00350	99.57
2.5 - 3.5	$465,233,866.12	$1,762,466.66	0.00379	99.23
3.5 - 4.5	$446,988,561.83	$888,590.40	0.00199	98.85
4.5 - 5.5	$436,655,673.70	$712,819.60	0.00163	98.65
5.5 - 6.5	$422,299,787.49	$571,574.55	0.00135	98.49
6.5 - 7.5	$409,609,623.04	$716,908.55	0.00175	98.36
7.5 - 8.5	$395,143,447.42	$347,622.18	0.00088	98.19
8.5 - 9.5	$380,681,230.25	$511,789.76	0.00134	98.10
9.5 - 10.5	$364,377,564.85	$474,450.59	0.00130	97.97
10.5 - 11.5	$354,276,105.18	$370,748.25	0.00105	97.84
11.5 - 12.5	$340,777,483.64	$436,521.41	0.00128	97.74
12.5 - 13.5	$334,482,405.43	$506,795.10	0.00152	97.61
13.5 - 14.5	$328,951,361.08	$582,677.23	0.00177	97.47
14.5 - 15.5	$315,550,213.29	$602,106.50	0.00191	97.29
15.5 - 16.5	$303,246,575.30	$572,997.88	0.00189	97.11
16.5 - 17.5	$293,724,221.97	$575,510.27	0.00196	96.92
17.5 - 18.5	$280,536,998.56	$636,340.31	0.00227	96.73
18.5 - 19.5	$269,747,209.69	$759,669.75	0.00282	96.52
19.5 - 20.5	$261,496,107.57	$1,040,317.63	0.00398	96.24
20.5 - 21.5	$248,764,106.55	$799,370.81	0.00321	95.86
21.5 - 22.5	$237,006,496.77	$735,007.34	0.00310	95.55
22.5 - 23.5	$218,439,245.16	$777,376.55	0.00356	95.26
23.5 - 24.5	$201,287,705.16	$881,008.19	0.00438	94.92
24.5 - 25.5	$183,177,625.14	$794,209.55	0.00434	94.50
25.5 - 26.5	$166,809,610.64	$866,737.00	0.00520	94.09
26.5 - 27.5	$141,975,706.77	$1,069,694.62	0.00753	93.60
27.5 - 28.5	$126,711,157.78	$1,042,275.51	0.00823	92.90
28.5 - 29.5	$115,853,829.11	$1,091,100.65	0.00942	92.13
29.5 - 30.5	$134,448,487.02	$19,094,208.48	0.14202	91.27
30.5 - 31.5	$106,312,797.54	$2,211,636.56	0.02080	78.30
31.5 - 32.5	$96,407,582.98	$1,775,959.55	0.01842	76.68
32.5 - 33.5	$86,444,675.43	$1,834,056.15	0.02122	75.26
33.5 - 34.5	$77,429,065.28	$2,038,514.78	0.02633	73.67
34.5 - 35.5	$70,245,363.50	$1,503,989.61	0.02141	71.73
35.5 - 36.5	$61,227,282.89	$1,398,181.11	0.02284	70.19

MEC
Electric Division
364.00 Poles, Towers, and Fixtures
Observed Life Table
Retirement Expr. 1993 TO 2017
Placement Years 1963 TO 2017

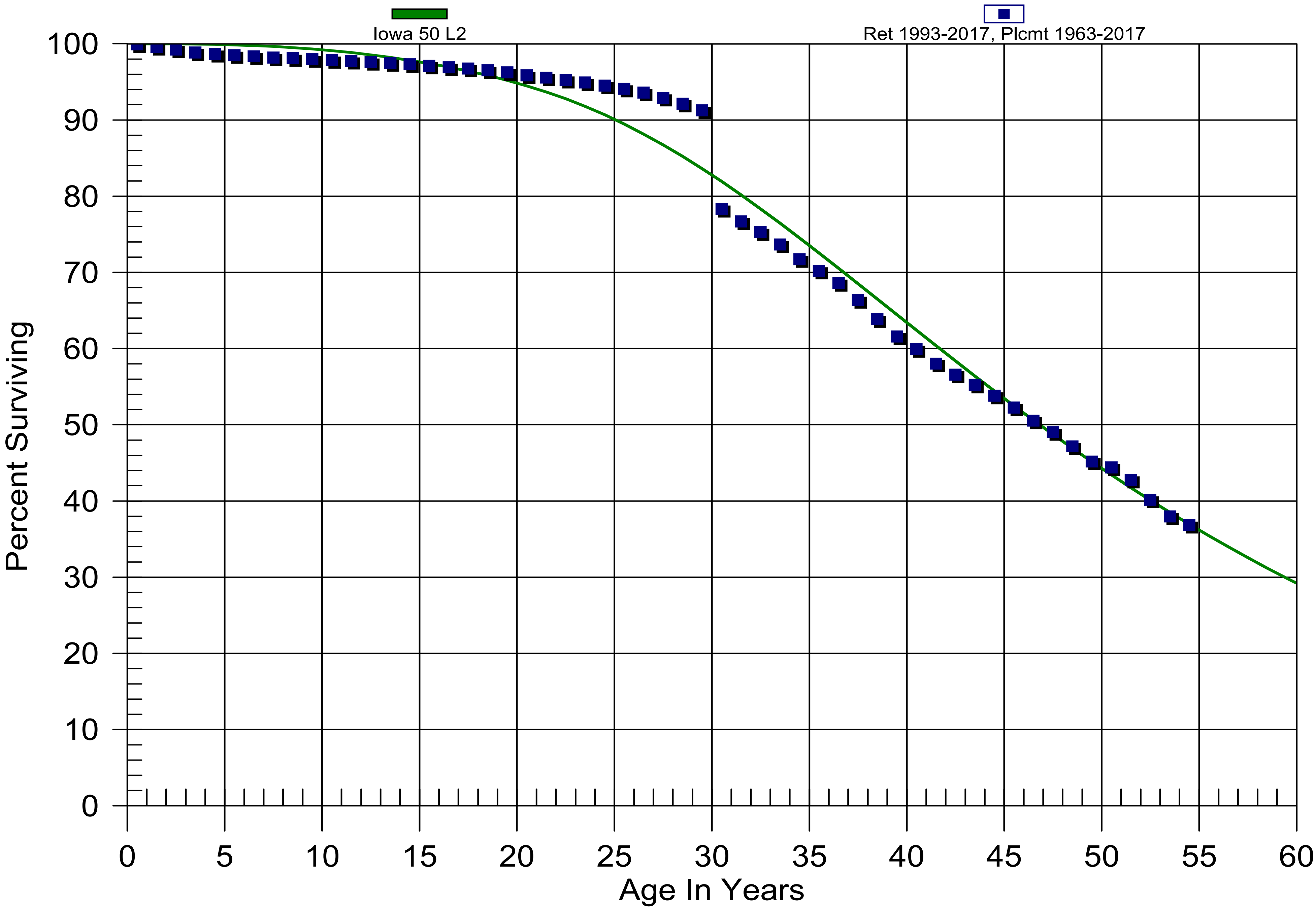
Age Interval	$ Surviving At Beginning of Age Interval	$ Retired During The Age Interval	Retirement Ratio	% Surviving At Beginning of Age Interval
36.5 - 37.5	$54,013,637.78	$1,753,063.34	0.03246	68.59
37.5 - 38.5	$47,234,546.44	$1,789,329.43	0.03788	66.36
38.5 - 39.5	$41,767,797.01	$1,483,690.29	0.03552	63.85
39.5 - 40.5	$36,801,709.72	$988,212.91	0.02685	61.58
40.5 - 41.5	$32,651,163.81	$1,034,236.00	0.03168	59.93
41.5 - 42.5	$28,149,715.81	$704,923.66	0.02504	58.03
42.5 - 43.5	$25,434,567.15	$594,493.41	0.02337	56.58
43.5 - 44.5	$22,096,132.74	$579,953.63	0.02625	55.25
44.5 - 45.5	$19,194,818.11	$549,346.39	0.02862	53.80
45.5 - 46.5	$16,405,814.72	$543,381.28	0.03312	52.26
46.5 - 47.5	$13,939,480.44	$420,710.34	0.03018	50.53
47.5 - 48.5	$12,195,189.10	$460,118.14	0.03773	49.01
48.5 - 49.5	$10,444,721.96	$440,184.05	0.04214	47.16
49.5 - 50.5	$8,934,243.91	$153,408.62	0.01717	45.17
50.5 - 51.5	$7,747,203.29	$286,778.69	0.03702	44.39
51.5 - 52.5	$6,432,942.60	$391,285.12	0.06083	42.75
52.5 - 53.5	$5,296,683.48	$288,683.90	0.05450	40.15
53.5 - 54.5	$4,049,044.58	$119,442.58	0.02950	37.96

MEC

Electric Division

364.00 Poles, Towers, and Fixtures

Original And Smooth Survivor Curves



MEC
Electric Division
365.00 Overhead Conductors and Devices

Observed Life Table
Retirement Expr. 1993 TO 2017
Placement Years 1960 TO 2017

Age Interval	*$ Surviving At Beginning of Age Interval*	*$ Retired During The Age Interval*	*Retirement Ratio*	*% Surviving At Beginning of Age Interval*
0.0 - 0.5	$676,941,942.92	$612,760.25	0.00091	100.00
0.5 - 1.5	$663,539,570.01	$4,749,740.72	0.00716	99.91
1.5 - 2.5	$664,521,705.38	$8,998,306.73	0.01354	99.19
2.5 - 3.5	$624,446,680.26	$9,283,685.59	0.01487	97.85
3.5 - 4.5	$593,843,270.12	$9,582,017.73	0.01614	96.40
4.5 - 5.5	$577,140,241.58	$8,797,635.57	0.01524	94.84
5.5 - 6.5	$561,634,570.54	$9,083,989.42	0.01617	93.40
6.5 - 7.5	$534,987,913.62	$8,289,334.06	0.01549	91.88
7.5 - 8.5	$505,976,699.31	$6,718,402.91	0.01328	90.46
8.5 - 9.5	$473,502,214.11	$4,945,155.24	0.01044	89.26
9.5 - 10.5	$444,794,621.12	$3,998,950.54	0.00899	88.33
10.5 - 11.5	$424,389,885.21	$3,365,473.26	0.00793	87.53
11.5 - 12.5	$400,318,376.85	$4,080,256.91	0.01019	86.84
12.5 - 13.5	$384,001,923.75	$4,456,862.50	0.01161	85.95
13.5 - 14.5	$375,516,338.37	$4,882,528.88	0.01300	84.96
14.5 - 15.5	$357,665,831.57	$4,739,622.73	0.01325	83.85
15.5 - 16.5	$351,312,339.66	$3,640,897.36	0.01036	82.74
16.5 - 17.5	$344,575,496.00	$3,543,959.81	0.01029	81.88
17.5 - 18.5	$333,139,624.39	$3,384,753.73	0.01016	81.04
18.5 - 19.5	$328,918,726.83	$3,619,430.45	0.01100	80.22
19.5 - 20.5	$321,848,670.27	$3,476,811.92	0.01080	79.34
20.5 - 21.5	$312,457,115.59	$3,718,687.00	0.01190	78.48
21.5 - 22.5	$304,926,258.46	$3,730,128.40	0.01223	77.54
22.5 - 23.5	$285,819,497.51	$2,488,016.13	0.00870	76.60
23.5 - 24.5	$275,755,525.20	$2,232,081.37	0.00809	75.93
24.5 - 25.5	$258,876,996.85	$1,939,203.29	0.00749	75.31
25.5 - 26.5	$236,720,507.61	$1,748,301.16	0.00739	74.75
26.5 - 27.5	$206,963,336.99	$2,614,145.69	0.01263	74.20
27.5 - 28.5	$187,101,119.45	$1,895,792.76	0.01013	73.26
28.5 - 29.5	$175,484,638.89	$1,970,657.80	0.01123	72.52
29.5 - 30.5	$199,008,552.09	$25,971,105.98	0.13050	71.70
30.5 - 31.5	$160,488,392.11	$1,236,848.37	0.00771	62.35
31.5 - 32.5	$149,418,326.74	$1,198,993.14	0.00802	61.87
32.5 - 33.5	$139,219,503.68	$1,465,625.68	0.01053	61.37
33.5 - 34.5	$129,960,167.00	$1,947,015.71	0.01498	60.72
34.5 - 35.5	$121,696,999.29	$1,827,197.03	0.01501	59.81
35.5 - 36.5	$112,265,977.26	$2,561,371.71	0.02282	58.92

