GAS UTILITIES DOCKET NO. 10928

STATEMENT OF INTENT OF TEXAS GAS SERVICE COMPANY, A DIVISION OF ONE GAS, INC., TO CHANGE GAS UTILITY RATES WITHIN THE UNINCORPORATED AREAS OF THE CENTRAL TEXAS SERVICE AREA AND THE GULF COAST SERVICE AREA	**BEFORE THE** **RAILROAD COMMISSION** **OF TEXAS**

Direct Testimony of

David J. Garrett

On Behalf of

Gulf Cost Service Area Steering Committee

March 24, 2020

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I. <u>INTRODUCTION</u>

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 DJG-1.

Q. On whose behalf are you testifying in this proceeding?

A. I am testifying on behalf of the Gulf Coast Service Area Steering Committee ("GCSC"), which includes the Cities of Beaumont, Groves, Nederland, Port Arthur, and Port Neches.

Q. Describe the purpose and scope of your testimony in this proceeding.

A. I am responding to the depreciation study conducted by Foster Associates Consultants, LLC and sponsored in the Direct Testimony of Dr. Ronald E. White for Texas Gas Service Company ("TGS" or the "Company).

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. The table below summarizes the proposed depreciation rates and accruals by Company plant function and division.[2]

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[2] *See also* Exhibit DJG-2. The detailed calculations supporting the summary accrual adjustments can be found in Exhibit DJG-4 and Exhibit DJG-5.

Figure 1:
Summary Accrual Adjustment

Plant Function	Original Cost 12/31/2018	Company Accrual	GCSC Accrual	GCSC Adjustment
		CENTRAL TEXAS SERVICE AREA		
Transmission	7,211,812	127,302	127,311	9
Distribution	511,130,605	12,673,628	11,842,310	(831,318)
General	39,045,417	2,603,243	2,603,357	114
Total	557,387,834	15,404,173	14,572,978	(831,195)
		GULF COAST SERVICE AREA		
Transmission	-	-	-	-
Distribution	89,362,542	2,373,561	2,212,789	(160,772)
General	9,419,964	561,411	561,378	(34)
Total	98,782,506	2,934,972	2,774,167	(160,805)
Total Studied	$ 656,170,340	$ 18,339,145	$ 17,347,145	**$ (992,000)**

As shown in this table, my proposed depreciation rates would result in an adjustment reducing the Company's proposed depreciation accrual by $992,000. The original cost and accrual amounts correspond to plant balances as of the study date, December 31, 2018.

Q. Summarize the primary factors driving GCSC's adjustment.

A. I recommend adjustments to the proposed service life and net salvage parameters for four of the Company's distribution accounts in the Central Texas and Gulf Coast service areas. In my opinion, the service lives proposed by Dr. White for these accounts are too short given the average lives indicated by the Company's historical data, which result in unreasonably high depreciation rates. The table below summarizes these service life adjustments and their corresponding remaining lives and depreciation rates.

Figure 2:
Summary Depreciation Parameter Comparison

		Company Position				GCSC Position			
		Iowa Curve		Rem.	Depr.	Iowa Curve		Rem.	Depr.
Account No.	Description	Type	AL	Life	Rate	Type	AL	Life	Rate
Central Texas Service Area									
376.00	Mains	R1.5	65	53.9	1.87%	R2	71	58.6	1.72%
378.00	M&R Station Equip. - General	R0.5	55	48.1	2.10%	R1	60	51.7	1.95%
380.00	Services	R2	55	42.5	2.51%	R1.5	60	48.2	2.21%
385.00	Industrial M&R Station Equip.	R1	55	42.8	2.14%	R2.5	65	48.9	1.87%
Gulf Coast Service Area									
376.00	Mains	R1.5	65	49.6	1.98%	R2	71	53.7	1.83%
378.00	M&R Station Equip. - General	R0.5	55	47.5	2.22%	R1	60	51.1	2.06%
380.00	Services	R2	55	40.8	2.71%	R1.5	60	46.5	2.38%
385.00	Industrial M&R Station Equip.	R1	55	42.0	2.17%	R2.5	65	48.0	1.90%

I discuss my specific adjustments to these accounts 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 the most economically efficient decisions.[4] 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

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

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 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."[5] 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. Moreover, the *Lindheimer* Court found:

> [T]he company has the burden of making a convincing showing that the amounts it has charged to operating expenses for depreciation have not been excessive. That burden is not sustained by proof that its general accounting system has been correct. The calculations are mathematical, but the predictions underlying them are essentially matters of opinion.[6]

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

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

[6] *Id*. at 169 (emphasis added).

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 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]

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

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

[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.

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 in order to conduct my own independent analysis of the same data. The depreciation rates proposed by Dr. White were developed based on depreciable property recorded as of December 31, 2018. I used the same plant balances to develop my proposed depreciation rates and applied those rates to the Company's updated plant balances to arrive at my final adjustment to the Company's proposed depreciation rates.[11] The depreciation system I used to develop my proposed depreciation rates is discussed in more detail below.

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 <u>method</u> of allocation; 2) a <u>procedure</u> for applying the method of allocation; 3) a <u>technique</u> of applying the depreciation rate; and 4) a <u>model</u> for analyzing the characteristics of vintage property groups.[12] In this case, I used the straight line method, the average life procedure, the

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[11] *See* Exhibit DJG-4 for a detailed comparison between rates and accrual amounts as of the study date.

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

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.

V. SERVICE LIFE ESTIMATES

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.[13] 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

[13] 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).

ultimate average life of the group.[14] 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."[15] A more detailed explanation of how the Iowa curves are used in the actuarial analysis of depreciable property is set forth in Appendix C.

Q. Did Dr. White provide observed life tables as part of his depreciation study?

A. No. Typically, depreciation analysts provide OLTs as part of their depreciation studies so that the historical retirement patterns for each account can be observed and analyzed by interested parties. As further shown in the graphs below, OLTs are a critical part of the visual curve fitting process, and more importantly, help the Commission in making informed decisions about the most appropriate service life for each account. Instead of simply providing the OLTs as is typically done in depreciation study, Dr. White states that the OLTs "can be created from the data provided. . . ."[16] I did create OLTs from the data Dr. White is referring to, and those OLTs are the basis for the visual Iowa curve graphs below. What the graphs will show is that the Iowa curves selected by Dr. White for the accounts at issue are not consistent with the historical data and skew his results given the historical data provided as part of the depreciation study.

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

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

[16] Response to GCSC RFI 1-3.

Q. Describe your approach in estimating the service lives of mass property.

A. 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, however, 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. For the adjusted accounts discussed below, there was sufficient historical data provided such that mathematical curve fitting techniques were helpful in selecting the most reasonable Iowa curve and average life. Each one of the Iowa curves I selected provides a better mathematical fit to the historical data than the Iowa curve proposed by the Company.

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."[17] 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

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

OLT curve, but also conducted further analyses that involved fitting Iowa curves to the most significant part of the OLT curve for certain accounts. In other words, to verify the accuracy of my curve selection, I narrowed the focus of my additional calculation to consider the top 99% 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. The specific adjustments for each account are discussed in order below.[18]

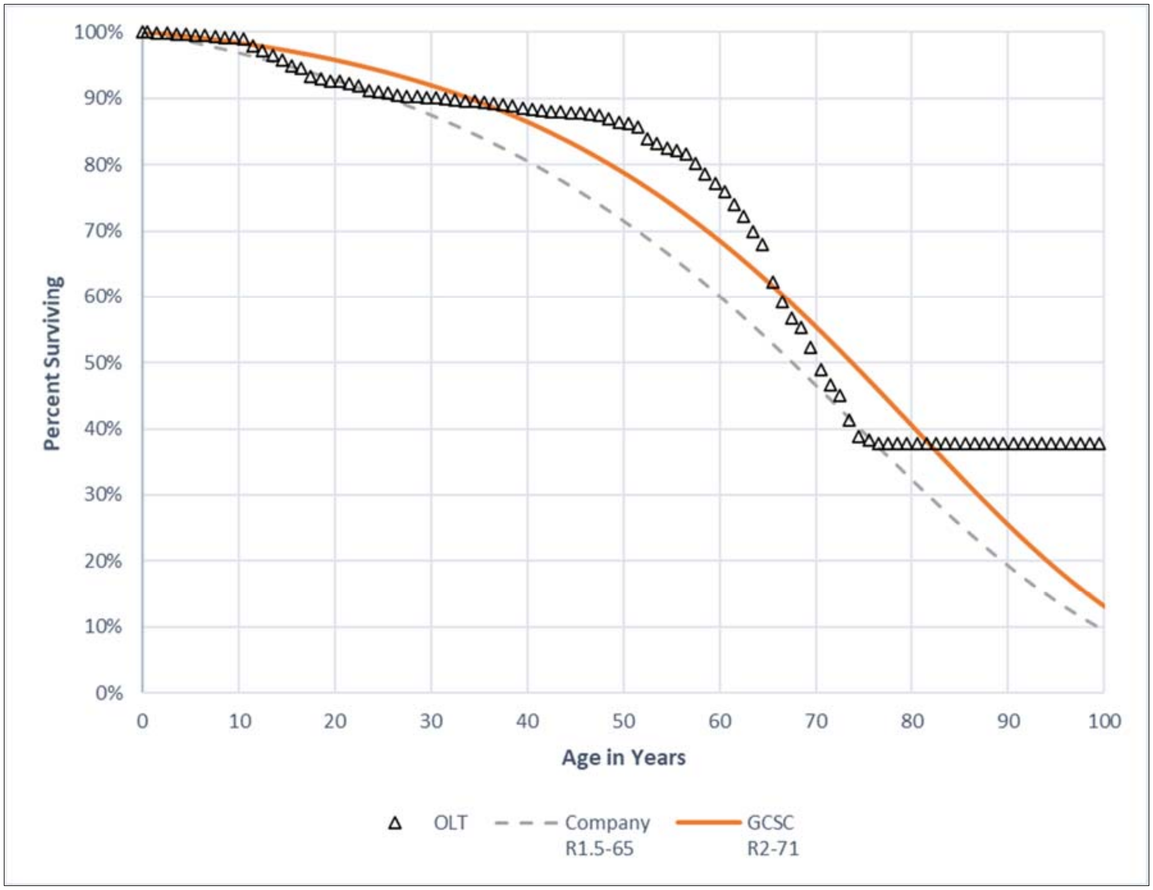
1. Account 376 – Mains

Q. Describe your service life estimate for this account and compare it with the Company's estimate.

A. The OLT curve for Account 376 (shown in black triangles in the graph below) displays the historical retirement pattern for the assets in this account. Dr. White selected the R1.5-65 Iowa curve for this account, and I selected the R2-71 Iowa curve. Both curves are shown in the graph below along with the OLT curve.

[18] Other Iowa curve graphs can be found in Exhibit DJG-10, and the corresponding remaining life calculations based on my Iowa curve selections can be found in Exhibit DJG-11.

Figure 3:
Account 376 – Mains



The data information presented in this graph highlights the importance of visual Iowa curve fitting and the usefulness of OLT curves and graphs in the decision-making process for selecting the best Iowa curve. Without a graph like this, it would be impractical to determine which Iowa curve might provide a better fit to the OLT curve. With all of the information displayed, however, it is clear that the R1.5-65 curve selected by Dr. White does not provide as good a fit as the R2-71 curve I selected. Specifically, Dr. White's curve appears to ignore large, relevant portions of historical data through age intervals 40-65. The R2-71 curve, on the other hand, gives more statistical credit to this relevant data.

Q. Does the Iowa curve you selected provide a better mathematical fit to OLT curve for this account?

A. Yes. While visual curve fitting techniques can aid in narrowing the reasonable range of potential Iowa curves for a particular account, as well as identifying the most statistically relevant portions of the curve, mathematical curve fitting can confirm the goodness of fit for a particular curve and can also help in deciding between two or more closely-fitting Iowa curves. The best mathematically-fitted curve is the one that minimizes the distance between the OLT curve and the Iowa curve, thus providing the closest fit. The "distance" between the curves is calculated using the "sum-of-squared differences" ("SSD") technique. For this account, the total SSD, or "distance" between Dr. White's curve and the OLT curve is 1.3894, while the total SSD between the R2-71 curve and the OLT curve is only 0.6336. Thus, the R2-71 curve I selected provides a better mathematical fit to the OLT curve, and in my opinion results in a more objectively reasonable service life and depreciation rate estimate for this account.[19]

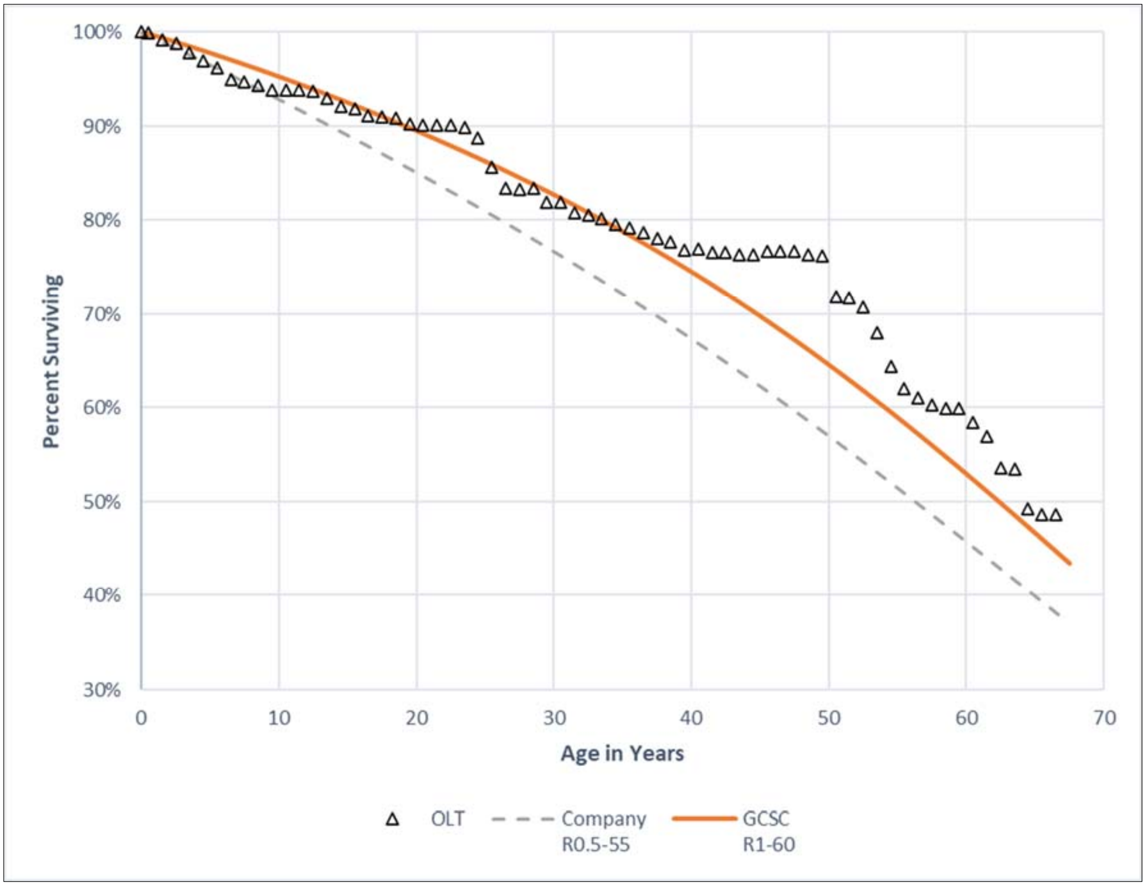
2. Account 378 – Measuring and Regulating Station Equipment

Q. Describe your service life estimate for this account and compare it with the Company's estimate.

A. The OLT curve for this account follows a typical utility survivor curve pattern through the majority of the pertinent age intervals. Dr. White selected the R0.5-55 curve for this account, and I selected the R1-60 curve. The following graph shows both Iowa curves with the OLT curve.

[19] Exhibit DJG-6.

Figure 4:
Account 378 – Measuring and Regulating Station Equipment



As clearly shown in this graph, the Iowa curve selected by Dr. White provides a very poor fit to the historical retirement pattern in this account. Specifically, the Iowa curve Dr. White selected is too short, which results in an unreasonably high depreciation rate and expense. The main purpose of Iowa curve fitting is to use past information to predict future information; or specifically, using a historical retirement pattern to predict remaining life. This task cannot be accomplished in the historical information is essentially ignored, which appears to be the case in Dr. White's Iowa curve selection for this account.

Q. Does the Iowa curve you selected provide a better mathematical fit to OLT curve for this account?

A. Yes. While it is visually clear that the R1-60 curve I selected provides the better fit to the observed data for this account, we can confirm the results mathematically. Specifically, the total SSD for the Iowa curve Dr. White selected is 0.5875, and the SSD for the R1-60 Iowa curve I selected is only 0.1164, which means it provides the better mathematical fit.[20]

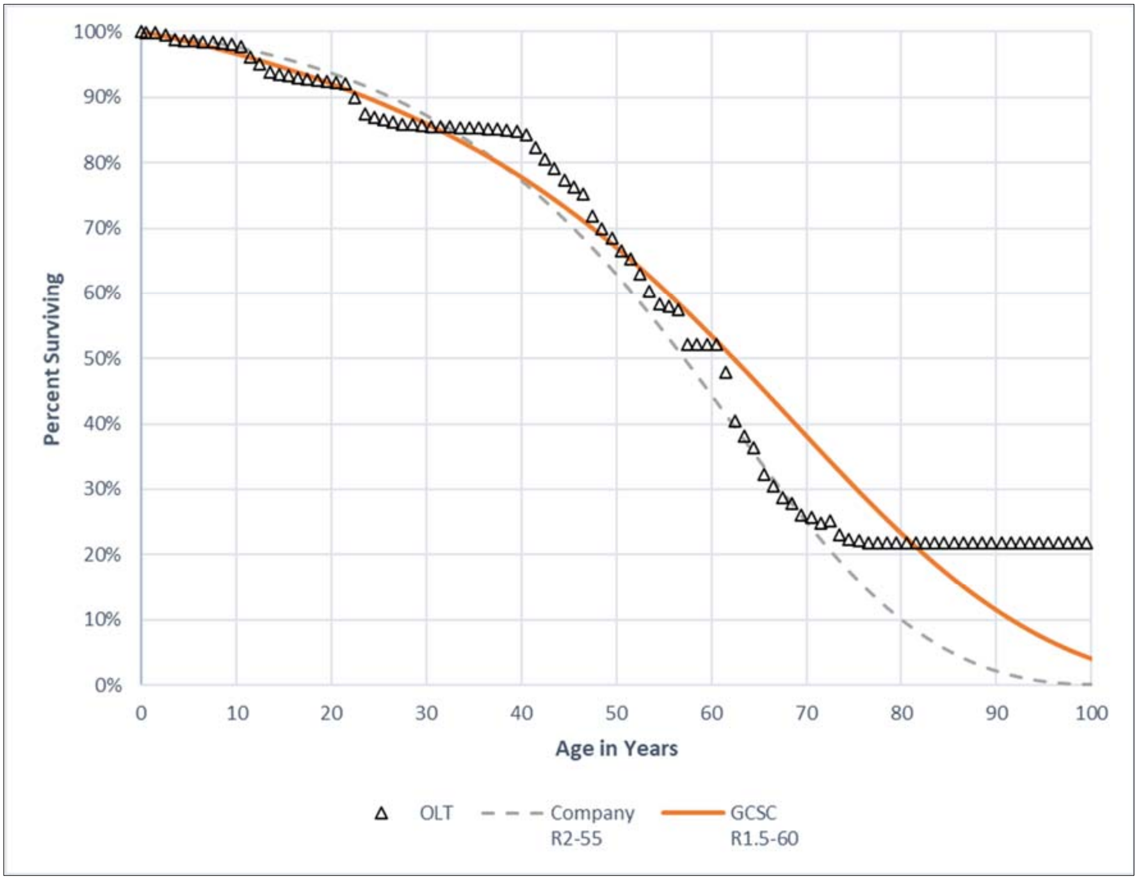
3. <u>Account 380 – Services</u>

Q. Describe your service life estimate for this account and compare it with the Company's estimate.

A. Dr. White selected the R2-55 curve for this account, and I selected the R1.5-60 curve. Both curves are shown in the graph below with the OLT curve.

[20] Exhibit DJG-7.

Figure 5:
Account 380 – Services



As shown the graph, both Iowa curves follow the general pattern of the OLT curve. We can use mathematical curve fitting to determine which curve provides the better fit to the observed data.

Q. Does the Iowa curve you selected provide a better mathematical fit to OLT curve for this account?

A. Yes. Specifically, the total SSD for the Iowa curve Dr. White selected is 1.1239, and the SSD for the R1.5-60 curve I selected is 0.6612, which means that it provides the better mathematical fit to the OLT curve.[21]

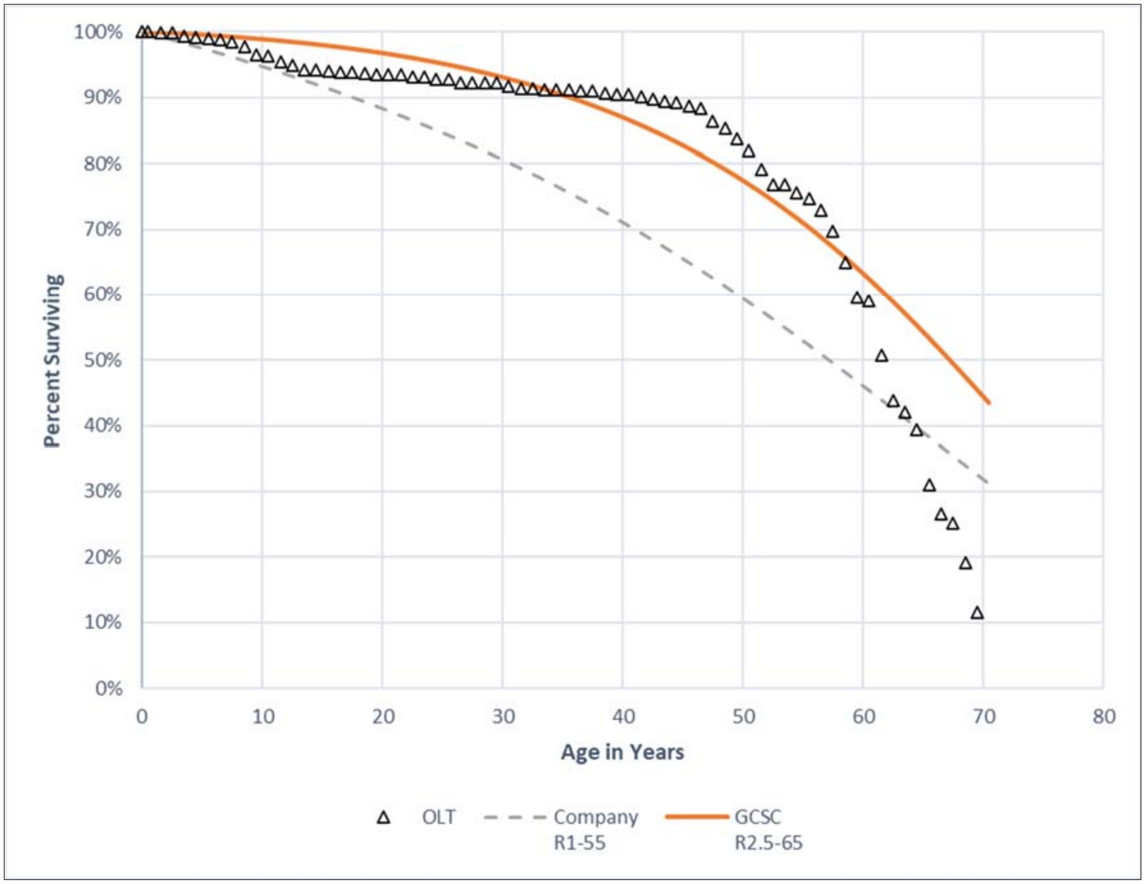
4. Account 385 – Industrial Measuring and Regulating Station Equipment

Q. Describe your service life estimate for this account and compare it with the Company's estimate.

A. Dr. White selected the R1-55 curve for this account, and I selected the R2.5-65 curve. Both curves are shown in the graph below with the OLT curve.

[21] Exhibit DJG-8.

Figure 6:
Account 385 – Industrial Measuring and Regulating Station Equipment



As shown the graph, the Iowa curve selected by Dr. White provides a poor fit to the Company's historical data. This account presents an example of why it is important to visually check the Iowa curve selecting with the historical retirement pattern produced by the observed life table. Again, Dr. White did not provide the OLTs as part of his depreciation study. Here, the Iowa curve Dr. White selected does not even appear to represent an actual attempt to match the historical retirement pattern. As a result of this unreasonably short Iowa curve selection, the corresponding depreciation rate proposed by Dr. White for this account is unreasonably high.

Q. Does the Iowa curve you selected provide a better mathematical fit to OLT curve for this account?

A. Yes. The SSD for the Iowa curve Dr. White selected is 1.3789, and the SSD for the Iowa curve I selected is 0.5172, and results in a more reasonable depreciation rate for this account.[22]

VI. CONCLUSION AND RECOMMENDATION

Q. Summarize the key points of your testimony.

A. The Company bears the burden to make a convincing showing that its proposed service lives and net salvage rates are not excessive. For several accounts the Company did not meet that burden in my opinion. As shown in the graphs above, several of Dr. White's Iowa curve selections provide very poor fits to the actual retirement patterns in those accounts. This conclusion can be easily reached by actually examining the observed life tables and OLT curves for each account. By selecting unreasonably short Iowa curves for these accounts, it results in depreciation rate proposals that are unreasonably high. In light of the evidence provided in my testimony, my Iowa curve selections are corresponding depreciation rate adjustments are reasonable. I recommend the Commission adopt the depreciation rates presented in Exhibit DJG-3 for the adjusted accounts.

Q. Does this conclude your testimony?

A. Yes.

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[22] *See* Exhibit DJG-9.

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.[23] 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.[24] The figure below illustrates the basic concept of a depreciation system and includes some of the available parameters.[25]

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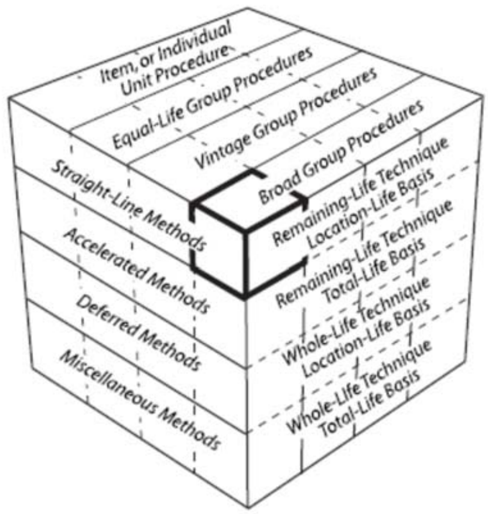
[23] Wolf *supra* n. 7, at 69-70.

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

[25] 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 7:
The Depreciation System Cube



1. <u>Allocation Methods</u>

The "method" refers to the pattern of depreciation in relation to the accounting periods. The method most commonly used in the regulatory context is the "straight-line method" – a type of age-life method in which the depreciable cost of plant is charged in equal amounts to each accounting period over the service life of plant.[26] 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.[27] The basic formula for the straight-line method is as follows:[28]

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

[27] *Id*.

