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Speaker of the House of Representatives

November 4, 2016

Ms. Carlotta Stauffer, Commission Clerk
Florida Public Service Commission
2540 Shumard Oak Boulevard
Tallahassee, FL 32399-0850

RE: Docket 160159-GU Petition for approval of 2016 depreciation study by Peoples Gas System

Dear Ms. Stauffer:

Please find attached a preliminary report by the Office of Public Counsel regarding the revised depreciation study filed by Peoples Gas System (PGS). In order to aid staff in its review of the study and the petition, we have outlined several issues of particular concern. In short, our analysis indicates that PGS's study results in unreasonably high proposed depreciation rates. OPC recommends an adjustment of at least $20,087,410 from PGS's revised proposal.

Should you have any questions, please call or e-mail me.

Sincerely,

Stephanie A. Morse
Associate Public Counsel

Enclosure

cc: All Counsel of Record
Division of Accounting & Finance (Mark Cicchetti)
Division of Economics (Jenny Wu, William McNulty)

BEFORE THE FLORIDA PUBLIC SERVICE COMMISSION

In Re the Petition for Approval of
2016 Depreciation Study by Peoples Gas System

Docket No. 160-159-GU

Preliminary Report of

David J. Garrett

on behalf of the

Florida Office of Public Counsel

November 4, 2016

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EXECUTIVE SUMMARY

This preliminary report is prepared on behalf of the Florida Office of Public Counsel ("OPC") and sets forth my recommendations regarding the 2016 Depreciation Study filed by Peoples Gas System ("PGS" or the "Company"). 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 all of the Company's depreciable accounts. In this case, PGS initially recommended a $4.9 million dollar decrease in depreciation expense.[1] This decrease was primarily driven by Account 37600 – Mains Steel, an account for which the Company proposed to extend the average life from 40 years to 45 years. Subsequently, PGS filed a revised depreciation study that extended the average life for this account to 50 years.[2] PGS filed a second revised depreciation study proposing an $8.5 million reduction to current depreciation expense.[3]

In looking at PGS's depreciation study, it is clear that the Company has significantly underestimated the average lives of several material accounts. The Iowa curves chosen by PGS for several accounts provide very poor fits to the Company's historical retirement patterns. Depreciation studies are often filed with graphs that visually display the utility's observed mortality patterns by account, along with the utility's selected Iowa curve. This allows regulators and intervenors to see if the utility's selected Iowa curve provides a good fit to the observed data. In this case, PGS did not include any such graphs with its depreciation study. However, a visual

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[1] 2016 Second Revised Depreciation Study p. 2.

[2] Revised 2016 Depreciation Study p. 2.

[3] *Id*. at p. 13.

representation of the Company's proposal in this manner would have demonstrated that its selected Iowa curves for several accounts resulted in very poor fits. Ultimately, the Company's proposal results in an unreasonably high proposed depreciation expense.

In contrast, the curves I propose are much better fits to the Company's observed data, and as a result, the depreciation rates I recommend are much more reasonable. The Company's proposed depreciation expense is $51.3 million. I recommend an adjustment of $20.1 million, reducing the Company's depreciation expense to $31.2 million.[4]

Although PGS has 34 accounts, my total adjustment for this preliminary report is comprised of adjustments to six accounts. The table below summarizes and compares the proposed depreciation rates and expenses for these six accounts.[5]

Figure 1:
Proposed Depreciation Rate and Accrual Adjustments

	Original Cost	PGS Proposal		OPC Proposal		OPC
Account	12/31/2015	Rate	Accrual	Rate	Accrual	Adjustment
37600 - Mains Steel	$ 385,317,174	2.6%	$ 10,018,247	2.0%	$ 7,804,962	$ (2,213,285)
37602 - Mains Plastic	401,310,012	3.0%	12,039,300	1.3%	5,106,690	(6,932,610)
38000 - Services Steel	46,376,347	5.3%	2,457,946	1.4%	640,781	(1,817,165)
38002 - Services Plastic	247,505,036	4.5%	11,137,727	1.9%	4,736,295	(6,401,432)
38100 - Meters	63,032,755	5.9%	3,718,933	3.8%	2,374,559	(1,344,374)
38200 - Meter Installation	49,175,177	4.5%	2,212,883	1.7%	834,339	(1,378,544)
Total						**$ (20,087,410)**

While I am currently only recommending adjustments to these six accounts, it does not necessarily mean that PGS's proposed rates for all of its other accounts are ideal. Due to Staff's request to the Company for additional information regarding several accounts, I have limited my preliminary analysis at this time to the accounts and issues discussed herein.

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[4] Exhibit DJG 3.

[5] *See also* Exhibits DJG 2.

ANALYTIC METHODS

The legal standards governing depreciation analysis do not mandate a specific procedure for conducting depreciation analysis. Nonetheless, depreciation analysts must generally 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 four primary parameters: 1) a method of allocation; 2) a procedure for applying the method of allocation; 3) a technique of applying the depreciation rate; and 4) a model for analyzing the characteristics of vintage property groups.[6] In this case, I relied on the Company's observed life tables produced from its own historical retirement data. I then used the straight line method, the average life procedure, and the remaining life technique to develop my proposed depreciation rates. I provide a more detailed discussion of depreciation system parameters, theories, and equations in Appendix A.

The study of retirement patterns of industrial property is derived from the actuarial process used to study human mortality. Just as actuaries study historical human mortality data in order to predict how long a group of people will live, depreciation analysts study historical plant data in order to estimate the average lives of property groups. The most common actuarial method used by depreciation analysts is called the "retirement rate method." In the retirement rate method, original property data, including additions, retirements, transfers, and other transactions, are

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[6] *See* Frank K. Wolf & W. Chester Fitch, *Depreciation Systems* 70 (Iowa State University Press 1994).

organized by vintage and transaction year.[7] 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 an "observed survivor curve." The observed survivor curve derived from the observed life table, however, must be fitted and smoothed with a complete curve in order to determine the average life of the group.[8] The curves most widely used for this fitting process were developed at Iowa State University in the early 1900s and are commonly known as the "Iowa curves."[9] A more detailed explanation of how the Iowa curves are used in the actuarial analysis of depreciable property is set forth in Appendix C.

MASS PROPERTY ANALYSIS

PGS's distribution accounts are referred to as "mass" property accounts. These accounts contain a large number of relatively small units that will not be retired concurrently. Estimating the service life of any single unit contained in a mass account, such as one gas meter, would not require any actuarial analysis or curve-fitting techniques. Since we must develop a single rate for an entire group of assets, however, actuarial analysis is required to calculate the average life of the group of assets within an account.