MEC

Electric Division

365.00 Overhead Conductors and Devices

Observed Life Table

Retirement Expr. 1993 TO 2017
Placement Years 1960 TO 2017

Age Interval	$ Surviving At Beginning of Age Interval	$ Retired During The Age Interval	Retirement Ratio	% Surviving At Beginning of Age Interval
36.5 - 37.5	$102,174,350.55	$1,876,921.82	0.01837	57.57
37.5 - 38.5	$93,600,136.73	$1,522,117.36	0.01626	56.51
38.5 - 39.5	$85,288,506.37	$1,186,686.50	0.01391	55.59
39.5 - 40.5	$78,610,503.87	$455,085.04	0.00579	54.82
40.5 - 41.5	$70,911,650.83	$532,806.09	0.00751	54.50
41.5 - 42.5	$63,496,723.74	$431,392.43	0.00679	54.09
42.5 - 43.5	$58,757,053.31	$434,745.32	0.00740	53.73
43.5 - 44.5	$50,992,452.99	$505,569.08	0.00991	53.33
44.5 - 45.5	$44,363,183.91	$468,001.20	0.01055	52.80
45.5 - 46.5	$37,896,052.71	$361,127.72	0.00953	52.24
46.5 - 47.5	$32,289,253.99	$351,137.90	0.01087	51.75
47.5 - 48.5	$27,427,005.09	$299,186.92	0.01091	51.18
48.5 - 49.5	$23,402,178.17	$231,337.53	0.00989	50.62
49.5 - 50.5	$19,508,058.64	$115,997.82	0.00595	50.12
50.5 - 51.5	$16,637,894.82	$204,103.58	0.01227	49.83
51.5 - 52.5	$14,082,829.24	$214,724.19	0.01525	49.22
52.5 - 53.5	$11,961,819.05	$200,589.23	0.01677	48.46
53.5 - 54.5	$9,635,763.82	$84,869.74	0.00881	47.65
54.5 - 55.5	$471,377.08	$403.53	0.00086	47.23
55.5 - 56.5	$470,973.55	$68.45	0.00015	47.19
56.5 - 57.5	$470,905.10	$793.10	0.00168	47.18

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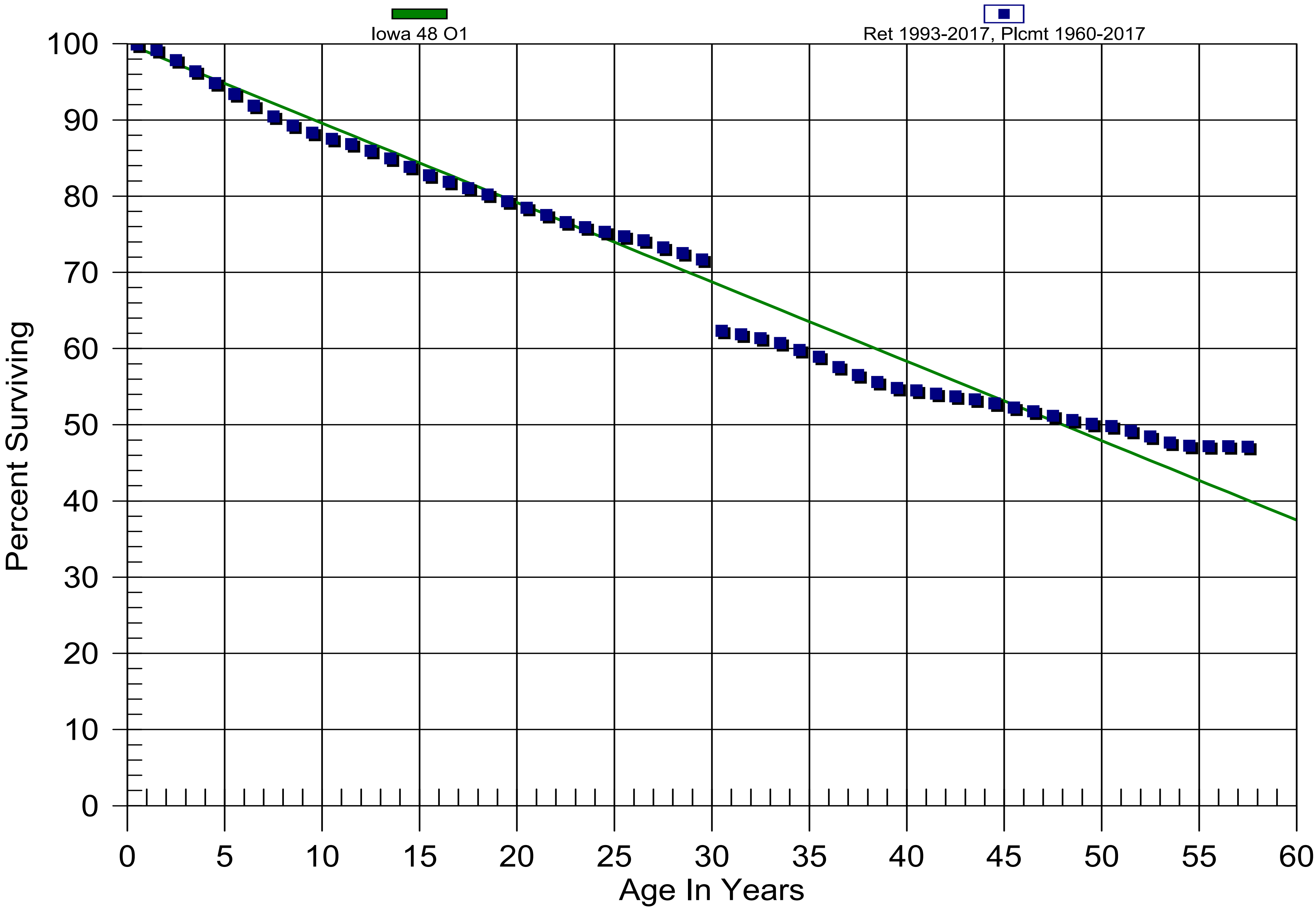
Electric Division

365.00 Overhead Conductors and Devices

Original And Smooth Survivor Curves



MEC
Electric Division
366.00 Underground Conduit

Observed Life Table
Retirement Expr. 1993 TO 2017
Placement Years 1963 TO 2017

Age Interval	$ Surviving At Beginning of Age Interval	$ Retired During The Age Interval	Retirement Ratio	% Surviving At Beginning of Age Interval
0.0 - 0.5	$148,820,170.11	$0.00	0.00000	100.00
0.5 - 1.5	$147,459,370.06	$71,327.31	0.00048	100.00
1.5 - 2.5	$147,166,893.16	$14,315.79	0.00010	99.95
2.5 - 3.5	$148,176,910.53	$4,134.89	0.00003	99.94
3.5 - 4.5	$148,098,287.92	$5,263.02	0.00004	99.94
4.5 - 5.5	$148,318,888.22	$21,646.35	0.00015	99.94
5.5 - 6.5	$149,776,935.38	$8,896.74	0.00006	99.92
6.5 - 7.5	$135,164,052.12	$18,106.70	0.00013	99.92
7.5 - 8.5	$134,197,161.42	$4,194.01	0.00003	99.90
8.5 - 9.5	$134,133,573.30	$3,369.00	0.00003	99.90
9.5 - 10.5	$131,727,435.27	$1,354.30	0.00001	99.90
10.5 - 11.5	$130,043,812.48	$2,227.00	0.00002	99.90
11.5 - 12.5	$124,866,523.47	$1,345.24	0.00001	99.89
12.5 - 13.5	$123,787,610.75	$35,077.13	0.00028	99.89
13.5 - 14.5	$109,586,958.70	$1,516.14	0.00001	99.86
14.5 - 15.5	$106,646,528.10	$12,103.77	0.00011	99.86
15.5 - 16.5	$106,554,207.85	$6,626.31	0.00006	99.85
16.5 - 17.5	$103,835,605.05	$5,122.80	0.00005	99.84
17.5 - 18.5	$98,772,848.47	$3,037.55	0.00003	99.84
18.5 - 19.5	$90,334,579.65	$7,419.87	0.00008	99.84
19.5 - 20.5	$85,032,670.81	$5,596.57	0.00007	99.83
20.5 - 21.5	$77,145,979.56	$12,722.10	0.00016	99.82
21.5 - 22.5	$68,701,712.75	$68,904.38	0.00100	99.81
22.5 - 23.5	$60,014,808.23	$14,967.34	0.00025	99.71
23.5 - 24.5	$54,621,105.51	$33,824.65	0.00062	99.68
24.5 - 25.5	$49,607,979.01	$44,079.22	0.00089	99.62
25.5 - 26.5	$43,976,782.18	$40,351.47	0.00092	99.53
26.5 - 27.5	$39,040,063.67	$23,182.94	0.00059	99.44
27.5 - 28.5	$37,169,030.32	$17,319.06	0.00047	99.38
28.5 - 29.5	$36,204,650.48	$19,278.17	0.00053	99.33
29.5 - 30.5	$49,510,975.39	$992,877.46	0.02005	99.28
30.5 - 31.5	$45,628,776.93	$39,114.33	0.00086	97.29
31.5 - 32.5	$44,345,602.60	$26,530.04	0.00060	97.21
32.5 - 33.5	$43,454,141.56	$19,536.43	0.00045	97.15
33.5 - 34.5	$42,122,173.13	$39,111.00	0.00093	97.10
34.5 - 35.5	$40,837,693.13	$21,168.82	0.00052	97.01
35.5 - 36.5	$38,166,695.31	$24,270.40	0.00064	96.96