[28] *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.[29] 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:[30]

Equation 2:
Straight-Line Rate

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

2. Grouping Procedures

The "procedure" refers to the way the allocation method is applied through subdividing the total property into groups.[31] While single units may be analyzed for depreciation, a group plan of depreciation is particularly adaptable to utility property. Employing a grouping procedure allows for a composite application of depreciation rates to groups of similar property, rather than

[29] *Id*. at 57.

[30] *Id*. at 56.

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

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.[32] 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.[33]

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.[34] 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.[35] Under the equal life procedure the property is divided into subgroups that each has a common life.[36]

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

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[32] *Id*. at 74.

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

[34] *See* Wolf *supr*a n. 7, at 74-75.

[35] *Id*. at 75.

[36] *Id*.

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.[37]

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.[38] 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 <u>current</u> depreciation parameters.[39] An imbalance exists when the actual accumulated depreciation account does not equal the CAD. The choice of application technique will affect how the imbalance is dealt with.

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

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

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

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

in the annual accrual.[40] 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:[41]

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.[42]

4. Analysis Model

The fourth parameter of a depreciation system, the "model," relates to the way of viewing the life and salvage characteristics of the vintage groups that have been combined to form a continuous property group for depreciation purposes.[43] A continuous property group is created when vintage groups are combined to form a common group. Over time, the characteristics of the property may change, but the continuous property group will continue. The two analysis models

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[40] 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.").

[41] *Id*. at 64.

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

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

used among practitioners, the “broad group” and the “vintage group,” are two ways of viewing the life and salvage characteristics of the vintage groups that have been combined to 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.

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.[44] 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.[45] A frequency curve is a graph of the frequency of retirements as a function of age. Several types of survivor and frequency curves are illustrated in the figures below.

1. Development

The survivor curves used by analysts today were developed over several decades from extensive analysis of utility and industrial property. In 1931, Edwin Kurtz and Robley Winfrey used extensive data from a range of 65 industrial property groups to create survivor curves representing the life characteristics of each group of property.[46] They generalized the 65 curves

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

[45] *Id*. at 23.

[46] *Id*. at 34.

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.[47] 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."[48] 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.[49] 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 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

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[47] *Id.*

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

[49] 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).

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:[50]

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.[51]

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

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

[51] *Id*.

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.

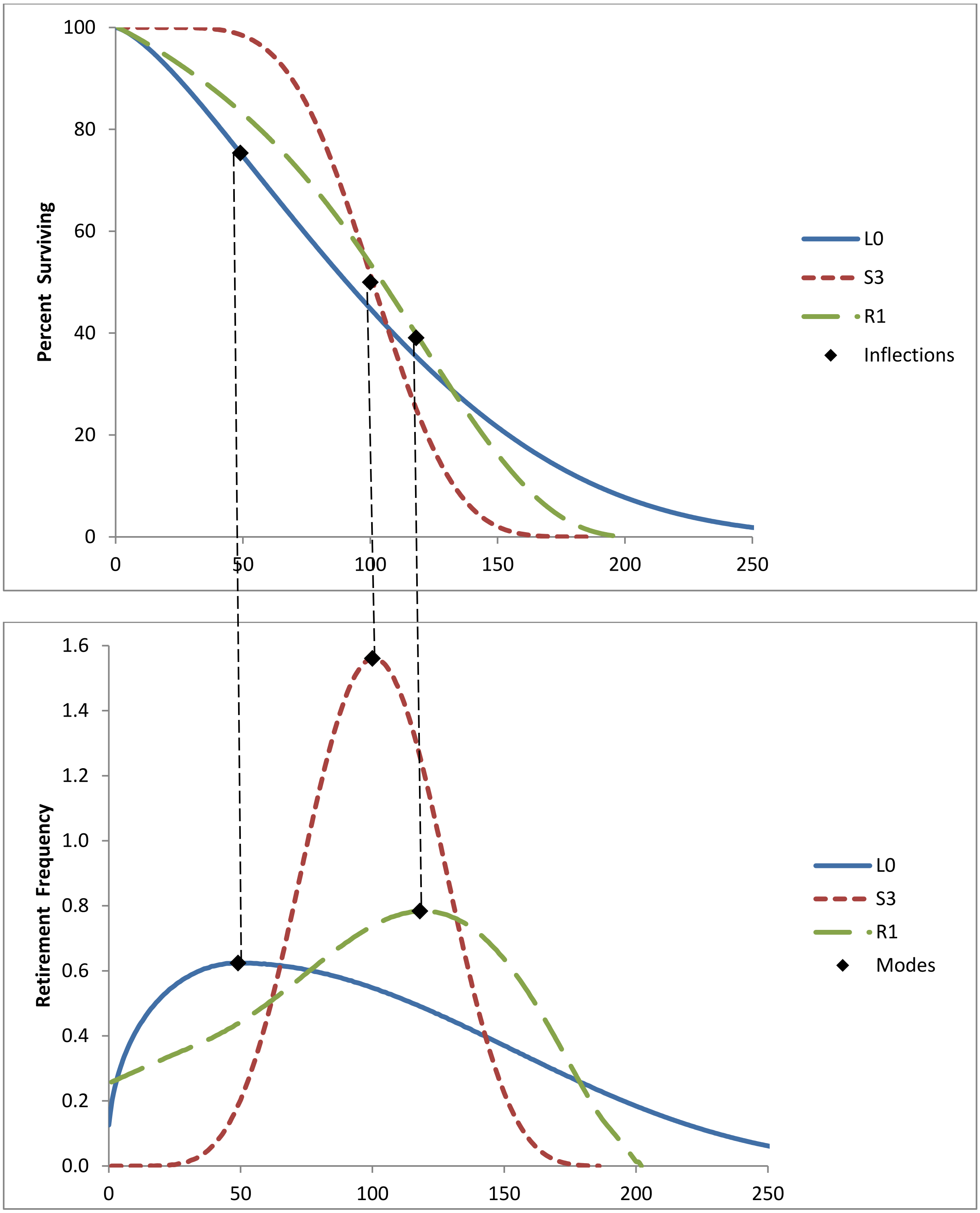
2. Classification

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).[52] 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.

[52] 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 8:
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:

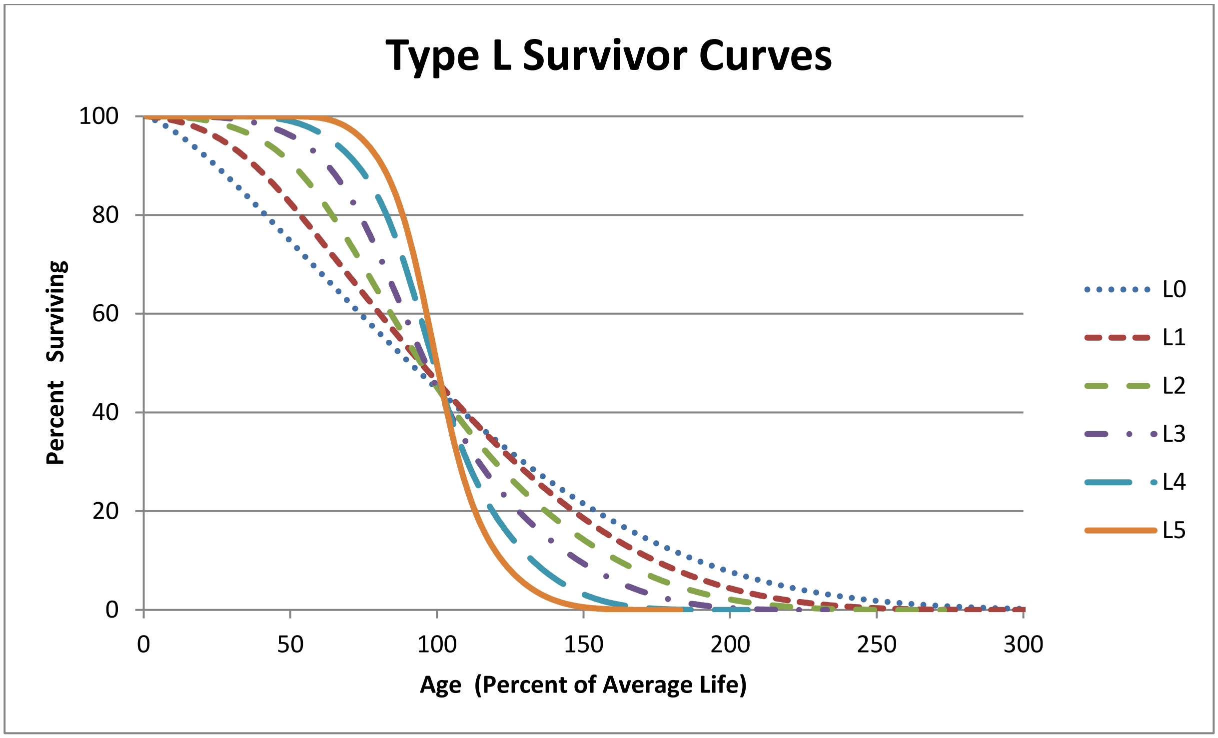
> Since the location of a particular survivor on a graph is affected by both its span in years and the shape of the curve, it is difficult to classify a group of curves unless one of these variables can be controlled. This is easily done by expressing the age in percent of average life."[53]

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.

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

Figure 9:
Type L Survivor and Frequency Curves



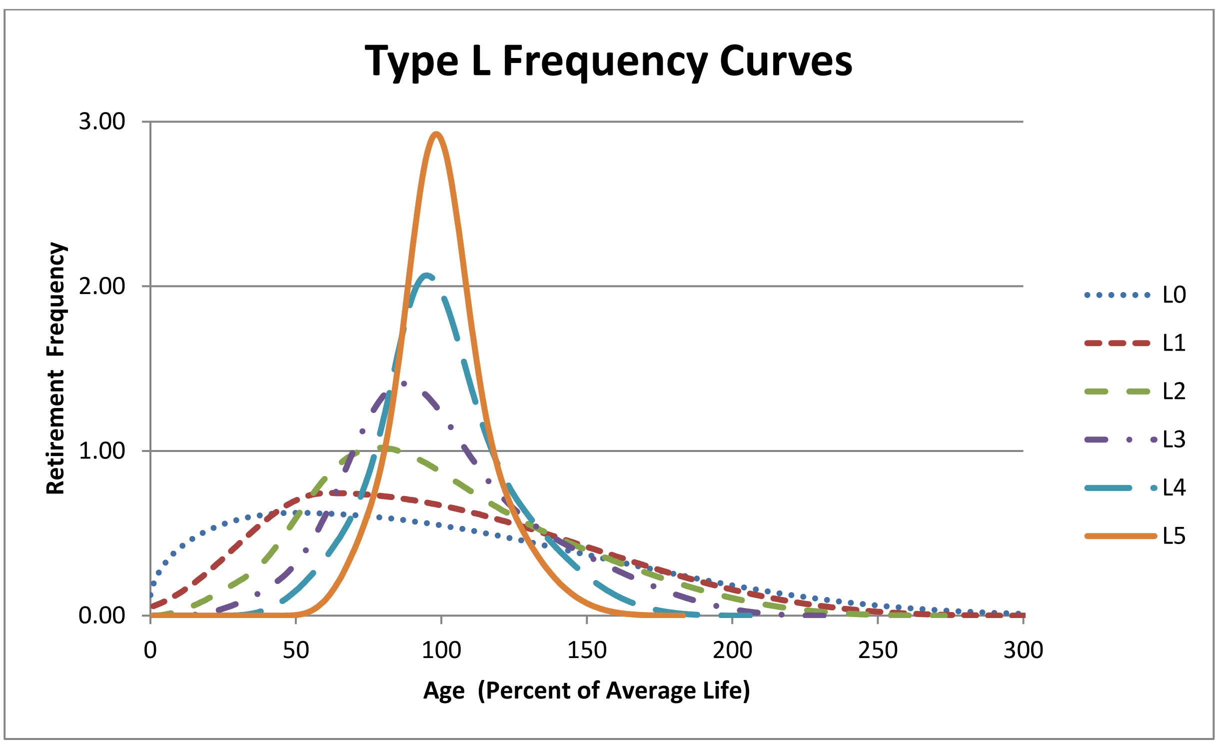
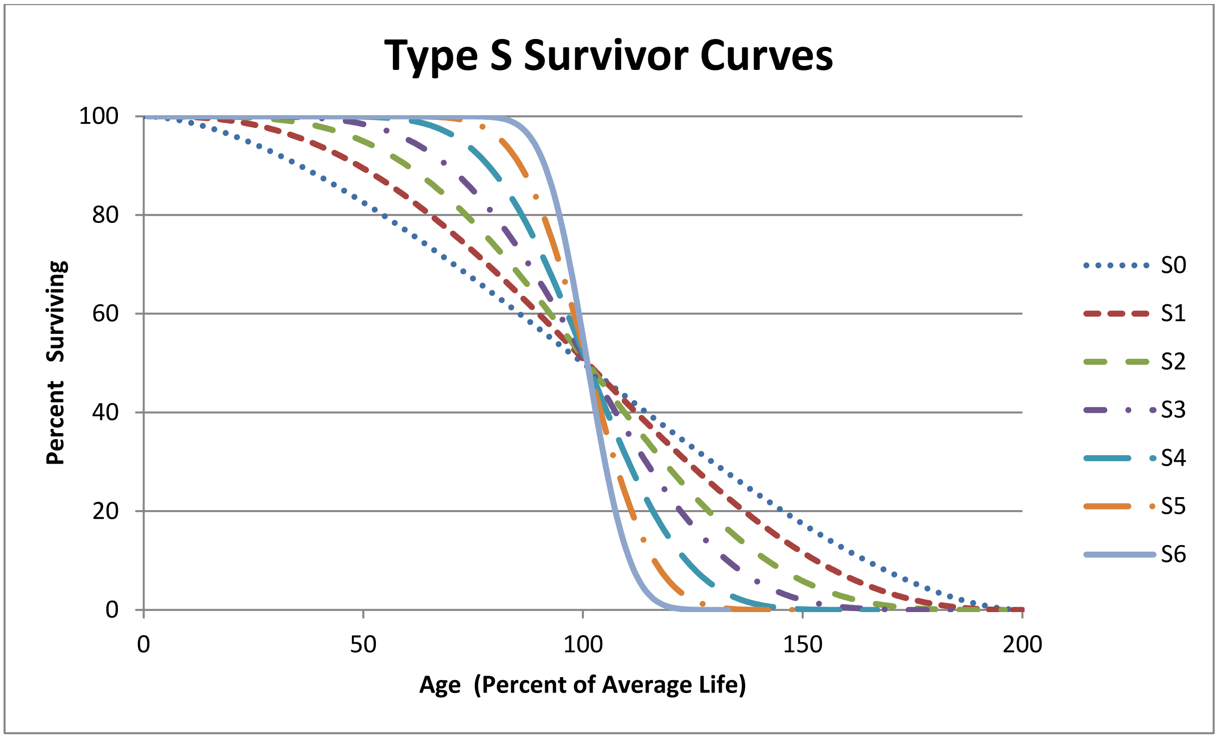


Figure 10:
Type S Survivor and Frequency Curves



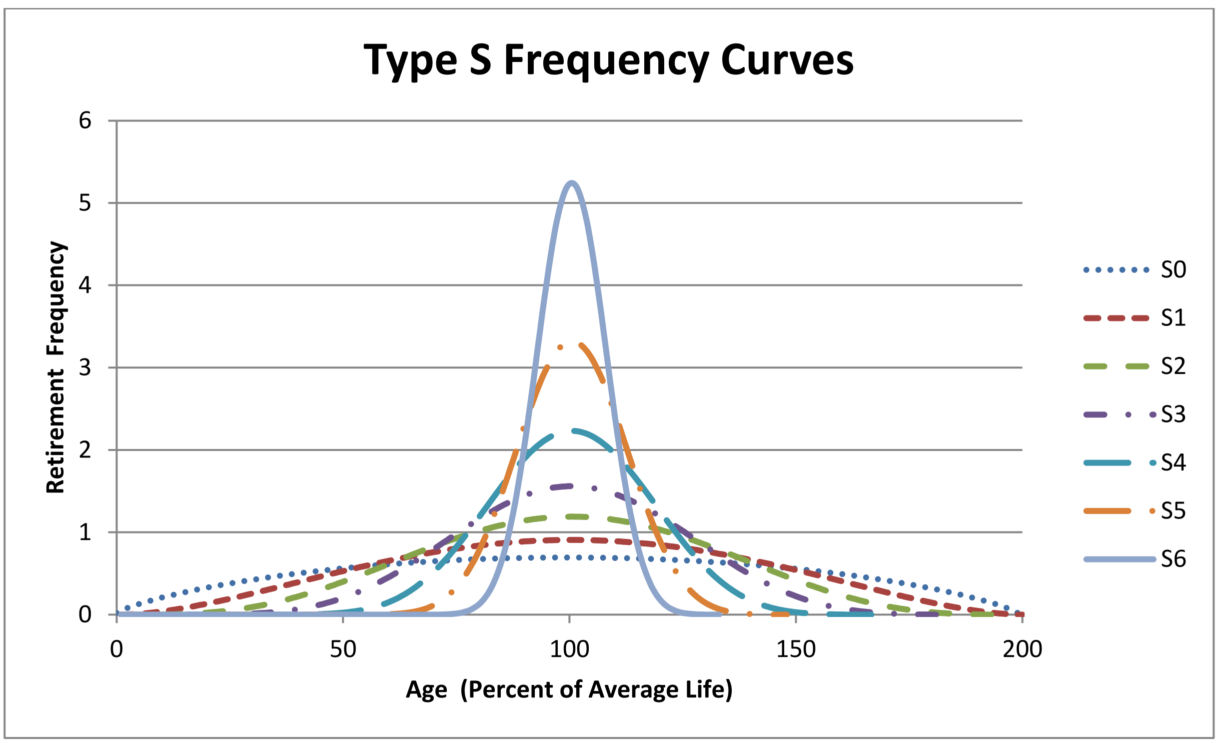
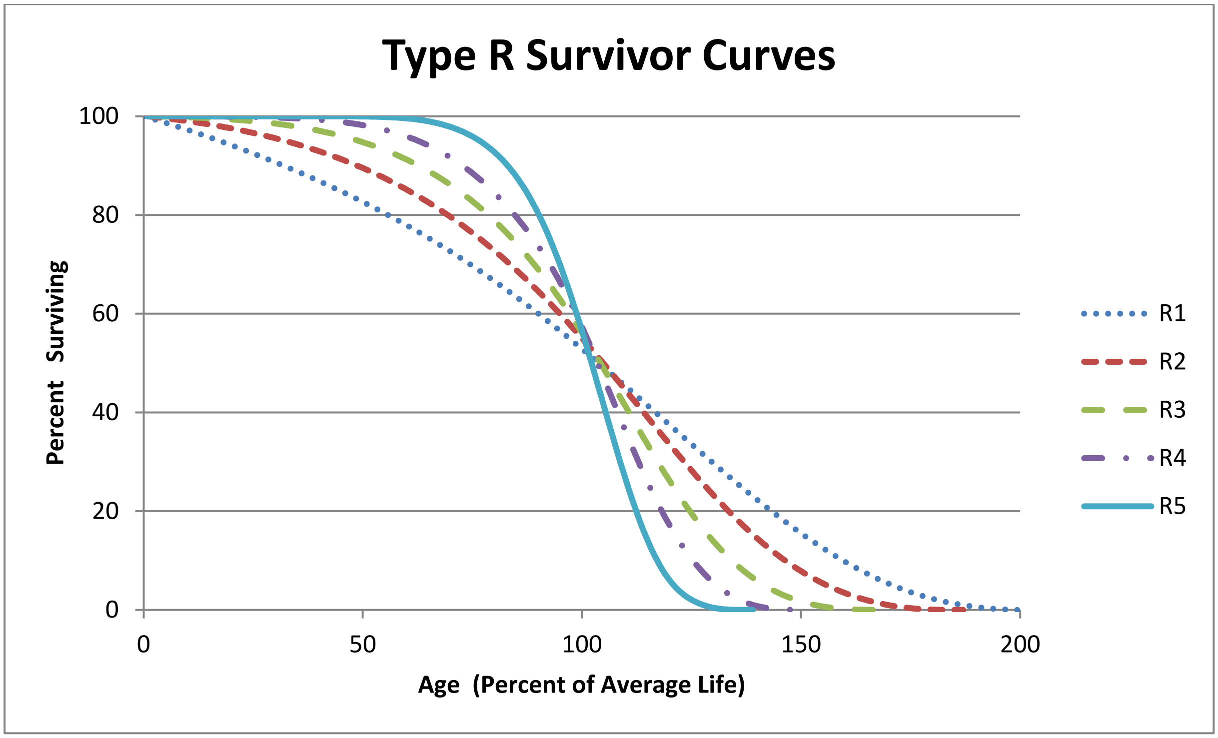
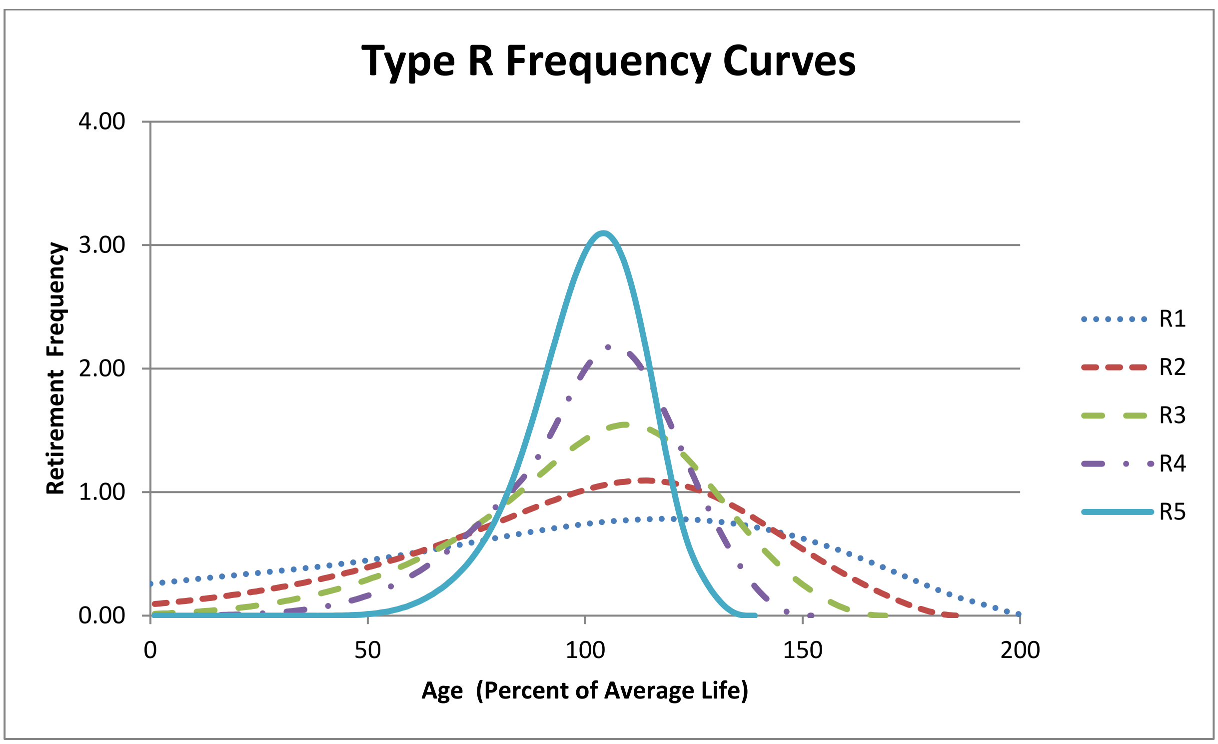


Figure 11:
Type R Survivor and Frequency Curves





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. <u>Types of Lives</u>

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.[54]

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:[55]

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

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[54] 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.

[55] *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.[56] 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.[57] 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

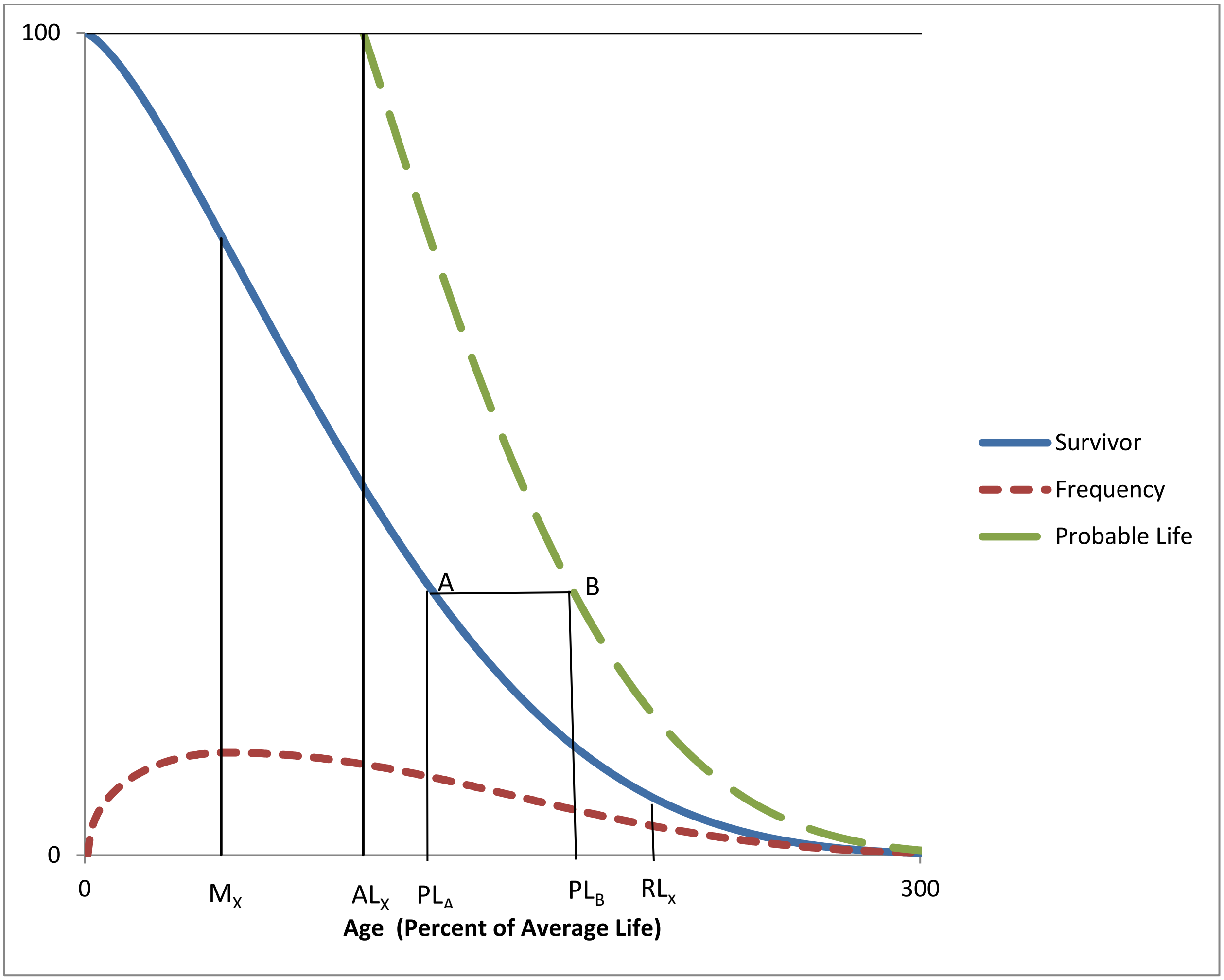
$$Average\ Remaining\ Life = \frac{Area\ Under\ Survivor\ Curve\ from\ Age\ x\ to\ Max\ Life}{S_X}$$

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

[56] *Id*. at 73.