To develop depreciation rates for PGS's distribution accounts, I obtained the Company's historical plant data in order to analyze the observed retirement patterns for each account. I then used Iowa curves to smooth and complete the observed data to calculate the average remaining

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[7] 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).

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

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

life of each account. Finally, I analyzed the Company's proposed net salvage rates for each mass account by reviewing the historical salvage data. Based upon my analysis, I do not recommend any changes to the Company's proposed salvage rates at this time.

The Company's property data includes observed life tables ("OLT") for each account. The data points on the OLT can be plotted to form an observed survivor curve (or "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. The Iowa curves are empirically-derived curves based on the extensive studies of the actual mortality patterns of many different types of industrial property.[10] 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 judgement. The first step of my approach to curve-fitting involves visually inspecting the OLT curve for any irregularities. For example, if the "tail" end of the curve is erratic and shows a sharp decline over a short period of time, it may indicate that this portion of the data is less reliable, as further discussed below. After inspecting the OLT curve, I use a mathematical curve-fitting technique which essentially involves measuring the distance between the OLT curve and the selected Iowa curve in order to get an objective, mathematical assessment of how well the curve fits. After selecting an Iowa curve, I observe the OLT curve along with the Iowa curve on the same graph to determine how well the curve fits. I may repeat this process several times for any given account to ensure that the most reasonable Iowa curve is selected. Once I select the best Iowa curve, I can then calculate the average remaining life under the curve to develop depreciation rates for each account.[11] With each of the

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[10] A description of the curve fitting methodology is included in Appendix C, page 12.

[11] *See* Appendix A.

six accounts discussed below, the Iowa curves I selected provide significantly better visual and mathematical fits to the observed data than the Iowa curves selected by the Company. Thus, the depreciation rates arising from my selected curves are much more accurate and reasonable.

Account 37600 – Mains Steel

This is the account discussed the most by PGS in its depreciation study. The Company initially proposed a five-year increase in the average life for this account, from 45 years to 50 years, which resulted in a decrease in depreciation expense of $4.2 million. Subsequently, the Company revised its depreciation study to add an additional five years to the average life.[12] The Company attributed the initial and revised increases to the average life for this account to its Cast Iron and Base Steel replacement program. While it would make sense to assume that the average life for this account would increase under the terms of this program, it is imperative to actually analyze the historical data for this account and conduct the visual and mathematical curve-fitting processes. Doing so actually reveals that the most appropriate average life for this account is 55 years. The graphs below show the Iowa curve I selected as well as the Company's selected curve. Both Iowa curves are juxtaposed with the OLT curve.

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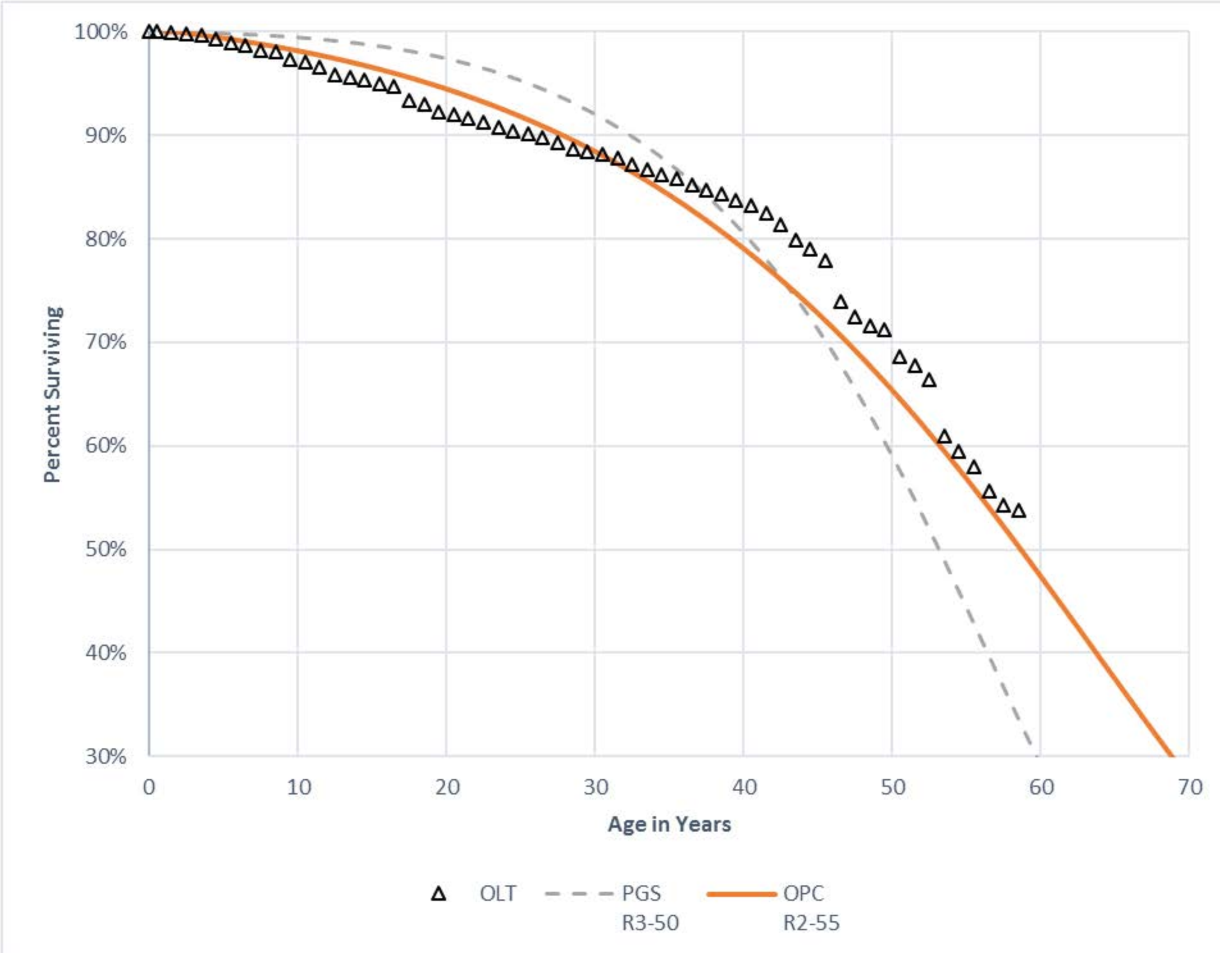
[12] First Revised 2016 Depreciation Study p. 4.

Figure 2:
Account 37600 – Mains Steel



First, it is visually apparent that the R2-55 curve I selected is a better fit than the R3-50 curve PGS selected. As shown in the graph, the Company's R3 curve shape is too steep for this account. From age 10 to age 30, the R3 curve is not declining fast enough, then starting at age 30, the R3 curve declines much more rapidly than the historical pattern of this account indicates. Furthermore, a 50-year average life underestimates the average life indicated by the OLT curve. In contrast, the R2-55 curve I selected provides a far superior curve shape and average life that closely conforms with the observed data.