MEC

Electric Division

366.00 Underground Conduit

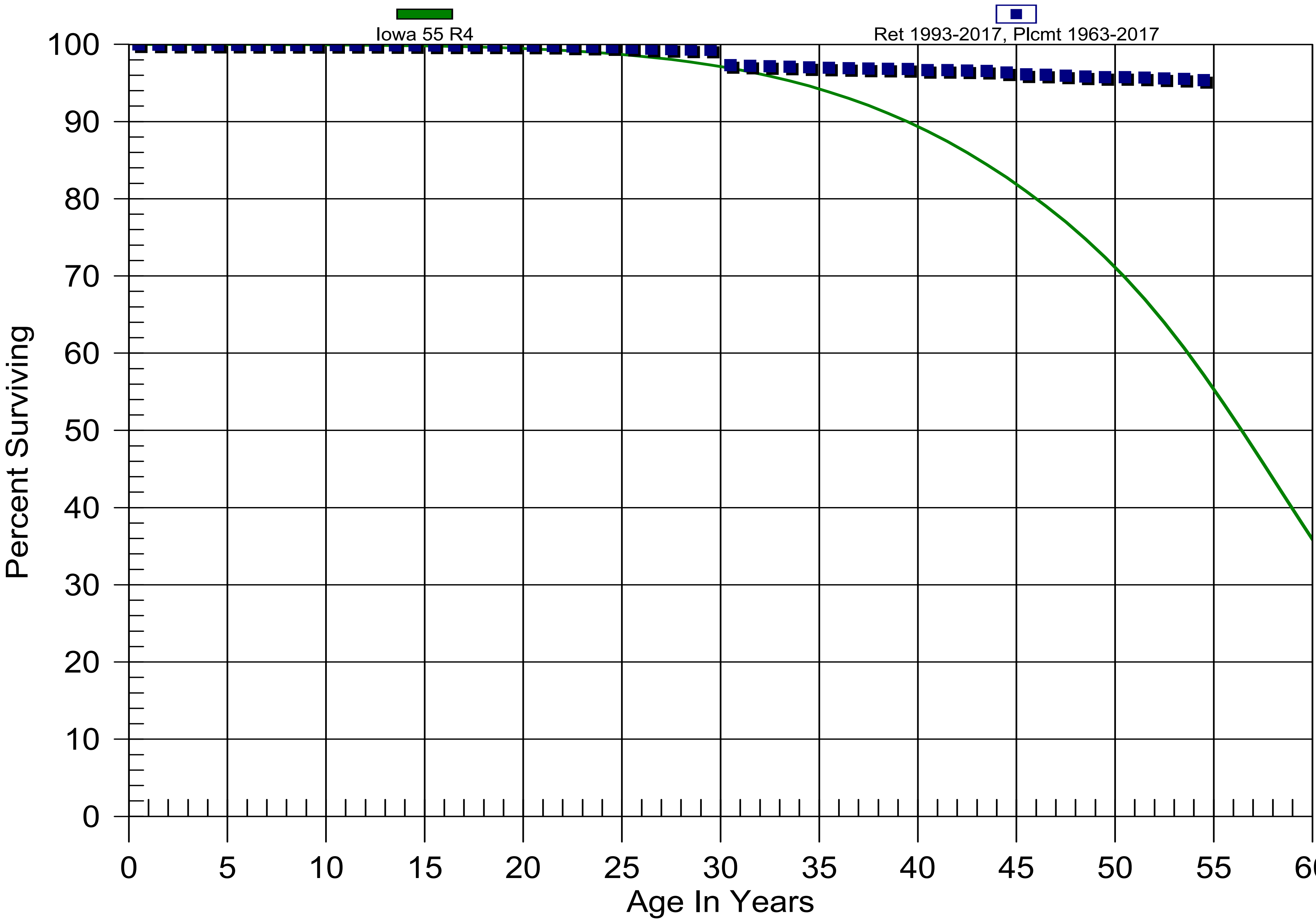
Observed Life Table

Retirement Expr. 1993 TO 2017
Placement Years 1963 TO 2017

Age Interval	$ Surviving At Beginning of Age Interval	$ Retired During The Age Interval	Retirement Ratio	% Surviving At Beginning of Age Interval
36.5 - 37.5	$37,818,474.91	$22,590.69	0.00060	96.90
37.5 - 38.5	$36,156,156.22	$9,713.15	0.00027	96.84
38.5 - 39.5	$34,439,250.07	$7,609.19	0.00022	96.82
39.5 - 40.5	$32,491,443.88	$40,925.30	0.00126	96.80
40.5 - 41.5	$29,646,999.58	$7,648.54	0.00026	96.68
41.5 - 42.5	$27,141,450.04	$10,132.30	0.00037	96.65
42.5 - 43.5	$26,493,332.74	$18,360.00	0.00069	96.61
43.5 - 44.5	$24,903,645.74	$46,955.25	0.00189	96.55
44.5 - 45.5	$22,601,083.49	$57,304.55	0.00254	96.37
45.5 - 46.5	$19,856,994.94	$11,340.85	0.00057	96.12
46.5 - 47.5	$18,614,663.09	$22,416.56	0.00120	96.07
47.5 - 48.5	$17,966,509.53	$21,157.70	0.00118	95.95
48.5 - 49.5	$17,098,530.83	$15,189.07	0.00089	95.84
49.5 - 50.5	$16,373,515.76	$437.91	0.00003	95.75
50.5 - 51.5	$15,914,425.85	$7,115.34	0.00045	95.75
51.5 - 52.5	$15,485,435.51	$18,024.98	0.00116	95.71
52.5 - 53.5	$15,122,696.53	$12,393.48	0.00082	95.60
53.5 - 54.5	$14,704,283.05	$23,841.05	0.00162	95.52

MEC

Electric Division
366.00 Underground Conduit
Original And Smooth Survivor Curves



MEC
Electric Division
367.10 Underground Conductors and Devices
Observed Life Table
Retirement Expr. 1993 TO 2017
Placement Years 1963 TO 2017

Age Interval	*$ Surviving At Beginning of Age Interval*	*$ Retired During The Age Interval*	*Retirement Ratio*	*% Surviving At Beginning of Age Interval*
0.0 - 0.5	$689,924,599.14	$4,516,973.67	0.00655	100.00
0.5 - 1.5	$629,570,267.13	$8,520,694.72	0.01353	99.35
1.5 - 2.5	$569,396,143.82	$9,077,405.38	0.01594	98.00
2.5 - 3.5	$521,674,510.86	$3,996,948.96	0.00766	96.44
3.5 - 4.5	$487,839,238.21	$3,264,937.15	0.00669	95.70
4.5 - 5.5	$444,709,115.97	$3,378,110.04	0.00760	95.06
5.5 - 6.5	$412,341,328.37	$2,364,406.97	0.00573	94.34
6.5 - 7.5	$377,762,826.36	$2,117,093.37	0.00560	93.80
7.5 - 8.5	$354,954,967.52	$2,559,879.77	0.00721	93.27
8.5 - 9.5	$332,494,206.50	$2,190,735.62	0.00659	92.60
9.5 - 10.5	$308,755,962.63	$2,060,550.50	0.00667	91.99
10.5 - 11.5	$281,700,503.62	$1,530,883.21	0.00543	91.37
11.5 - 12.5	$258,995,032.04	$1,914,486.36	0.00739	90.88
12.5 - 13.5	$236,622,041.77	$1,772,202.93	0.00749	90.21
13.5 - 14.5	$223,864,877.82	$1,560,994.11	0.00697	89.53
14.5 - 15.5	$202,176,602.56	$1,440,192.22	0.00712	88.91
15.5 - 16.5	$190,052,366.99	$1,090,536.80	0.00574	88.27
16.5 - 17.5	$181,411,916.94	$1,144,928.27	0.00631	87.77
17.5 - 18.5	$172,478,254.50	$1,034,695.32	0.00600	87.21
18.5 - 19.5	$161,359,587.23	$1,180,624.20	0.00732	86.69
19.5 - 20.5	$152,888,846.87	$1,192,627.69	0.00780	86.05
20.5 - 21.5	$142,116,756.79	$1,426,575.94	0.01004	85.38
21.5 - 22.5	$123,063,178.08	$1,875,468.48	0.01524	84.53
22.5 - 23.5	$109,439,214.68	$2,246,383.08	0.02053	83.24
23.5 - 24.5	$100,024,986.33	$1,704,011.89	0.01704	81.53
24.5 - 25.5	$88,146,656.30	$1,616,236.12	0.01834	80.14
25.5 - 26.5	$78,382,604.49	$1,072,153.30	0.01368	78.67
26.5 - 27.5	$67,801,517.91	$709,349.32	0.01046	77.59
27.5 - 28.5	$60,668,936.07	$778,635.81	0.01283	76.78
28.5 - 29.5	$56,502,293.29	$953,151.19	0.01687	75.80
29.5 - 30.5	$74,522,103.74	$6,276,677.61	0.08423	74.52
30.5 - 31.5	$63,742,396.13	$890,330.22	0.01397	68.24
31.5 - 32.5	$59,555,766.91	$860,692.87	0.01445	67.29
32.5 - 33.5	$55,839,860.04	$847,667.06	0.01518	66.32
33.5 - 34.5	$52,298,866.98	$1,039,971.57	0.01989	65.31
34.5 - 35.5	$49,032,728.41	$939,031.98	0.01915	64.01
35.5 - 36.5	$45,738,259.43	$602,911.62	0.01318	62.79

MEC
Electric Division
367.10 Underground Conductors and Devices
Observed Life Table
Retirement Expr. 1993 TO 2017
Placement Years 1963 TO 2017

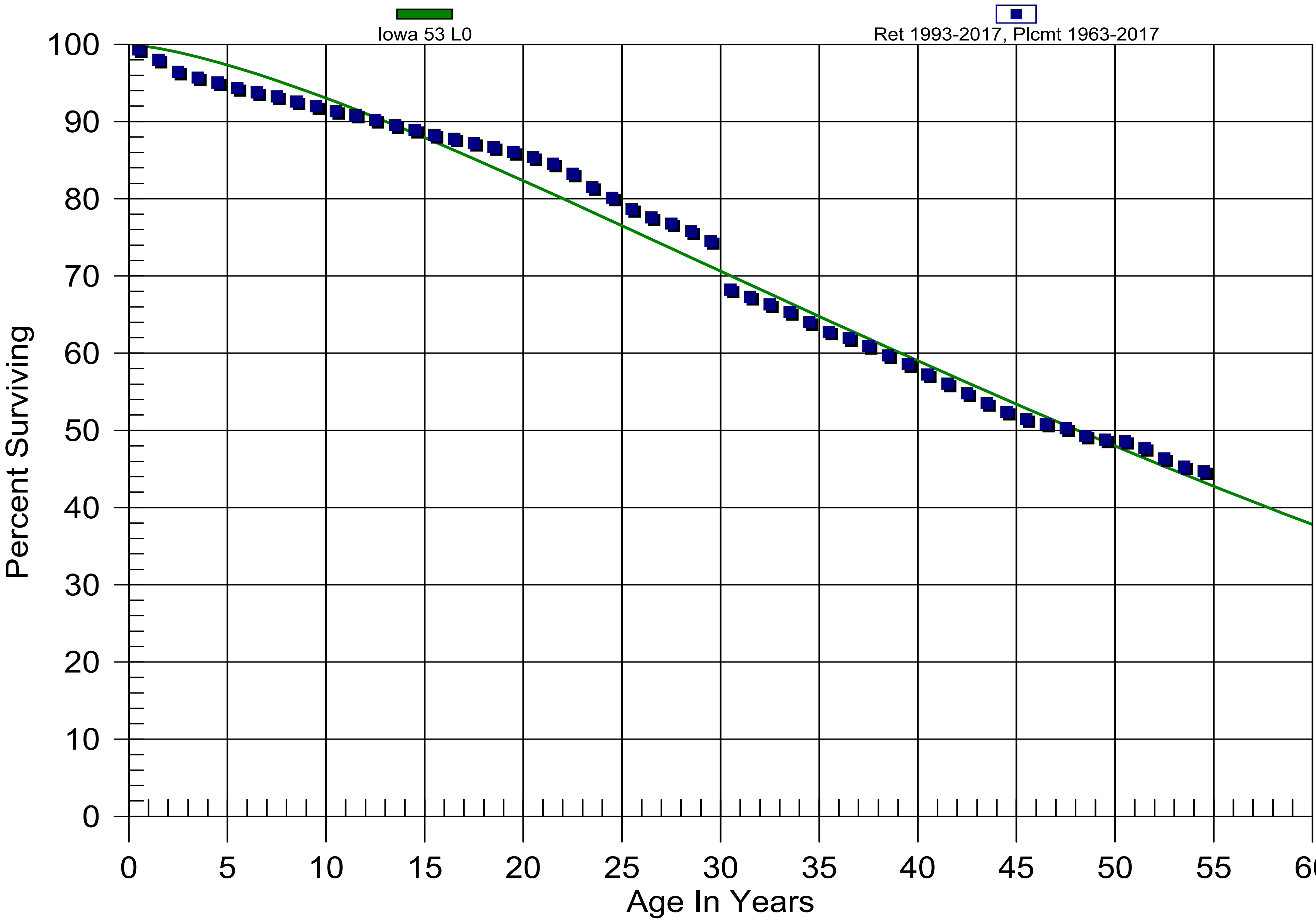
Age Interval	$ Surviving At Beginning of Age Interval	$ Retired During The Age Interval	Retirement Ratio	% Surviving At Beginning of Age Interval
36.5 - 37.5	$42,600,857.81	$720,045.16	0.01690	61.96
37.5 - 38.5	$39,461,376.65	$779,214.82	0.01975	60.91
38.5 - 39.5	$36,551,892.83	$694,626.23	0.01900	59.71
39.5 - 40.5	$33,570,712.60	$765,476.85	0.02280	58.57
40.5 - 41.5	$30,987,564.75	$638,797.39	0.02061	57.24
41.5 - 42.5	$28,050,048.36	$627,168.65	0.02236	56.06
42.5 - 43.5	$26,417,327.71	$613,786.08	0.02323	54.80
43.5 - 44.5	$24,002,185.63	$503,788.62	0.02099	53.53
44.5 - 45.5	$21,487,086.01	$395,275.71	0.01840	52.41
45.5 - 46.5	$17,982,278.30	$208,839.58	0.01161	51.44
46.5 - 47.5	$16,910,017.72	$194,370.98	0.01149	50.85
47.5 - 48.5	$16,162,229.74	$307,068.59	0.01900	50.26
48.5 - 49.5	$15,152,998.15	$156,915.05	0.01036	49.31
49.5 - 50.5	$14,328,855.10	$49,198.34	0.00343	48.80
50.5 - 51.5	$13,673,199.76	$253,892.49	0.01857	48.63
51.5 - 52.5	$12,837,707.27	$364,263.25	0.02837	47.73
52.5 - 53.5	$12,026,613.02	$274,859.23	0.02285	46.37
53.5 - 54.5	$10,736,546.79	$147,205.79	0.01371	45.31