[57] *Id*. at 74.

Figure 12:
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.[58] The probable life is also illustrated in this figure. The probable life at age PL_A is the age at point PL_B. Thus, to read the probable life at age PL_A, see the

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

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.[59]

Figure 13:
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 Property Records ("CPR"). Generally, a CPR should contain 1) an inventory of property record

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

units; 2) the association of costs with such units; and 3) the dates of installation and removal of plant. Since actuarial analysis includes the examination of historical data to forecast future retirements, the historical data used in the analysis should not contain events that are anomalous or unlikely to recur.[60] Historical data is used in the retirement rate actuarial method, which is discussed further below.

The Retirement Rate Method

There are several systematic actuarial methods that use historical data to calculate observed survivor curves for property groups. Of these methods, the retirement rate method is superior, and is widely employed by depreciation analysts.[61] 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 method may not be employed. The first matrix is the exposure matrix, which shows the exposures

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

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

at the beginning of each year.[62] 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 14:
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	

[62] 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 15:
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.[63] Adoption of the half-year convention leads to age intervals of 0-0.5 years, 0.5-1.5 years, etc., as shown in the matrices.

The purpose of the matrices is to calculate the totals for each age interval, which are shown in the second column from the right in each matrix. This column is calculated by adding each number from the corresponding age interval in the matrix. For example, in the exposure matrix, the total amount of exposures at the beginning of the 8.5-9.5 age interval is $847,000. This number was calculated by adding the numbers shown on the "stairs" to the left (192+184+216+255=847).

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

The same calculation is applied to each number in the column. The amounts retired during the year in the retirements matrix affect the exposures at the beginning of each year in the exposures matrix. For example, the amount exposed to retirement in 2008 from the 2003 vintage is \$261,000. The amount retired during 2008 from the 2003 vintage is \$16,000. Thus, the amount exposed to retirement 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 16:
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			

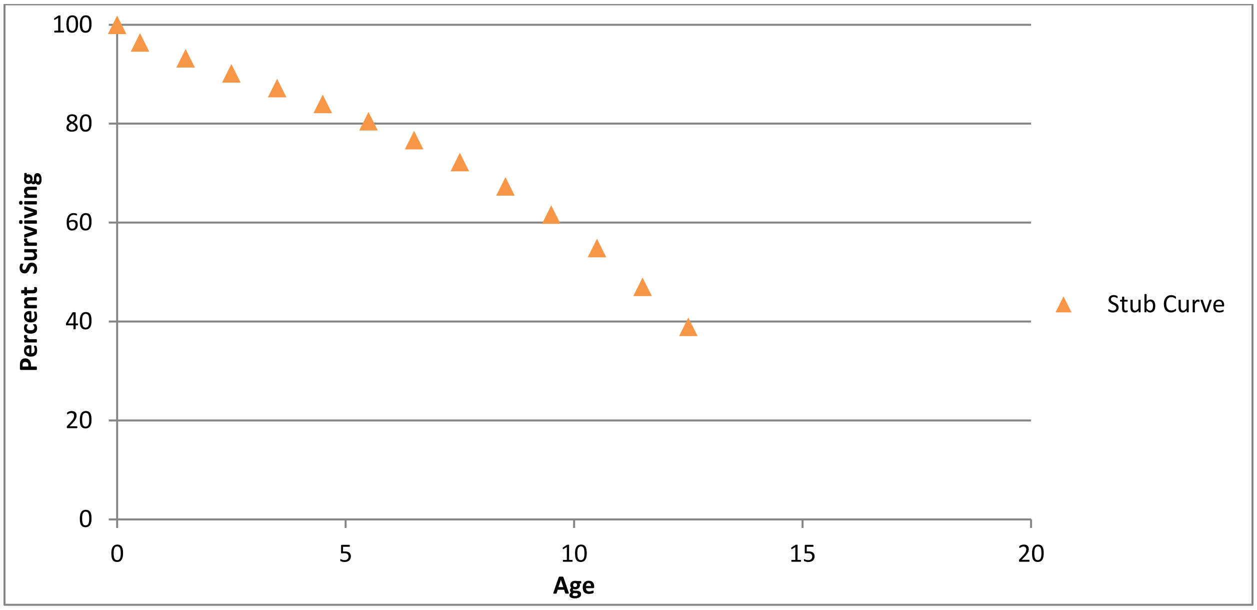
Column F on the right shows the percentages surviving at the beginning of each age interval. This column starts at 100% surviving. Each consecutive number below is calculated by multiplying the percent surviving from the previous age interval by the corresponding survivor ratio for that age interval. 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)[64].

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

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

observed survivor curve such as this that does not reach zero percent surviving is called a "stub" curve. The figure below illustrates the stub survivor curve derived from the OLT above.

Figure 17:
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.[65] 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.[66]

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.

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

[66] *Id*.

Figure 18:
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.[67] 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 isolate and analyze the effect of that change in the property group's physical characteristics. While

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

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.[68]

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

Figure 19:
Experience Bands

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

The shaded cells within the experience band equal the total exposures at the beginning of age interval 4.5–5.5 ($1,237). The same experience band would be used for the retirement matrix covering the same experience years of 2011 – 2013. This 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.[69] Likewise, the use of experience bands allows analysis of the effects of an unusual environmental event. For example, if an unusually severe ice storm occurred in 2013, destruction from that storm would affect an electric utility's line transformers of all ages. That is, each of the line transformers from each placement year would be affected, including those recently installed in 2012, as well as those installed in 2003. Using experience bands, an analyst could isolate or even eliminate the 2013 experience year from the analysis. In contrast, a placement band would not effectively isolate the

[69] *Id.*

ice storm's effect on life characteristics. Rather, the placement band would show an unusually large rate of retirement during 2013, making it more difficult to accurately fit the data with a smooth Iowa curve. Experience bands tend to yield the most complete stub curves for recent bands because they have the greatest number of vintages included. Longer stub curves are better for forecasting. The experience bands, however, may also result in more erratic retirement dispersion making the curve fitting process more difficult.

Depreciation analysts must use professional judgment in determining the types of bands to use and the band widths. In practice, analysts may use various combinations of placement and experience bands in order to increase the data sample size, identify trends and changes in life characteristics, and isolate unusual events. Regardless of which bands are used, observed survivor curves in depreciation analysis rarely reach zero percent. This is because, as seen in the OLT above, relatively newer vintage groups have not yet been fully retired at the time the property is studied. An analyst could confine the analysis to older, fully retired vintage groups to get complete survivor curves, but such analysis would ignore some of the property currently in service and would arguably not provide an accurate description of life characteristics for current plant in service. Because a complete curve is necessary to calculate the average life of the property group, however, curve fitting techniques using Iowa curves or other standardized curves may be employed in order to complete the stub curve.

Curve Fitting

Depreciation analysts typically use the survivor curve rather than the frequency curve to fit the observed stub curves. The most commonly used generalized survivor curves in the curve fitting process are the Iowa curves discussed above. As Wolf notes, if "the Iowa curves are adopted as a model, an underlying assumption is that the process describing the retirement pattern is one of the 22 [or more] processes described by the Iowa curves."[70]

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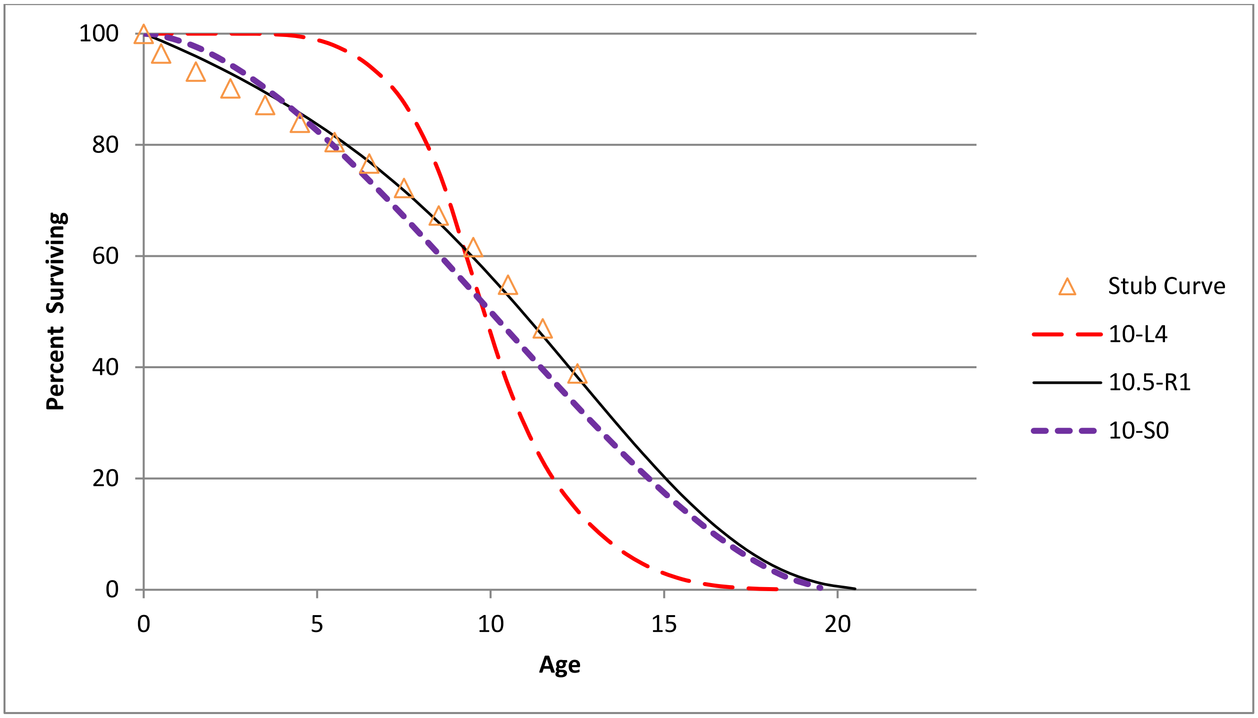
[70] Wolf *supra* n. 7, at 46 (22 curves includes Winfrey's 18 original curves plus Cowles's four "O" type curves).

Figure 20:
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.[71]

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."[72]

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.

---

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

[72] *Id*. at 48.

Figure 21:
Mathematical Fitting

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

101 Park Avenue, Suite 1125
Oklahoma City, OK 73102

DAVID J. GARRETT

405.249.1050
dgarrett@resolveuc.com

EDUCATION

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

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

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

PROFESSIONAL DESIGNATIONS

Society of Depreciation Professionals
Certified Depreciation Professional (CDP)

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

The Mediation Institute
Certified Civil / Commercial & Employment Mediator

WORK EXPERIENCE

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

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

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

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

TEACHING EXPERIENCE

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

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

PUBLICATIONS

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

VOLUNTEER EXPERIENCE

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

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

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

PROFESSIONAL ASSOCIATIONS

Oklahoma Bar Association 2007 – Present

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

Society of Utility Regulatory Financial Analysts 2014 – Present

SELECTED CONTINUING PROFESSIONAL EDUCATION

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

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

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

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

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

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

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

Utility Regulatory Proceedings

Regulatory Agency	Utility Applicant	Docket Number	Issues Addressed	Parties Represented
Public Utility Commission of Texas	Southwestern Public Service Company	PUC 49831	Depreciation rates, service lives, net salvage	Alliance of Xcel Municipalities
South Carolina Public Service Commission	Blue Granite Water Company	2019-290-WS	Depreciation rates, service lives, net salvage	South Carolina Office of Regulatory Staff
Railroad Commission of Texas	CenterPoint Energy Resources	GUD 10920	Depreciation rates and grouping procedure	Alliance of CenterPoint Municipalities
Pennsylvania Public Utility Commission	Aqua Pennsylvania Wastewater	A-2019-3009052	Fair market value estimates for wastewater assets	Pennsylvania Office of Consumer Advocate
New Mexico Public Regulation Commission	Southwestern Public Service Company	19-00170-UT	Cost of capital and authorized rate of return	The New Mexico Large Customer Group; Occidental Permian
Indiana Utility Regulatory Commission	Duke Energy Indiana	45253	Cost of capital, depreciation rates, net salvage	Indiana Office of Utility Consumer Counselor
Maryland Public Service Commission	Columbia Gas of Maryland	9609	Depreciation rates, service lives, net salvage	Maryland Office of People's Counsel
Washington Utilities & Transportation Commission	Avista Corporation	UE-190334	Cost of capital, awarded rate of return, capital structure	Washington Office of Attorney General
Indiana Utility Regulatory Commission	Indiana Michigan Power Company	45235	Cost of capital, depreciation rates, net salvage	Indiana Office of Utility Consumer Counselor
Public Utilities Commission of the State of California	Pacific Gas & Electric Company	18-12-009	Depreciation rates, service lives, net salvage	The Utility Reform Network
Oklahoma Corporation Commission	The Empire District Electric Company	PUD 201800133	Cost of capital, authorized ROE, depreciation rates	Oklahoma Industrial Energy Consumers and Oklahoma Energy Results
Arkansas Public Service Commission	Southwestern Electric Power Company	19-008-U	Cost of capital, depreciation rates, net salvage	Western Arkansas Large Energy Consumers
Public Utility Commission of Texas	CenterPoint Energy Houston Electric	PUC 49421	Depreciation rates, service lives, net salvage	Texas Coast Utilities Coalition
Massachusetts Department of Public Utilities	Massachusetts Electric Company and Nantucket Electric Company	D.P.U. 18-150	Depreciation rates, service lives, net salvage	Massachusetts Office of the Attorney General, Office of Ratepayer Advocacy
Oklahoma Corporation Commission	Oklahoma Gas & Electric Company	PUD 201800140	Cost of capital, authorized ROE, depreciation rates	Oklahoma Industrial Energy Consumers and Oklahoma Energy Results
Public Service Commission of the State of Montana	Montana-Dakota Utilities Company	D2018.9.60	Depreciation rates, service lives, net salvage	Montana Consumer Counsel and Denbury Onshore
Indiana Utility Regulatory Commission	Northern Indiana Public Service Company	45159	Depreciation rates, grouping procedure, demolition costs	Indiana Office of Utility Consumer Counselor

Utility Regulatory Proceedings

Regulatory Agency	Utility Applicant	Docket Number	Issues Addressed	Parties Represented
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
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

Utility Regulatory Proceedings

Regulatory Agency	Utility Applicant	Docket Number	Issues Addressed	Parties Represented
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
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	Original Cost 12/31/2018	Company Accrual	GCSC Accrual	GCSC Adjustment
		CENTRAL TEXAS SERVICE AREA		
Transmission	7,211,812	127,302	127,311	9
Distribution	511,130,605	12,673,628	11,842,310	(831,318)
General	39,045,417	2,603,243	2,603,357	114
Total	557,387,834	15,404,173	14,572,978	(831,195)
		GULF COAST SERVICE AREA		
Transmission	-	-	-	-
Distribution	89,362,542	2,373,561	2,212,789	(160,772)
General	9,419,964	561,411	561,378	(34)
Total	98,782,506	2,934,972	2,774,167	(160,805)
Total Studied	$ 656,170,340	$ 18,339,145	$ 17,347,145	**$ (992,000)**

Depreciation Parameter Comparison

Account No.	Description	Company Position: Iowa Curve Type	Company Position: Iowa Curve AL	Company Position: Rem. Life	Company Position: Depr. Rate	GCSC Position: Iowa Curve Type	GCSC Position: Iowa Curve AL	GCSC Position: Rem. Life	GCSC Position: Depr. Rate
Central Texas Service Area									
376.00	Mains	R1.5	65	53.9	1.87%	R2	71	58.6	1.72%
378.00	M&R Station Equip. - General	R0.5	55	48.1	2.10%	R1	60	51.7	1.95%
380.00	Services	R2	55	42.5	2.51%	R1.5	60	48.2	2.21%
385.00	Industrial M&R Station Equip.	R1	55	42.8	2.14%	R2.5	65	48.9	1.87%
Gulf Coast Service Area									
376.00	Mains	R1.5	65	49.6	1.98%	R2	71	53.7	1.83%
378.00	M&R Station Equip. - General	R0.5	55	47.5	2.22%	R1	60	51.1	2.06%
380.00	Services	R2	55	40.8	2.71%	R1.5	60	46.5	2.38%
385.00	Industrial M&R Station Equip.	R1	55	42.0	2.17%	R2.5	65	48.0	1.90%

Detailed Rate Comparison

		[1]	[2]		[3]		[4]	
			Company Proposal		GCSC Proposal		Difference	
Account No.	Description	Plant Balance 12/31/2018	Rate	Annual Accrual	Rate	Annual Accrual	Rate	Annual Accrual
CENTRAL TEXAS SERVICE AREA								
	Transmission Plant							
367.00	Mains	5,842,991	1.75%	102,252	1.75%	102,305	0.00%	53
369.00	Meas. and Reg. Station Equipment	1,368,821	1.83%	25,049	1.83%	25,006	0.00%	(44)
	Total Transmission Plant	7,211,812	1.77%	127,302	1.77%	127,311	0.00%	9
	Distribution Plant							
375.10	Structures and Improvements	23,247	1.79%	416	1.79%	416	0.00%	0
375.20	Other System Structures	916	2.38%	22	2.38%	22	0.00%	0
376.00	Mains	267,015,686	1.87%	4,993,193	1.72%	4,590,733	-0.15%	(402,460)
376.90	Mains - Cathodic Protection	24,244,272	6.47%	1,568,365	6.59%	1,598,744	0.13%	30,378
378.00	Meas. and Reg. Station Equip. - General	10,731,479	2.10%	225,361	1.95%	209,446	-0.15%	(15,915)
379.00	Meas. and Reg. Station Equip. - City Gate	1,489,030	1.62%	24,122	1.62%	24,126	0.00%	3
380.00	Services	138,654,767	2.51%	3,480,235	2.21%	3,063,790	-0.30%	(416,445)
381.00	Meters	50,891,528	3.93%	2,000,037	3.93%	2,000,901	0.00%	864
383.00	House Regulators	7,012,117	2.47%	173,199	2.47%	172,869	0.00%	(331)
385.00	Industrial Meas. and Reg. Station Equip.	10,075,723	2.14%	215,620	1.87%	188,167	-0.27%	(27,454)
386.00	Other Property on Customers' Premises	991,840	-0.70%	(6,943)	-0.70%	(6,903)	0.00%	40
	Total Distribution Plant	511,130,605	2.48%	12,673,628	2.32%	11,842,310	-0.16%	(831,318)
	General Plant							
390.10	Structures and Improvements	1,811,483	2.35%	42,570	2.35%	42,574	0.00%	5
392.00	Transportation Equipment	10,155,493	8.47%	860,170	8.47%	860,269	0.00%	99
396.00	Power Operated Equipment	1,088,765	5.09%	55,418	5.09%	55,429	0.00%	11
391.10	Office Furniture and Fixtures	890,291	6.52%	58,060	6.52%	58,060	0.00%	-
391.90	Computers and Electronic Equipment	3,670,450	4.48%	164,432	4.48%	164,432	0.00%	-
393.00	Stores Equipment	5,387	6.67%	359	6.67%	359	0.00%	-
394.00	Tools, Shop and Garage Equipment	5,924,999	6.57%	389,176	6.57%	389,176	0.00%	-
397.00	Communication Equipment	15,368,189	6.67%	1,024,367	6.67%	1,024,367	0.00%	-
398.00	Miscellaneous Equipment	130,360	6.67%	8,691	6.67%	8,691	0.00%	-

Detailed Rate Comparison

		[1]	[2]		[3]		[4]	
			Company Proposal		GCSC Proposal		Difference	
Account No.	Description	Plant Balance 12/31/2018	Rate	Annual Accrual	Rate	Annual Accrual	Rate	Annual Accrual
	Total General Plant	39,045,417	6.67%	2,603,243	6.67%	2,603,357	0.00%	114
	TOTAL CENTRAL TEXAS SERVICE AREA	557,387,834	2.76%	15,404,173	2.61%	14,572,978	-0.15%	(831,195)
GULF COAST SERVICE AREA								
	Transmission Plant							
367.00	Mains	-	0.00%	-	0.00%	-	0.00%	-
369.00	Meas. and Reg. Station Equipment	-	0.00%	-	0.00%	-	0.00%	-
	Total Transmission Plant	-		-		-	0.00%	-
	Distribution Plant							
375.10	Structures and Improvements	20,631	1.61%	332	1.61%	332	0.00%	0
375.20	Other System Structures							
376.00	Mains	35,286,797	1.98%	698,679	1.83%	645,235	-0.15%	(53,444)
376.90	Mains - Cathodic Protection	2,351,912	3.83%	89,995	4.26%	100,271	0.44%	10,277
378.00	Meas. and Reg. Station Equip. - General	1,799,915	2.22%	39,958	2.06%	37,065	-0.16%	(2,893)
379.00	Meas. and Reg. Station Equip. - City Gate	895,878	1.81%	16,215	1.81%	16,198	0.00%	(18)
380.00	Services	32,272,723	2.71%	874,591	2.38%	767,913	-0.33%	(106,678)
381.00	Meters	11,830,365	4.49%	531,183	4.49%	531,536	0.00%	353
383.00	House Regulators	1,762,515	2.88%	50,760	2.88%	50,714	0.00%	(47)
385.00	Industrial Meas. and Reg. Station Equip.	3,070,397	2.17%	66,628	1.90%	58,304	-0.27%	(8,324)
386.00	Other Property on Customers' Premises	71,409	7.31%	5,220	7.31%	5,222	0.00%	2
	Total Distribution Plant	89,362,542	2.66%	2,373,561	2.48%	2,212,789	-0.18%	(160,772)
	General Plant							
390.10	Structures and Improvements	2,738,060	2.53%	69,273	2.53%	69,163	0.00%	(110)
392.00	Transportation Equipment	2,032,672	8.57%	174,200	8.57%	174,258	0.00%	58
396.00	Power Operated Equipment	454,183	6.36%	28,886	6.36%	28,905	0.00%	19

Detailed Rate Comparison

		[1]	[2]		[3]		[4]	
			Company Proposal		GCSC Proposal		Difference	
Account No.	Description	Plant Balance 12/31/2018	Rate	Annual Accrual	Rate	Annual Accrual	Rate	Annual Accrual
391.10	Office Furniture and Fixtures	100,964	6.49%	6,557	6.49%	6,557	0.00%	-
391.90	Computers and Electronic Equipment	186,729	13.17%	24,587	13.17%	24,587	0.00%	-
393.00	Stores Equipment	3,423	6.67%	228	6.67%	228	0.00%	-
394.00	Tools, Shop and Garage Equipment	1,160,224	6.45%	74,802	6.45%	74,802	0.00%	-
397.00	Communication Equipment	2,743,709	6.67%	182,879	6.67%	182,879	0.00%	-
398.00	Miscellaneous Equipment							
	Total General Plant	9,419,964	5.96%	561,411	5.96%	561,378	0.00%	(34)
	TOTAL GULF COAST SERVICE AREA	98,782,506	2.97%	2,934,972	2.81%	2,774,167	-0.16%	(160,805)
	TOTAL PLANT STUDIED	**656,170,340**	**2.79%**	**18,339,145**	**2.64%**	**17,347,145**	**-0.15%**	**(992,000)**

[1] From Company depreciation study; plant balances as of the study date

[2] Company Depreciation Study

[3] Rates and Accruals from Rate Development exhibit. (Some unadjusted accounts hard coded to zero to account for rounding differences)

[4] = [3] - [2]