While it is visually clear that the Iowa R2-55 curve is a better fit than PGS's proposed R3-50 curve, this fact can also be confirmed mathematically. Mathematical curve fitting essentially involves measuring the distance between the OLT curve (i.e., the black triangles) and the selected Iowa curve. The best mathematically-fitted curve is the one that minimizes the distance between the OLT curve and the Iowa curve, thus providing the closest fit. The "distance" between the curves is calculated using the "sum-of-squared differences" ("SSD") technique. In Account 37600, the total SSD, or "distance" between the Company's curve and the OLT curve is 3.5968, while the total SSD between the R2-55 curve and the OLT curve is only 1.0373.[13] Thus, the R2-55 curve provides the superior mathematical fit. Applying the R2-55 curve to this account results in a remaining life of 45.5 years and a depreciation rate of 2.03%.[14]

Account 37602 – Mains Plastic

As with the other accounts discussed in this section, it is clear that the Company's selected Iowa curve for this account is far too short. In other words, the Company's own historical data indicates that the average life of the assets in this account is much longer than what the Company has proposed. The graph below again shows the OLT curve, which represents the actual historical retirement pattern for this account. The graph also shows the R3-40 curve the Company selected, as well as the R2-75 curve I selected.

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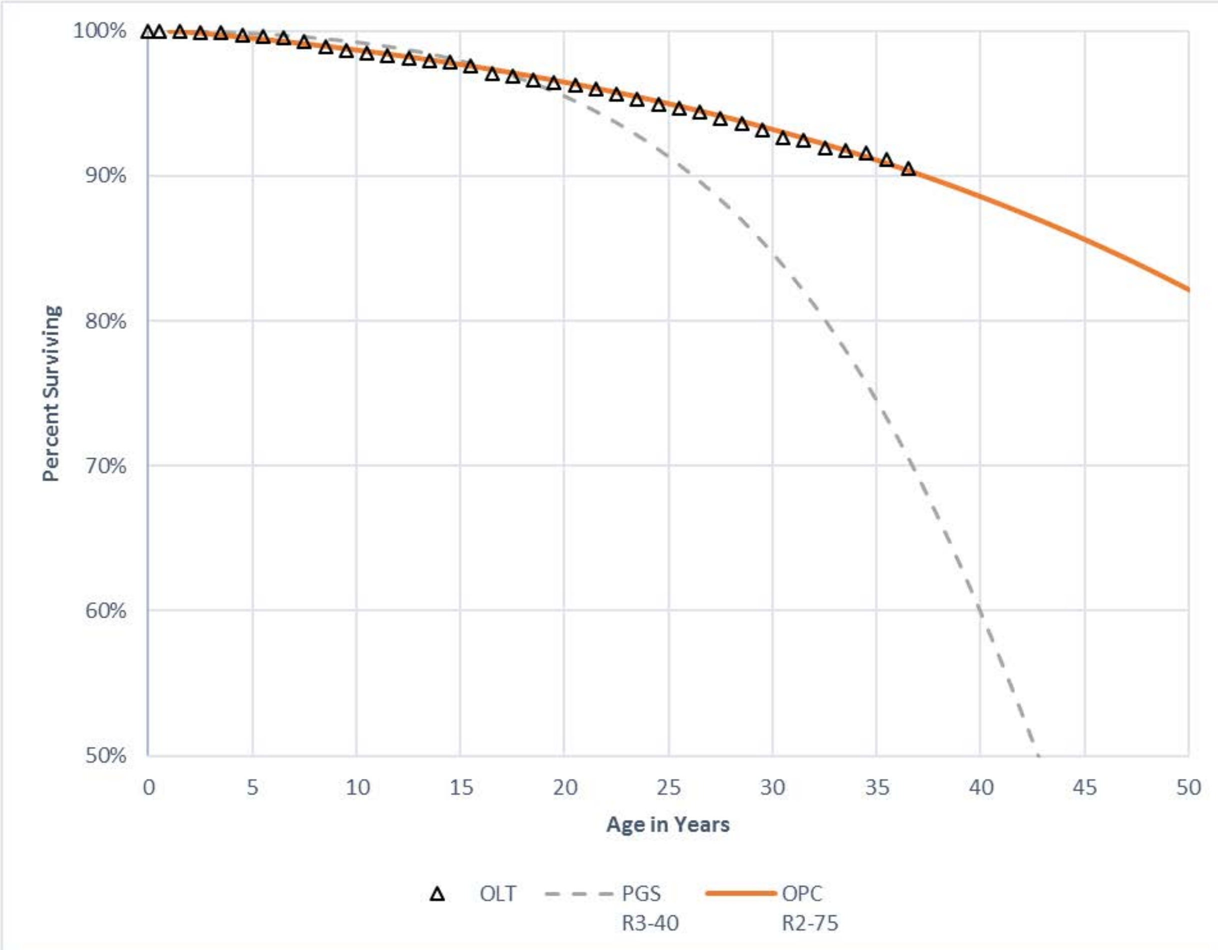
[13] Exhibit DJG 5.

[14] Exhibit DJG 6.

Figure 3:
Account 37602 – Mains Plastic



The OLT curve produced in this account is ideal for the Iowa curve fitting process. That is, it is a relatively smooth curve with a normal shape. Unsurprisingly, there is an Iowa curve that provides an excellent fit to this OLT curve. That Iowa curve is the R2-75 curve. As shown in the graph, the R2-75 curve passes through nearly all of the black triangles in the OLT curve. In stark contrast to the R2-75 curve, the Company's R3-40 curve does not fit the observed data. From age zero to age 20, the Company's curve provides a relatively good fit; however, starting at age 20, the Company's curve takes a sharp decline. This does not describe what is actually happening in this account. To reiterate, the OLT curve represented by the black triangles is the actual, historical retirement pattern in this account. We use Iowa curve to try to predict how the retirement pattern in this account will continue into the future (approximately after age 36 for this account). For example, suppose the Company had selected an Iowa curve that mirrored the R2-75 curve I selected until about age 36, then took a different direction. In that scenario, we might have a debate based on other factors regarding the future retirement pattern for this account. However, by selecting the R3-40 curve, the Company is not only wrong in its prediction of the future; more importantly, it is wrong in the way it portrays what actually happened in the past. At age 20, the retirement pattern in this account in fact did not take a sharp decline. Rather, it continued along in the same manner as best described by the R2-75 curve I selected. Thus, the Company's selected curve is far too short and results in unreasonably high proposed depreciation rates.