MEC

Electric Division

367.10 Underground Conductors and Devices

Original And Smooth Survivor Curves



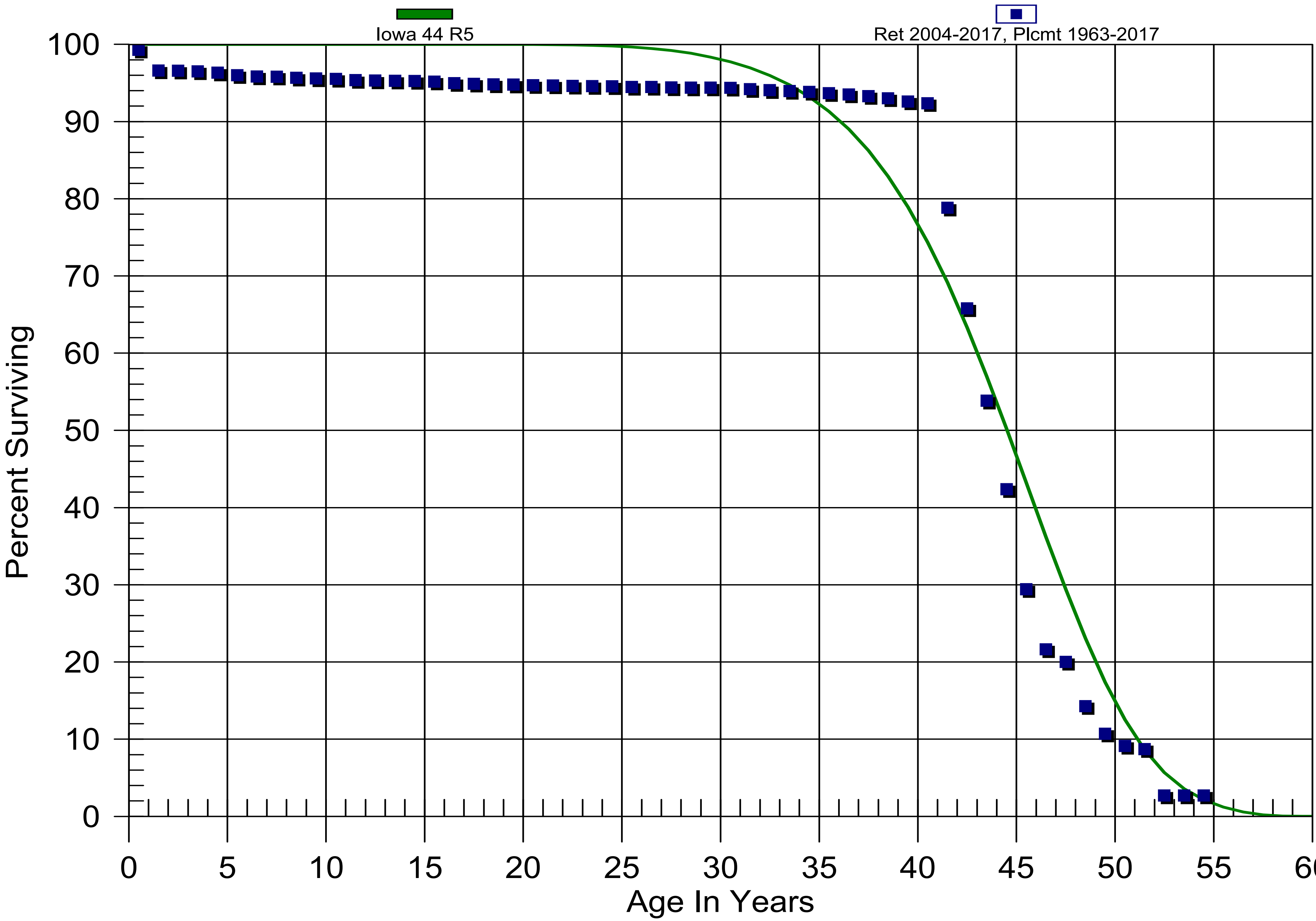
MEC
Electric Division
368.20 Line Transformers - Bare Cost
Observed Life Table
Retirement Expr. 2004 TO 2017
Placement Years 1963 TO 2017

Age Interval	$ Surviving At Beginning of Age Interval	$ Retired During The Age Interval	Retirement Ratio	% Surviving At Beginning of Age Interval
0.0 - 0.5	$163,241,193.79	$1,133,464.34	0.00694	100.00
0.5 - 1.5	$157,393,487.97	$4,281,188.98	0.02720	99.31
1.5 - 2.5	$150,089,138.09	$33,142.52	0.00022	96.60
2.5 - 3.5	$144,704,386.41	$123,152.97	0.00085	96.58
3.5 - 4.5	$138,666,651.28	$256,849.76	0.00185	96.50
4.5 - 5.5	$127,490,309.38	$438,509.25	0.00344	96.32
5.5 - 6.5	$120,669,906.39	$191,320.88	0.00159	95.99
6.5 - 7.5	$115,657,135.05	$52,395.89	0.00045	95.84
7.5 - 8.5	$112,493,472.47	$142,581.43	0.00127	95.80
8.5 - 9.5	$105,703,530.23	$97,568.52	0.00092	95.67
9.5 - 10.5	$98,088,559.31	$50,058.75	0.00051	95.59
10.5 - 11.5	$89,801,713.18	$157,609.45	0.00176	95.54
11.5 - 12.5	$83,886,469.65	$60,163.59	0.00072	95.37
12.5 - 13.5	$76,758,556.60	$14,628.34	0.00019	95.30
13.5 - 14.5	$77,252,755.81	$13,619.05	0.00018	95.28
14.5 - 15.5	$84,986,001.04	$85,056.35	0.00100	95.27
15.5 - 16.5	$88,682,560.63	$173,224.79	0.00195	95.17
16.5 - 17.5	$90,575,973.24	$90,359.53	0.00100	94.98
17.5 - 18.5	$96,017,663.06	$73,074.24	0.00076	94.89
18.5 - 19.5	$96,731,816.09	$49,179.13	0.00051	94.82
19.5 - 20.5	$98,882,343.45	$67,281.00	0.00068	94.77
20.5 - 21.5	$97,521,890.87	$24,840.84	0.00025	94.70
21.5 - 22.5	$95,076,178.53	$56,492.75	0.00059	94.68
22.5 - 23.5	$94,736,057.44	$34,128.31	0.00036	94.62
23.5 - 24.5	$94,318,034.41	$16,980.10	0.00018	94.59
24.5 - 25.5	$90,344,029.87	$79,551.74	0.00088	94.57
25.5 - 26.5	$87,438,916.86	$24,063.77	0.00028	94.49
26.5 - 27.5	$85,861,729.03	$49,215.32	0.00057	94.46
27.5 - 28.5	$82,489,139.76	$7,228.41	0.00009	94.41
28.5 - 29.5	$70,817,916.41	$6,734.82	0.00010	94.40
29.5 - 30.5	$64,481,845.32	$20,847.96	0.00032	94.39
30.5 - 31.5	$59,100,498.49	$97,545.34	0.00165	94.36
31.5 - 32.5	$48,854,698.82	$71,192.96	0.00146	94.21
32.5 - 33.5	$42,434,456.17	$57,028.47	0.00134	94.07
33.5 - 34.5	$37,362,267.85	$44,356.05	0.00119	93.94
34.5 - 35.5	$33,326,322.59	$51,671.94	0.00155	93.83
35.5 - 36.5	$29,640,567.47	$58,091.75	0.00196	93.69

MEC
Electric Division
368.20 Line Transformers - Bare Cost
Observed Life Table
Retirement Expr. 2004 TO 2017
Placement Years 1963 TO 2017

Age Interval	$ Surviving At Beginning of Age Interval	$ Retired During The Age Interval	Retirement Ratio	% Surviving At Beginning of Age Interval
36.5 - 37.5	$25,934,257.49	$62,688.60	0.00242	93.50
37.5 - 38.5	$22,295,985.54	$64,732.84	0.00290	93.28
38.5 - 39.5	$20,454,030.98	$87,553.62	0.00428	93.01
39.5 - 40.5	$18,280,484.30	$44,349.12	0.00243	92.61
40.5 - 41.5	$18,112,542.11	$2,656,908.42	0.14669	92.38
41.5 - 42.5	$14,534,227.71	$2,405,972.62	0.16554	78.83
42.5 - 43.5	$10,843,118.09	$1,970,259.13	0.18171	65.78
43.5 - 44.5	$8,281,211.96	$1,762,290.71	0.21281	53.83
44.5 - 45.5	$6,411,604.25	$1,960,166.40	0.30572	42.37
45.5 - 46.5	$4,381,623.85	$1,160,250.02	0.26480	29.42
46.5 - 47.5	$3,141,501.83	$234,246.74	0.07457	21.63
47.5 - 48.5	$2,860,294.09	$820,924.89	0.28701	20.02
48.5 - 49.5	$2,019,813.20	$506,051.68	0.25054	14.27
49.5 - 50.5	$1,483,738.52	$219,932.81	0.14823	10.70
50.5 - 51.5	$1,224,235.71	$53,560.37	0.04375	9.11
51.5 - 52.5	$1,158,626.34	$800,477.34	0.69088	8.71
52.5 - 53.5	$342,908.00	$0.00	0.00000	2.69
53.5 - 54.5	$299,953.00	$0.00	0.00000	2.69

MEC
Electric Division
368.20 Line Transformers - Bare Cost
Original And Smooth Survivor Curves



MEC
Electric Division
355.00 Poles and Fixtures

Original Cost Of Utility Plant In Service
And Development Of Composite Remaining Life as of December 31, 2017
Based Upon Broad Group/Remaining Life Procedure and Technique

Average Service Life: 57 **Survivor Curve:** R2

Year (1)	Original Cost (2)	Avg. Service Life (3)	Avg. Annual Accrual (4)	Avg. Remaining Life (5)	Future Annual Accruals (6)
1923	51,228.00	57.00	898.73	3.03	2,726.62
1950	737,127.00	57.00	12,932.00	11.34	146,585.80
1955	254,771.00	57.00	4,469.65	13.31	59,493.68
1956	128,816.00	57.00	2,259.92	13.73	31,039.61
1957	15,651.00	57.00	274.58	14.17	3,890.55
1959	2,068.00	57.00	36.28	15.07	546.66
1960	45,958.00	57.00	806.28	15.53	12,524.07
1961	20,024.00	57.00	351.30	16.01	5,623.95
1963	4,544.00	57.00	79.72	16.99	1,354.47
1965	34,446.00	57.00	604.31	18.02	10,887.35
1966	83,152.00	57.00	1,458.80	18.54	27,052.22
1967	96,325.00	57.00	1,689.91	19.08	32,244.67
1968	3,151.00	57.00	55.28	19.63	1,085.16
1969	45,044.00	57.00	790.24	20.19	15,954.35
1970	26,942.00	57.00	472.66	20.76	9,811.68
1971	19,678.00	57.00	345.23	21.34	7,365.49
1972	377,472.00	57.00	6,622.29	21.92	145,192.04
1973	135,630.00	57.00	2,379.46	22.52	53,594.48
1974	83,698.00	57.00	1,468.38	23.13	33,966.77
1975	134,009.00	57.00	2,351.03	23.75	55,831.96
1976	849.00	57.00	14.89	24.38	363.07
1977	73,776.00	57.00	1,294.31	25.01	32,374.13
1978	68,680.00	57.00	1,204.91	25.66	30,915.89
1979	683.00	57.00	11.98	26.31	315.27
1980	440.00	57.00	7.72	26.97	208.23
1981	233,013.00	57.00	4,087.93	27.65	113,020.28
1982	753,409.00	57.00	13,217.65	28.33	374,429.90