Depreciation Rate Development

Account No.	Description	[1] Original Cost	[2] Iowa Curve Type	AL	[3] Net Salvage	[4] Depreciable Base	[5] Book Reserve	[6] Future Accruals	[7] Remaining Life	[8] Service Life Accrual	[9] Service Life Rate	[10] Net Salvage Accrual	[11] Net Salvage Rate	[12] Total Accrual	[13] Total Rate
CENTRAL TEXAS SERVICE AREA															
	Transmission Plant														
367.00	Mains	5,842,991	R1 -	60	-10.0%	6,427,290	1,560,640	4,866,650	47.6	90,022	1.54%	12,283	0.21%	102,305	**1.75%**
369.00	Meas. and Reg. Station Equipment	1,368,821	R1 -	60	-10.0%	1,505,703	48,616	1,457,088	58.3	22,657	1.66%	2,349	0.17%	25,006	**1.83%**
	Total Transmission Plant	7,211,812			-10.0%	7,932,993	1,609,255	6,323,738	49.7	112,679	1.56%	14,632	0.20%	127,311	**1.77%**
	Distribution Plant														
375.10	Structures and Improvements	23,247	R4 -	40	-5.0%	24,409	17,812	6,597	15.9	343	1.48%	73	0.32%	416	**1.79%**
375.20	Other System Structures	916	R2 -	40	-5.0%	962	359	602	27.6	20	2.20%	2	0.18%	22	**2.38%**
376.00	Mains	267,015,686	R2 -	71	-20.0%	320,418,823	51,447,762	268,971,061	58.6	3,679,261	1.38%	911,472	0.34%	4,590,733	**1.72%**
376.90	Mains - Cathodic Protection	24,244,272	SQ -	15	0.0%	24,244,272	10,367,177	13,877,095	8.7	1,598,744	6.59%	-	0.00%	1,598,744	**6.59%**
378.00	Meas. and Reg. Station Equip. - General	10,731,479	R1 -	60	-20.0%	12,877,775	2,043,147	10,834,627	51.7	167,955	1.57%	41,490	0.39%	209,446	**1.95%**
379.00	Meas. and Reg. Station Equip. - City Gate	1,489,030	R1.5 -	65	-10.0%	1,637,933	333,947	1,303,986	54.1	21,371	1.44%	2,755	0.19%	24,126	**1.62%**
380.00	Services	138,654,767	R1.5 -	60	-30.0%	180,251,197	32,484,610	147,766,587	48.2	2,201,330	1.59%	862,460	0.62%	3,063,790	**2.21%**
381.00	Meters	50,891,528	R2.5 -	25	-10.0%	55,980,681	21,185,004	34,795,677	17.4	1,708,253	3.36%	292,648	0.58%	2,000,901	**3.93%**
383.00	House Regulators	7,012,117	R3 -	35	-5.0%	7,362,723	3,353,899	4,008,824	23.2	157,750	2.25%	15,119	0.22%	172,869	**2.47%**
385.00	Industrial Meas. and Reg. Station Equip.	10,075,723	R2.5 -	65	-20.0%	12,090,868	2,891,385	9,199,482	48.9	146,949	1.46%	41,218	0.41%	188,167	**1.87%**
386.00	Other Property on Customers' Premises	991,840	S3 -	20	0.0%	991,840	1,012,825	(20,985)	3.0	-6,903	-0.70%	-	0.00%	(6,903)	**-0.70%**
	Total Distribution Plant	511,130,605			-20.5%	615,881,483	125,137,929	490,743,554	41.4	9,675,073	1.89%	2,167,237	0.42%	11,842,310	**2.32%**
	General Plant														
390.10	Structures and Improvements	1,811,483	R1.5 -	40	-5.0%	1,902,057	773,835	1,128,223	26.5	39,157	2.16%	3,418	0.19%	42,574	**2.35%**
392.00	Transportation Equipment	10,155,493	L0 -	10	5.0%	9,647,718	2,748,361	6,899,357	8.0	923,583	9.09%	(63,314)	-0.62%	860,269	**8.47%**
396.00	Power Operated Equipment	1,088,765	L2 -	13	10.0%	979,889	596,321	383,567	6.9	71,162	6.54%	(15,734)	-1.45%	55,429	**5.09%**
391.10	Office Furniture and Fixtures	890,291	SQ -	15	0.0%	890,291	444,178	446,113	7.5					58,060	**6.52%**
391.90	Computers and Electronic Equipment	3,670,450	SQ -	7	0.0%	3,670,450	3,311,635	358,815	1.7					164,432	**4.48%**
393.00	Stores Equipment	5,387	SQ -	15	0.0%	5,387	1,743	3,644	10.2					359	**6.67%**
394.00	Tools, Shop and Garage Equipment	5,924,999	SQ -	15	0.0%	5,924,999	1,938,127	3,986,872	10.1					389,176	**6.57%**
397.00	Communication Equipment	15,368,189	SQ -	15	0.0%	15,368,189	5,794,276	9,573,913	9.3					1,024,367	**6.67%**
398.00	Miscellaneous Equipment	130,360	SQ -	15	0.0%	130,360	70,699	59,661	6.9					8,691	**6.67%**
	Total General Plant	39,045,417			1.3%	38,519,340	15,679,175	22,840,165	8.8	1,033,901	2.65%	(75,629)	4.02%	2,603,357	**6.67%**
	TOTAL CENTRAL TEXAS SERVICE AREA	557,387,834			-18.8%	662,333,816	142,426,359	519,907,457	35.7	10,821,654	1.94%	2,106,240	0.67%	14,572,978	**2.61%**
GULF COAST SERVICE AREA															
	Transmission Plant														
367.00	Mains	-			0.0%	-	-	-							
369.00	Meas. and Reg. Station Equipment	-			0.0%	-	-	-							
	Total Transmission Plant	-			0.0%	-	-	-	#DIV/0!	-	#DIV/0!	-	#DIV/0!	-	**#DIV/0!**
	Distribution Plant														
375.10	Structures and Improvements	20,631	R4 -	40	-5.0%	21,663	15,591	6,071	18.3	276	1.34%	56	0.27%	332	**1.61%**
375.20	Other System Structures	-			0.0%	-	-	-							
376.00	Mains	35,286,797	R2 -	71	-20.0%	42,344,156	7,695,054	34,649,102	53.7	513,813	1.46%	131,422	0.37%	645,235	**1.83%**
376.90	Mains - Cathodic Protection	2,351,912	SQ -	15	0.0%	2,351,912	1,738,252	613,660	6.1	100,271	4.26%	-	0.00%	100,271	**4.26%**
378.00	Meas. and Reg. Station Equip. - General	1,799,915	R1 -	60	-20.0%	2,159,898	265,523	1,894,375	51.1	30,021	1.67%	7,043	0.39%	37,065	**2.06%**
379.00	Meas. and Reg. Station Equip. - City Gate	895,878	R1.5 -	65	-10.0%	985,466	231,455	754,011	46.6	14,273	1.59%	1,925	0.21%	16,198	**1.81%**
380.00	Services	32,272,723	R1.5 -	60	-30.0%	41,954,540	6,269,628	35,684,912	46.5	559,567	1.73%	208,346	0.65%	767,913	**2.38%**
381.00	Meters	11,830,365	R2.5 -	25	-10.0%	13,013,402	3,605,211	9,408,190	17.7	464,698	3.93%	66,838	0.56%	531,536	**4.49%**

Depreciation Rate Development

		[1]	[2]		[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]	[13]
Account		Original	Iowa Curve		Net	Depreciable	Book	Future	Remaining	Service Life		Net Salvage		Total	
No.	Description	Cost	Type	AL	Salvage	Base	Reserve	Accruals	Life	Accrual	Rate	Accrual	Rate	Accrual	Rate
383.00	House Regulators	1,762,515	R3	35	-5.0%	1,850,641	587,360	1,263,281	24.9	47,176	2.68%	3,538	0.20%	50,714	**2.88%**
385.00	Industrial Meas. and Reg. Station Equip.	3,070,397	R2.5	65	-20.0%	3,684,476	883,553	2,800,923	48.0	45,521	1.48%	12,783	0.42%	58,304	**1.90%**
386.00	Other Property on Customers' Premises	71,409	S3	20	0.0%	71,409	59,973	11,436	2.2	5,222	7.31%	-	0.00%	5,222	**7.31%**
	Total Distribution Plant	89,362,542			-21.3%	108,437,562	21,351,601	87,085,961	39.4	1,780,839	1.99%	431,950	0.48%	2,212,789	**2.48%**
	General Plant														
390.10	Structures and Improvements	2,738,060	R1.5	40	-5.0%	2,874,963	1,111,303	1,763,660	25.5	63,794	2.33%	5,369	0.20%	69,163	**2.53%**
392.00	Transportation Equipment	2,032,672	L0	10	5.0%	1,931,038	631,077	1,299,962	7.5	187,881	9.24%	(13,624)	-0.67%	174,258	**8.57%**
396.00	Power Operated Equipment	454,183	L2	13	10.0%	408,765	154,404	254,360	8.8	34,066	7.50%	(5,161)	-1.14%	28,905	**6.36%**
391.10	Office Furniture and Fixtures	100,964	SQ	15	0.0%	100,964	62,017	38,947	5.8					6,557	**6.49%**
391.90	Computers and Electronic Equipment	186,729	SQ	7	0.0%	186,729	127,243	59,486	2.2					24,587	**13.17%**
393.00	Stores Equipment	3,423	SQ	15	0.0%	3,423	2,853	570	2.5					228	**6.67%**
394.00	Tools, Shop and Garage Equipment	1,160,224	SQ	15	0.0%	1,160,224	485,164	675,060	8.7					74,802	**6.45%**
397.00	Communication Equipment	2,743,709	SQ	15	0.0%	2,743,709	929,359	1,814,350	9.9					182,879	**6.67%**
398.00	Miscellaneous Equipment	-			0.0%	-	-	-							
	Total General Plant	9,419,964			0.1%	9,409,815	3,503,420	5,906,395	10.5	285,742	3.03%	(13,416)	2.93%	561,378	**5.96%**
	TOTAL GULF COAST SERVICE AREA	98,782,506			-19.3%	117,847,377	24,855,021	92,992,356	33.5	2,066,581	2.09%	418,534	0.72%	2,774,167	**2.81%**
	TOTAL PLANT STUDIED	**656,170,340**			**-18.9%**	**780,181,193**	**167,281,380**	**612,899,813**	**35.3**	**12,888,234**	**1.96%**	**2,524,774**	**0.68%**	**17,347,145**	**2.64%**

[1] From Company depreciation study; plant balances as of the study date
[2] Selected Iowa curve type and average life through mathematical and visual curve fitting-techniques and professional judgement.
[3] For life span accounts, weighted net salvage considering interim and terminal retirements. For mass accounts, estimated net salvage through historical analysis.
[4] = [1]*(1-[3])
[5] From the Company's property records; any negative book reserve balances were replaced with the Company's redistibuted reserve calculations
[6] = [4] - [5]
[7] Average remaining life based on Iowas Curve in Column [2]
[8] = ([1] - [5]) / [7]
[9] = [8] / [1]
[10] = [12] - [8]
[11] = [13] - [9]
[12] = [6] / [7]. Some unadjusted accruals may be hard coded to match the Company's proposed accrual.
[13] = [12] / [1]. Some unadjusted rates may be hard coded to match the Company's proposed rate.

Account 376 Curve Fitting

[1]	[2]	[3]	[4]	[5]	[6]	[7]
Age (Years)	**Exposures (Dollars)**	**Observed Life Table (OLT)**	**Company R1.5-65**	**GCSC R2-71**	**Company SSD**	**GCSC SSD**
0.0	219,690,681	100.00%	100.00%	100.00%	0.0000	0.0000
0.5	195,306,390	100.00%	99.86%	99.93%	0.0000	0.0000
1.5	188,744,008	99.96%	99.59%	99.80%	0.0000	0.0000
2.5	171,613,456	99.92%	99.30%	99.65%	0.0000	0.0000
3.5	146,454,192	99.80%	99.01%	99.50%	0.0001	0.0000
4.5	135,241,300	99.67%	98.71%	99.34%	0.0001	0.0000
5.5	106,212,420	99.60%	98.39%	99.18%	0.0001	0.0000
6.5	92,213,157	99.56%	98.07%	99.00%	0.0002	0.0000
7.5	89,969,970	99.36%	97.74%	98.82%	0.0003	0.0000
8.5	87,960,907	99.26%	97.41%	98.63%	0.0003	0.0000
9.5	85,998,804	99.17%	97.06%	98.43%	0.0004	0.0001
10.5	77,379,938	99.06%	96.70%	98.22%	0.0006	0.0001
11.5	75,518,214	98.01%	96.33%	98.01%	0.0003	0.0000
12.5	70,499,246	97.33%	95.95%	97.78%	0.0002	0.0000
13.5	71,971,302	96.61%	95.57%	97.54%	0.0001	0.0001
14.5	69,806,280	95.89%	95.17%	97.30%	0.0001	0.0002
15.5	61,984,877	94.99%	94.76%	97.04%	0.0000	0.0004
16.5	65,539,714	94.67%	94.34%	96.77%	0.0000	0.0004
17.5	66,539,551	93.36%	93.91%	96.50%	0.0000	0.0010
18.5	64,706,316	93.07%	93.46%	96.21%	0.0000	0.0010
19.5	61,875,775	92.72%	93.01%	95.90%	0.0000	0.0010
20.5	63,172,653	92.60%	92.54%	95.59%	0.0000	0.0009
21.5	61,303,304	92.20%	92.07%	95.26%	0.0000	0.0009
22.5	62,057,218	91.99%	91.58%	94.92%	0.0000	0.0009
23.5	62,611,736	91.17%	91.07%	94.57%	0.0000	0.0012
24.5	63,413,412	90.98%	90.56%	94.20%	0.0000	0.0010
25.5	64,008,670	90.85%	90.03%	93.82%	0.0001	0.0009
26.5	63,887,375	90.57%	89.48%	93.42%	0.0001	0.0008
27.5	58,637,659	90.39%	88.92%	93.01%	0.0002	0.0007
28.5	56,718,970	90.33%	88.35%	92.59%	0.0004	0.0005
29.5	55,897,718	90.18%	87.76%	92.14%	0.0006	0.0004
30.5	53,998,764	90.11%	87.16%	91.69%	0.0009	0.0002
31.5	50,388,935	89.91%	86.53%	91.21%	0.0011	0.0002
32.5	45,005,679	89.71%	85.90%	90.72%	0.0015	0.0001
33.5	39,099,171	89.62%	85.24%	90.20%	0.0019	0.0000
34.5	34,163,961	89.55%	84.56%	89.67%	0.0025	0.0000
35.5	32,402,058	89.45%	83.87%	89.13%	0.0031	0.0000
36.5	28,969,255	89.28%	83.16%	88.56%	0.0037	0.0001
37.5	25,324,528	89.11%	82.43%	87.97%	0.0045	0.0001
38.5	22,451,061	88.85%	81.68%	87.36%	0.0051	0.0002
39.5	20,073,624	88.52%	80.90%	86.73%	0.0058	0.0003
40.5	18,013,628	88.32%	80.11%	86.08%	0.0067	0.0005
41.5	17,112,214	88.16%	79.30%	85.41%	0.0079	0.0008
42.5	16,394,131	88.09%	78.46%	84.72%	0.0093	0.0011
43.5	15,646,292	87.99%	77.60%	84.00%	0.0108	0.0016
44.5	14,033,333	87.89%	76.72%	83.26%	0.0125	0.0021
45.5	12,868,356	87.80%	75.81%	82.49%	0.0144	0.0028
46.5	12,046,777	87.73%	74.88%	81.70%	0.0165	0.0036
47.5	11,445,767	87.51%	73.93%	80.89%	0.0184	0.0044

Account 376 Curve Fitting

[1] Age (Years)	[2] Exposures (Dollars)	[3] Observed Life Table (OLT)	[4] Company R1.5-65	[5] GCSC R2-71	[6] Company SSD	[7] GCSC SSD
48.5	11,008,707	87.00%	72.96%	80.05%	0.0197	0.0048
49.5	10,297,761	86.45%	71.96%	79.19%	0.0210	0.0053
50.5	9,708,712	86.26%	70.94%	78.30%	0.0235	0.0063
51.5	9,562,090	85.76%	69.89%	77.38%	0.0252	0.0070
52.5	8,929,593	84.00%	68.82%	76.43%	0.0231	0.0057
53.5	8,462,127	83.19%	67.72%	75.46%	0.0239	0.0060
54.5	7,770,758	82.50%	66.60%	74.46%	0.0253	0.0065
55.5	7,645,944	82.09%	65.45%	73.43%	0.0277	0.0075
56.5	7,924,113	81.70%	64.29%	72.38%	0.0303	0.0087
57.5	7,090,829	80.15%	63.09%	71.30%	0.0291	0.0078
58.5	6,367,045	78.60%	61.88%	70.18%	0.0280	0.0071
59.5	5,416,310	77.23%	60.64%	69.04%	0.0275	0.0067
60.5	4,904,823	75.87%	59.38%	67.88%	0.0272	0.0064
61.5	4,497,047	74.07%	58.10%	66.68%	0.0255	0.0055
62.5	3,960,526	72.23%	56.80%	65.46%	0.0238	0.0046
63.5	3,419,716	69.90%	55.48%	64.21%	0.0208	0.0032
64.5	3,099,812	67.96%	54.14%	62.93%	0.0191	0.0025
65.5	2,570,914	62.28%	52.78%	61.63%	0.0090	0.0000
66.5	2,195,551	59.32%	51.41%	60.30%	0.0063	0.0001
67.5	1,745,150	56.85%	50.02%	58.94%	0.0047	0.0004
68.5	1,615,529	55.31%	48.62%	57.56%	0.0045	0.0005
69.5	1,366,107	52.36%	47.21%	56.17%	0.0027	0.0014
70.5	1,094,422	49.04%	45.78%	54.74%	0.0011	0.0033
71.5	981,173	46.69%	44.35%	53.30%	0.0005	0.0044
72.5	870,659	45.10%	42.92%	51.84%	0.0005	0.0045
73.5	702,380	41.43%	41.48%	50.36%	0.0000	0.0080
74.5	643,082	38.83%	40.03%	48.87%	0.0001	0.0101
75.5	405,063	38.26%	38.59%	47.36%	0.0000	0.0083
76.5	0	37.76%	37.15%	45.84%	0.0000	0.0065
77.5	0	37.76%	35.72%	44.32%	0.0004	0.0043
78.5	0	37.76%	34.29%	42.78%	0.0012	0.0025
79.5	0	37.76%	32.88%	41.24%	0.0024	0.0012
80.5	0	37.76%	31.47%	39.70%	0.0040	0.0004
81.5	0	37.76%	30.09%	38.16%	0.0059	0.0000
82.5	0	37.76%	28.71%	36.62%	0.0082	0.0001
83.5	0	37.76%	27.36%	35.09%	0.0108	0.0007
84.5	0	37.76%	26.03%	33.57%	0.0138	0.0018
85.5	0	37.76%	24.72%	32.06%	0.0170	0.0032
86.5	0	37.76%	23.44%	30.56%	0.0205	0.0052
87.5	0	37.76%	22.18%	29.09%	0.0243	0.0075
88.5	0	37.76%	20.95%	27.63%	0.0282	0.0103
89.5	0	37.76%	19.76%	26.19%	0.0324	0.0134
90.5	0	37.76%	18.60%	24.78%	0.0367	0.0168
91.5	0	37.76%	17.47%	23.40%	0.0412	0.0206
92.5	0	37.76%	16.37%	22.05%	0.0457	0.0247
93.5	0	37.76%	15.31%	20.74%	0.0504	0.0290
94.5	0	37.76%	14.29%	19.45%	0.0551	0.0335
95.5	0	37.76%	13.30%	18.21%	0.0598	0.0382
96.5	0	37.76%	12.36%	17.00%	0.0645	0.0431

Account 376 Curve Fitting

[1] Age (Years)	[2] Exposures (Dollars)	[3] Observed Life Table (OLT)	[4] Company R1.5-65	[5] GCSC R2-71	[6] Company SSD	[7] GCSC SSD
97.5	1,801	37.76%	11.44%	15.84%	0.0693	0.0480
98.5	1,412	37.76%	10.57%	14.72%	0.0739	0.0531
99.5	1,414	37.82%	9.74%	13.64%	0.0789	0.0585
100.5	851	22.77%	8.94%	12.60%	0.0191	0.0103
101.5	851	22.77%	8.18%	11.61%	0.0213	0.0125
102.5	851	22.77%	7.47%	10.67%	0.0234	0.0147
103.5			6.78%	9.76%		
Sum of Squared Differences				[8]	1.3894	0.6336
Sum of Squared Differences				[9]	0.5606	0.1325

[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.

[9] = Sum of squared differences up to the 1% of beginning exposures cut-off.

*The bold horizontal line represents the 1% of beginning exposures cut-off.

Account 378 Curve Fitting

[1] Age (Years)	[2] Exposures (Dollars)	[3] Observed Life Table (OLT)	[4] Company R0.5-55	[5] GCSC R1-60	[6] Company SSD	[7] GCSC SSD
0.0	10,475,717	100.00%	100.00%	100.00%	0.0000	0.0000
0.5	9,609,115	99.98%	99.66%	99.79%	0.0000	0.0000
1.5	9,047,426	99.19%	98.96%	99.35%	0.0000	0.0000
2.5	8,293,377	98.76%	98.26%	98.90%	0.0000	0.0000
3.5	5,838,124	97.80%	97.56%	98.44%	0.0000	0.0000
4.5	5,366,167	97.00%	96.85%	97.98%	0.0000	0.0001
5.5	4,558,746	96.15%	96.13%	97.50%	0.0000	0.0002
6.5	4,301,577	94.91%	95.40%	97.01%	0.0000	0.0004
7.5	4,235,477	94.72%	94.67%	96.51%	0.0000	0.0003
8.5	4,337,549	94.40%	93.94%	96.01%	0.0000	0.0003
9.5	4,147,945	93.81%	93.20%	95.49%	0.0000	0.0003
10.5	3,322,035	93.81%	92.45%	94.96%	0.0002	0.0001
11.5	3,063,834	93.79%	91.70%	94.42%	0.0004	0.0000
12.5	2,811,522	93.76%	90.94%	93.88%	0.0008	0.0000
13.5	2,614,796	92.94%	90.17%	93.32%	0.0008	0.0000
14.5	2,346,578	92.05%	89.40%	92.75%	0.0007	0.0000
15.5	2,106,073	91.89%	88.63%	92.18%	0.0011	0.0000
16.5	2,175,373	91.14%	87.85%	91.59%	0.0011	0.0000
17.5	2,118,433	91.04%	87.06%	90.99%	0.0016	0.0000
18.5	2,191,308	90.92%	86.27%	90.39%	0.0022	0.0000
19.5	2,268,930	90.20%	85.47%	89.77%	0.0022	0.0000
20.5	2,363,098	90.09%	84.66%	89.15%	0.0029	0.0001
21.5	2,400,524	90.09%	83.85%	88.52%	0.0039	0.0002
22.5	2,484,184	90.09%	83.03%	87.87%	0.0050	0.0005
23.5	2,516,203	89.91%	82.21%	87.22%	0.0059	0.0007
24.5	2,398,640	88.70%	81.38%	86.55%	0.0054	0.0005
25.5	2,185,410	85.69%	80.54%	85.87%	0.0027	0.0000
26.5	2,051,557	83.45%	79.69%	85.18%	0.0014	0.0003
27.5	1,847,686	83.28%	78.83%	84.48%	0.0020	0.0001
28.5	1,554,432	83.36%	77.97%	83.76%	0.0029	0.0000
29.5	1,510,061	81.90%	77.10%	83.04%	0.0023	0.0001
30.5	1,418,225	81.90%	76.21%	82.29%	0.0032	0.0000
31.5	1,350,927	80.79%	75.32%	81.53%	0.0030	0.0001
32.5	1,281,382	80.53%	74.42%	80.76%	0.0037	0.0000
33.5	1,116,868	80.20%	73.51%	79.98%	0.0045	0.0000
34.5	1,027,251	79.52%	72.59%	79.17%	0.0048	0.0000
35.5	813,071	79.19%	71.66%	78.35%	0.0057	0.0001
36.5	721,408	78.70%	70.72%	77.52%	0.0064	0.0001
37.5	694,424	78.04%	69.77%	76.67%	0.0068	0.0002
38.5	590,798	77.66%	68.81%	75.80%	0.0078	0.0003
39.5	446,677	76.80%	67.84%	74.91%	0.0080	0.0004
40.5	325,370	76.97%	66.85%	74.01%	0.0102	0.0009
41.5	276,447	76.54%	65.86%	73.08%	0.0114	0.0012
42.5	203,201	76.52%	64.85%	72.14%	0.0136	0.0019
43.5	116,156	76.39%	63.84%	71.19%	0.0158	0.0027
44.5	94,316	76.39%	62.81%	70.21%	0.0184	0.0038
45.5	65,420	76.67%	61.78%	69.22%	0.0222	0.0056
46.5	68,672	76.67%	60.73%	68.20%	0.0254	0.0072
47.5	69,631	76.67%	59.67%	67.18%	0.0289	0.0090

Account 378 Curve Fitting

[1] Age (Years)	[2] Exposures (Dollars)	[3] Observed Life Table (OLT)	[4] Company R0.5-55	[5] GCSC R1-60	[6] Company SSD	[7] GCSC SSD
48.5	69,196	76.31%	58.60%	66.13%	0.0313	0.0104
49.5	69,090	76.21%	57.53%	65.06%	0.0349	0.0124
50.5	64,594	71.87%	56.44%	63.98%	0.0238	0.0062
51.5	56,564	71.70%	55.35%	62.88%	0.0267	0.0078
52.5	54,586	70.74%	54.24%	61.76%	0.0272	0.0081
53.5	43,159	68.02%	53.13%	60.63%	0.0222	0.0055
54.5	39,617	64.45%	52.01%	59.48%	0.0155	0.0025
55.5	34,397	62.08%	50.88%	58.31%	0.0125	0.0014
56.5	34,518	61.03%	49.75%	57.13%	0.0127	0.0015
57.5	29,316	60.35%	48.61%	55.94%	0.0138	0.0019
58.5	23,976	59.91%	47.46%	54.73%	0.0155	0.0027
59.5	23,260	59.91%	46.31%	53.51%	0.0185	0.0041
60.5	22,157	58.43%	45.16%	52.28%	0.0176	0.0038
61.5	21,349	56.99%	44.00%	51.03%	0.0169	0.0035
62.5	19,941	53.56%	42.83%	49.78%	0.0115	0.0014
63.5	18,770	53.48%	41.67%	48.51%	0.0140	0.0025
64.5	11,803	49.19%	40.50%	47.24%	0.0075	0.0004
65.5	10,949	48.69%	39.33%	45.95%	0.0088	0.0007
66.5	4,546	48.69%	38.17%	44.66%	0.0111	0.0016
67.5			37.00%	43.37%		
Sum of Squared Differences				[8]	0.5875	0.1164
Sum of Squared Differences				[9]	0.1505	0.0124

[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.

[9] = Sum of squared differences up to the 1% of beginning exposures cut-off.

*The bold horizontal line represents the 1% of beginning exposures cut-off.