Although it is visually clear that PGS's proposed curve provides a very poor fit to the observed data in comparison to the R2-75 curve, I have also confirmed this fact mathematically. The sum of squared differences approach reveals that the R2-75 curve I selected is by far the better fit.[15] Selecting the R2-75 curve for this account would result in an average remaining life of 67.7 years and a depreciation rate of 1.27%.[16]

Account 38000 – Services Steel

In Account 38000, PGS again selected a poor Iowa curve shape and average life to represent the mortality characteristics of the assets in the account. The Company's curve results in an unreasonably short average life and an unreasonably high depreciation rate. The graph below shows the OLT curve along with the Company's R3-32 curve and my R0.5-50 curve.

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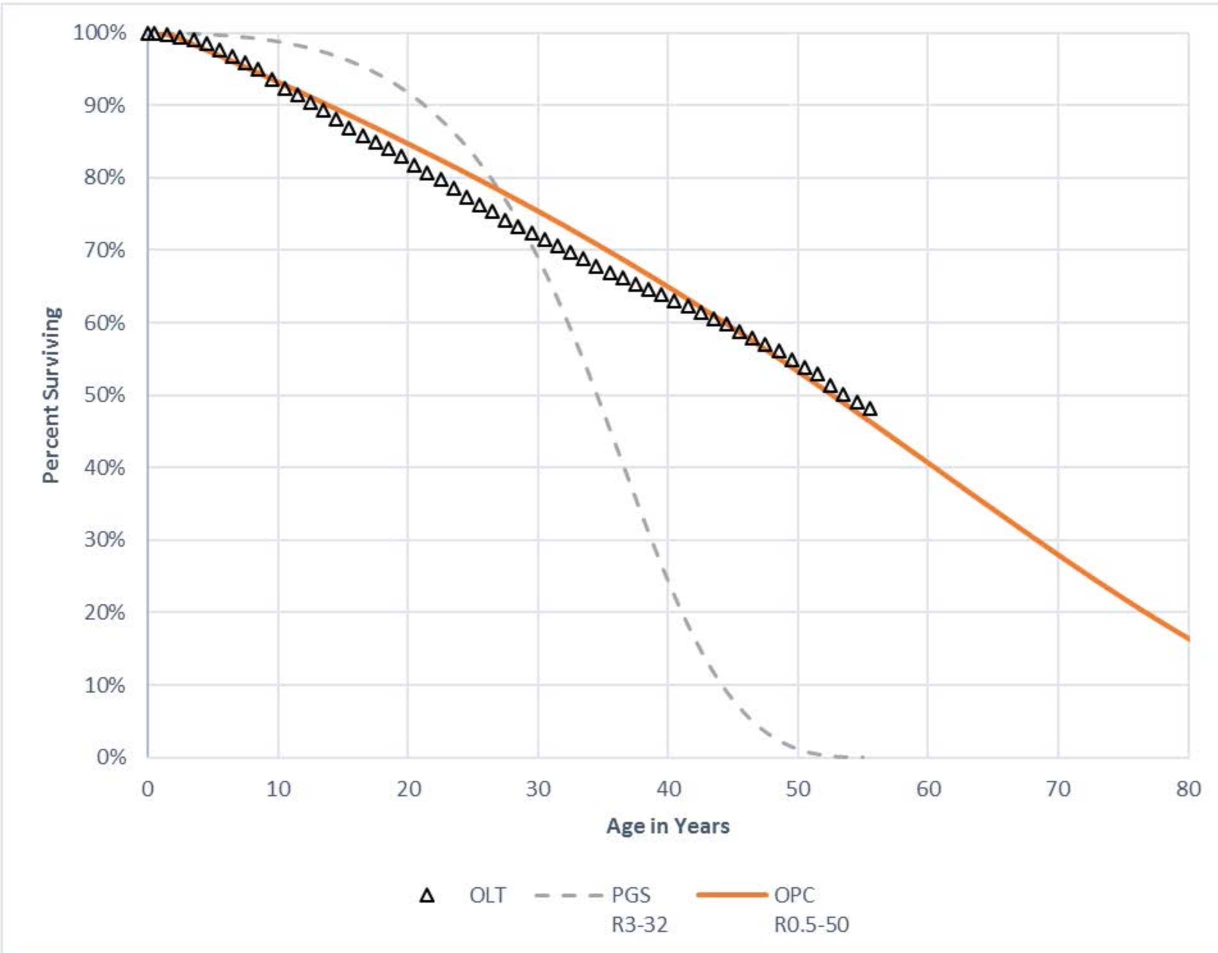
[15] Exhibit DJG 7.

[16] Exhibit DJG 8.

Figure 4:
Account 38000 – Services Steel



As shown in this graph, not only is the Company's R3-32 curve too short, but the shape of the curve does not match the shape of the OLT curve. This OLT curve has a very steady, almost linear decline from age zero to about age 55. By selecting an R3 curve, the Company is suggesting that the retirements in this account have dropped sharply starting at about age 20. Clearly however, the historical retirement pattern in the OLT curve shows us that is not the case. The entire point of the curve-fitting process is to use the historical retirement pattern in an account to predict what will happen in the future. The actual retirement pattern in this account (the OLT curve), according to the Company's own records, indicates a very different rate of retirement than what is represented by the Company's R3-32 curve. Thus, the R3-32 curve does not provide an accurate estimation of what will happen in the future with regards to the retirements in this account. As a result, the Company's calculated remaining life for this account is far too short, and its calculated depreciation rate is far too high.

In contrast, the R0.5-50 curve I selected provides an excellent fit to the OLT curve; and thus, it provides a much better estimate of the future retirement rate for this account. As with all of the accounts discussed in this report, the Iowa curve I recommend for this account is a much better visual and mathematical fit than the Company's proposed Iowa curve.[17] Selecting the R0.5-50 curve for this account results in a remaining life of 54.3 years and a depreciation rate of 1.37%.[18]