MEC
Electric Division
355.00 Poles and Fixtures

Original Cost Of Utility Plant In Service
And Development Of Composite Remaining Life as of December 31, 2017
Based Upon Broad Group/Remaining Life Procedure and Technique

Average Service Life: 57 **Survivor Curve:** R2

Year (1)	Original Cost (2)	Avg. Service Life (3)	Avg. Annual Accrual (4)	Avg. Remaining Life (5)	Future Annual Accruals (6)
1983	50,482.00	57.00	885.65	29.02	25,697.02
1985	108,264.00	57.00	1,899.36	30.42	57,776.19
1986	503.00	57.00	8.82	31.13	274.73
1988	39,214.00	57.00	687.96	32.58	22,414.62
1989	8,905.00	57.00	156.23	33.32	5,205.21
1991	1,210.00	57.00	21.23	34.81	739.02
1992	68,243.00	57.00	1,197.24	35.57	42,587.00
1993	51,285.00	57.00	899.73	36.34	32,693.62
1994	8,653.00	57.00	151.81	37.11	5,633.51
1995	82,807.00	57.00	1,452.75	37.89	55,043.59
1996	87,436.00	57.00	1,533.96	38.67	59,324.92
1997	470,030.00	57.00	8,246.11	39.47	325,454.57
1998	115,509.00	57.00	2,026.47	40.27	81,600.16
1999	64,892.00	57.00	1,138.45	41.07	46,759.64
2000	953,294.00	57.00	16,724.39	41.88	700,485.26
2001	2,076,961.00	57.00	36,437.77	42.70	1,555,992.18
2002	3,327,217.00	57.00	58,372.01	43.53	2,540,774.67
2003	2,812,539.00	57.00	49,342.60	44.36	2,188,720.90
2004	3,570,048.00	57.00	62,632.18	45.19	2,830,526.93
2005	2,149,791.00	57.00	37,715.49	46.04	1,736,239.51
2006	1,239,114.00	57.00	21,738.76	46.88	1,019,178.17
2007	490,919.00	57.00	8,612.58	47.74	411,131.71
2008	61,439.00	57.00	1,077.87	48.59	52,378.00
2009	4,061.00	57.00	71.25	49.46	3,523.66
2010	387,141.00	57.00	6,791.92	50.33	341,819.95
2011	484,104.00	57.00	8,493.02	51.20	434,857.07
2012	314,318.00	57.00	5,514.33	52.08	287,186.66

MEC
Electric Division
355.00 Poles and Fixtures

Original Cost Of Utility Plant In Service
And Development Of Composite Remaining Life as of December 31, 2017
Based Upon Broad Group/Remaining Life Procedure and Technique

Average Service Life: *57* *Survivor Curve:* *R2*

Year (1)	Original Cost (2)	Avg. Service Life (3)	Avg. Annual Accrual (4)	Avg. Remaining Life (5)	Future Annual Accruals (6)
2013	4,077,136.00	57.00	71,528.43	52.96	3,788,467.54
2014	879,488.00	57.00	15,429.56	53.85	830,936.45
2015	850,651.00	57.00	14,923.65	54.75	817,026.85
2016	1,494,202.00	57.00	26,213.97	55.64	1,458,661.49
2017	2,168,538.00	57.00	38,044.38	56.55	2,151,304.84
Total	31,928,978.00	57.00	560,155.39	44.84	25,118,813.96

Composite Average Remaining Life ... 44.84 Years

MEC
Electric Division
356.00 Overhead Conductors and Devices

Original Cost Of Utility Plant In Service
And Development Of Composite Remaining Life as of December 31, 2017
Based Upon Broad Group/Remaining Life Procedure and Technique

Average Service Life: 63 **Survivor Curve:** R1.5

Year (1)	Original Cost (2)	Avg. Service Life (3)	Avg. Annual Accrual (4)	Avg. Remaining Life (5)	Future Annual Accruals (6)
1923	75,111.00	63.00	1,192.23	8.94	10,662.89
1955	498,639.00	63.00	7,914.82	20.49	162,167.21
1956	125,246.00	63.00	1,988.01	20.97	41,680.56
1957	22,901.00	63.00	363.50	21.45	7,798.26
1960	74,476.00	63.00	1,182.15	22.96	27,144.31
1961	60.00	63.00	0.95	23.48	22.36
1962	61.00	63.00	0.97	24.01	23.25
1963	11,950.00	63.00	189.68	24.54	4,655.30
1965	113,112.00	63.00	1,795.41	25.64	46,034.70
1966	582,108.00	63.00	9,239.71	26.20	242,069.50
1967	103,365.00	63.00	1,640.70	26.77	43,916.84
1968	12,752.00	63.00	202.41	27.34	5,534.09
1969	57,892.00	63.00	918.91	27.92	25,660.56
1970	71,954.00	63.00	1,142.11	28.52	32,568.37
1971	85,114.00	63.00	1,351.00	29.11	39,331.32
1972	131,685.00	63.00	2,090.22	29.72	62,118.37
1973	398,435.00	63.00	6,324.30	30.33	191,813.70
1974	285,162.00	63.00	4,526.33	30.95	140,090.77
1975	109,441.00	63.00	1,737.14	31.58	54,853.62
1976	8,396.00	63.00	133.27	32.21	4,292.50
1977	38,365.00	63.00	608.96	32.85	20,004.47
1978	11,237.00	63.00	178.36	33.50	5,974.38
1979	953.00	63.00	15.13	34.15	516.58
1980	3,214.00	63.00	51.02	34.81	1,775.72
1981	55,497.00	63.00	880.90	35.47	31,249.28
1982	561,044.00	63.00	8,905.36	36.15	321,899.76
1983	13,378.00	63.00	212.35	36.82	7,819.35

MEC
Electric Division
356.00 Overhead Conductors and Devices

Original Cost Of Utility Plant In Service
And Development Of Composite Remaining Life as of December 31, 2017
Based Upon Broad Group/Remaining Life Procedure and Technique

Average Service Life: 63 **Survivor Curve:** R1.5

Year (1)	Original Cost (2)	Avg. Service Life (3)	Avg. Annual Accrual (4)	Avg. Remaining Life (5)	Future Annual Accruals (6)
1984	383.00	63.00	6.08	37.51	228.02
1985	44,988.00	63.00	714.09	38.20	27,275.06
1986	15,024.00	63.00	238.47	38.89	9,274.57
1987	1,259.00	63.00	19.98	39.59	791.20
1988	68,194.00	63.00	1,082.43	40.30	43,618.27
1989	33,337.00	63.00	529.15	41.01	21,699.30
1990	18,421.00	63.00	292.39	41.72	12,199.26
1991	3,207.00	63.00	50.90	42.44	2,160.54
1992	24,766.00	63.00	393.11	43.17	16,969.80
1993	12,746.00	63.00	202.32	43.90	8,881.12
1994	88,567.00	63.00	1,405.81	44.63	62,743.93
1995	13,174.00	63.00	209.11	45.37	9,487.13
1996	347.00	63.00	5.51	46.11	253.98
1997	104,488.00	63.00	1,658.52	46.86	77,715.12
1998	117,232.00	63.00	1,860.81	47.61	88,592.01
1999	78,756.00	63.00	1,250.08	48.36	60,459.40
2000	411,448.00	63.00	6,530.85	49.12	320,808.90
2001	351,904.00	63.00	5,585.72	49.88	278,642.27
2002	3,424,141.00	63.00	54,350.85	50.65	2,752,863.19
2003	376,477.00	63.00	5,975.76	51.42	307,275.64
2004	1,866,378.00	63.00	29,624.72	52.19	1,546,237.29
2005	548,191.00	63.00	8,701.35	52.97	460,918.61
2006	322,322.00	63.00	5,116.17	53.75	275,006.41
2007	549,930.00	63.00	8,728.95	54.54	476,046.34
2008	2,525,562.00	63.00	40,087.85	55.33	2,217,885.75
2010	292,262.00	63.00	4,639.03	56.91	264,024.04
2011	1,837,432.00	63.00	29,165.27	57.71	1,683,234.96

MEC
Electric Division
356.00 Overhead Conductors and Devices

Original Cost Of Utility Plant In Service
And Development Of Composite Remaining Life as of December 31, 2017
Based Upon Broad Group/Remaining Life Procedure and Technique

Average Service Life: 63 **Survivor Curve:** R1.5

Year (1)	Original Cost (2)	Avg. Service Life (3)	Avg. Annual Accrual (4)	Avg. Remaining Life (5)	Future Annual Accruals (6)
2012	184,816.00	63.00	2,933.56	58.52	171,661.10
2013	3,090,048.00	63.00	49,047.84	59.32	2,909,712.71
2014	781,770.00	63.00	12,408.91	60.13	746,195.13
2015	6,502,913.00	63.00	103,219.71	60.95	6,291,123.55
2016	478,803.00	63.00	7,599.96	61.77	469,428.12
2017	4,884,095.00	63.00	77,524.47	62.59	4,852,121.06
Total	32,504,929.00	63.00	515,945.61	54.26	27,997,211.83

Composite Average Remaining Life ... 54.26 Years

MEC
Electric Division
362.00 Station Equipment

Original Cost Of Utility Plant In Service
And Development Of Composite Remaining Life as of December 31, 2017
Based Upon Broad Group/Remaining Life Procedure and Technique

Average Service Life: 49 **Survivor Curve:** S0

Year (1)	Original Cost (2)	Avg. Service Life (3)	Avg. Annual Accrual (4)	Avg. Remaining Life (5)	Future Annual Accruals (6)
1924	1,948.00	49.00	39.76	1.68	66.68
1925	279.00	49.00	5.69	2.04	11.62
1930	350.00	49.00	7.14	3.89	27.77
1931	7,136.00	49.00	145.63	4.26	620.64
1932	51,873.00	49.00	1,058.64	4.63	4,905.43
1933	379.00	49.00	7.73	5.01	38.76
1939	84,527.00	49.00	1,725.05	7.30	12,600.35
1940	134,662.00	49.00	2,748.21	7.69	21,137.22
1941	87,514.00	49.00	1,786.00	8.08	14,430.21
1942	53,660.00	49.00	1,095.10	8.47	9,274.91
1943	10,508.00	49.00	214.45	8.86	1,900.18
1944	525.00	49.00	10.71	9.25	99.15
1945	15,936.00	49.00	325.23	9.65	3,137.80
1946	285,928.00	49.00	5,835.28	10.04	58,610.35
1947	48,227.00	49.00	984.23	10.44	10,277.16
1948	327,517.00	49.00	6,684.04	10.84	72,463.44
1949	368,080.00	49.00	7,511.86	11.24	84,451.40
1950	671,097.00	49.00	13,695.89	11.65	159,493.22
1951	176,866.00	49.00	3,609.52	12.05	43,494.99
1952	1,256,163.00	49.00	25,636.04	12.46	319,340.13
1953	656,995.00	49.00	13,408.09	12.87	172,497.93
1954	1,394,947.00	49.00	28,468.38	13.28	377,937.15
1955	1,693,846.00	49.00	34,568.37	13.69	473,177.80
1956	610,382.00	49.00	12,456.81	14.10	175,674.86
1957	404,127.00	49.00	8,247.51	14.52	119,744.19
1958	425,185.00	49.00	8,677.27	14.94	129,618.55
1959	1,826,267.00	49.00	37,270.85	15.36	572,436.84