Account 380 Curve Fitting

[1] Age (Years)	[2] Exposures (Dollars)	[3] Observed Life Table (OLT)	[4] Company R2-55	[5] GCSC R1.5-60	[6] Company SSD	[7] GCSC SSD
0.0	116,594,145	100.00%	100.00%	100.00%	0.0000	0.0000
0.5	107,465,003	99.99%	99.91%	99.85%	0.0000	0.0000
1.5	100,314,458	99.91%	99.73%	99.55%	0.0000	0.0000
2.5	94,890,220	99.57%	99.54%	99.24%	0.0000	0.0000
3.5	88,971,602	98.86%	99.34%	98.92%	0.0000	0.0000
4.5	82,963,693	98.69%	99.12%	98.59%	0.0000	0.0000
5.5	75,576,426	98.60%	98.89%	98.25%	0.0000	0.0000
6.5	73,105,884	98.48%	98.65%	97.90%	0.0000	0.0000
7.5	67,168,572	98.44%	98.39%	97.53%	0.0000	0.0001
8.5	65,032,645	98.34%	98.12%	97.16%	0.0000	0.0001
9.5	61,906,769	98.05%	97.83%	96.78%	0.0000	0.0002
10.5	57,305,936	97.81%	97.53%	96.38%	0.0000	0.0002
11.5	57,333,564	96.19%	97.21%	95.97%	0.0001	0.0000
12.5	58,978,996	95.11%	96.87%	95.55%	0.0003	0.0000
13.5	58,369,312	93.90%	96.52%	95.12%	0.0007	0.0001
14.5	58,191,262	93.57%	96.14%	94.67%	0.0007	0.0001
15.5	53,505,582	93.30%	95.75%	94.21%	0.0006	0.0001
16.5	52,626,479	93.00%	95.33%	93.74%	0.0005	0.0001
17.5	52,088,229	92.83%	94.89%	93.26%	0.0004	0.0000
18.5	51,898,817	92.68%	94.43%	92.76%	0.0003	0.0000
19.5	49,545,481	92.54%	93.95%	92.25%	0.0002	0.0000
20.5	47,014,169	92.34%	93.44%	91.72%	0.0001	0.0000
21.5	41,538,234	92.11%	92.91%	91.18%	0.0001	0.0001
22.5	40,826,538	89.99%	92.35%	90.62%	0.0006	0.0000
23.5	40,455,536	87.55%	91.76%	90.05%	0.0018	0.0006
24.5	40,614,235	87.00%	91.15%	89.46%	0.0017	0.0006
25.5	38,982,405	86.61%	90.50%	88.85%	0.0015	0.0005
26.5	38,438,843	86.21%	89.83%	88.23%	0.0013	0.0004
27.5	36,423,874	85.95%	89.13%	87.59%	0.0010	0.0003
28.5	34,531,845	85.82%	88.39%	86.93%	0.0007	0.0001
29.5	32,968,189	85.67%	87.62%	86.24%	0.0004	0.0000
30.5	31,526,891	85.61%	86.81%	85.54%	0.0001	0.0000
31.5	28,963,260	85.56%	85.97%	84.82%	0.0000	0.0001
32.5	25,140,890	85.48%	85.10%	84.08%	0.0000	0.0002
33.5	22,592,074	85.42%	84.18%	83.31%	0.0002	0.0004
34.5	19,828,858	85.33%	83.23%	82.52%	0.0004	0.0008
35.5	18,193,162	85.27%	82.24%	81.71%	0.0009	0.0013
36.5	16,337,102	85.23%	81.20%	80.87%	0.0016	0.0019
37.5	14,190,241	85.18%	80.13%	80.01%	0.0026	0.0027
38.5	12,265,446	85.08%	79.01%	79.12%	0.0037	0.0035
39.5	10,402,289	84.84%	77.85%	78.21%	0.0049	0.0044
40.5	8,870,901	84.21%	76.64%	77.27%	0.0057	0.0048
41.5	7,622,959	82.39%	75.39%	76.31%	0.0049	0.0037
42.5	6,433,620	80.61%	74.09%	75.31%	0.0043	0.0028
43.5	5,301,854	79.22%	72.75%	74.29%	0.0042	0.0024
44.5	4,651,264	77.42%	71.36%	73.25%	0.0037	0.0017
45.5	4,245,295	76.33%	69.92%	72.17%	0.0041	0.0017
46.5	3,842,937	75.32%	68.43%	71.06%	0.0047	0.0018
47.5	3,456,133	71.79%	66.90%	69.93%	0.0024	0.0003

Account 380 Curve Fitting

[1] Age (Years)	[2] Exposures (Dollars)	[3] Observed Life Table (OLT)	[4] Company R2-55	[5] GCSC R1.5-60	[6] Company SSD	[7] GCSC SSD
48.5	3,204,900	69.96%	65.32%	68.77%	0.0022	0.0001
49.5	2,940,571	68.48%	63.70%	67.58%	0.0023	0.0001
50.5	2,744,973	66.54%	62.03%	66.36%	0.0020	0.0000
51.5	2,654,718	65.28%	60.32%	65.12%	0.0025	0.0000
52.5	2,499,084	62.97%	58.57%	63.84%	0.0019	0.0001
53.5	2,198,507	60.32%	56.78%	62.54%	0.0013	0.0005
54.5	1,993,365	58.39%	54.95%	61.21%	0.0012	0.0008
55.5	2,182,094	58.05%	53.09%	59.85%	0.0025	0.0003
56.5	2,338,200	57.42%	51.20%	58.47%	0.0039	0.0001
57.5	1,972,302	52.25%	49.28%	57.07%	0.0009	0.0023
58.5	1,762,308	52.22%	47.33%	55.64%	0.0024	0.0012
59.5	1,547,607	52.22%	45.37%	54.19%	0.0047	0.0004
60.5	1,355,797	52.11%	43.40%	52.72%	0.0076	0.0000
61.5	1,105,666	47.96%	41.41%	51.23%	0.0043	0.0011
62.5	784,369	40.39%	39.42%	49.73%	0.0001	0.0087
63.5	658,775	38.10%	37.43%	48.21%	0.0000	0.0102
64.5	560,707	36.42%	35.45%	46.67%	0.0001	0.0105
65.5	441,377	32.32%	33.49%	45.13%	0.0001	0.0164
66.5	355,393	30.60%	31.54%	43.58%	0.0001	0.0168
67.5	283,551	28.75%	29.62%	42.02%	0.0001	0.0176
68.5	226,364	27.77%	27.73%	40.46%	0.0000	0.0161
69.5	163,792	26.12%	25.88%	38.89%	0.0000	0.0163
70.5	130,550	25.73%	24.08%	37.33%	0.0003	0.0135
71.5	111,781	24.78%	22.32%	35.78%	0.0006	0.0121
72.5	102,188	25.13%	20.62%	34.24%	0.0020	0.0083
73.5	86,812	23.07%	18.98%	32.70%	0.0017	0.0093
74.5	72,509	22.27%	17.40%	31.18%	0.0024	0.0079
75.5	11,962	22.16%	15.88%	29.68%	0.0039	0.0057
76.5	0	21.81%	14.44%	28.20%	0.0054	0.0041
77.5	0	21.81%	13.07%	26.75%	0.0076	0.0024
78.5	0	21.81%	11.77%	25.31%	0.0101	0.0012
79.5	0	21.81%	10.55%	23.91%	0.0127	0.0004
80.5	0	21.81%	9.40%	22.54%	0.0154	0.0001
81.5	0	21.81%	8.33%	21.21%	0.0182	0.0000
82.5	0	21.81%	7.33%	19.91%	0.0210	0.0004
83.5	0	21.81%	6.41%	18.64%	0.0237	0.0010
84.5	0	21.81%	5.56%	17.42%	0.0264	0.0019
85.5	0	21.81%	4.77%	16.24%	0.0290	0.0031
86.5	0	21.81%	4.06%	15.10%	0.0315	0.0045
87.5	0	21.81%	3.41%	14.00%	0.0338	0.0061
88.5	0	21.81%	2.83%	12.94%	0.0360	0.0079
89.5	0	21.81%	2.31%	11.93%	0.0380	0.0098
90.5	0	21.81%	1.86%	10.97%	0.0398	0.0118
91.5	0	21.81%	1.46%	10.05%	0.0414	0.0138
92.5	0	21.81%	1.11%	9.17%	0.0428	0.0160
93.5	0	21.81%	0.82%	8.34%	0.0440	0.0181
94.5	0	21.81%	0.59%	7.55%	0.0450	0.0203
95.5	0	21.81%	0.40%	6.81%	0.0459	0.0225
96.5	0	21.81%	0.25%	6.12%	0.0465	0.0246

Account 380 Curve Fitting

[1]	[2]	[3]	[4]	[5]	[6]	[7]
Age (Years)	**Exposures (Dollars)**	**Observed Life Table (OLT)**	**Company R2-55**	**GCSC R1.5-60**	**Company SSD**	**GCSC SSD**
97.5	0	21.81%	0.14%	5.46%	0.0469	0.0267
98.5	125	21.81%	0.07%	4.86%	0.0473	0.0287
99.5	125	21.81%	0.03%	4.29%	0.0474	0.0307
100.5	118	20.53%	0.01%	3.77%	0.0421	0.0281
101.5	118	20.53%	0.00%	3.29%	0.0421	0.0297
102.5	118	20.53%	0.00%	2.86%	0.0421	0.0312
103.5	118	20.53%	0.00%	2.46%	0.0421	0.0326
104.5	85	14.74%	0.00%	2.11%	0.0217	0.0160
105.5	85	14.74%	0.00%	1.79%	0.0217	0.0168
106.5	85	14.74%	0.00%	1.52%	0.0217	0.0175
107.5	85	14.74%	0.00%	1.27%	0.0217	0.0181
108.5			0.00%	1.06%		
Sum of Squared Differences				[8]	1.1239	0.6612
Sum of Squared Differences				[9]	0.0966	0.0445

[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.

[9] = Sum of squared differences up to the 1% of beginning exposures cut-off.

*The bold horizontal line represents the 1% of beginning exposures cut-off.

Account 385 Curve Fitting

[1] Age (Years)	[2] Exposures (Dollars)	[3] Observed Life Table (OLT)	[4] Company R1-55	[5] GCSC R2.5-65	[6] Company SSD	[7] GCSC SSD
0.0	7,329,754	100.00%	100.00%	100.00%	0.0000	0.0000
0.5	6,770,833	100.00%	99.77%	99.96%	0.0000	0.0000
1.5	6,377,130	99.97%	99.29%	99.87%	0.0000	0.0000
2.5	5,601,269	99.97%	98.80%	99.77%	0.0001	0.0000
3.5	4,628,132	99.30%	98.30%	99.67%	0.0001	0.0000
4.5	5,885,238	99.21%	97.78%	99.57%	0.0002	0.0000
5.5	5,742,060	98.99%	97.26%	99.45%	0.0003	0.0000
6.5	5,673,818	98.91%	96.72%	99.33%	0.0005	0.0000
7.5	5,583,092	98.49%	96.17%	99.20%	0.0005	0.0001
8.5	5,371,356	97.81%	95.61%	99.07%	0.0005	0.0002
9.5	5,270,889	96.59%	95.03%	98.92%	0.0002	0.0005
10.5	5,212,629	96.37%	94.45%	98.77%	0.0004	0.0006
11.5	5,159,292	95.55%	93.85%	98.60%	0.0003	0.0009
12.5	5,293,349	95.00%	93.24%	98.43%	0.0003	0.0012
13.5	5,202,536	94.27%	92.62%	98.24%	0.0003	0.0016
14.5	5,411,147	94.18%	91.99%	98.05%	0.0005	0.0015
15.5	5,239,044	93.98%	91.35%	97.84%	0.0007	0.0015
16.5	5,352,280	93.88%	90.69%	97.62%	0.0010	0.0014
17.5	5,419,259	93.81%	90.03%	97.38%	0.0014	0.0013
18.5	5,426,824	93.69%	89.35%	97.13%	0.0019	0.0012
19.5	5,109,881	93.60%	88.66%	96.87%	0.0024	0.0011
20.5	4,972,475	93.58%	87.96%	96.59%	0.0032	0.0009
21.5	4,820,748	93.45%	87.25%	96.30%	0.0038	0.0008
22.5	4,866,065	93.15%	86.52%	95.99%	0.0044	0.0008
23.5	4,841,729	93.10%	85.78%	95.66%	0.0054	0.0007
24.5	3,321,793	92.84%	85.02%	95.32%	0.0061	0.0006
25.5	3,188,001	92.78%	84.25%	94.95%	0.0073	0.0005
26.5	2,911,224	92.23%	83.47%	94.57%	0.0077	0.0005
27.5	2,785,687	92.33%	82.67%	94.16%	0.0093	0.0003
28.5	2,696,712	92.20%	81.85%	93.74%	0.0107	0.0002
29.5	2,661,170	92.19%	81.01%	93.29%	0.0125	0.0001
30.5	2,544,977	91.82%	80.16%	92.81%	0.0136	0.0001
31.5	2,427,097	91.40%	79.28%	92.32%	0.0147	0.0001
32.5	2,203,455	91.44%	78.39%	91.80%	0.0170	0.0000
33.5	2,022,949	91.28%	77.48%	91.25%	0.0190	0.0000
34.5	1,692,251	91.21%	76.55%	90.67%	0.0215	0.0000
35.5	1,537,989	91.16%	75.60%	90.07%	0.0242	0.0001
36.5	1,336,431	91.03%	74.62%	89.44%	0.0269	0.0003
37.5	1,142,553	91.00%	73.63%	88.77%	0.0302	0.0005
38.5	1,114,413	90.69%	72.62%	88.08%	0.0327	0.0007
39.5	1,047,958	90.56%	71.58%	87.35%	0.0360	0.0010
40.5	984,381	90.42%	70.52%	86.59%	0.0396	0.0015
41.5	936,568	90.08%	69.44%	85.80%	0.0426	0.0018
42.5	882,183	89.83%	68.34%	84.97%	0.0462	0.0024
43.5	836,223	89.49%	67.22%	84.10%	0.0496	0.0029
44.5	762,556	89.21%	66.08%	83.20%	0.0535	0.0036
45.5	692,891	88.66%	64.92%	82.25%	0.0564	0.0041
46.5	648,181	88.44%	63.73%	81.26%	0.0611	0.0052
47.5	561,106	86.42%	62.53%	80.23%	0.0571	0.0038

Account 385 Curve Fitting

[1]	[2]	[3]	[4]	[5]	[6]	[7]
Age (Years)	**Exposures (Dollars)**	**Observed Life Table (OLT)**	**Company R1-55**	**GCSC R2.5-65**	**Company SSD**	**GCSC SSD**
48.5	466,956	85.44%	61.30%	79.16%	0.0583	0.0039
49.5	419,760	83.77%	60.06%	78.04%	0.0562	0.0033
50.5	352,978	81.95%	58.79%	76.88%	0.0536	0.0026
51.5	300,307	79.10%	57.51%	75.67%	0.0466	0.0012
52.5	248,989	76.83%	56.21%	74.40%	0.0425	0.0006
53.5	218,248	76.81%	54.90%	73.09%	0.0480	0.0014
54.5	185,796	75.60%	53.57%	71.73%	0.0485	0.0015
55.5	149,400	74.74%	52.22%	70.32%	0.0507	0.0020
56.5	118,337	72.96%	50.86%	68.86%	0.0488	0.0017
57.5	100,775	69.71%	49.49%	67.34%	0.0409	0.0006
58.5	72,635	64.99%	48.11%	65.77%	0.0285	0.0001
59.5	60,431	59.57%	46.71%	64.15%	0.0165	0.0021
60.5	49,608	59.17%	45.31%	62.48%	0.0192	0.0011
61.5	38,863	50.73%	43.90%	60.76%	0.0047	0.0101
62.5	30,451	43.87%	42.48%	58.99%	0.0002	0.0229
63.5	18,883	41.98%	41.06%	57.18%	0.0001	0.0231
64.5	16,926	39.32%	39.64%	55.32%	0.0000	0.0256
65.5	12,147	31.08%	38.21%	53.43%	0.0051	0.0500
66.5	8,533	26.61%	36.79%	51.50%	0.0104	0.0620
67.5	7,953	25.26%	35.37%	49.54%	0.0102	0.0590
68.5	5,693	19.23%	33.95%	47.56%	0.0217	0.0802
69.5	3,273	11.50%	32.54%	45.55%	0.0442	0.1160
70.5			31.13%	43.53%		
Sum of Squared Differences				[8]	1.3789	0.5172
Sum of Squared Differences				[9]	1.2181	0.0652

[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.
[9] = Sum of squared differences up to the 1% of beginning exposures cut-off.
*The bold horizontal line represents the 1% of beginning exposures cut-off.

TGS
Gas Division
376.01, 376.02

Observed Life Table
Retirement Expr. 1999 TO 2018
Placement Years 1900 TO 2018

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	$219,690,681.44	$7,617.05	0.00003	100.00
0.5 - 1.5	$195,306,390.24	$75,846.15	0.00039	100.00
1.5 - 2.5	$188,744,008.12	$74,636.50	0.00040	99.96
2.5 - 3.5	$171,613,456.04	$199,019.49	0.00116	99.92
3.5 - 4.5	$146,454,192.23	$192,640.38	0.00132	99.80
4.5 - 5.5	$135,241,300.43	$99,164.15	0.00073	99.67
5.5 - 6.5	$106,212,419.90	$40,047.88	0.00038	99.60
6.5 - 7.5	$92,213,157.49	$183,372.55	0.00199	99.56
7.5 - 8.5	$89,969,969.72	$97,036.46	0.00108	99.36
8.5 - 9.5	$87,960,907.31	$73,135.01	0.00083	99.26
9.5 - 10.5	$85,998,804.07	$94,686.82	0.00110	99.17
10.5 - 11.5	$77,379,937.60	$819,681.92	0.01059	99.06
11.5 - 12.5	$75,518,214.05	$528,604.87	0.00700	98.01
12.5 - 13.5	$70,499,245.63	$519,290.43	0.00737	97.33
13.5 - 14.5	$71,971,301.99	$536,582.82	0.00746	96.61
14.5 - 15.5	$69,806,280.13	$655,247.96	0.00939	95.89
15.5 - 16.5	$61,984,877.35	$209,295.86	0.00338	94.99
16.5 - 17.5	$65,539,714.09	$906,596.71	0.01383	94.67
17.5 - 18.5	$66,539,550.92	$208,879.77	0.00314	93.36
18.5 - 19.5	$64,706,315.89	$240,578.04	0.00372	93.07
19.5 - 20.5	$61,875,774.53	$78,812.99	0.00127	92.72
20.5 - 21.5	$63,172,653.18	$272,977.89	0.00432	92.60
21.5 - 22.5	$61,303,303.87	$139,288.21	0.00227	92.20
22.5 - 23.5	$62,057,217.96	$557,389.20	0.00898	91.99
23.5 - 24.5	$62,611,735.80	$125,772.82	0.00201	91.17
24.5 - 25.5	$63,413,412.30	$93,402.58	0.00147	90.98
25.5 - 26.5	$64,008,670.36	$195,203.17	0.00305	90.85
26.5 - 27.5	$63,887,375.09	$130,090.06	0.00204	90.57
27.5 - 28.5	$58,637,658.51	$38,957.31	0.00066	90.39
28.5 - 29.5	$56,718,970.05	$91,977.49	0.00162	90.33
29.5 - 30.5	$55,897,718.45	$43,319.37	0.00077	90.18
30.5 - 31.5	$53,998,763.66	$123,119.49	0.00228	90.11
31.5 - 32.5	$50,388,934.97	$111,626.65	0.00222	89.91
32.5 - 33.5	$45,005,678.53	$43,982.08	0.00098	89.71
33.5 - 34.5	$39,099,171.04	$30,961.06	0.00079	89.62
34.5 - 35.5	$34,163,960.54	$36,578.24	0.00107	89.55
35.5 - 36.5	$32,402,057.63	$63,707.66	0.00197	89.45

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Gas Division
376.01, 376.02

Observed Life Table
Retirement Expr. 1999 TO 2018
Placement Years 1900 TO 2018

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	$28,969,255.25	$55,831.70	0.00193	89.28
37.5 - 38.5	$25,324,527.51	$73,003.99	0.00288	89.11
38.5 - 39.5	$22,451,061.30	$83,813.74	0.00373	88.85
39.5 - 40.5	$20,073,623.94	$44,640.64	0.00222	88.52
40.5 - 41.5	$18,013,628.14	$31,850.02	0.00177	88.32
41.5 - 42.5	$17,112,213.73	$14,992.18	0.00088	88.16
42.5 - 43.5	$16,394,131.14	$17,654.68	0.00108	88.09
43.5 - 44.5	$15,646,292.19	$17,888.03	0.00114	87.99
44.5 - 45.5	$14,033,332.57	$14,816.94	0.00106	87.89
45.5 - 46.5	$12,868,356.45	$10,362.32	0.00081	87.80
46.5 - 47.5	$12,046,777.45	$30,155.84	0.00250	87.73
47.5 - 48.5	$11,445,766.72	$66,670.45	0.00582	87.51
48.5 - 49.5	$11,008,706.91	$68,939.62	0.00626	87.00
49.5 - 50.5	$10,297,761.28	$22,463.22	0.00218	86.45
50.5 - 51.5	$9,708,711.67	$56,324.40	0.00580	86.26
51.5 - 52.5	$9,562,090.11	$196,277.72	0.02053	85.76
52.5 - 53.5	$8,929,592.67	$86,602.55	0.00970	84.00
53.5 - 54.5	$8,462,127.19	$70,429.02	0.00832	83.19
54.5 - 55.5	$7,770,757.91	$38,578.99	0.00496	82.50
55.5 - 56.5	$7,645,944.17	$36,477.72	0.00477	82.09
56.5 - 57.5	$7,924,112.98	$149,814.77	0.01891	81.70
57.5 - 58.5	$7,090,829.21	$137,169.90	0.01934	80.15
58.5 - 59.5	$6,367,045.31	$110,929.88	0.01742	78.60
59.5 - 60.5	$5,416,310.43	$95,515.89	0.01763	77.23
60.5 - 61.5	$4,904,822.54	$116,591.01	0.02377	75.87
61.5 - 62.5	$4,497,046.53	$111,568.16	0.02481	74.07
62.5 - 63.5	$3,960,526.37	$127,905.19	0.03229	72.23
63.5 - 64.5	$3,419,716.18	$94,552.07	0.02765	69.90
64.5 - 65.5	$3,099,812.11	$259,294.79	0.08365	67.96
65.5 - 66.5	$2,570,914.32	$122,248.88	0.04755	62.28
66.5 - 67.5	$2,195,551.44	$91,188.62	0.04153	59.32
67.5 - 68.5	$1,745,149.82	$47,381.06	0.02715	56.85
68.5 - 69.5	$1,615,528.76	$86,104.25	0.05330	55.31
69.5 - 70.5	$1,366,106.51	$86,610.76	0.06340	52.36
70.5 - 71.5	$1,094,421.75	$52,526.80	0.04800	49.04
71.5 - 72.5	$981,172.95	$33,369.06	0.03401	46.69
72.5 - 73.5	$870,658.89	$70,866.84	0.08139	45.10

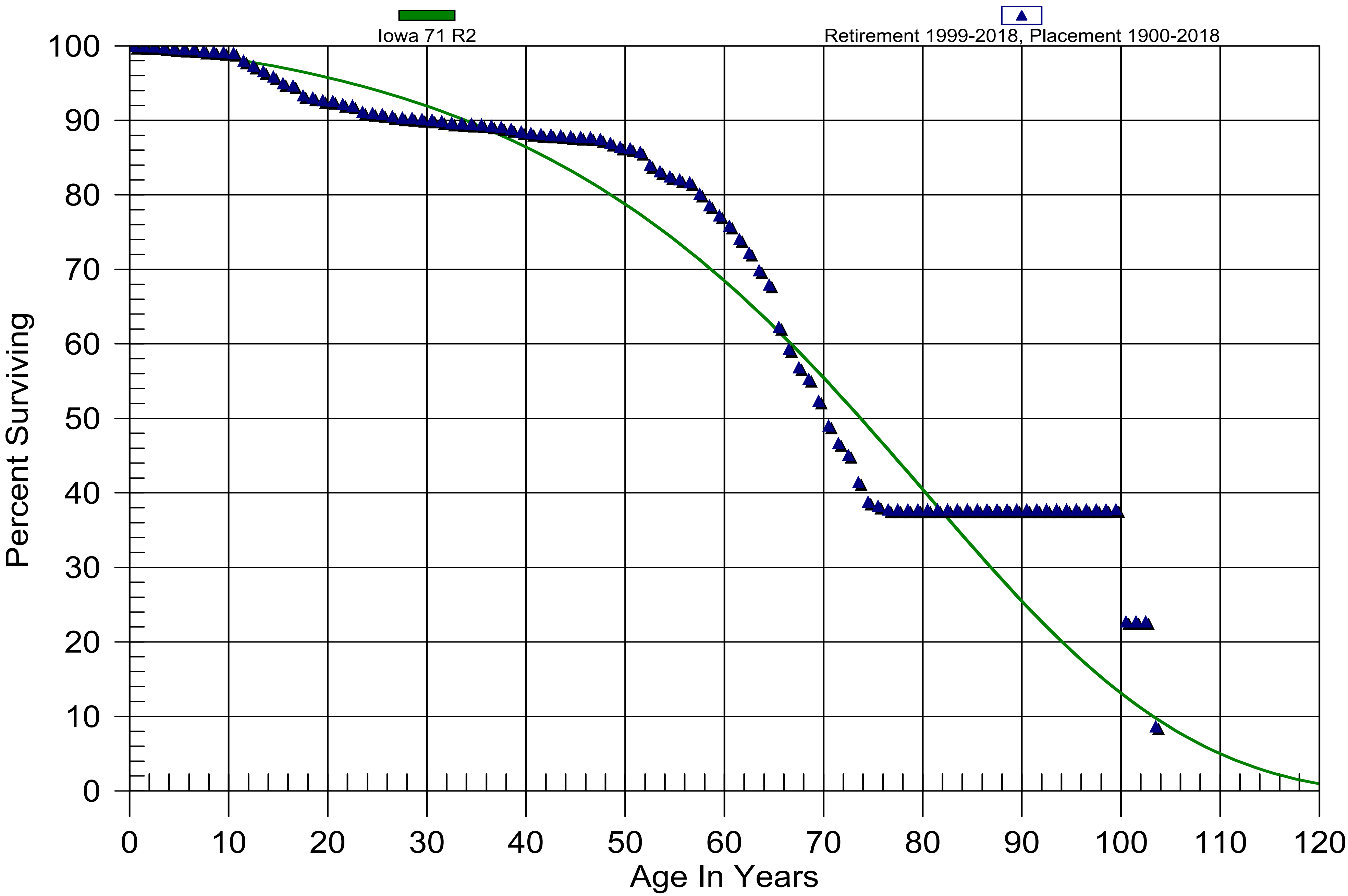
TGS
Gas Division
376.01, 376.02

Observed Life Table
Retirement Expr. 1999 TO 2018
Placement Years 1900 TO 2018

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	$702,380.05	$44,123.86	0.06282	41.43
74.5 - 75.5	$643,082.19	$9,419.63	0.01465	38.83
75.5 - 76.5	$405,062.56	$5,224.56	0.01290	38.26
76.5 - 77.5	$0.00	$0.00	0.00000	37.76
77.5 - 78.5	$0.00	$0.00	0.00000	37.76
78.5 - 79.5	$0.00	$0.00	0.00000	37.76
79.5 - 80.5	$0.00	$0.00	0.00000	37.76
80.5 - 81.5	$0.00	$0.00	0.00000	37.76
81.5 - 82.5	$0.00	$0.00	0.00000	37.76
82.5 - 83.5	$0.00	$0.00	0.00000	37.76
83.5 - 84.5	$0.00	$0.00	0.00000	37.76
84.5 - 85.5	$0.00	$0.00	0.00000	37.76
85.5 - 86.5	$0.00	$0.00	0.00000	37.76
86.5 - 87.5	$0.00	$0.00	0.00000	37.76
87.5 - 88.5	$0.00	$0.00	0.00000	37.76
88.5 - 89.5	$0.00	$0.00	0.00000	37.76
89.5 - 90.5	$0.00	$0.00	0.00000	37.76
90.5 - 91.5	$0.00	$0.00	0.00000	37.76
91.5 - 92.5	$0.00	$0.00	0.00000	37.76
92.5 - 93.5	$0.00	$0.00	0.00000	37.76
93.5 - 94.5	$0.00	$0.00	0.00000	37.76
94.5 - 95.5	$0.00	$0.00	0.00000	37.76
95.5 - 96.5	$0.00	$0.00	0.00000	37.76
96.5 - 97.5	$0.00	$0.00	0.00000	37.76
97.5 - 98.5	$1,800.54	$0.00	0.00000	37.76
98.5 - 99.5	$1,411.54	($2.00)	-0.00142	37.76
99.5 - 100.5	$1,413.54	$562.38	0.39785	37.82
100.5 - 101.5	$851.16	$0.00	0.00000	22.77
101.5 - 102.5	$851.16	$0.00	0.00000	22.77
102.5 - 103.5	$851.16	$527.16	0.61934	22.77

TGS

Gas Division
376.01, 376.02
Original And Smooth Survivor Curves



TGS
Gas Division
378.01, 378.02

Observed Life Table

Retirement Expr. 1999 TO 2018
Placement Years 1942 TO 2018

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	$10,475,716.56	$1,705.07	0.00016	100.00
0.5 - 1.5	$9,609,115.13	$75,908.20	0.00790	99.98
1.5 - 2.5	$9,047,425.81	$39,524.05	0.00437	99.19
2.5 - 3.5	$8,293,376.76	$80,941.60	0.00976	98.76
3.5 - 4.5	$5,838,124.16	$47,650.90	0.00816	97.80
4.5 - 5.5	$5,366,166.77	$47,089.59	0.00878	97.00
5.5 - 6.5	$4,558,746.01	$58,744.75	0.01289	96.15
6.5 - 7.5	$4,301,577.26	$8,464.96	0.00197	94.91
7.5 - 8.5	$4,235,477.10	$14,223.70	0.00336	94.72
8.5 - 9.5	$4,337,549.16	$27,084.87	0.00624	94.40
9.5 - 10.5	$4,147,945.14	$0.00	0.00000	93.81
10.5 - 11.5	$3,322,035.27	$891.17	0.00027	93.81
11.5 - 12.5	$3,063,834.00	$1,041.32	0.00034	93.79
12.5 - 13.5	$2,811,522.13	$24,606.33	0.00875	93.76
13.5 - 14.5	$2,614,795.52	$24,897.66	0.00952	92.94
14.5 - 15.5	$2,346,578.43	$4,033.78	0.00172	92.05
15.5 - 16.5	$2,106,072.51	$17,375.09	0.00825	91.89
16.5 - 17.5	$2,175,373.37	$2,332.83	0.00107	91.14
17.5 - 18.5	$2,118,433.34	$2,671.50	0.00126	91.04
18.5 - 19.5	$2,191,308.31	$17,512.62	0.00799	90.92
19.5 - 20.5	$2,268,930.03	$2,656.54	0.00117	90.20
20.5 - 21.5	$2,363,097.51	$0.00	0.00000	90.09
21.5 - 22.5	$2,400,524.30	$0.00	0.00000	90.09
22.5 - 23.5	$2,484,184.42	$4,992.50	0.00201	90.09
23.5 - 24.5	$2,516,202.93	$33,834.07	0.01345	89.91
24.5 - 25.5	$2,398,640.38	$81,327.57	0.03391	88.70
25.5 - 26.5	$2,185,410.30	$57,311.94	0.02622	85.69
26.5 - 27.5	$2,051,556.55	$4,127.75	0.00201	83.45
27.5 - 28.5	$1,847,686.49	($1,738.56)	-0.00094	83.28
28.5 - 29.5	$1,554,431.84	$27,071.56	0.01742	83.36
29.5 - 30.5	$1,510,061.28	$0.00	0.00000	81.90
30.5 - 31.5	$1,418,225.28	$19,323.34	0.01363	81.90
31.5 - 32.5	$1,350,926.90	$4,376.12	0.00324	80.79
32.5 - 33.5	$1,281,381.96	$5,240.69	0.00409	80.53
33.5 - 34.5	$1,116,868.16	$9,396.39	0.00841	80.20
34.5 - 35.5	$1,027,250.57	$4,258.13	0.00415	79.52
35.5 - 36.5	$813,071.35	$5,011.45	0.00616	79.19