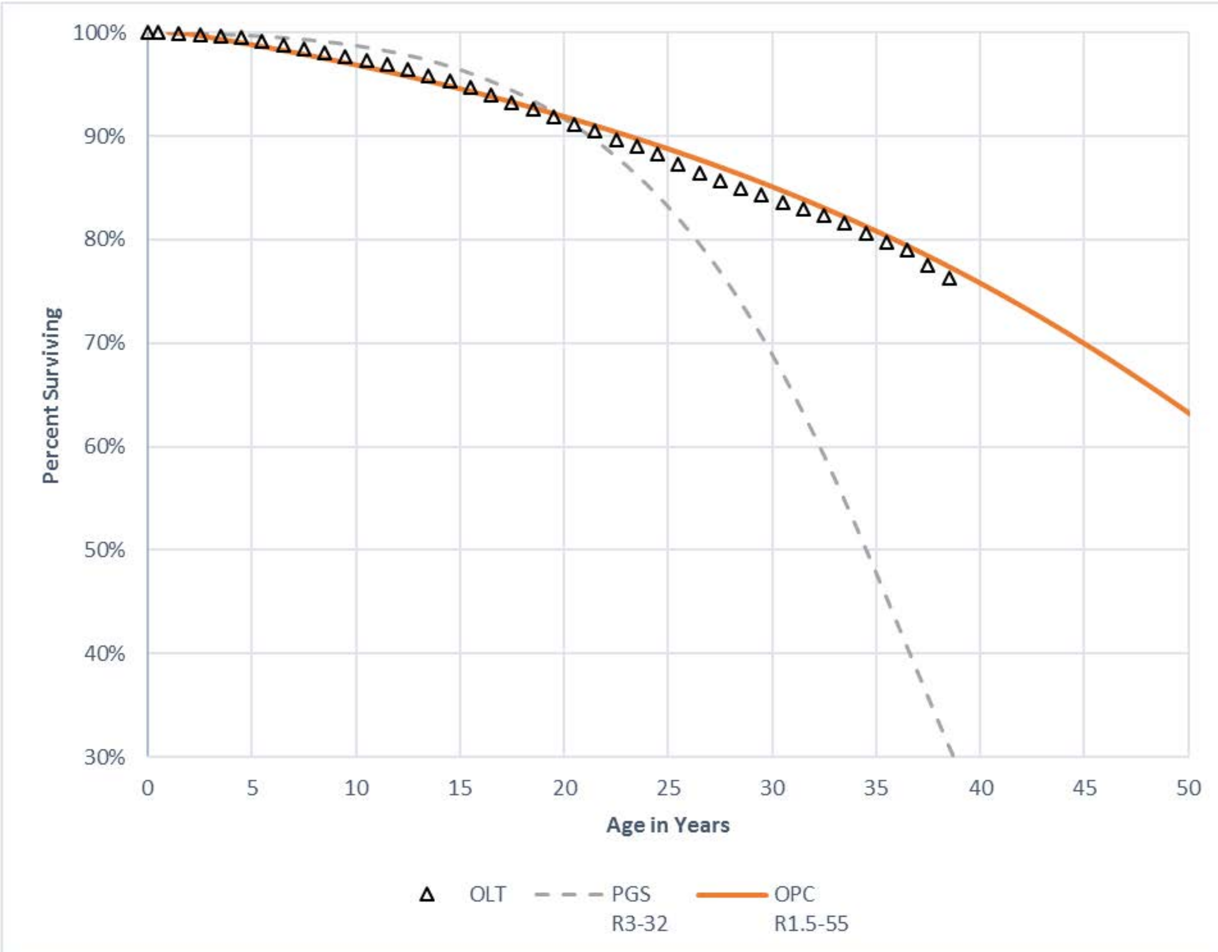
Account 38002 – Services Plastic

The situation in Account 38002 is similar to that in Account 37602 discussed above. The shape of the OLT curve for both accounts shows a steady, smooth decline that is ideal for the Iowa curve-fitting process. Also like Account 37602, the Company's chosen curve shape and average life for this account do not provide a good fit to the OLT curve. It is also interesting to note that PGS selected the same Iowa curve for this account (the R3-32 curve) as it did for the previous account (Account 38000), even though the retirement rates shown in the OLT curves for these two accounts indicate noticeably different mortality patterns and average lives. The graph below shows the OLT curve along with the Company's R3-32 curve and my R1.5-55 curve.

[17] Exhibit DJG 9.

[18] Exhibit DJG 10.

Figure 5:
Account 38002 – Services Plastic



As shown in this graph, not only is the Company's R3-32 curve too short, but the shape of the curve does not match the shape of the OLT curve. The OLT curve has a very steady, consistent decline from age zero to about age 40. By selecting an R3 curve, the Company is suggesting that the retirements in this account have dropped sharply starting at about age 20. Clearly however, the historical retirement pattern in the OLT curve shows us that was not the case.

Since the OLT curve pattern for this account is ideal for curve fitting, it is not surprising that there is an Iowa curve, the R1.5-55 curve, that provides an excellent fit to the OLT curve for this account. The fact that the R1.5-55 curve provides a much better fit to the OLT curve can be confirmed mathematically. I have calculated the sum of squared differences for PGS's selected curve and the R1.5-55 curve and confirmed that the curve I selected is a much better mathematical fit.[19] Selecting the R1.5-55 curve for this account results in an average remaining life of 48.9 years and a depreciation rate of 1.91%.[20]

<u>Account 38100 – Meters</u>

The OLT curve pattern for account 38100 is relatively unusual. This means that unlike Account 38002 discussed above, there is not an Iowa curve that will provide a near-perfect fit to the OLT curve. Nonetheless, it is imperative to use the same visual and mathematical curve-fitting techniques in order to select the Iowa curve that best fits the observed data. The Company's selected curve provides a poor fit to the observed data. The graph below shows the OLT curve along with the Company's L1-16 curve and my R1-21 curve.