MEC
Electric Division
362.00 Station Equipment

Original Cost Of Utility Plant In Service
And Development Of Composite Remaining Life as of December 31, 2017
Based Upon Broad Group/Remaining Life Procedure and Technique

Average Service Life: 49 *Survivor Curve:* S0

Year (1)	Original Cost (2)	Avg. Service Life (3)	Avg. Annual Accrual (4)	Avg. Remaining Life (5)	Future Annual Accruals (6)
1960	4,116,759.00	49.00	84,015.70	15.78	1,325,956.69
1961	1,386,887.00	49.00	28,303.89	16.21	458,749.72
1962	2,242,324.00	49.00	45,761.83	16.64	761,302.68
1963	663,223.00	49.00	13,535.20	17.07	231,003.35
1964	1,129,713.00	49.00	23,055.42	17.50	403,471.93
1965	1,114,464.00	49.00	22,744.22	17.94	407,938.96
1966	1,067,075.00	49.00	21,777.09	18.37	400,143.13
1967	864,954.00	49.00	17,652.17	18.82	332,140.20
1968	1,117,064.00	49.00	22,797.28	19.26	439,076.50
1969	1,120,980.00	49.00	22,877.20	19.71	450,845.39
1970	2,079,064.00	49.00	42,429.98	20.16	855,277.60
1971	1,660,361.00	49.00	33,885.00	20.61	698,394.14
1972	3,082,089.00	49.00	62,899.93	21.07	1,325,129.86
1973	1,967,474.00	49.00	40,152.63	21.53	864,372.25
1974	4,620,421.00	49.00	94,294.54	21.99	2,073,583.05
1975	1,060,282.00	49.00	21,638.46	22.46	485,943.00
1976	1,732,608.00	49.00	35,359.43	22.93	810,718.07
1977	2,387,789.00	49.00	48,730.51	23.40	1,140,403.73
1978	1,765,982.00	49.00	36,040.54	23.88	860,666.16
1979	1,082,848.00	49.00	22,098.99	24.36	538,393.39
1980	1,715,701.00	49.00	35,014.39	24.85	870,082.66
1981	1,289,963.00	49.00	26,325.84	25.34	667,113.17
1982	1,300,037.00	49.00	26,531.43	25.84	685,466.45
1983	1,899,450.00	49.00	38,764.38	26.34	1,020,901.24
1984	1,218,090.00	49.00	24,859.04	26.84	667,240.35
1985	1,795,381.00	49.00	36,640.52	27.35	1,002,149.54
1986	3,534,156.00	49.00	72,125.81	27.87	2,009,855.86

MEC
Electric Division
362.00 Station Equipment

Original Cost Of Utility Plant In Service
And Development Of Composite Remaining Life as of December 31, 2017
Based Upon Broad Group/Remaining Life Procedure and Technique

Average Service Life: 49 **Survivor Curve: S0**

Year (1)	Original Cost (2)	Avg. Service Life (3)	Avg. Annual Accrual (4)	Avg. Remaining Life (5)	Future Annual Accruals (6)
1987	1,178,316.00	49.00	24,047.32	28.39	682,619.36
1988	2,065,566.00	49.00	42,154.51	28.91	1,218,798.77
1989	1,873,515.00	49.00	38,235.09	29.44	1,125,819.06
1990	2,262,458.00	49.00	46,172.73	29.98	1,384,385.34
1991	8,752,759.00	49.00	178,628.17	30.53	5,453,017.95
1992	8,133,767.00	49.00	165,995.65	31.08	5,158,857.09
1993	11,170,628.00	49.00	227,972.56	31.64	7,212,194.44
1994	11,903,834.00	49.00	242,935.98	32.20	7,822,887.26
1995	6,379,606.00	49.00	130,196.36	32.77	4,267,078.18
1996	4,565,104.00	49.00	93,165.62	33.35	3,107,521.90
1997	7,501,293.00	49.00	153,087.99	33.94	5,196,377.81
1998	12,090,384.00	49.00	246,743.13	34.54	8,522,834.76
1999	14,521,203.00	49.00	296,351.81	35.15	10,416,182.33
2000	11,062,689.00	49.00	225,769.72	35.76	8,074,501.68
2001	7,514,798.00	49.00	153,363.60	36.39	5,581,010.50
2002	21,537,126.00	49.00	439,534.26	37.03	16,274,961.79
2003	21,049,030.00	49.00	429,573.09	37.68	16,184,608.46
2004	20,775,664.00	49.00	423,994.18	38.34	16,254,328.88
2005	11,710,421.00	49.00	238,988.77	39.01	9,322,718.58
2006	22,430,229.00	49.00	457,760.90	39.70	18,171,912.37
2007	16,289,082.00	49.00	332,431.06	40.40	13,429,597.16
2008	23,147,195.00	49.00	472,392.89	41.11	19,422,053.45
2009	26,214,585.00	49.00	534,992.84	41.85	22,387,658.17
2010	35,508,085.00	49.00	724,656.57	42.60	30,868,021.85
2011	26,601,189.00	49.00	542,882.74	43.37	23,542,636.37
2012	25,250,083.00	49.00	515,309.08	44.16	22,753,962.50
2013	19,856,961.00	49.00	405,245.09	44.97	18,223,347.54

MEC
Electric Division
362.00 Station Equipment

Original Cost Of Utility Plant In Service
And Development Of Composite Remaining Life as of December 31, 2017
Based Upon Broad Group/Remaining Life Procedure and Technique

Average Service Life: 49 **Survivor Curve: S0**

Year (1)	Original Cost (2)	Avg. Service Life (3)	Avg. Annual Accrual (4)	Avg. Remaining Life (5)	Future Annual Accruals (6)
2014	31,843,256.00	49.00	649,863.96	45.81	29,768,109.10
2015	52,436,964.00	49.00	1,070,144.74	46.67	49,946,848.51
2016	63,416,281.00	49.00	1,294,212.98	47.57	61,568,227.39
2017	47,106,955.00	49.00	961,368.78	48.51	46,636,549.52
Total	635,759,089.00	49.00	12,974,707.05	39.66	514,603,415.90

Composite Average Remaining Life ... 39.66 Years

MEC
Electric Division
364.00 Poles, Towers, and Fixtures

Original Cost Of Utility Plant In Service
And Development Of Composite Remaining Life as of December 31, 2017
Based Upon Broad Group/Remaining Life Procedure and Technique

Average Service Life: 50 **Survivor Curve:** L2

Year (1)	Original Cost (2)	Avg. Service Life (3)	Avg. Annual Accrual (4)	Avg. Remaining Life (5)	Future Annual Accruals (6)
1963	3,929,602.00	50.00	78,592.05	18.38	1,444,672.81
1964	958,955.00	50.00	19,179.10	18.62	357,160.41
1965	744,974.00	50.00	14,899.48	18.86	281,035.12
1966	1,027,482.00	50.00	20,549.64	19.10	392,526.39
1967	1,033,632.00	50.00	20,672.64	19.34	399,823.11
1968	1,070,294.00	50.00	21,405.88	19.58	419,138.62
1969	1,290,349.00	50.00	25,806.98	19.82	511,533.14
1970	1,323,581.00	50.00	26,471.62	20.06	531,134.20
1971	1,922,953.00	50.00	38,459.06	20.31	781,090.46
1972	2,239,657.00	50.00	44,793.15	20.56	920,878.76
1973	2,321,361.00	50.00	46,427.23	20.81	966,228.85
1974	2,743,941.00	50.00	54,878.83	21.07	1,156,314.48
1975	2,010,225.00	50.00	40,204.51	21.34	857,782.52
1976	3,467,212.00	50.00	69,344.25	21.61	1,498,414.70
1977	3,162,333.00	50.00	63,246.67	21.89	1,384,479.99
1978	3,482,397.00	50.00	69,647.95	22.18	1,544,947.96
1979	3,677,420.00	50.00	73,548.41	22.49	1,653,806.80
1980	5,026,028.00	50.00	100,520.57	22.80	2,292,143.58
1981	5,815,464.00	50.00	116,309.29	23.13	2,690,701.59
1982	7,514,091.00	50.00	150,281.84	23.48	3,528,818.17
1983	5,145,187.00	50.00	102,903.75	23.85	2,453,862.90
1984	7,181,554.00	50.00	143,631.10	24.23	3,480,203.09
1985	8,186,948.00	50.00	163,738.98	24.63	4,033,667.04
1986	7,693,578.00	50.00	153,871.58	25.06	3,856,250.88
1987	9,041,481.00	50.00	180,829.64	25.51	4,613,304.76
1988	11,461,822.00	50.00	229,236.47	25.99	5,957,248.36
1989	12,555,425.00	50.00	251,108.53	26.49	6,651,665.78

MEC
Electric Division
364.00 Poles, Towers, and Fixtures

Original Cost Of Utility Plant In Service
And Development Of Composite Remaining Life as of December 31, 2017
Based Upon Broad Group/Remaining Life Procedure and Technique

Average Service Life: 50 *Survivor Curve:* L2

Year (1)	Original Cost (2)	Avg. Service Life (3)	Avg. Annual Accrual (4)	Avg. Remaining Life (5)	Future Annual Accruals (6)
1990	16,294,445.00	50.00	325,888.94	27.02	8,805,078.26
1991	26,684,130.00	50.00	533,682.67	27.58	14,717,190.88
1992	18,426,091.00	50.00	368,521.87	28.16	10,379,066.99
1993	19,824,479.00	50.00	396,489.63	28.78	11,411,466.98
1994	19,097,950.00	50.00	381,959.05	29.43	11,240,430.96
1995	20,757,010.00	50.00	415,140.25	30.11	12,497,827.34
1996	14,681,600.00	50.00	293,632.04	30.81	9,046,954.28
1997	15,489,843.00	50.00	309,796.90	31.54	9,772,015.93
1998	11,232,163.00	50.00	224,643.29	32.30	7,256,302.31
1999	14,090,234.00	50.00	281,804.72	33.08	9,322,774.92
2000	15,733,420.00	50.00	314,668.44	33.88	10,661,972.80
2001	13,699,606.00	50.00	273,992.15	34.70	9,507,726.53
2002	16,899,622.00	50.00	337,992.48	35.53	12,009,643.18
2003	18,125,146.00	50.00	362,502.97	36.38	13,186,629.76
2004	10,215,902.00	50.00	204,318.07	37.23	7,607,559.25
2005	12,747,725.00	50.00	254,954.53	38.10	9,714,892.32
2006	20,182,967.00	50.00	403,659.39	38.99	15,737,989.61
2007	18,397,734.00	50.00	367,954.73	39.89	14,676,099.64
2008	22,817,326.00	50.00	456,346.58	40.80	18,617,258.26
2009	22,044,263.00	50.00	440,885.32	41.72	18,393,829.50
2010	22,820,830.00	50.00	456,416.66	42.66	19,469,336.61
2011	21,150,038.00	50.00	423,000.81	43.61	18,445,365.17
2012	24,100,896.00	50.00	482,017.98	44.57	21,481,900.00
2013	22,794,694.00	50.00	455,893.94	45.54	20,760,416.65
2014	30,417,241.00	50.00	608,344.90	46.52	28,299,259.30
2015	40,962,956.00	50.00	819,259.22	47.51	38,920,517.23
2016	30,236,089.00	50.00	604,721.86	48.50	29,329,949.92

MEC
Electric Division
364.00 Poles, Towers, and Fixtures

Original Cost Of Utility Plant In Service
And Development Of Composite Remaining Life as of December 31, 2017
Based Upon Broad Group/Remaining Life Procedure and Technique

Average Service Life: *50* ***Survivor Curve:*** *L2*

Year (1)	Original Cost (2)	Avg. Service Life (3)	Avg. Annual Accrual (4)	Avg. Remaining Life (5)	Future Annual Accruals (6)
2017	41,100,363.00	50.00	822,007.36	49.50	40,689,408.07
Total	697,052,709.00	50.00	13,941,055.95	36.34	506,617,697.12