TGS
Gas Division
378.01, 378.02

Observed Life Table
Retirement Expr. 1999 TO 2018
Placement Years 1942 TO 2018

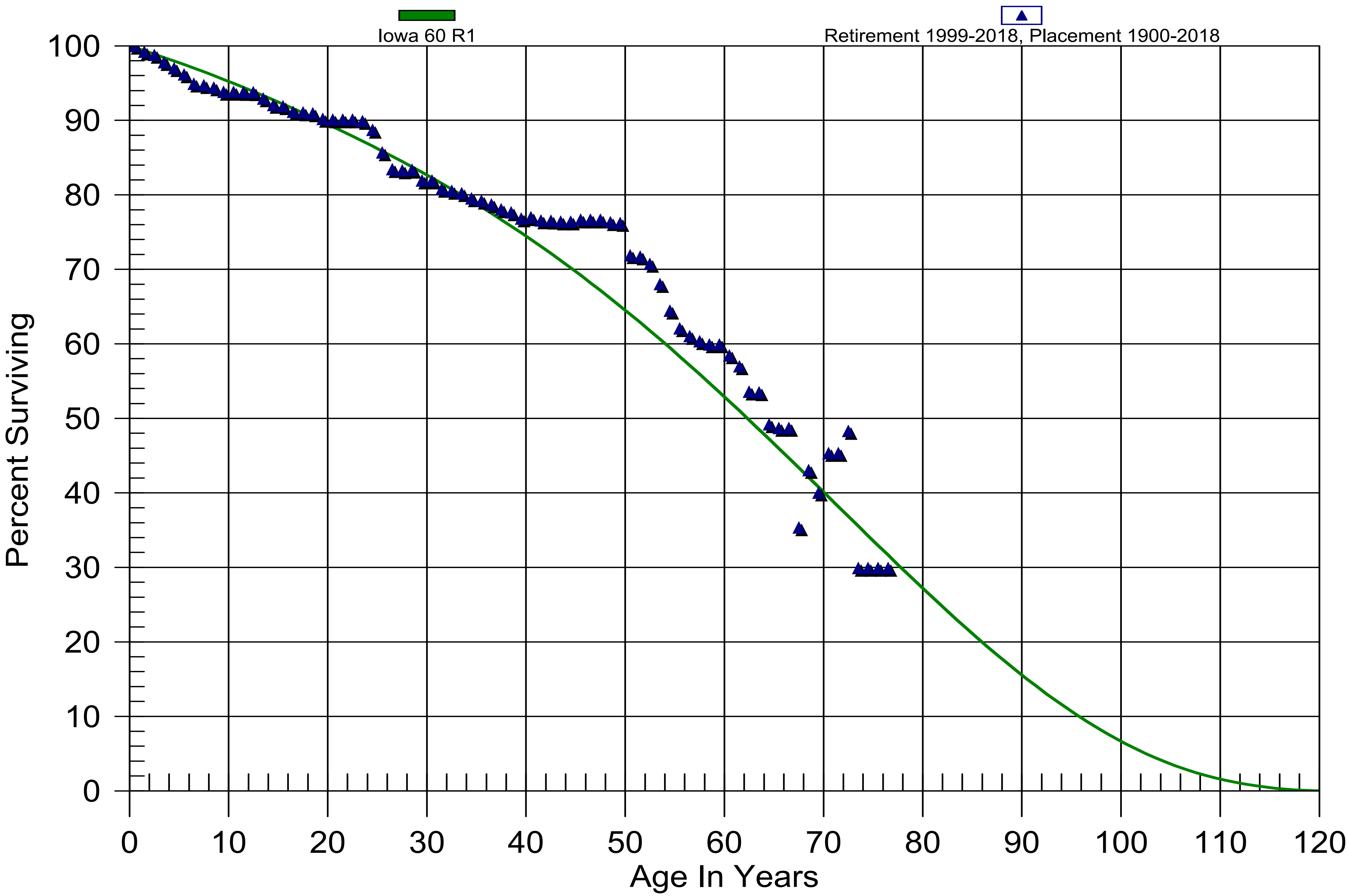
Age Interval	*$ Surviving At Beginning of Age Interval*	*$ Retired During The Age Interval*	*Retirement Ratio*	*% Surviving At Beginning of Age Interval*
36.5 - 37.5	$721,408.01	$6,113.20	0.00847	78.70
37.5 - 38.5	$694,423.81	$3,388.72	0.00488	78.04
38.5 - 39.5	$590,798.09	$6,531.44	0.01106	77.66
39.5 - 40.5	$446,677.16	($1,025.43)	-0.00230	76.80
40.5 - 41.5	$325,370.13	$1,851.48	0.00569	76.97
41.5 - 42.5	$276,446.72	$44.66	0.00016	76.54
42.5 - 43.5	$203,200.54	$350.38	0.00172	76.52
43.5 - 44.5	$116,156.16	$0.00	0.00000	76.39
44.5 - 45.5	$94,315.89	($338.91)	-0.00359	76.39
45.5 - 46.5	$65,420.05	$0.00	0.00000	76.67
46.5 - 47.5	$68,672.31	$0.00	0.00000	76.67
47.5 - 48.5	$69,631.09	$324.16	0.00466	76.67
48.5 - 49.5	$69,196.33	$95.05	0.00137	76.31
49.5 - 50.5	$69,090.08	$3,927.36	0.05684	76.21
50.5 - 51.5	$64,593.72	$152.80	0.00237	71.87
51.5 - 52.5	$56,563.92	$759.40	0.01343	71.70
52.5 - 53.5	$54,585.52	$2,101.77	0.03850	70.74
53.5 - 54.5	$43,158.74	$2,263.17	0.05244	68.02
54.5 - 55.5	$39,616.57	$1,459.78	0.03685	64.45
55.5 - 56.5	$34,397.44	$580.81	0.01689	62.08
56.5 - 57.5	$34,517.51	$385.12	0.01116	61.03
57.5 - 58.5	$29,316.39	$212.37	0.00724	60.35
58.5 - 59.5	$23,976.02	$0.00	0.00000	59.91
59.5 - 60.5	$23,260.02	$573.25	0.02465	59.91
60.5 - 61.5	$22,156.77	$548.28	0.02475	58.43
61.5 - 62.5	$21,349.49	$1,282.21	0.06006	56.99
62.5 - 63.5	$19,941.28	$32.94	0.00165	53.56
63.5 - 64.5	$18,770.34	$1,504.15	0.08013	53.48
64.5 - 65.5	$11,803.19	$119.34	0.01011	49.19
65.5 - 66.5	$10,948.85	$0.00	0.00000	48.69
66.5 - 67.5	$4,545.85	$1,244.19	0.27370	48.69
67.5 - 68.5	$2,520.66	($548.37)	-0.21755	35.37
68.5 - 69.5	$2,267.03	$160.00	0.07058	43.06
69.5 - 70.5	$2,107.03	($280.08)	-0.13293	40.02
70.5 - 71.5	$1,839.11	$0.00	0.00000	45.34
71.5 - 72.5	$1,839.11	($120.00)	-0.06525	45.34
72.5 - 73.5	$1,959.11	$746.11	0.38084	48.30

TGS
Gas Division
378.01, 378.02

Observed Life Table
Retirement Expr. 1999 TO 2018
Placement Years 1942 TO 2018

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	$658.00	$0.00	0.00000	29.90
74.5 - 75.5	$658.00	$0.00	0.00000	29.90
75.5 - 76.5	$539.00	$0.00	0.00000	29.90

TGS
Gas Division
378.01, 378.02
Original And Smooth Survivor Curves



TGS
Gas Division
380.01, 380.02

Observed Life Table

Retirement Expr. 1999 TO 2018
Placement Years 1900 TO 2018

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	$116,594,145.17	$13,526.74	0.00012	100.00
0.5 - 1.5	$107,465,003.25	$83,586.96	0.00078	99.99
1.5 - 2.5	$100,314,458.20	$344,613.56	0.00344	99.91
2.5 - 3.5	$94,890,220.46	$676,844.11	0.00713	99.57
3.5 - 4.5	$88,971,601.52	$146,105.62	0.00164	98.86
4.5 - 5.5	$82,963,693.39	$80,846.04	0.00097	98.69
5.5 - 6.5	$75,576,425.87	$94,130.47	0.00125	98.60
6.5 - 7.5	$73,105,883.90	$28,640.63	0.00039	98.48
7.5 - 8.5	$67,168,571.76	$69,641.40	0.00104	98.44
8.5 - 9.5	$65,032,644.66	$190,984.91	0.00294	98.34
9.5 - 10.5	$61,906,769.22	$148,724.27	0.00240	98.05
10.5 - 11.5	$57,305,936.37	$947,804.13	0.01654	97.81
11.5 - 12.5	$57,333,564.12	$648,411.58	0.01131	96.19
12.5 - 13.5	$58,978,995.71	$749,128.57	0.01270	95.11
13.5 - 14.5	$58,369,311.91	$200,638.88	0.00344	93.90
14.5 - 15.5	$58,191,261.51	$171,133.03	0.00294	93.57
15.5 - 16.5	$53,505,582.24	$170,958.14	0.00320	93.30
16.5 - 17.5	$52,626,478.94	$95,739.02	0.00182	93.00
17.5 - 18.5	$52,088,229.22	$85,808.17	0.00165	92.83
18.5 - 19.5	$51,898,817.19	$79,136.73	0.00152	92.68
19.5 - 20.5	$49,545,480.83	$107,383.39	0.00217	92.54
20.5 - 21.5	$47,014,168.89	$115,830.18	0.00246	92.34
21.5 - 22.5	$41,538,233.56	$957,898.04	0.02306	92.11
22.5 - 23.5	$40,826,538.12	$1,105,369.74	0.02707	89.99
23.5 - 24.5	$40,455,536.34	$252,888.67	0.00625	87.55
24.5 - 25.5	$40,614,234.66	$184,186.57	0.00454	87.00
25.5 - 26.5	$38,982,404.84	$177,622.56	0.00456	86.61
26.5 - 27.5	$38,438,843.02	$118,223.54	0.00308	86.21
27.5 - 28.5	$36,423,873.73	$56,155.23	0.00154	85.95
28.5 - 29.5	$34,531,845.46	$58,823.81	0.00170	85.82
29.5 - 30.5	$32,968,188.93	$22,077.01	0.00067	85.67
30.5 - 31.5	$31,526,891.27	$18,941.01	0.00060	85.61
31.5 - 32.5	$28,963,260.04	$26,787.28	0.00092	85.56
32.5 - 33.5	$25,140,890.47	$18,908.87	0.00075	85.48
33.5 - 34.5	$22,592,074.01	$24,210.34	0.00107	85.42
34.5 - 35.5	$19,828,857.62	$12,041.72	0.00061	85.33
35.5 - 36.5	$18,193,161.98	$10,197.59	0.00056	85.27

TGS
Gas Division
380.01, 380.02

Observed Life Table
Retirement Expr. 1999 TO 2018
Placement Years 1900 TO 2018

Age Interval	$ Surviving At Beginning of Age Interval	$ Retired During The Age Interval	Retirement Ratio	% Surviving At Beginning of Age Interval
36.5 - 37.5	$16,337,101.85	$9,484.80	0.00058	85.23
37.5 - 38.5	$14,190,241.17	$15,790.15	0.00111	85.18
38.5 - 39.5	$12,265,446.02	$35,228.84	0.00287	85.08
39.5 - 40.5	$10,402,288.76	$76,377.11	0.00734	84.84
40.5 - 41.5	$8,870,900.97	$191,761.54	0.02162	84.21
41.5 - 42.5	$7,622,958.62	$164,985.22	0.02164	82.39
42.5 - 43.5	$6,433,620.37	$111,291.04	0.01730	80.61
43.5 - 44.5	$5,301,853.56	$119,963.82	0.02263	79.22
44.5 - 45.5	$4,651,264.14	$65,896.99	0.01417	77.42
45.5 - 46.5	$4,245,294.98	$55,718.61	0.01312	76.33
46.5 - 47.5	$3,842,936.83	$180,460.95	0.04696	75.32
47.5 - 48.5	$3,456,132.72	$87,973.75	0.02545	71.79
48.5 - 49.5	$3,204,899.69	$67,953.37	0.02120	69.96
49.5 - 50.5	$2,940,570.70	$83,187.65	0.02829	68.48
50.5 - 51.5	$2,744,973.45	$51,853.56	0.01889	66.54
51.5 - 52.5	$2,654,717.76	$94,240.34	0.03550	65.28
52.5 - 53.5	$2,499,083.71	$105,146.61	0.04207	62.97
53.5 - 54.5	$2,198,506.77	$70,046.64	0.03186	60.32
54.5 - 55.5	$1,993,364.71	$11,749.63	0.00589	58.39
55.5 - 56.5	$2,182,093.72	$23,759.27	0.01089	58.05
56.5 - 57.5	$2,338,200.47	$210,344.21	0.08996	57.42
57.5 - 58.5	$1,972,302.26	$1,077.39	0.00055	52.25
58.5 - 59.5	$1,762,307.87	$40.58	0.00002	52.22
59.5 - 60.5	$1,547,607.29	$3,343.77	0.00216	52.22
60.5 - 61.5	$1,355,796.52	$107,967.30	0.07963	52.11
61.5 - 62.5	$1,105,666.22	$174,633.12	0.15794	47.96
62.5 - 63.5	$784,369.10	$44,453.15	0.05667	40.39
63.5 - 64.5	$658,774.95	$28,963.53	0.04397	38.10
64.5 - 65.5	$560,707.42	$63,191.02	0.11270	36.42
65.5 - 66.5	$441,377.40	$23,462.28	0.05316	32.32
66.5 - 67.5	$355,393.12	$21,463.70	0.06039	30.60
67.5 - 68.5	$283,551.42	$9,643.59	0.03401	28.75
68.5 - 69.5	$226,363.83	$13,451.81	0.05943	27.77
69.5 - 70.5	$163,792.02	$2,472.79	0.01510	26.12
70.5 - 71.5	$130,550.23	$4,819.34	0.03692	25.73
71.5 - 72.5	$111,780.89	($1,573.67)	-0.01408	24.78
72.5 - 73.5	$102,187.56	$8,385.34	0.08206	25.13

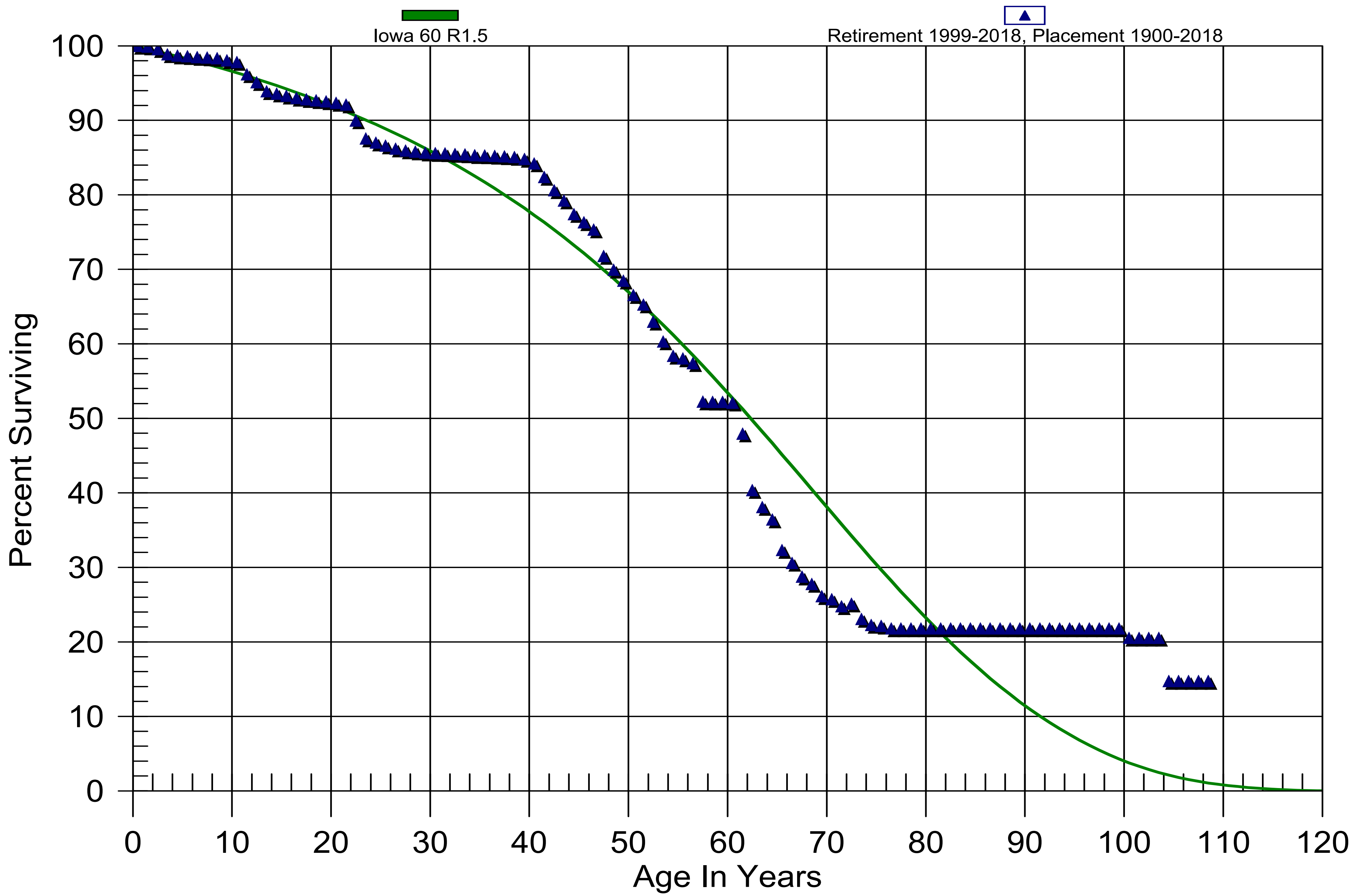
TGS
Gas Division
380.01, 380.02

Observed Life Table
Retirement Expr. 1999 TO 2018
Placement Years 1900 TO 2018

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	$86,812.22	$3,012.92	0.03471	23.07
74.5 - 75.5	$72,509.30	$346.27	0.00478	22.27
75.5 - 76.5	$11,962.03	$186.03	0.01555	22.16
76.5 - 77.5	$0.00	$0.00	0.00000	21.81
77.5 - 78.5	$0.00	$0.00	0.00000	21.81
78.5 - 79.5	$0.00	$0.00	0.00000	21.81
79.5 - 80.5	$0.00	$0.00	0.00000	21.81
80.5 - 81.5	$0.00	$0.00	0.00000	21.81
81.5 - 82.5	$0.00	$0.00	0.00000	21.81
82.5 - 83.5	$0.00	$0.00	0.00000	21.81
83.5 - 84.5	$0.00	$0.00	0.00000	21.81
84.5 - 85.5	$0.00	$0.00	0.00000	21.81
85.5 - 86.5	$0.00	$0.00	0.00000	21.81
86.5 - 87.5	$0.00	$0.00	0.00000	21.81
87.5 - 88.5	$0.00	$0.00	0.00000	21.81
88.5 - 89.5	$0.00	$0.00	0.00000	21.81
89.5 - 90.5	$0.00	$0.00	0.00000	21.81
90.5 - 91.5	$0.00	$0.00	0.00000	21.81
91.5 - 92.5	$0.00	$0.00	0.00000	21.81
92.5 - 93.5	$0.00	$0.00	0.00000	21.81
93.5 - 94.5	$0.00	$0.00	0.00000	21.81
94.5 - 95.5	$0.00	$0.00	0.00000	21.81
95.5 - 96.5	$0.00	$0.00	0.00000	21.81
96.5 - 97.5	$0.00	$0.00	0.00000	21.81
97.5 - 98.5	$0.00	$0.00	0.00000	21.81
98.5 - 99.5	$125.41	$0.00	0.00000	21.81
99.5 - 100.5	$125.41	$7.41	0.05909	21.81
100.5 - 101.5	$118.00	$0.00	0.00000	20.53
101.5 - 102.5	$118.00	$0.00	0.00000	20.53
102.5 - 103.5	$118.00	$0.00	0.00000	20.53
103.5 - 104.5	$118.00	$33.24	0.28169	20.53
104.5 - 105.5	$84.76	$0.00	0.00000	14.74
105.5 - 106.5	$84.76	$0.00	0.00000	14.74
106.5 - 107.5	$84.76	$0.00	0.00000	14.74
107.5 - 108.5	$84.76	$0.00	0.00000	14.74

TGS

Gas Division
380.01, 380.02
Original And Smooth Survivor Curves



TGS
Gas Division
385.01, 385.02

Observed Life Table

Retirement Expr. 1999 TO 2018
Placement Years 1900 TO 2018

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	$7,329,753.66	$32.87	0.00000	100.00
0.5 - 1.5	$6,770,832.70	$1,871.84	0.00028	100.00
1.5 - 2.5	$6,377,129.87	$0.00	0.00000	99.97
2.5 - 3.5	$5,601,268.87	$37,420.24	0.00668	99.97
3.5 - 4.5	$4,628,131.52	$4,343.07	0.00094	99.30
4.5 - 5.5	$5,885,237.58	$12,939.81	0.00220	99.21
5.5 - 6.5	$5,742,060.21	$4,618.09	0.00080	98.99
6.5 - 7.5	$5,673,817.97	$24,297.84	0.00428	98.91
7.5 - 8.5	$5,583,092.26	$38,618.43	0.00692	98.49
8.5 - 9.5	$5,371,355.70	$66,967.29	0.01247	97.81
9.5 - 10.5	$5,270,889.41	$11,930.48	0.00226	96.59
10.5 - 11.5	$5,212,628.91	$44,375.12	0.00851	96.37
11.5 - 12.5	$5,159,292.43	$29,811.68	0.00578	95.55
12.5 - 13.5	$5,293,348.85	$40,318.57	0.00762	95.00
13.5 - 14.5	$5,202,536.43	$4,934.93	0.00095	94.27
14.5 - 15.5	$5,411,146.81	$11,961.12	0.00221	94.18
15.5 - 16.5	$5,239,043.83	$5,375.66	0.00103	93.98
16.5 - 17.5	$5,352,280.10	$3,725.21	0.00070	93.88
17.5 - 18.5	$5,419,259.38	$7,162.47	0.00132	93.81
18.5 - 19.5	$5,426,824.08	$5,416.88	0.00100	93.69
19.5 - 20.5	$5,109,880.82	$1,109.96	0.00022	93.60
20.5 - 21.5	$4,972,475.20	$6,858.68	0.00138	93.58
21.5 - 22.5	$4,820,748.27	$15,155.53	0.00314	93.45
22.5 - 23.5	$4,866,064.97	$3,021.44	0.00062	93.15
23.5 - 24.5	$4,841,728.65	$13,500.76	0.00279	93.10
24.5 - 25.5	$3,321,792.79	$2,091.58	0.00063	92.84
25.5 - 26.5	$3,188,000.98	$18,711.13	0.00587	92.78
26.5 - 27.5	$2,911,224.23	($2,982.90)	-0.00102	92.23
27.5 - 28.5	$2,785,686.52	$3,866.07	0.00139	92.33
28.5 - 29.5	$2,696,711.75	$404.15	0.00015	92.20
29.5 - 30.5	$2,661,170.00	$10,546.40	0.00396	92.19
30.5 - 31.5	$2,544,976.73	$11,674.86	0.00459	91.82
31.5 - 32.5	$2,427,096.66	($967.64)	-0.00040	91.40
32.5 - 33.5	$2,203,454.90	$3,838.61	0.00174	91.44
33.5 - 34.5	$2,022,949.09	$1,402.08	0.00069	91.28
34.5 - 35.5	$1,692,250.57	$1,011.90	0.00060	91.21
35.5 - 36.5	$1,537,989.14	$2,238.27	0.00146	91.16

TGS
Gas Division
385.01, 385.02

Observed Life Table
Retirement Expr. 1999 TO 2018
Placement Years 1900 TO 2018

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	$1,336,430.51	$425.70	0.00032	91.03
37.5 - 38.5	$1,142,552.60	$3,883.49	0.00340	91.00
38.5 - 39.5	$1,114,412.73	$1,565.27	0.00140	90.69
39.5 - 40.5	$1,047,957.93	$1,579.81	0.00151	90.56
40.5 - 41.5	$984,381.27	$3,698.92	0.00376	90.42
41.5 - 42.5	$936,568.39	$2,654.46	0.00283	90.08
42.5 - 43.5	$882,182.95	$3,287.83	0.00373	89.83
43.5 - 44.5	$836,223.41	$2,626.59	0.00314	89.49
44.5 - 45.5	$762,555.75	$4,728.71	0.00620	89.21
45.5 - 46.5	$692,890.66	$1,714.64	0.00247	88.66
46.5 - 47.5	$648,180.68	$14,802.84	0.02284	88.44
47.5 - 48.5	$561,105.68	$6,356.10	0.01133	86.42
48.5 - 49.5	$466,955.58	$9,124.69	0.01954	85.44
49.5 - 50.5	$419,760.40	$9,144.49	0.02179	83.77
50.5 - 51.5	$352,977.65	$12,256.89	0.03472	81.95
51.5 - 52.5	$300,306.76	$8,622.43	0.02871	79.10
52.5 - 53.5	$248,989.18	$75.49	0.00030	76.83
53.5 - 54.5	$218,248.26	$3,423.44	0.01569	76.81
54.5 - 55.5	$185,795.82	$2,112.40	0.01137	75.60
55.5 - 56.5	$149,400.10	$3,560.49	0.02383	74.74
56.5 - 57.5	$118,336.72	$5,270.40	0.04454	72.96
57.5 - 58.5	$100,775.32	$6,824.81	0.06772	69.71
58.5 - 59.5	$72,634.51	$6,054.07	0.08335	64.99
59.5 - 60.5	$60,431.44	$408.00	0.00675	59.57
60.5 - 61.5	$49,608.44	$7,077.43	0.14267	59.17
61.5 - 62.5	$38,863.01	$5,254.77	0.13521	50.73
62.5 - 63.5	$30,451.24	$1,310.38	0.04303	43.87
63.5 - 64.5	$18,882.86	$1,197.45	0.06341	41.98
64.5 - 65.5	$16,926.41	$3,547.12	0.20956	39.32
65.5 - 66.5	$12,147.29	$1,748.34	0.14393	31.08
66.5 - 67.5	$8,532.95	$432.06	0.05063	26.61
67.5 - 68.5	$7,952.89	$1,897.06	0.23854	25.26
68.5 - 69.5	$5,692.83	$2,290.25	0.40230	19.23
69.5 - 70.5	$3,272.58	$0.00	0.00000	11.50
70.5 - 71.5	$2,132.58	$574.03	0.26917	11.50
71.5 - 72.5	$1,558.55	($1,066.49)	-0.68428	8.40
72.5 - 73.5	$2,625.04	($288.41)	-0.10987	14.15