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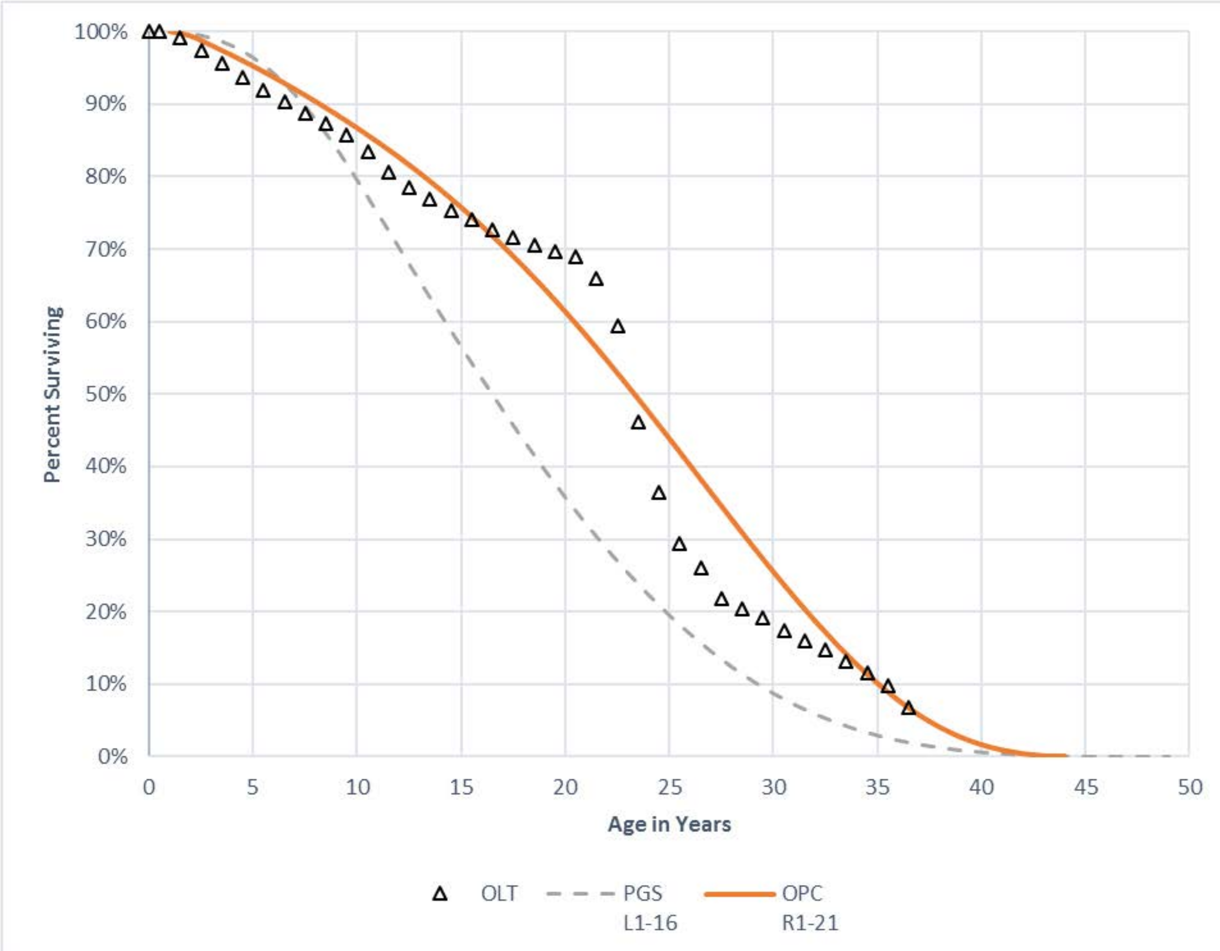
[19] Exhibit DJG 11.

[20] Exhibit DJG 12.

Figure 6:
Account 38100 – Meters



As shown in this graph, the L1 curve shape does not provide a good fit to the OLT curve. When dealing with an OLT curve of an unusual shape, it is often even more important to confirm any results mathematically. I have calculated the sum of squared differences for PGS's selected curve and the R1-21 curve and found that the R1-21 curve is in fact a better fit.[21] Selecting the R1-21 curve for this account would result in an average remaining life of 16.9 years and a depreciation rate of 3.77%.[22]

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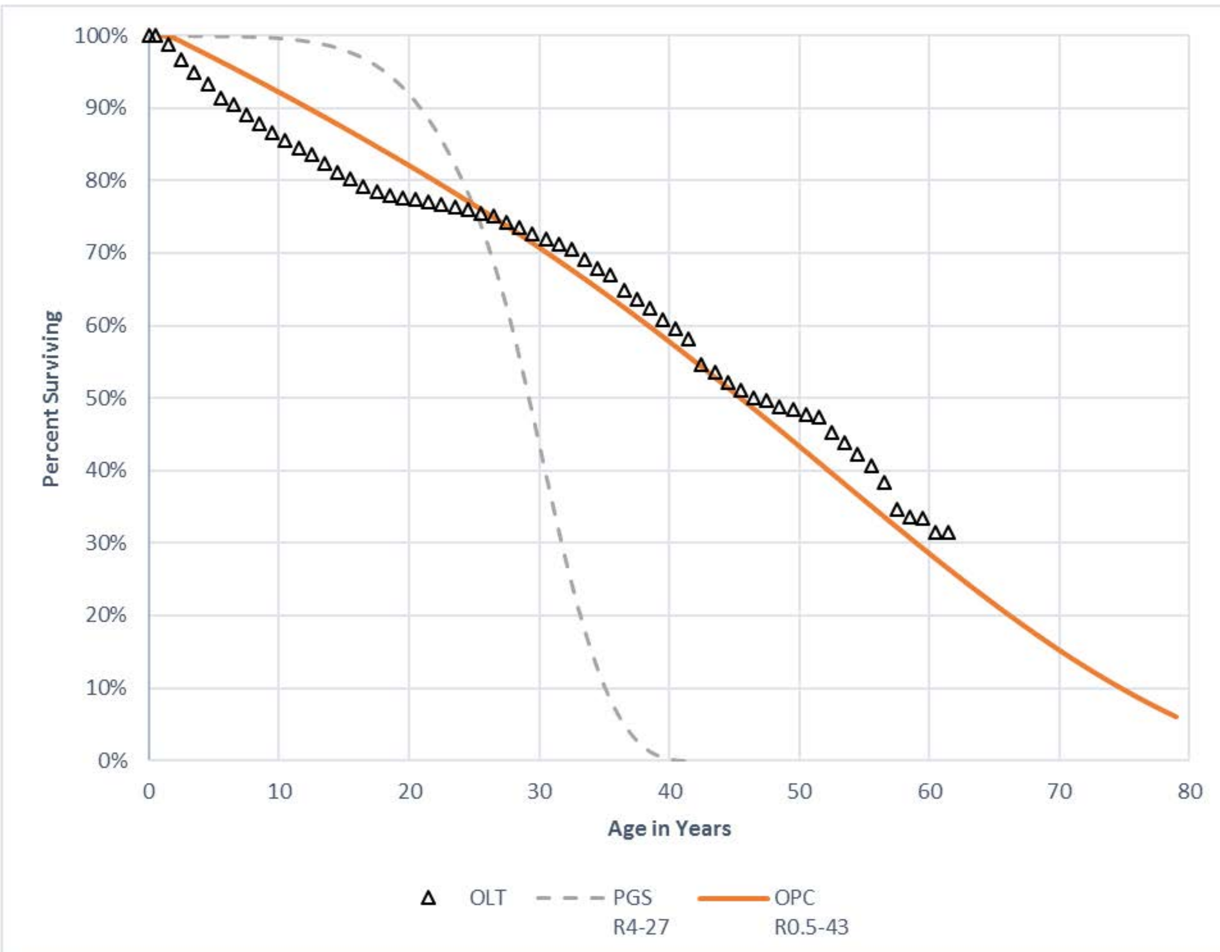
[21] Exhibit DJG 13.

[22] Exhibit DJG 14.

Account 38200 – Meter Installations

For Account 38200, PGS again selected a poor Iowa curve shape and average life to calculate the depreciation rate. The Company's selected curve results in an unreasonably short average life and an unreasonably high depreciation rate. The graph below shows the OLT curve along with the Company's R4-27 curve and my R0.5-43 curve.