Composite Average Remaining Life ... ***36.34 Years***

MEC
Electric Division
365.00 Overhead Conductors and Devices

Original Cost Of Utility Plant In Service
And Development Of Composite Remaining Life as of December 31, 2017
Based Upon Broad Group/Remaining Life Procedure and Technique

Average Service Life: 48 **Survivor Curve:** O1

Year (1)	Original Cost (2)	Avg. Service Life (3)	Avg. Annual Accrual (4)	Avg. Remaining Life (5)	Future Annual Accruals (6)
1960	470,112.00	48.00	9,793.74	19.25	188,561.19
1963	9,079,517.00	48.00	189,151.49	20.75	3,925,464.44
1964	2,125,466.00	48.00	44,279.34	21.25	941,066.25
1965	1,906,286.00	48.00	39,713.22	21.75	863,876.54
1966	2,350,962.00	48.00	48,977.05	22.25	1,089,876.88
1967	2,754,166.00	48.00	57,376.91	22.75	1,305,482.20
1968	3,662,782.00	48.00	76,305.89	23.25	1,774,317.04
1969	3,725,640.00	48.00	77,615.40	23.75	1,843,570.35
1970	4,511,111.00	48.00	93,978.94	24.25	2,279,231.34
1971	5,245,671.00	48.00	109,281.86	24.75	2,705,001.85
1972	5,999,130.00	48.00	124,978.49	25.25	3,156,016.33
1973	6,123,700.00	48.00	127,573.63	25.75	3,285,330.27
1974	7,329,855.00	48.00	152,701.18	26.25	4,008,769.31
1975	4,308,278.00	48.00	89,753.36	26.75	2,401,112.80
1976	6,882,121.00	48.00	143,373.64	27.25	3,907,261.24
1977	7,243,768.00	48.00	150,907.75	27.75	4,188,030.27
1978	5,491,316.00	48.00	114,399.32	28.25	3,232,034.21
1979	6,789,513.00	48.00	141,444.36	28.75	4,066,833.25
1980	6,697,292.00	48.00	139,523.14	29.25	4,081,350.46
1981	7,530,255.00	48.00	156,876.07	29.75	4,667,393.15
1982	7,603,825.00	48.00	158,408.74	30.25	4,792,191.24
1983	6,316,152.00	48.00	131,582.94	30.75	4,046,442.68
1984	7,793,711.00	48.00	162,364.59	31.25	5,074,217.92
1985	9,471,207.00	48.00	197,311.47	31.75	6,265,026.92
1986	10,092,157.00	48.00	210,247.58	32.25	6,780,891.44
1987	12,882,363.00	48.00	268,375.30	32.75	8,789,804.93
1988	14,490,304.00	48.00	301,873.17	33.25	10,037,851.35

MEC
Electric Division
365.00 Overhead Conductors and Devices

Original Cost Of Utility Plant In Service
And Development Of Composite Remaining Life as of December 31, 2017
Based Upon Broad Group/Remaining Life Procedure and Technique

Average Service Life: 48 **Survivor Curve:** O1

Year (1)	Original Cost (2)	Avg. Service Life (3)	Avg. Annual Accrual (4)	Avg. Remaining Life (5)	Future Annual Accruals (6)
1989	14,935,976.00	48.00	311,157.75	33.75	10,502,150.62
1990	22,097,493.00	48.00	460,351.98	34.25	15,767,896.24
1991	33,922,241.00	48.00	706,694.24	34.75	24,558,897.16
1992	26,106,598.00	48.00	543,872.75	35.25	19,172,479.87
1993	20,162,132.00	48.00	420,033.05	35.75	15,016,917.15
1994	13,182,624.00	48.00	274,630.57	36.25	9,955,830.99
1995	21,873,422.00	48.00	455,683.96	36.75	16,747,159.73
1996	12,613,225.00	48.00	262,768.41	37.25	9,788,563.84
1997	14,679,809.00	48.00	305,821.08	37.75	11,545,250.69
1998	12,082,574.00	48.00	251,713.48	38.25	9,628,451.15
1999	10,368,335.00	48.00	216,001.14	38.75	8,370,393.57
2000	14,298,007.00	48.00	297,867.09	39.25	11,691,758.44
2001	12,481,058.00	48.00	260,015.01	39.75	10,336,005.55
2002	11,870,155.00	48.00	247,288.21	40.25	9,953,734.55
2003	20,618,005.00	48.00	429,530.15	40.75	17,504,013.08
2004	13,748,541.00	48.00	286,420.19	41.25	11,815,267.31
2005	21,089,958.00	48.00	439,362.24	41.75	18,344,032.21
2006	29,639,604.00	48.00	617,475.05	42.25	26,089,232.26
2007	25,400,120.00	48.00	529,154.85	42.75	22,622,142.21
2008	31,195,360.00	48.00	649,885.75	43.25	28,108,496.63
2009	33,758,831.00	48.00	703,289.95	43.75	30,769,936.52
2010	30,614,759.00	48.00	637,790.23	44.25	28,223,115.89
2011	27,905,870.00	48.00	581,356.56	44.75	26,016,521.11
2012	20,750,599.00	48.00	432,292.45	45.25	19,561,831.68
2013	22,954,070.00	48.00	478,196.86	45.75	21,878,159.53
2014	37,633,593.00	48.00	784,011.98	46.25	36,261,614.00
2015	55,042,455.00	48.00	1,146,686.79	46.75	53,609,141.80

MEC

Electric Division

365.00 Overhead Conductors and Devices

Original Cost Of Utility Plant In Service

And Development Of Composite Remaining Life as of December 31, 2017

Based Upon Broad Group/Remaining Life Procedure and Technique

Average Service Life: 48 *Survivor Curve:* O1

Year (1)	Original Cost (2)	Avg. Service Life (3)	Avg. Annual Accrual (4)	Avg. Remaining Life (5)	Future Annual Accruals (6)
2016	32,604,777.00	48.00	679,247.81	47.25	32,095,358.64
2017	41,970,680.00	48.00	874,365.51	47.75	41,752,099.39
Total	854,477,531.00	48.00	17,801,133.67	39.18	697,383,457.62

Composite Average Remaining Life ... 39.18 Years

MEC
Electric Division
366.00 Underground Conduit

Original Cost Of Utility Plant In Service
And Development Of Composite Remaining Life as of December 31, 2017
Based Upon Broad Group/Remaining Life Procedure and Technique

Average Service Life: 55 **Survivor Curve:** R4

Year (1)	Original Cost (2)	Avg. Service Life (3)	Avg. Annual Accrual (4)	Avg. Remaining Life (5)	Future Annual Accruals (6)
1963	14,680,442.00	55.00	266,915.91	8.29	2,212,628.33
1964	406,020.00	55.00	7,382.15	8.78	64,847.88
1965	344,714.00	55.00	6,267.50	9.31	58,343.31
1966	421,875.00	55.00	7,670.42	9.86	75,622.62
1967	458,652.00	55.00	8,339.09	10.44	87,085.27
1968	709,826.00	55.00	12,905.87	11.05	142,646.06
1969	846,821.00	55.00	15,396.68	11.69	179,913.99
1970	625,737.00	55.00	11,376.98	12.34	140,356.39
1971	1,230,991.00	55.00	22,381.55	13.00	290,989.60
1972	2,686,784.00	55.00	48,850.40	13.68	668,451.33
1973	2,255,607.00	55.00	41,010.85	14.38	589,641.75
1974	1,571,327.00	55.00	28,569.45	15.08	430,938.99
1975	637,985.00	55.00	11,599.67	15.80	183,307.38
1976	2,497,901.00	55.00	45,416.18	16.53	750,946.42
1977	2,803,519.00	55.00	50,972.84	17.28	880,701.81
1978	1,940,197.00	55.00	35,276.15	18.04	636,311.93
1979	1,707,193.00	55.00	31,039.73	18.81	583,909.93
1980	1,639,728.00	55.00	29,813.10	19.60	584,302.82
1981	1,697,086.00	55.00	30,855.97	20.40	629,443.77
1982	2,673,879.00	55.00	48,615.76	21.21	1,031,171.94
1983	1,270,107.00	55.00	23,092.75	22.04	508,931.80
1984	1,404,080.00	55.00	25,528.61	22.88	584,070.54
1985	965,063.00	55.00	17,546.52	23.73	416,408.38
1986	1,456,993.00	55.00	26,490.66	24.60	651,565.37
1987	3,007,416.00	55.00	54,680.04	25.47	1,392,792.93
1988	1,793,867.00	55.00	32,615.62	26.36	859,638.09
1989	1,604,936.00	55.00	29,180.52	27.25	795,292.45

MEC
Electric Division
366.00 Underground Conduit

Original Cost Of Utility Plant In Service
And Development Of Composite Remaining Life as of December 31, 2017
Based Upon Broad Group/Remaining Life Procedure and Technique

Average Service Life: 55 **Survivor Curve:** R4

Year (1)	Original Cost (2)	Avg. Service Life (3)	Avg. Annual Accrual (4)	Avg. Remaining Life (5)	Future Annual Accruals (6)
1990	2,338,253.00	55.00	42,513.50	28.16	1,197,239.57
1991	5,436,489.00	55.00	98,844.80	29.08	2,874,171.03
1992	6,340,774.00	55.00	115,286.28	30.00	3,458,854.18
1993	5,545,395.00	55.00	100,824.90	30.93	3,118,880.32
1994	6,192,141.00	55.00	112,583.87	31.87	3,588,522.59
1995	8,944,359.00	55.00	162,623.97	32.82	5,337,556.97
1996	9,506,370.00	55.00	172,842.30	33.77	5,837,722.96
1997	10,501,461.00	55.00	190,934.79	34.73	6,631,899.04
1998	7,547,392.00	55.00	137,224.68	35.70	4,898,638.68
1999	9,869,969.00	55.00	179,453.16	36.67	6,579,851.46
2000	6,253,140.00	55.00	113,692.94	37.64	4,279,325.08
2001	5,291,756.00	55.00	96,213.31	38.62	3,715,391.75
2002	3,271,508.00	55.00	59,481.69	39.60	2,355,255.69
2003	5,265,924.00	55.00	95,743.64	40.58	3,885,211.74
2004	16,528,697.00	55.00	300,520.40	41.56	12,490,985.31
2005	3,086,023.00	55.00	56,109.25	42.55	2,387,588.12
2006	6,773,737.00	55.00	123,158.29	43.54	5,362,603.02
2007	4,150,240.00	55.00	75,458.57	44.53	3,360,463.08
2008	3,775,419.00	55.00	68,643.67	45.53	3,125,128.86
2009	1,442,960.00	55.00	26,235.52	46.52	1,220,502.33
2010	1,710,559.00	55.00	31,100.93	47.52	1,477,794.62
2011	15,628,641.00	55.00	284,155.82	48.51	13,785,034.15
2012	1,524,028.00	55.00	27,709.47	49.51	1,371,871.26
2013	1,673,882.00	55.00	30,434.08	50.51	1,537,121.25
2014	1,405,561.00	55.00	25,555.54	51.50	1,316,226.56
2015	1,744,348.00	55.00	31,715.27	52.50	1,665,143.42
2016	5,498,826.00	55.00	99,978.20	53.50	5,348,997.16

MEC
Electric Division
366.00 Underground Conduit

Original Cost Of Utility Plant In Service
And Development Of Composite Remaining Life as of December 31, 2017
Based Upon Broad Group/Remaining Life Procedure and Technique

***Average Service Life:* 55** ***Survivor Curve:* R4**

Year (1)	Original Cost (2)	Avg. Service Life (3)	Avg. Annual Accrual (4)	Avg. Remaining Life (5)	Future Annual Accruals (6)
2017	7,608,084.00	55.00	138,328.17	54.50	7,538,975.97
Total	218,194,682.00	55.00	3,967,157.97	34.07	135,177,217.23