TGS

Gas Division

385.01, 385.02

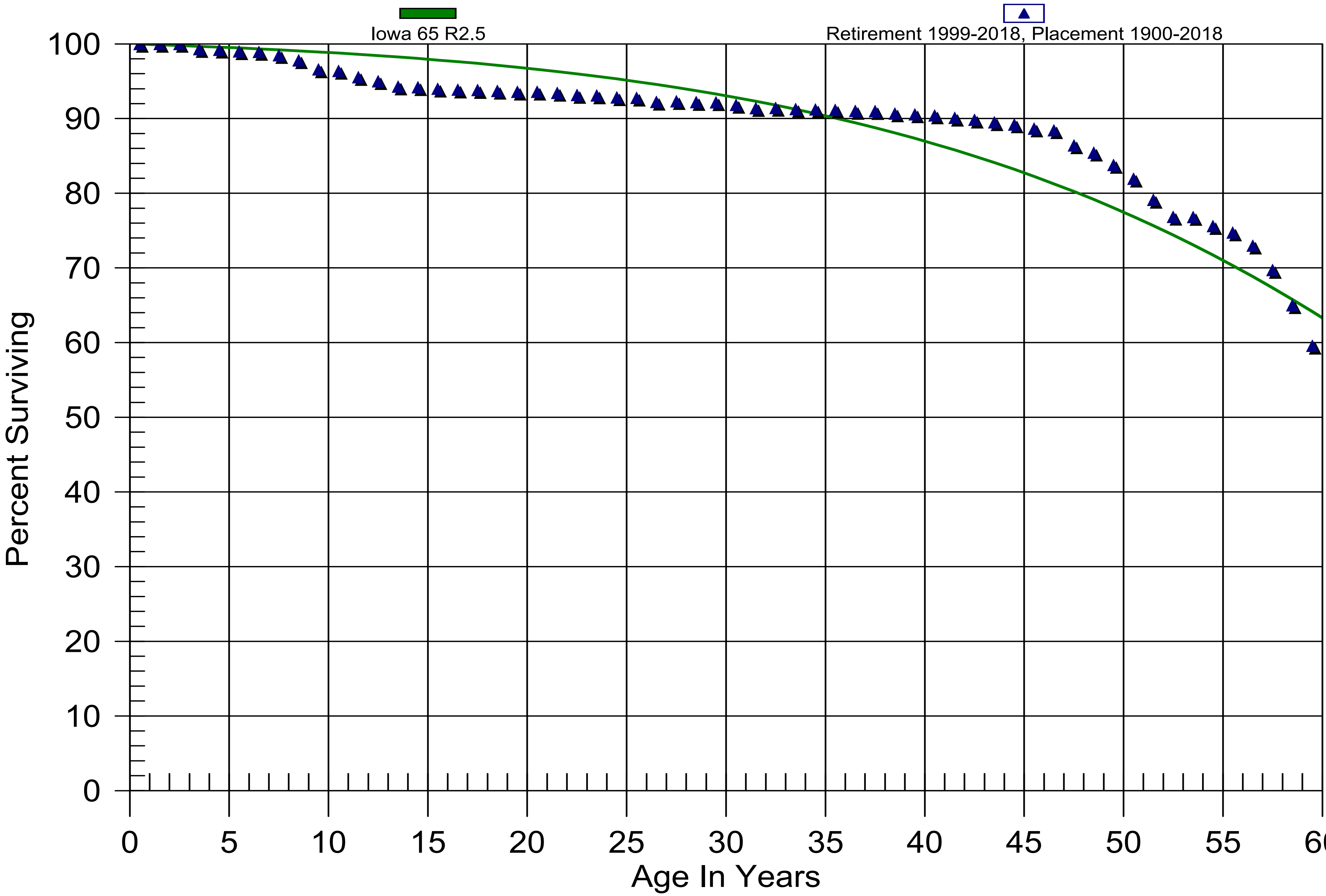
Observed Life Table

Retirement Expr. 1999 TO 2018
Placement Years 1900 TO 2018

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	$3,803.28	$1,738.28	0.45705	15.71
74.5 - 75.5	$2,065.00	$0.00	0.00000	8.53

TGS

Gas Division
385.01, 385.02
Original And Smooth Survivor Curves



TGS
Gas Division
376.01 Mains - Central Texas

Original Cost Of Utility Plant In Service
And Development Of Composite Remaining Life as of December 31, 2018
Based Upon Broad Group/Remaining Life Procedure and Technique

Average Service Life: 71 *Survivor Curve:* R2

Year (1)	Original Cost (2)	Avg. Service Life (3)	Avg. Annual Accrual (4)	Avg. Remaining Life (5)	Future Annual Accruals (6)
1942	399,838.00	71.00	5,631.51	17.15	96,590.45
1943	792.00	71.00	11.15	17.59	196.17
1944	1,150.00	71.00	16.20	18.03	292.01
1945	21,176.00	71.00	298.25	18.48	5,511.15
1946	50,535.00	71.00	711.76	18.94	13,479.36
1947	28,803.00	71.00	405.68	19.40	7,871.94
1948	92,649.00	71.00	1,304.91	19.88	25,943.19
1949	158,600.00	71.00	2,233.80	20.36	45,490.28
1950	61,785.00	71.00	870.21	20.86	18,150.58
1951	124,407.00	71.00	1,752.21	21.36	37,423.91
1952	89,070.00	71.00	1,254.50	21.87	27,431.30
1953	140,096.00	71.00	1,973.18	22.39	44,170.23
1954	114,326.00	71.00	1,610.22	22.91	36,890.83
1955	284,778.00	71.00	4,010.95	23.45	94,039.57
1956	261,413.00	71.00	3,681.87	23.99	88,319.56
1957	178,411.00	71.00	2,512.83	24.54	61,657.53
1958	256,337.00	71.00	3,610.37	25.10	90,612.70
1959	542,330.00	71.00	7,638.44	25.66	196,032.14
1960	393,747.00	71.00	5,545.72	26.24	145,521.37
1961	458,156.00	71.00	6,452.89	26.82	173,084.05
1962	409,418.00	71.00	5,766.44	27.41	158,070.80
1963	493,737.00	71.00	6,954.03	28.01	194,803.71
1964	460,892.00	71.00	6,491.42	28.62	185,774.88
1965	471,334.00	71.00	6,638.49	29.23	194,071.13
1966	367,146.00	71.00	5,171.06	29.86	154,383.52
1967	317,637.00	71.00	4,473.75	30.48	136,373.46
1968	829,764.00	71.00	11,686.80	31.12	363,715.67

TGS

Gas Division

376.01 Mains - Central Texas

Original Cost Of Utility Plant In Service

And Development Of Composite Remaining Life as of December 31, 2018

Based Upon Broad Group/Remaining Life Procedure and Technique

Average Service Life: 71 *Survivor Curve:* R2

Year (1)	Original Cost (2)	Avg. Service Life (3)	Avg. Annual Accrual (4)	Avg. Remaining Life (5)	Future Annual Accruals (6)
1969	755,043.00	71.00	10,634.39	31.76	337,799.05
1970	682,825.00	71.00	9,617.24	32.42	311,768.07
1971	990,861.00	71.00	13,955.76	33.08	461,590.31
1972	1,140,712.00	71.00	16,066.34	33.74	542,105.18
1973	1,412,574.00	71.00	19,895.37	34.41	684,673.13
1974	1,556,067.00	71.00	21,916.40	35.09	769,084.33
1975	702,067.00	71.00	9,888.25	35.78	353,796.05
1976	709,077.00	71.00	9,986.98	36.47	364,238.48
1977	881,481.00	71.00	12,415.20	37.17	461,494.42
1978	2,031,308.00	71.00	28,609.92	37.88	1,083,660.64
1979	2,838,839.00	71.00	39,983.57	38.59	1,542,890.09
1980	3,146,512.00	71.00	44,316.99	39.31	1,742,028.97
1981	3,768,272.00	71.00	53,074.16	40.03	2,124,682.43
1982	3,577,337.00	71.00	50,384.94	40.76	2,053,914.11
1983	1,974,924.00	71.00	27,815.78	41.50	1,154,382.99
1984	5,066,311.00	71.00	71,356.36	42.24	3,014,295.49
1985	5,579,163.00	71.00	78,579.62	42.99	3,378,414.51
1986	4,756,342.00	71.00	66,990.61	43.75	2,930,669.17
1987	3,562,497.00	71.00	50,175.92	44.51	2,233,289.70
1988	2,542,394.00	71.00	35,808.30	45.27	1,621,217.33
1989	1,422,944.00	71.00	20,041.43	46.05	922,818.72
1990	1,883,465.00	71.00	26,527.63	46.82	1,242,146.28
1991	6,020,283.00	71.00	84,792.56	47.61	4,036,684.49
1992	875,898.00	71.00	12,336.57	48.40	597,040.39
1993	788,095.00	71.00	11,099.91	49.19	545,992.92
1994	951,552.00	71.00	13,402.12	49.99	669,925.53
1995	164,596.00	71.00	2,318.25	50.79	117,748.80

TGS
Gas Division
376.01 Mains - Central Texas

Original Cost Of Utility Plant In Service
And Development Of Composite Remaining Life as of December 31, 2018
Based Upon Broad Group/Remaining Life Procedure and Technique

Average Service Life: 71 *Survivor Curve:* R2

Year (1)	Original Cost (2)	Avg. Service Life (3)	Avg. Annual Accrual (4)	Avg. Remaining Life (5)	Future Annual Accruals (6)
1996	328,713.00	71.00	4,629.75	51.60	238,896.52
1997	2,628,812.00	71.00	37,025.45	52.42	1,940,707.67
1998	631,659.00	71.00	8,896.59	53.23	473,600.37
1999	5,486,420.00	71.00	77,273.38	54.06	4,177,286.16
2000	4,880,037.00	71.00	68,732.79	54.89	3,772,532.19
2001	1,656,105.00	71.00	23,325.38	55.72	1,299,679.19
2002	202,000.00	71.00	2,845.07	56.56	160,913.48
2003	9,288,330.00	71.00	130,821.31	57.40	7,509,265.82
2004	5,921,294.00	71.00	83,398.35	58.25	4,857,866.25
2005	3,458,474.00	71.00	48,710.81	59.10	2,878,825.12
2006	9,496,581.00	71.00	133,754.42	59.96	8,019,331.14
2007	4,071,884.00	71.00	57,350.37	60.82	3,487,888.46
2008	10,542,056.00	71.00	148,479.39	61.68	9,158,403.60
2009	2,863,956.00	71.00	40,337.33	62.55	2,523,137.99
2010	3,882,751.00	71.00	54,686.53	63.42	3,468,415.70
2011	7,940,349.00	71.00	111,835.70	64.30	7,191,016.10
2012	14,825,644.00	71.00	208,811.51	65.18	13,610,730.58
2013	28,117,239.00	71.00	396,016.73	66.07	26,163,329.36
2014	10,709,603.00	71.00	150,839.20	66.96	10,099,541.40
2015	23,845,715.00	71.00	335,854.53	67.85	22,786,991.31
2016	15,862,267.00	71.00	223,411.80	68.74	15,358,045.27
2017	8,679,695.00	71.00	122,249.00	69.64	8,513,907.86
2018	24,906,336.00	71.00	350,792.82	70.55	24,747,287.14
Total	267,015,686.00	71.00	3,760,777.43	58.59	220,331,851.74

Composite Average Remaining Life ... 58.59 Years

TGS
Gas Division
376.02 Mains - Gulf Coast

Original Cost Of Utility Plant In Service
And Development Of Composite Remaining Life as of December 31, 2018
Based Upon Broad Group/Remaining Life Procedure and Technique

Average Service Life: ***71*** *Survivor Curve:* ***R2***

Year (1)	Original Cost (2)	Avg. Service Life (3)	Avg. Annual Accrual (4)	Avg. Remaining Life (5)	Future Annual Accruals (6)
1943	227,808.00	71.00	3,208.56	17.59	56,426.93
1944	14,024.00	71.00	197.52	18.03	3,560.98
1945	76,236.00	71.00	1,073.74	18.48	19,840.76
1946	26,610.00	71.00	374.79	18.94	7,097.77
1947	31,919.00	71.00	449.56	19.40	8,723.55
1948	92,425.00	71.00	1,301.76	19.88	25,880.47
1949	4,718.00	71.00	66.45	20.36	1,353.24
1950	20,455.00	71.00	288.10	20.86	6,009.07
1951	234,806.00	71.00	3,307.12	21.36	70,633.96
1952	164,044.00	71.00	2,310.47	21.87	50,521.39
1953	129,507.00	71.00	1,824.04	22.39	40,831.67
1954	111,026.00	71.00	1,563.74	22.91	35,825.99
1955	126,222.00	71.00	1,777.77	23.45	41,681.11
1956	163,539.00	71.00	2,303.36	23.99	55,252.39
1957	112,774.00	71.00	1,588.36	24.54	38,973.86
1958	159,635.00	71.00	2,248.38	25.10	56,429.46
1959	297,475.00	71.00	4,189.78	25.66	107,526.16
1960	192,867.00	71.00	2,716.43	26.24	71,279.96
1961	225,313.00	71.00	3,173.42	26.82	85,119.67
1962	226,228.00	71.00	3,186.30	27.41	87,343.60
1963	169,088.00	71.00	2,381.52	28.01	66,713.59
1964	195,688.00	71.00	2,756.16	28.62	78,877.29
1965	42,425.00	71.00	597.53	29.23	17,468.44
1966	192,001.00	71.00	2,704.23	29.86	80,735.70
1967	41,313.00	71.00	581.87	30.48	17,737.22
1968	53,352.00	71.00	751.44	31.12	23,386.12
1969	176,175.00	71.00	2,481.33	31.76	78,819.02

TGS
Gas Division
376.02 Mains - Gulf Coast

Original Cost Of Utility Plant In Service
And Development Of Composite Remaining Life as of December 31, 2018
Based Upon Broad Group/Remaining Life Procedure and Technique

Average Service Life: 71 **Survivor Curve:** R2

Year (1)	Original Cost (2)	Avg. Service Life (3)	Avg. Annual Accrual (4)	Avg. Remaining Life (5)	Future Annual Accruals (6)
1970	32,981.00	71.00	464.52	32.42	15,058.65
1971	138,554.00	71.00	1,951.46	33.08	64,545.06
1972	68,771.00	71.00	968.60	33.74	32,682.32
1973	155,834.00	71.00	2,194.84	34.41	75,532.58
1974	313,271.00	71.00	4,412.26	35.09	154,833.83
1975	540,992.00	71.00	7,619.59	35.78	272,624.74
1976	447,572.00	71.00	6,303.82	36.47	229,908.66
1977	291,895.00	71.00	4,111.19	37.17	152,819.99
1978	400,927.00	71.00	5,646.85	37.88	213,886.23
1979	297,556.00	71.00	4,190.92	38.59	161,719.70
1980	272,374.00	71.00	3,836.25	39.31	150,796.63
1981	517,325.00	71.00	7,286.25	40.03	291,685.77
1982	441,584.00	71.00	6,219.48	40.76	253,533.73
1983	432,252.00	71.00	6,088.05	41.50	252,660.03
1984	542,952.00	71.00	7,647.20	42.24	323,039.34
1985	804,274.00	71.00	11,327.78	42.99	487,021.25
1986	1,107,233.00	71.00	15,594.80	43.75	682,233.03
1987	293,867.00	71.00	4,138.96	44.51	184,221.95
1988	198,958.00	71.00	2,802.22	45.27	126,870.25
1989	238,039.00	71.00	3,352.66	46.05	154,374.90
1990	739,792.00	71.00	10,419.59	46.82	487,893.26
1991	295,466.00	71.00	4,161.49	47.61	198,114.11
1992	289,698.00	71.00	4,080.25	48.40	197,467.52
1993	118,819.00	71.00	1,673.50	49.19	82,317.91
1994	155,043.00	71.00	2,183.70	49.99	109,155.64
1995	71,173.00	71.00	1,002.43	50.79	50,915.79
1996	21,561.00	71.00	303.68	51.60	15,669.74

TGS
Gas Division
376.02 Mains - Gulf Coast

Original Cost Of Utility Plant In Service
And Development Of Composite Remaining Life as of December 31, 2018
Based Upon Broad Group/Remaining Life Procedure and Technique

Average Service Life: 71 *Survivor Curve:* R2

Year (1)	Original Cost (2)	Avg. Service Life (3)	Avg. Annual Accrual (4)	Avg. Remaining Life (5)	Future Annual Accruals (6)
1997	212,339.00	71.00	2,990.68	52.42	156,758.23
1998	446,071.00	71.00	6,282.68	53.23	334,451.64
1999	337,999.00	71.00	4,760.54	54.06	257,347.88
2000	212,050.00	71.00	2,986.61	54.89	163,926.10
2001	805,030.00	71.00	11,338.43	55.72	631,771.98
2002	334,342.00	71.00	4,709.03	56.56	266,337.30
2003	482,317.00	71.00	6,793.18	57.40	389,935.17
2004	1,527,763.00	71.00	21,517.75	58.25	1,253,386.22
2005	1,115,690.00	71.00	15,713.91	59.10	928,697.57
2006	1,522,602.00	71.00	21,445.06	59.96	1,285,752.17
2007	1,300,354.00	71.00	18,314.81	60.82	1,113,855.33
2008	1,068,791.00	71.00	15,053.37	61.68	928,511.42
2009	1,103,374.00	71.00	15,540.45	62.55	972,069.70
2010	1,154,195.00	71.00	16,256.24	63.42	1,031,028.79
2011	1,814,038.00	71.00	25,549.78	64.30	1,642,846.74
2012	1,092,100.00	71.00	15,381.66	65.18	1,002,605.95
2013	1,840,164.00	71.00	25,917.76	66.07	1,712,288.21
2014	1,463,742.00	71.00	20,616.05	66.96	1,380,361.43
2015	1,411,228.00	71.00	19,876.41	67.85	1,348,571.02
2016	1,587,834.00	71.00	22,363.82	68.74	1,537,360.73
2017	1,069,406.00	71.00	15,062.03	69.64	1,048,979.73
2018	648,932.00	71.00	9,139.87	70.55	644,788.00
Total	35,286,797.00	71.00	496,996.23	53.70	26,687,263.30

Composite Average Remaining Life ... 53.70 Years

TGS
Gas Division
378.01 M&R Station Equip. General - Central Texas

Original Cost Of Utility Plant In Service
And Development Of Composite Remaining Life as of December 31, 2018
Based Upon Broad Group/Remaining Life Procedure and Technique

Average Service Life: **60** *Survivor Curve:* **R1**

Year (1)	Original Cost (2)	Avg. Service Life (3)	Avg. Annual Accrual (4)	Avg. Remaining Life (5)	Future Annual Accruals (6)
1942	539.00	60.00	8.98	14.74	132.45
1960	918.00	60.00	15.30	22.77	348.39
1962	383.00	60.00	6.38	23.77	151.74
1963	3,000.00	60.00	50.00	24.28	1,213.95
1964	521.00	60.00	8.68	24.79	215.30
1965	11,002.00	60.00	183.36	25.32	4,641.96
1966	1,219.00	60.00	20.32	25.84	525.02
1967	7,454.00	60.00	124.23	26.37	3,276.43
1968	1,117.00	60.00	18.62	26.91	501.00
1969	42.00	60.00	0.70	27.45	19.22
1970	1,135.00	60.00	18.92	28.01	529.75
1971	1,706.00	60.00	28.43	28.56	812.07
1972	4,692.00	60.00	78.20	29.12	2,277.32
1973	27,044.00	60.00	450.72	29.69	13,381.40
1974	14,448.00	60.00	240.80	30.26	7,286.90
1975	50,211.00	60.00	836.83	30.84	25,807.05
1976	66,473.00	60.00	1,107.86	31.42	34,813.09
1977	46,297.00	60.00	771.60	32.01	24,701.79
1978	115,233.00	60.00	1,920.51	32.61	62,625.62
1979	134,342.00	60.00	2,238.99	33.21	74,353.66
1980	92,817.00	60.00	1,546.92	33.81	52,308.70
1981	24,916.00	60.00	415.26	34.42	14,295.04
1982	85,909.00	60.00	1,431.79	35.04	50,171.67
1983	213,260.00	60.00	3,554.26	35.66	126,754.66
1984	80,841.00	60.00	1,347.32	36.29	48,892.63
1985	163,239.00	60.00	2,720.60	36.92	100,440.92
1986	48,116.00	60.00	801.92	37.55	30,115.48

TGS

Gas Division

378.01 M&R Station Equip. General - Central Texas

Original Cost Of Utility Plant In Service

And Development Of Composite Remaining Life as of December 31, 2018

Based Upon Broad Group/Remaining Life Procedure and Technique

Average Service Life: 60 *Survivor Curve:* R1

Year (1)	Original Cost (2)	Avg. Service Life (3)	Avg. Annual Accrual (4)	Avg. Remaining Life (5)	Future Annual Accruals (6)
1987	52,080.00	60.00	867.98	38.19	33,150.73
1988	92,953.00	60.00	1,549.19	38.84	60,166.46
1989	17,341.00	60.00	289.01	39.49	11,411.86
1990	273,112.00	60.00	4,551.78	40.14	182,699.26
1991	159,282.00	60.00	2,654.65	40.79	108,291.81
1992	63,951.00	60.00	1,065.83	41.45	44,181.89
1993	160,030.00	60.00	2,667.11	42.11	112,325.47
1994	110,886.00	60.00	1,848.06	42.78	79,063.43
1995	37,061.00	60.00	617.67	43.45	26,838.67
1997	19,024.00	60.00	317.06	44.80	14,203.81
1998	22,566.00	60.00	376.09	45.48	17,103.40
1999	28,430.00	60.00	473.82	46.16	21,869.89
2000	29,549.00	60.00	492.47	46.84	23,067.27
2001	82,335.00	60.00	1,372.22	47.53	65,215.29
2002	2,397.00	60.00	39.95	48.21	1,926.05
2003	380,213.00	60.00	6,336.76	48.90	309,888.21
2004	291,127.00	60.00	4,852.02	49.60	240,643.83
2005	93,903.00	60.00	1,565.02	50.29	78,707.28
2006	283,995.00	60.00	4,733.16	50.99	241,347.12
2007	160,705.00	60.00	2,678.36	51.69	138,451.64
2008	958,201.00	60.00	15,969.70	52.40	836,769.83
2009	176,575.00	60.00	2,942.86	53.10	156,279.43
2010	187,415.00	60.00	3,123.52	53.82	168,095.23
2011	287,323.00	60.00	4,788.62	54.53	261,120.26
2012	285,901.00	60.00	4,764.92	55.25	263,250.33
2013	932,046.00	60.00	15,533.79	55.97	869,411.80
2014	527,216.00	60.00	8,786.76	56.69	498,155.66

TGS
Gas Division
378.01 M&R Station Equip. General - Central Texas

Original Cost Of Utility Plant In Service
And Development Of Composite Remaining Life as of December 31, 2018
Based Upon Broad Group/Remaining Life Procedure and Technique

Average Service Life: 60 *Survivor Curve:* R1

Year (1)	Original Cost (2)	Avg. Service Life (3)	Avg. Annual Accrual (4)	Avg. Remaining Life (5)	Future Annual Accruals (6)
2015	1,753,152.00	60.00	29,218.62	57.42	1,677,786.15
2016	669,503.00	60.00	11,158.16	58.15	648,894.75
2017	507,632.00	60.00	8,460.37	58.89	498,224.33
2018	888,701.00	60.00	14,811.39	59.63	883,197.37
Total	10,731,479.00	60.00	178,854.43	51.73	9,252,331.75

Composite Average Remaining Life ... 51.73 Years

TGS
Gas Division
378.02 M&R Station Equip. General - Gulf Coast
Original Cost Of Utility Plant In Service
And Development Of Composite Remaining Life as of December 31, 2018
Based Upon Broad Group/Remaining Life Procedure and Technique

Average Service Life: **60** *Survivor Curve:* **R1**

Year (1)	Original Cost (2)	Avg. Service Life (3)	Avg. Annual Accrual (4)	Avg. Remaining Life (5)	Future Annual Accruals (6)
1943	119.00	60.00	1.98	15.15	30.04
1945	555.00	60.00	9.25	15.97	147.69
1948	548.00	60.00	9.13	17.23	157.39
1950	802.00	60.00	13.37	18.10	241.97
1951	781.00	60.00	13.02	18.54	241.39
1952	6,403.00	60.00	106.71	18.99	2,026.82
1953	735.00	60.00	12.25	19.45	238.21
1954	5,463.00	60.00	91.05	19.90	1,812.29
1955	1,138.00	60.00	18.97	20.37	386.31
1956	126.00	60.00	2.10	20.84	43.76
1957	259.00	60.00	4.32	21.31	92.00
1958	530.00	60.00	8.83	21.79	192.50
1959	716.00	60.00	11.93	22.28	265.86
1960	4,210.00	60.00	70.17	22.77	1,597.74
1961	4,816.00	60.00	80.27	23.27	1,867.61
1962	1,353.00	60.00	22.55	23.77	536.04
1963	1,002.00	60.00	16.70	24.28	405.46
1964	758.00	60.00	12.63	24.79	313.23
1965	74.00	60.00	1.23	25.32	31.22
1967	423.00	60.00	7.05	26.37	185.93
1970	271.00	60.00	4.52	28.01	126.49
1971	1,712.00	60.00	28.53	28.56	814.92
1973	3,464.00	60.00	57.73	29.69	1,713.99
1974	12,678.00	60.00	211.30	30.26	6,394.19
1975	37,621.00	60.00	627.00	30.84	19,336.14
1976	7,049.00	60.00	117.48	31.42	3,691.69
1977	1,507.00	60.00	25.12	32.01	804.06

TGS
Gas Division
378.02 M&R Station Equip. General - Gulf Coast
Original Cost Of Utility Plant In Service
And Development Of Composite Remaining Life as of December 31, 2018
Based Upon Broad Group/Remaining Life Procedure and Technique