Figure 7:
Account 38200 – Meter Installations



The Company's selected curve for this account is a very poor choice for several reasons. First, the shape of the R4 curve is not even close to the shape of the OLT curve. By selecting an R4 curve, the Company is suggesting that the retirements in this account have dropped very sharply starting at about age 20. Clearly however, the historical retirement pattern in the OLT curve indicates a very different result. Even more egregious is the fact that by using the R4-27 curve, the Company is saying that there no assets surviving after age 41 (i.e., the R4-27 curve reaches zero percent at age 41). However, the Company's own retirement records (the OLT curve) show that there are still assets exposed to retirement in this account past age 60.[23] Therefore, not only is PGS's curve selection unreasonable, but it represents an impossibility given the historical data in this account.

In stark contrast to the Company's curve, the R0.5-43 curve I recommend provides a good fit to the OLT curve and thus results in a more appropriate depreciation rate calculation. Unsurprisingly, the R0.5-43 curve provides a much better mathematical fit than the Company's curve.[24] Selecting the R0.5-43 curve for this account would result in an average remaining life of 40.2 years and a depreciation rate of 1.70%.[25]

CONCLUSION AND RECOMMENDATION

I employed a well-established depreciation system and used actuarial analysis to statistically analyze the Company's depreciable assets in order to develop reasonable depreciation rates. PGS did not select Iowa curves that provide good fits to its own historical data. Specifically, PGS's selected Iowa curves for each of the accounts discussed above were far too short, as shown in the corresponding graphs. All else held constant, shorter Iowa curves result in higher

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[23] *See also* 2016 Depreciation Study at p. 420.

[24] Exhibit DJG 15.

[25] Exhibit DJG 16.

depreciation rates. Because PGS's selected Iowa curves are unreasonably short given the observed historical data, its proposed depreciation rates are much too high.

It is also important to keep in mind that we should not give too much weight to the subjective elements of depreciation analysis. For example, the Company has attributed changes in the average life of Account 37600 to "the impact of the Cast Iron and Base Steel replacement program."[26] While I would agree that it is reasonable to assume that replacing old cast iron and bare steel main pipe with plastic main pipe would effectively tend to increase the average life of Account 37600, those assumptions do not outweigh the necessity of analyzing the Company's actual historical data in order to objectively determine the account's average life. As discussed above, this account's average life should be estimated at 55 years instead of 45 or 50 years. I reached this conclusion not by simply assuming that PGS's replacement program would add a few years to the currently approved average life for this account; rather, I reached this conclusion by using well-established, objective actuarial analysis along with visual and mathematical curve-fitting techniques based on the Company's own retirement data for this account.

Ultimately, the depreciation rates I recommend are prudent, fair, and reasonable. My proposed depreciation rates would result an adjustment to reduce the Company's proposed depreciation expense by $20,087,410.[27] Likewise, my proposed adjustments would result in an annual depreciation expense of $31,172,522.[28]

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[26] Revised 2016 Depreciation Study p. 4.

[27] Exhibit DJG 3. This depreciation expense is based on plant balances as of December 31, 2015, which are the plant balances that were provided in the depreciation study. In order to calculated the current depreciation expense, my proposed rates would need to be applied to current plant balances.

[28] Exhibit DJG 3.

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.[29] 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.[30] The figure below illustrates the basic concept of a depreciation system and includes some of the available parameters.[31]

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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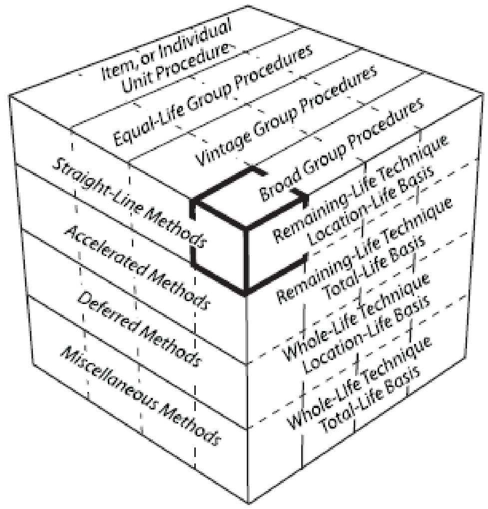
[29] Wolf *supra* n. 6, at 69-70.

[30] *See* Wolf *supra* n. 6, at 70, 139-40.

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

Figure 8:
The Depreciation System Cube



1. Allocation Methods

The "method" refers to the pattern of depreciation in relation to the accounting periods. The method most commonly used in the regulatory context is the "straight-line method" – a type of age-life method in which the depreciable cost of plant is charged in equal amounts to each accounting period over the service life of plant.[32] 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.[33] The basic formula for the straight-line method is as follows:[34]

[32] NARUC *supra* n. 7, at 56.

[33] *Id*.

[34] *Id*.

Equation 1:
Straight-Line Accrual

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

Gross plant is a known figure from the utility's records, while both net salvage and service life must be estimated in order to calculate the annual accrual. The straight-line method differs from accelerated methods of recovery, such as the "sum-of-the-years-digits" method and the "declining balance" method. Accelerated methods are primarily used for tax purposes and are rarely used in the regulatory context for determining annual accruals.[35] In practice, the annual accrual is expressed as a rate which is applied to the original cost of plant in order to determine the annual accrual in dollars. The formula for determining the straight-line rate is as follows:[36]

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.[37] While single units may be analyzed for depreciation, a group plan of depreciation is particularly adaptable to utility property. Employing a grouping procedure allows for a composite application of depreciation rates to groups of similar property, rather than

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[35] *Id*. at 57.

[36] *Id*. at 56.

[37] Wolf *supra* n. 6, at 74-75.

excessively conducting calculations for each unit. Whereas an individual unit of property has a single life, a group of property displays a dispersion of lives and the life characteristics of the group must be described statistically.[38] 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.[39]

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 depreciation, 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.[40] 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.[41] Under the equal life procedure the property is divided into subgroups that each has a common life.[42]

3. <u>Application Techniques</u>

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

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[38] *Id*. at 74.

[39] NARUC *supra* n. 7, at 61-62.

[40] *See* Wolf *supr*a n. 6, at 74-75.

[41] *Id*. at 75.

[42] *Id*.

the remaining life technique seeks to recover undepreciated costs over the remaining life of the plant.[43]

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.[44] 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.[45] 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

[43] NARUC *supra* n. 7, at 63-64.

[44] Wolf *supra* n. 6, at 83.

[45] NARUC *supra* n. 7, at 325.

in the annual accrual.[46] 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:[47]

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.[48]

4. <u>Analysis Model</u>

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.[49] 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

[46] NARUC *supra* n. 7, 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.").