Composite Average Remaining Life ... 34.07 Years

MEC
Electric Division
367.10 Underground Conductors and Devices

Original Cost Of Utility Plant In Service
And Development Of Composite Remaining Life as of December 31, 2017
Based Upon Broad Group/Remaining Life Procedure and Technique

Average Service Life: 53 **Survivor Curve:** L0

Year (1)	Original Cost (2)	Avg. Service Life (3)	Avg. Annual Accrual (4)	Avg. Remaining Life (5)	Future Annual Accruals (6)
1963	10,589,341.00	53.00	199,805.12	30.00	5,994,045.55
1964	1,015,207.00	53.00	19,155.45	30.29	580,266.22
1965	446,831.00	53.00	8,431.04	30.59	257,890.53
1966	581,600.00	53.00	10,973.93	30.89	338,948.62
1967	606,457.00	53.00	11,442.94	31.19	356,882.09
1968	667,228.00	53.00	12,589.60	31.49	396,471.87
1969	702,163.00	53.00	13,248.77	31.80	421,306.28
1970	553,417.00	53.00	10,442.16	32.11	335,288.93
1971	863,421.00	53.00	16,291.47	32.42	528,195.55
1972	3,109,532.00	53.00	58,672.24	32.74	1,920,752.29
1973	2,011,311.00	53.00	37,950.45	33.06	1,254,465.13
1974	1,801,356.00	53.00	33,988.91	33.38	1,134,438.80
1975	1,005,552.00	53.00	18,973.27	33.70	639,421.37
1976	2,298,719.00	53.00	43,373.41	34.03	1,475,940.05
1977	1,817,671.00	53.00	34,296.75	34.36	1,178,412.97
1978	2,286,554.00	53.00	43,143.87	34.69	1,496,813.12
1979	2,130,269.00	53.00	40,195.01	35.03	1,408,045.90
1980	2,419,436.00	53.00	45,651.16	35.37	1,614,702.14
1981	2,534,490.00	53.00	47,822.06	35.71	1,707,908.39
1982	2,355,437.00	53.00	44,443.59	36.06	1,602,658.60
1983	2,226,167.00	53.00	42,004.46	36.41	1,529,405.57
1984	2,693,326.00	53.00	50,819.06	36.76	1,868,310.69
1985	2,855,214.00	53.00	53,873.64	37.12	1,999,834.69
1986	3,296,299.00	53.00	62,196.26	37.48	2,331,188.20
1987	4,503,030.00	53.00	84,965.48	37.85	3,215,528.02
1988	2,870,135.00	53.00	54,155.18	38.21	2,069,401.63
1989	5,199,795.00	53.00	98,112.40	38.58	3,785,505.60

MEC
Electric Division
367.10 Underground Conductors and Devices

Original Cost Of Utility Plant In Service
And Development Of Composite Remaining Life as of December 31, 2017
Based Upon Broad Group/Remaining Life Procedure and Technique

Average Service Life: 53 **Survivor Curve:** L0

Year (1)	Original Cost (2)	Avg. Service Life (3)	Avg. Annual Accrual (4)	Avg. Remaining Life (5)	Future Annual Accruals (6)
1990	7,066,543.00	53.00	133,335.16	38.96	5,194,458.53
1991	10,764,630.00	53.00	203,112.56	39.34	7,989,662.83
1992	9,713,957.00	53.00	183,287.92	39.72	7,279,852.37
1993	11,817,215.00	53.00	222,973.27	40.10	8,942,177.95
1994	8,811,620.00	53.00	166,262.17	40.50	6,732,806.57
1995	13,229,856.00	53.00	249,627.71	40.89	10,207,597.80
1996	19,979,128.00	53.00	376,976.43	41.29	15,566,432.27
1997	14,900,718.00	53.00	281,154.39	41.70	11,724,501.10
1998	10,631,523.00	53.00	200,601.03	42.12	8,448,655.98
1999	13,760,848.00	53.00	259,646.74	42.54	11,045,290.09
2000	10,022,210.00	53.00	189,104.20	42.97	8,125,954.15
2001	11,666,761.00	53.00	220,134.43	43.41	9,556,168.11
2002	13,936,492.00	53.00	262,960.88	43.86	11,533,411.22
2003	24,015,153.00	53.00	453,130.22	44.32	20,082,298.30
2004	14,902,499.00	53.00	281,187.99	44.79	12,594,148.22
2005	24,569,437.00	53.00	463,588.74	45.27	20,986,351.36
2006	24,410,100.00	53.00	460,582.29	45.76	21,077,977.82
2007	28,315,895.00	53.00	534,278.83	46.27	24,722,035.77
2008	25,232,714.00	53.00	476,103.79	46.79	22,279,084.92
2009	23,520,997.00	53.00	443,806.23	47.33	21,006,927.90
2010	24,071,885.00	53.00	454,200.67	47.89	21,751,796.88
2011	36,071,753.00	53.00	680,620.34	48.47	32,987,440.11
2012	33,675,260.00	53.00	635,402.08	49.07	31,176,218.82
2013	43,342,354.00	53.00	817,805.76	49.69	40,636,128.68
2014	35,476,654.00	53.00	669,391.70	50.34	33,696,197.81
2015	47,159,007.00	53.00	889,820.33	51.03	45,405,465.09
2016	64,204,471.00	53.00	1,211,442.89	51.76	62,706,357.73

MEC
Electric Division
367.10 Underground Conductors and Devices
Original Cost Of Utility Plant In Service
And Development Of Composite Remaining Life as of December 31, 2017
Based Upon Broad Group/Remaining Life Procedure and Technique

Average Service Life: 53 *Survivor Curve:* L0

Year (1)	Original Cost (2)	Avg. Service Life (3)	Avg. Annual Accrual (4)	Avg. Remaining Life (5)	Future Annual Accruals (6)
2017	66,877,716.00	53.00	1,261,883.05	52.56	66,323,670.27
Total	735,587,354.00	53.00	13,879,439.46	46.20	641,221,097.42

Composite Average Remaining Life ... 46.20 Years

MEC
Electric Division
368.20 Line Transformers - Bare Cost

Original Cost Of Utility Plant In Service
And Development Of Composite Remaining Life as of December 31, 2017
Based Upon Broad Group/Remaining Life Procedure and Technique

Average Service Life: 44 *Survivor Curve:* R5

Year (1)	Original Cost (2)	Avg. Service Life (3)	Avg. Annual Accrual (4)	Avg. Remaining Life (5)	Future Annual Accruals (6)
1963	299,953.00	44.00	6,817.27	1.45	9,867.23
1964	42,955.00	44.00	976.27	1.68	1,637.51
1965	15,241.00	44.00	346.39	1.85	641.96
1966	12,049.00	44.00	273.85	2.05	561.96
1967	39,570.00	44.00	899.34	2.26	2,034.64
1968	30,023.00	44.00	682.36	2.50	1,703.15
1969	19,556.00	44.00	444.46	2.75	1,221.38
1970	46,961.00	44.00	1,067.32	3.05	3,252.88
1971	79,872.00	44.00	1,815.31	3.38	6,138.66
1972	69,814.00	44.00	1,586.72	3.75	5,950.81
1973	107,317.00	44.00	2,439.08	4.16	10,142.40
1974	591,647.00	44.00	13,446.83	4.60	61,915.99
1975	1,285,137.00	44.00	29,208.33	5.09	148,671.60
1976	921,406.00	44.00	20,941.53	5.62	117,726.05
1977	1,839,967.00	44.00	41,818.39	6.19	258,882.37
1978	2,248,379.00	44.00	51,100.70	6.80	347,513.10
1979	1,962,522.00	44.00	44,603.80	7.46	332,560.11
1980	3,908,516.00	44.00	88,831.95	8.15	723,737.21
1981	4,437,221.00	44.00	100,848.25	8.88	895,068.75
1982	3,872,453.00	44.00	88,012.32	9.64	848,245.62
1983	5,265,786.00	44.00	119,679.70	10.44	1,248,992.22
1984	7,081,706.00	44.00	160,951.56	11.26	1,812,209.63
1985	8,231,360.00	44.00	187,080.66	12.11	2,265,085.66
1986	12,162,588.00	44.00	276,428.80	12.98	3,587,513.17
1987	7,856,804.00	44.00	178,567.83	13.87	2,477,075.71
1988	9,560,675.00	44.00	217,293.06	14.78	3,211,880.26
1989	13,085,017.00	44.00	297,393.58	15.71	4,671,172.14

MEC

Electric Division

368.20 Line Transformers - Bare Cost

Original Cost Of Utility Plant In Service

And Development Of Composite Remaining Life as of December 31, 2017

Based Upon Broad Group/Remaining Life Procedure and Technique

Average Service Life: 44 **Survivor Curve:** R5

Year (1)	Original Cost (2)	Avg. Service Life (3)	Avg. Annual Accrual (4)	Avg. Remaining Life (5)	Future Annual Accruals (6)
1990	4,264,727.00	44.00	96,927.84	16.65	1,613,605.29
1991	3,395,023.00	44.00	77,161.39	17.60	1,358,288.05
1992	5,087,747.00	44.00	115,633.27	18.57	2,147,131.35
1993	5,925,406.00	44.00	134,671.41	19.54	2,631,899.75
1994	4,309,627.00	44.00	97,948.32	20.53	2,010,509.26
1995	4,754,606.00	44.00	108,061.71	21.51	2,324,899.76
1996	6,304,676.00	44.00	143,291.38	22.51	3,225,088.02
1997	6,567,402.00	44.00	149,262.56	23.50	3,508,101.07
1998	4,907,001.00	44.00	111,525.31	24.50	2,732,456.25
1999	7,530,107.00	44.00	171,142.72	25.50	4,364,080.66
2000	6,731,424.00	44.00	152,990.42	26.50	4,054,121.59
2001	5,883,401.00	44.00	133,716.73	27.50	3,677,081.72
2002	5,833,381.00	44.00	132,579.88	28.50	3,778,393.85
2003	5,462,988.00	44.00	124,161.67	29.50	3,662,644.25
2004	4,030,491.00	44.00	91,604.17	30.50	2,793,834.69
2005	10,472,652.00	44.00	238,020.28	31.50	7,497,398.46
2006	10,877,936.00	44.00	247,231.49	32.50	8,034,773.82
2007	14,305,042.00	44.00	325,122.06	33.50	10,891,260.42
2008	11,862,136.00	44.00	269,600.19	34.50	9,300,934.20
2009	11,437,322.00	44.00	259,945.10	35.50	9,227,788.61
2010	9,461,911.00	44.00	215,048.37	36.50	7,849,048.23
2011	11,407,644.00	44.00	259,270.59	37.50	9,722,385.17
2012	11,300,860.00	44.00	256,843.62	38.50	9,888,220.07
2013	18,472,114.00	44.00	419,830.41	39.50	16,582,877.15
2014	12,706,087.00	44.00	288,781.33	40.50	11,695,352.33
2015	11,313,428.00	44.00	257,129.27	41.50	10,670,604.83
2016	9,014,771.00	44.00	204,885.86	42.50	8,707,442.21

MEC

Electric Division

368.20 Line Transformers - Bare Cost

Original Cost Of Utility Plant In Service

And Development Of Composite Remaining Life as of December 31, 2017

Based Upon Broad Group/Remaining Life Procedure and Technique

Average Service Life: 44 *Survivor Curve:* R5

Year (1)	Original Cost (2)	Avg. Service Life (3)	Avg. Annual Accrual (4)	Avg. Remaining Life (5)	Future Annual Accruals (6)
2017	10,274,769.00	44.00	233,522.84	43.50	10,158,007.58
Total	318,969,174.00	44.00	7,249,465.85	27.20	197,159,630.84

Composite Average Remaining Life ... 27.20 Years

COMMONWEALTH OF MASSACHUSETTS
DEPARTMENT OF PUBLIC UTILITIES

Massachusetts Electric Company and Nantucket Electric Company Petition for a General Increase in Electric Rates	)	**D.P.U. 18-150**

<u>AFFIDAVIT OF DAVID J. GARRETT</u>

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 22nd day of March 2019.

David J. Garrett