Average Service Life: 60 *Survivor Curve:* R1

Year (1)	Original Cost (2)	Avg. Service Life (3)	Avg. Annual Accrual (4)	Avg. Remaining Life (5)	Future Annual Accruals (6)
1978	8,717.00	60.00	145.28	32.61	4,737.42
1979	4,116.00	60.00	68.60	33.21	2,278.06
1980	12,548.00	60.00	209.13	33.81	7,071.65
1981	771.00	60.00	12.85	34.42	442.35
1982	2,881.00	60.00	48.02	35.04	1,682.53
1983	1,501.00	60.00	25.02	35.66	892.14
1984	857.00	60.00	14.28	36.29	518.31
1985	12,507.00	60.00	208.45	36.92	7,695.55
1986	18,327.00	60.00	305.44	37.55	11,470.74
1987	5,669.00	60.00	94.48	38.19	3,608.52
1990	25,381.00	60.00	423.01	40.14	16,978.71
1991	40,652.00	60.00	677.52	40.79	27,638.27
1992	30,509.00	60.00	508.47	41.45	21,077.78
1993	11,397.00	60.00	189.95	42.11	7,999.58
1994	1,172.00	60.00	19.53	42.78	835.65
1995	17,837.00	60.00	297.28	43.45	12,917.12
1997	2,300.00	60.00	38.33	44.80	1,717.24
1998	9,253.00	60.00	154.21	45.48	7,013.10
1999	22,448.00	60.00	374.13	46.16	17,268.22
2000	3,498.00	60.00	58.30	46.84	2,730.69
2002	1,685.00	60.00	28.08	48.21	1,353.94
2003	85,977.00	60.00	1,432.92	48.90	70,074.56
2004	36,443.00	60.00	607.37	49.60	30,123.57
2005	278,202.00	60.00	4,636.61	50.29	233,182.37
2006	37,529.00	60.00	625.47	50.99	31,893.22
2007	158,429.00	60.00	2,640.43	51.69	136,490.81
2008	48,193.00	60.00	803.20	52.40	42,085.58

TGS

Gas Division

378.02 M&R Station Equip. General - Gulf Coast

Original Cost Of Utility Plant In Service

And Development Of Composite Remaining Life as of December 31, 2018

Based Upon Broad Group/Remaining Life Procedure and Technique

Average Service Life: 60 **Survivor Curve:** R1

Year (1)	Original Cost (2)	Avg. Service Life (3)	Avg. Annual Accrual (4)	Avg. Remaining Life (5)	Future Annual Accruals (6)
2009	22,830.00	60.00	380.49	53.10	20,205.92
2011	43,777.00	60.00	729.60	54.53	39,784.71
2012	6,983.00	60.00	116.38	55.25	6,429.77
2014	7,168.00	60.00	119.46	56.69	6,772.90
2015	676,057.00	60.00	11,267.39	57.42	646,994.14
2016	45,022.00	60.00	750.35	58.15	43,636.16
2018	24,166.00	60.00	402.76	59.63	24,016.34
Total	1,799,915.00	60.00	29,997.99	51.11	1,533,312.60

Composite Average Remaining Life ... 51.11 Years

TGS
Gas Division
380.01 Services - Central Texas

Original Cost Of Utility Plant In Service
And Development Of Composite Remaining Life as of December 31, 2018
Based Upon Broad Group/Remaining Life Procedure and Technique

Average Service Life: 60 **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)
1942	11,776.00	60.00	196.26	12.67	2,486.77
1944	1,276.00	60.00	21.27	13.36	284.19
1945	681.00	60.00	11.35	13.72	155.73
1946	322.00	60.00	5.37	14.08	75.58
1948	5,667.00	60.00	94.45	14.83	1,400.74
1949	215.00	60.00	3.58	15.22	54.52
1950	501.00	60.00	8.35	15.61	130.34
1951	1,679.00	60.00	27.98	16.01	448.02
1952	8,139.00	60.00	135.65	16.42	2,227.36
1953	2,868.00	60.00	47.80	16.84	804.85
1954	1,034.00	60.00	17.23	17.26	297.52
1955	1,149.00	60.00	19.15	17.70	338.93
1956	49,276.00	60.00	821.26	18.14	14,899.55
1957	65,068.00	60.00	1,084.45	18.59	20,164.94
1958	85,017.00	60.00	1,416.93	19.05	26,999.42
1959	124,280.00	60.00	2,071.31	19.52	40,441.81
1960	119,974.00	60.00	1,999.54	20.00	39,997.29
1961	110,485.00	60.00	1,841.40	20.49	37,729.49
1962	1,413.00	60.00	23.55	20.99	494.21
1963	1,164.00	60.00	19.40	21.49	416.88
1964	148,121.00	60.00	2,468.66	22.00	54,318.28
1965	205,415.00	60.00	3,423.55	22.53	77,117.39
1966	120,488.00	60.00	2,008.11	23.06	46,299.42
1967	62,570.00	60.00	1,042.82	23.59	24,604.68
1968	226,095.00	60.00	3,768.21	24.14	90,973.23
1969	210,525.00	60.00	3,508.71	24.70	86,652.45
1970	206,413.00	60.00	3,440.18	25.26	86,903.74

TGS

Gas Division

380.01 Services - Central Texas

Original Cost Of Utility Plant In Service

And Development Of Composite Remaining Life as of December 31, 2018

Based Upon Broad Group/Remaining Life Procedure and Technique

Average Service Life: **60** *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)
1971	249,001.00	60.00	4,149.97	25.83	107,210.99
1972	399,367.00	60.00	6,656.04	26.41	175,816.21
1973	434,403.00	60.00	7,239.97	27.00	195,492.16
1974	429,811.00	60.00	7,163.44	27.60	197,699.30
1975	672,570.00	60.00	11,209.37	28.20	316,108.51
1976	727,090.00	60.00	12,118.03	28.81	349,153.49
1977	881,350.00	60.00	14,689.00	29.43	432,327.86
1978	1,239,834.00	60.00	20,663.67	30.06	621,115.39
1979	1,623,763.00	60.00	27,062.41	30.69	830,565.97
1980	1,780,312.00	60.00	29,671.53	31.33	929,659.82
1981	1,923,157.00	60.00	32,052.26	31.98	1,024,946.34
1982	1,823,307.00	60.00	30,388.11	32.63	991,638.54
1983	1,562,820.00	60.00	26,046.71	33.29	867,192.15
1984	2,526,780.00	60.00	42,112.53	33.96	1,430,187.74
1985	2,391,649.00	60.00	39,860.37	34.63	1,380,518.68
1986	3,640,641.00	60.00	60,676.67	35.31	2,142,746.01
1987	1,786,490.00	60.00	29,774.50	36.00	1,071,836.72
1988	1,092,697.00	60.00	18,211.41	36.69	668,196.91
1989	1,321,694.00	60.00	22,027.99	37.39	823,605.87
1990	1,444,481.00	60.00	24,074.41	38.09	917,048.14
1991	1,582,252.00	60.00	26,370.57	38.80	1,023,177.63
1992	380,533.00	60.00	6,342.15	39.51	250,604.84
1993	1,514,212.00	60.00	25,236.58	40.23	1,015,312.04
1994	99,341.00	60.00	1,655.66	40.96	67,810.07
1995	266,802.00	60.00	4,446.65	41.69	185,360.94
1996	795,960.00	60.00	13,265.85	42.42	562,723.96
1997	6,392,593.00	60.00	106,542.02	43.16	4,597,955.27

TGS

Gas Division

380.01 Services - Central Texas

Original Cost Of Utility Plant In Service

And Development Of Composite Remaining Life as of December 31, 2018

Based Upon Broad Group/Remaining Life Procedure and Technique

Average Service Life: 60 **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)
1998	3,862,132.00	60.00	64,368.15	43.90	2,825,696.55
1999	4,089,039.00	60.00	68,149.89	44.64	3,042,514.22
2000	1,986,084.00	60.00	33,101.03	45.40	1,502,653.11
2001	2,447,646.00	60.00	40,793.64	46.15	1,882,678.04
2002	2,573,525.00	60.00	42,891.60	46.91	2,012,007.34
2003	6,303,688.00	60.00	105,060.29	47.67	5,008,510.96
2004	1,545,811.00	60.00	25,763.23	48.44	1,247,971.70
2005	2,011,230.00	60.00	33,520.12	49.21	1,649,521.84
2006	1,262,921.00	60.00	21,048.45	49.99	1,052,115.23
2007	1,303,967.00	60.00	21,732.54	50.76	1,103,243.68
2008	6,190,228.00	60.00	103,169.31	51.55	5,318,116.01
2009	3,828,714.00	60.00	63,811.19	52.33	3,339,470.24
2010	2,226,513.00	60.00	37,108.13	53.12	1,971,353.99
2011	7,461,850.00	60.00	124,362.77	53.92	6,705,401.40
2012	1,955,961.00	60.00	32,598.99	54.72	1,783,721.39
2013	8,335,075.00	60.00	138,916.36	55.52	7,712,594.18
2014	5,179,580.00	60.00	86,325.37	56.33	4,862,356.22
2015	4,129,754.00	60.00	68,828.46	57.14	3,932,542.61
2016	4,499,255.00	60.00	74,986.74	57.95	4,345,450.03
2017	13,794,536.00	60.00	229,906.36	58.77	13,510,739.93
2018	12,912,737.00	60.00	215,209.87	59.59	12,823,996.28
Total	138,654,767.00	60.00	2,310,886.91	48.23	111,465,383.82

Composite Average Remaining Life ... 48.23 Years

TGS

Gas Division

380.02 Services - Gulf Coast

Original Cost Of Utility Plant In Service

And Development Of Composite Remaining Life as of December 31, 2018

Based Upon Broad Group/Remaining Life Procedure and Technique

Average Service Life: **60** *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)
1943	60,201.00	60.00	1,003.34	13.01	13,057.87
1944	10,014.00	60.00	166.90	13.36	2,230.32
1945	6,309.00	60.00	105.15	13.72	1,442.71
1946	10,845.00	60.00	180.75	14.08	2,545.47
1947	13,950.00	60.00	232.50	14.45	3,360.28
1948	25,102.00	60.00	418.36	14.83	6,204.60
1949	48,905.00	60.00	815.07	15.22	12,402.36
1950	47,043.00	60.00	784.04	15.61	12,238.42
1951	48,699.00	60.00	811.64	16.01	12,994.84
1952	54,383.00	60.00	906.37	16.42	14,882.71
1953	53,271.00	60.00	887.84	16.84	14,949.43
1954	68,070.00	60.00	1,134.49	17.26	19,586.11
1955	79,992.00	60.00	1,333.19	17.70	23,595.64
1956	97,388.00	60.00	1,623.12	18.14	29,447.15
1957	77,095.00	60.00	1,284.90	18.59	23,892.18
1958	103,450.00	60.00	1,724.15	19.05	32,853.31
1959	90,380.00	60.00	1,506.32	19.52	29,410.45
1960	88,943.00	60.00	1,482.37	20.00	29,652.08
1961	45,069.00	60.00	751.14	20.49	15,390.60
1962	163.00	60.00	2.72	20.99	57.01
1963	2,826.00	60.00	47.10	21.49	1,012.12
1964	2,521.00	60.00	42.02	22.00	924.49
1965	5,094.00	60.00	84.90	22.53	1,912.40
1966	4,966.00	60.00	82.77	23.06	1,908.26
1967	3,578.00	60.00	59.63	23.59	1,406.99
1968	13,031.00	60.00	217.18	24.14	5,243.25
1969	35,040.00	60.00	583.99	24.70	14,422.52

TGS
Gas Division
380.02 Services - Gulf Coast

Original Cost Of Utility Plant In Service
And Development Of Composite Remaining Life as of December 31, 2018
Based Upon Broad Group/Remaining Life Procedure and Technique

Average Service Life: **60** *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)
1970	28,788.00	60.00	479.79	25.26	12,120.29
1971	34,837.00	60.00	580.61	25.83	14,999.58
1972	24,200.00	60.00	403.33	26.41	10,653.74
1973	32,418.00	60.00	540.29	27.00	14,588.91
1974	231,415.00	60.00	3,856.87	27.60	106,443.49
1975	535,691.00	60.00	8,928.08	28.20	251,775.26
1976	475,535.00	60.00	7,925.49	28.81	228,355.09
1977	327,250.00	60.00	5,454.11	29.43	160,525.66
1978	413,341.00	60.00	6,888.94	30.06	207,070.02
1979	430,333.00	60.00	7,172.14	30.69	220,118.30
1980	353,321.00	60.00	5,888.62	31.33	184,500.43
1981	489,015.00	60.00	8,150.16	31.98	260,620.50
1982	293,301.00	60.00	4,888.30	32.63	159,517.06
1983	325,687.00	60.00	5,428.06	33.29	180,720.24
1984	515,709.00	60.00	8,595.05	33.96	291,897.47
1985	432,040.00	60.00	7,200.59	34.63	249,384.12
1986	366,783.00	60.00	6,112.98	35.31	215,874.84
1987	896,741.00	60.00	14,945.52	36.00	538,015.85
1988	643,283.00	60.00	10,721.26	36.69	393,375.03
1989	490,890.00	60.00	8,181.41	37.39	305,895.23
1990	691,170.00	60.00	11,519.37	38.09	438,798.54
1991	650,574.00	60.00	10,842.78	38.80	420,699.59
1992	477,636.00	60.00	7,960.51	39.51	314,553.25
1993	536,631.00	60.00	8,943.75	40.23	359,822.74
1994	241,537.00	60.00	4,025.57	40.96	164,872.93
1995	218,022.00	60.00	3,633.66	41.69	151,470.99
1996	185,522.00	60.00	3,092.00	42.42	131,159.45

TGS
Gas Division
380.02 Services - Gulf Coast

Original Cost Of Utility Plant In Service
And Development Of Composite Remaining Life as of December 31, 2018
Based Upon Broad Group/Remaining Life Procedure and Technique

Average Service Life: **60** *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)
1997	192,782.00	60.00	3,213.00	43.16	138,660.95
1998	231,077.00	60.00	3,851.24	43.90	169,065.55
1999	243,795.00	60.00	4,063.20	44.64	181,399.53
2000	265,587.00	60.00	4,426.40	45.40	200,940.71
2001	432,999.00	60.00	7,216.57	46.15	333,053.76
2002	263,239.00	60.00	4,387.27	46.91	205,802.86
2003	124,288.00	60.00	2,071.44	47.67	98,751.37
2004	1,481,019.00	60.00	24,683.37	48.44	1,195,663.51
2005	691,506.00	60.00	11,524.97	49.21	567,142.62
2006	830,617.00	60.00	13,843.46	49.99	691,971.07
2007	579,337.00	60.00	9,655.51	50.76	490,158.02
2008	50,480.00	60.00	841.32	51.55	43,368.11
2009	967,626.00	60.00	16,126.92	52.33	843,980.05
2010	2,038,830.00	60.00	33,980.12	53.12	1,805,179.51
2011	2,714,523.00	60.00	45,241.54	53.92	2,439,336.94
2012	1,352,815.00	60.00	22,546.66	54.72	1,233,687.71
2013	1,138,231.00	60.00	18,970.30	55.52	1,053,225.53
2014	1,073,718.00	60.00	17,895.10	56.33	1,007,958.06
2015	1,626,096.00	60.00	27,101.30	57.14	1,548,443.76
2016	2,118,256.00	60.00	35,303.87	57.95	2,045,844.39
2017	1,274,166.00	60.00	21,235.86	58.77	1,247,952.48
2018	1,143,738.00	60.00	19,062.09	59.59	1,135,877.84
Total	32,272,723.00	60.00	537,872.70	46.47	24,992,316.52

Composite Average Remaining Life ... 46.47 Years

TGS
Gas Division
385.01 Industrial M&R Station Equip. - Central Texas
Original Cost Of Utility Plant In Service
And Development Of Composite Remaining Life as of December 31, 2018
Based Upon Broad Group/Remaining Life Procedure and Technique

Average Service Life: 65 **Survivor Curve:** R2.5

Year (1)	Original Cost (2)	Avg. Service Life (3)	Avg. Annual Accrual (4)	Avg. Remaining Life (5)	Future Annual Accruals (6)
1955	7,690.00	65.00	118.31	16.24	1,920.78
1956	1,722.00	65.00	26.49	16.72	443.02
1957	1,756.00	65.00	27.02	17.22	465.20
1958	5,585.00	65.00	85.92	17.73	1,523.74
1959	3,477.00	65.00	53.49	18.26	976.59
1960	17,604.00	65.00	270.83	18.80	5,090.75
1961	9,740.00	65.00	149.85	19.35	2,899.24
1962	29,621.00	65.00	455.71	19.91	9,073.10
1963	31,241.00	65.00	480.63	20.49	9,846.13
1964	27,192.00	65.00	418.34	21.07	8,814.91
1965	25,439.00	65.00	391.37	21.67	8,481.25
1966	39,547.00	65.00	608.41	22.28	13,554.63
1967	37,100.00	65.00	570.77	22.90	13,070.85
1968	57,499.00	65.00	884.60	23.53	20,814.31
1969	31,501.00	65.00	484.63	24.17	11,714.81
1970	80,540.00	65.00	1,239.08	24.82	30,756.52
1971	56,903.00	65.00	875.43	25.49	22,310.54
1972	35,203.00	65.00	541.58	26.15	14,164.54
1973	62,112.00	65.00	955.57	26.84	25,643.67
1974	73,611.00	65.00	1,132.48	27.53	31,172.44
1975	48,023.00	65.00	738.81	28.22	20,851.60
1976	51,837.00	65.00	797.49	28.93	23,071.92
1977	43,130.00	65.00	663.54	29.64	19,670.36
1978	57,552.00	65.00	885.41	30.37	26,889.29
1979	68,356.00	65.00	1,051.63	31.10	32,705.09
1980	44,115.00	65.00	678.69	31.84	21,609.61
1981	187,863.00	65.00	2,890.20	32.59	94,179.89

TGS
Gas Division
385.01 Industrial M&R Station Equip. - Central Texas
Original Cost Of Utility Plant In Service
And Development Of Composite Remaining Life as of December 31, 2018
Based Upon Broad Group/Remaining Life Procedure and Technique

Average Service Life: 65 *Survivor Curve:* R2.5

Year (1)	Original Cost (2)	Avg. Service Life (3)	Avg. Annual Accrual (4)	Avg. Remaining Life (5)	Future Annual Accruals (6)
1982	188,692.00	65.00	2,902.95	33.34	96,790.86
1983	149,029.00	65.00	2,292.75	34.10	78,190.02
1984	234,634.00	65.00	3,609.75	34.87	125,887.91
1985	135,463.00	65.00	2,084.04	35.65	74,295.80
1986	235,114.00	65.00	3,617.13	36.44	131,792.50
1987	93,634.00	65.00	1,440.52	37.23	53,626.83
1988	163,941.00	65.00	2,522.17	38.02	95,904.85
1989	53,108.00	65.00	817.05	38.83	31,726.15
1990	111,988.00	65.00	1,722.89	39.64	68,297.17
1991	151,612.00	65.00	2,332.49	40.46	94,372.28
1992	237,149.00	65.00	3,648.44	41.28	150,620.13
1993	141,604.00	65.00	2,178.52	42.12	91,748.52
1994	1,464,467.00	65.00	22,530.23	42.95	967,694.32
1995	50,870.00	65.00	782.61	43.79	34,274.48
1997	164,092.00	65.00	2,524.49	45.50	114,859.73
1998	98,809.00	65.00	1,520.14	46.36	70,469.33
1999	211,604.00	65.00	3,255.44	47.22	153,735.26
2000	5,534.00	65.00	85.14	48.10	4,094.77
2002	2,918.00	65.00	44.89	49.85	2,238.02
2003	307,991.00	65.00	4,738.32	50.74	240,416.79
2004	113,317.00	65.00	1,743.34	51.63	90,009.24
2005	88,474.00	65.00	1,361.14	52.53	71,494.39
2006	119,612.00	65.00	1,840.18	53.43	98,314.12
2007	97,730.00	65.00	1,503.54	54.33	81,687.36
2008	203,574.00	65.00	3,131.90	55.24	173,004.88
2009	63,121.00	65.00	971.09	56.15	54,528.31
2010	216,969.00	65.00	3,337.98	57.07	190,495.18

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Gas Division

385.01 Industrial M&R Station Equip. - Central Texas

Original Cost Of Utility Plant In Service

And Development Of Composite Remaining Life as of December 31, 2018

Based Upon Broad Group/Remaining Life Procedure and Technique

Average Service Life: 65 *Survivor Curve:* R2.5

Year (1)	Original Cost (2)	Avg. Service Life (3)	Avg. Annual Accrual (4)	Avg. Remaining Life (5)	Future Annual Accruals (6)
2011	156,207.00	65.00	2,403.18	57.99	139,357.47
2012	308,714.00	65.00	4,749.44	58.91	279,806.54
2013	219,230.00	65.00	3,372.76	59.84	201,831.17
2014	297,727.00	65.00	4,580.41	60.77	278,361.43
2015	839,171.00	65.00	12,910.31	61.71	796,652.47
2016	738,494.00	65.00	11,361.43	62.64	711,722.35
2017	563,132.00	65.00	8,663.56	63.58	550,867.06
2018	712,039.00	65.00	10,954.43	64.53	706,859.16
Total	10,075,723.00	65.00	155,010.92	48.89	7,577,741.64

Composite Average Remaining Life ... 48.89 Years

TGS
Gas Division
385.02 Industrial M&R Station Equip. - Gulf Coast
Original Cost Of Utility Plant In Service
And Development Of Composite Remaining Life as of December 31, 2018
Based Upon Broad Group/Remaining Life Procedure and Technique

Average Service Life: 65 *Survivor Curve:* R2.5

Year (1)	Original Cost (2)	Avg. Service Life (3)	Avg. Annual Accrual (4)	Avg. Remaining Life (5)	Future Annual Accruals (6)
1943	2,065.00	65.00	31.77	11.44	363.29
1948	1,140.00	65.00	17.54	13.21	231.71
1949	130.00	65.00	2.00	13.60	27.21
1950	363.00	65.00	5.58	14.01	78.24
1951	148.00	65.00	2.28	14.43	32.85
1952	1,866.00	65.00	28.71	14.86	426.60
1953	1,232.00	65.00	18.95	15.30	290.08
1954	759.00	65.00	11.68	15.76	184.08
1955	2,568.00	65.00	39.51	16.24	641.43
1956	1,435.00	65.00	22.08	16.72	369.18
1957	1,912.00	65.00	29.42	17.22	506.53
1958	4,830.00	65.00	74.31	17.73	1,317.75
1959	2,672.00	65.00	41.11	18.26	750.49
1960	3,712.00	65.00	57.11	18.80	1,073.44
1961	2,551.00	65.00	39.25	19.35	759.34
1962	4,071.00	65.00	62.63	19.91	1,246.97
1963	8,254.00	65.00	126.98	20.49	2,601.39
1964	1,837.00	65.00	28.26	21.07	595.51
1965	7,067.00	65.00	108.72	21.67	2,356.11
1966	3,513.00	65.00	54.05	22.28	1,204.07
1967	3,314.00	65.00	50.98	22.90	1,167.57
1968	5,224.00	65.00	80.37	23.53	1,891.06
1969	7,789.00	65.00	119.83	24.17	2,896.63
1970	7,807.00	65.00	120.11	24.82	2,981.33
1971	16,281.00	65.00	250.48	25.49	6,383.46
1972	11,420.00	65.00	175.69	26.15	4,595.04
1973	6,911.00	65.00	106.32	26.84	2,853.29

TGS
Gas Division
385.02 Industrial M&R Station Equip. - Gulf Coast
Original Cost Of Utility Plant In Service
And Development Of Composite Remaining Life as of December 31, 2018
Based Upon Broad Group/Remaining Life Procedure and Technique

Average Service Life: 65 **Survivor Curve:** R2.5

Year (1)	Original Cost (2)	Avg. Service Life (3)	Avg. Annual Accrual (4)	Avg. Remaining Life (5)	Future Annual Accruals (6)
1974	5,419.00	65.00	83.37	27.53	2,294.81
1975	19,930.00	65.00	306.61	28.22	8,653.61
1976	6,907.00	65.00	106.26	28.93	3,074.21
1977	8,729.00	65.00	134.29	29.64	3,981.05
1978	19,843.00	65.00	305.28	30.37	9,270.99
1979	6,411.00	65.00	98.63	31.10	3,067.36
1980	4,059.00	65.00	62.45	31.84	1,988.29
1981	19,821.00	65.00	304.94	32.59	9,936.71
1982	51,771.00	65.00	796.48	33.34	26,556.29
1983	51,467.00	65.00	791.80	34.10	27,002.84
1984	132,785.00	65.00	2,042.84	34.87	71,242.98
1985	84,544.00	65.00	1,300.68	35.65	46,368.86
1986	55,173.00	65.00	848.81	36.44	30,927.07
1987	60,773.00	65.00	934.97	37.23	34,806.41
1988	6,563.00	65.00	100.97	38.02	3,839.33
1989	29,211.00	65.00	449.40	38.83	17,450.34
1990	61,907.00	65.00	952.41	39.64	37,754.70
1991	54,372.00	65.00	836.49	40.46	33,844.35
1992	68,854.00	65.00	1,059.29	41.28	43,731.15
1993	58,387.00	65.00	898.26	42.12	37,830.29
1994	127,254.00	65.00	1,957.75	42.95	84,087.23
1995	43,383.00	65.00	667.43	43.79	29,229.99
1997	34,040.00	65.00	523.69	45.50	23,827.03
1998	118,325.00	65.00	1,820.38	46.36	84,387.89
1999	173,186.00	65.00	2,664.40	47.22	125,823.68
2000	28,247.00	65.00	434.57	48.10	20,900.81
2001	142,437.00	65.00	2,191.34	48.97	107,312.62

TGS
Gas Division
385.02 Industrial M&R Station Equip. - Gulf Coast

Original Cost Of Utility Plant In Service
And Development Of Composite Remaining Life as of December 31, 2018
Based Upon Broad Group/Remaining Life Procedure and Technique

***Average Service Life:* 65** ***Survivor Curve:* R2.5**

Year (1)	Original Cost (2)	Avg. Service Life (3)	Avg. Annual Accrual (4)	Avg. Remaining Life (5)	Future Annual Accruals (6)
2002	120,392.00	65.00	1,852.18	49.85	92,337.12
2003	63,619.00	65.00	978.75	50.74	49,660.79
2004	52,434.00	65.00	806.68	51.63	41,649.04
2005	184,909.00	65.00	2,844.75	52.53	149,421.94
2006	35,546.00	65.00	546.86	53.43	29,216.75
2007	73,469.00	65.00	1,130.29	54.33	61,408.87
2008	18,897.00	65.00	290.72	55.24	16,059.38
2009	69,258.00	65.00	1,065.51	56.15	59,829.88
2010	142,113.00	65.00	2,186.35	57.07	124,772.86
2011	124,699.00	65.00	1,918.44	57.99	111,248.13
2012	99,356.00	65.00	1,528.55	58.91	90,052.47
2013	113,271.00	65.00	1,742.63	59.84	104,281.43
2014	43,399.00	65.00	667.68	60.77	40,576.12
2015	191,403.00	65.00	2,944.66	61.71	181,705.13
2016	37,367.00	65.00	574.88	62.64	36,012.38
2017	47,428.00	65.00	729.66	63.58	46,395.02
2018	68,168.00	65.00	1,048.74	64.53	67,672.10
Total	3,070,397.00	65.00	47,236.81	48.04	2,269,314.94

Composite Average Remaining Life ... 48.04 Years