[47] *Id*. at 64.

[48] Wolf *supra* n. 6, at 178.

[49] *See* Wolf *supra* n. 6, at 139 (I added the term "model" to distinguish this fourth depreciation system parameter from the other three parameters).

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

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

APPENDIX 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.[50] 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.[51] A frequency curve is a graph of the frequency of retirements as a function of age. Several types of survivor and frequency curves are illustrated in the figures below.

1. <u>Development</u>

The survivor curves used by analysts today were developed over several decades from extensive analysis of utility and industrial property. In 1931 Edwin Kurtz and Robley Winfrey used extensive data from a range of 65 industrial property groups to create survivor curves representing the life characteristics of each group of property.[52] They generalized the 65 curves

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[50] Wolf *supra* n. 6, at 276.

[51] *Id*. at 23.

[52] *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.[53] 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."[54] 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.[55] 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.

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[53] *Id*.

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

[55] 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. 6, at 305-38 (publishing the percent surviving for each Iowa curve, including "O" type curve, at one percent intervals).

In the 1970s, John Russo collected data from over 2,000 property accounts reflecting observations during the period 1965 – 1975 as part of his Ph.D. dissertation at Iowa State. Russo essentially repeated Winfrey's data collection, testing, and analysis methods used to develop the original Iowa curves, except that Russo studied industrial property in service several decades after Winfrey published the original Iowa curves. Russo drew three major conclusions from his research:[56]

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.[57]

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,

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[56] *See* Wolf *supra* n. 6, at 37.

[57] *Id*.

analysts commonly rely on several “half curves” derived from the original Iowa curves. Thus, the term “Iowa curves” could be said to describe up to 31 standardized survivor curves.

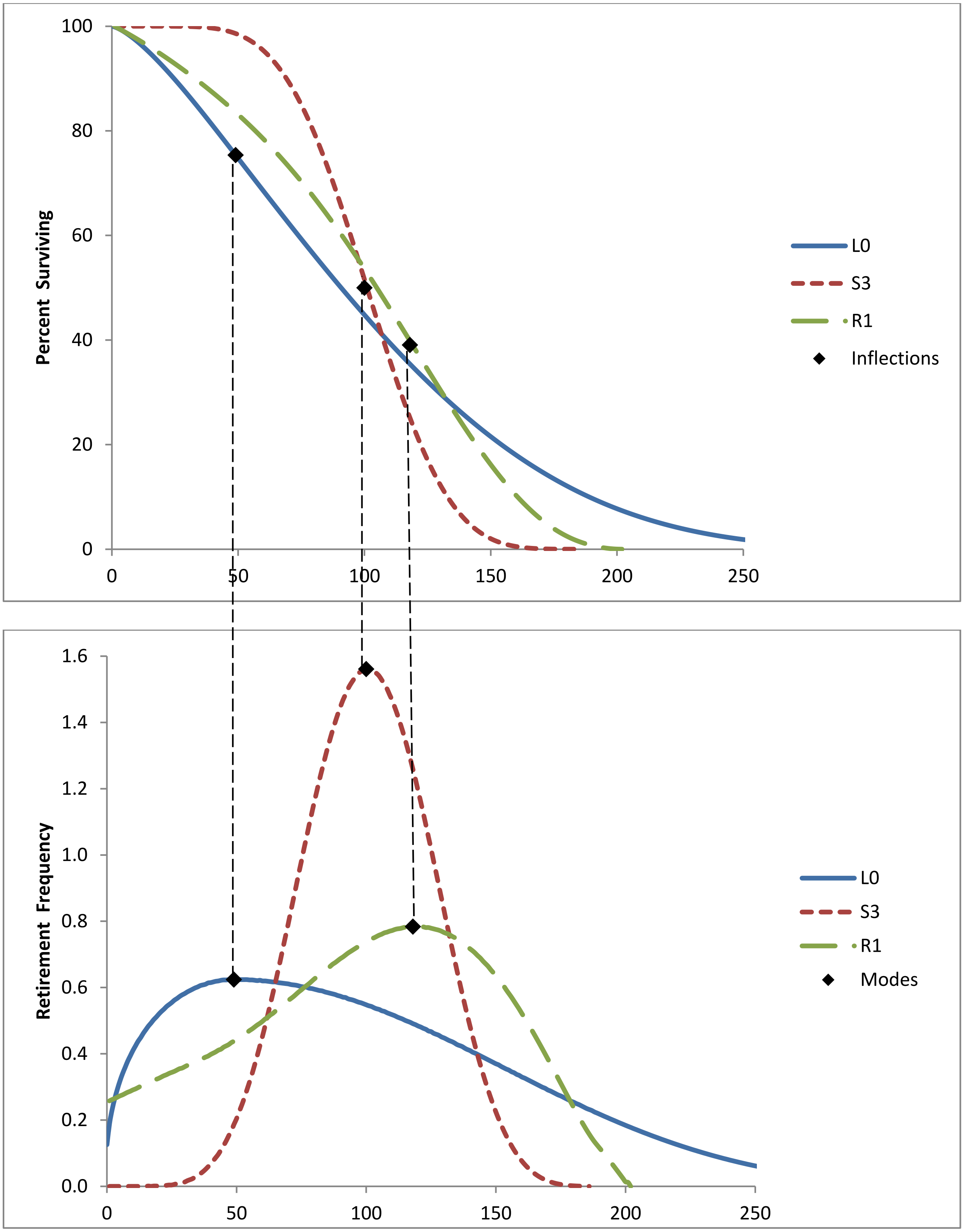
2. Classification

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

The classification of the survivor curves was made according to whether the mode of the retirement frequency curves was to the left, to the right, or coincident with average service life. There are three modal “families” of curves: six left modal curves (L0, L1, L2, L3, L4, L5); five right modal curves (R1, R2, R3, R4, R5); and seven symmetrical curves (S0, S1, S2, S3, S4, S5, S6).[58] 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.

[58] 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. 7, at 68).

Figure 9:
Modal Age Illustration



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

> Since the location of a particular survivor on a graph is affected by both its span in years and the shape of the curve, it is difficult to classify a group of curves unless one of these variables can be controlled. This is easily done by expressing the age in percent of average life."[59]

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

The third variable, variation of life, is represented by the numbers next to each letter. A lower number (e.g., L1) indicates a relatively low mode, large variation, and large maximum life; a higher number (e.g., L5) indicates a relatively high mode, small variation, and small maximum life. All three classification variables – modal location, average life, and variation of life – are used to describe each Iowa curve. For example, a 13-L1 Iowa curve describes a group of property with a 13-year average life, with the greatest number of retirements occurring before (or to the left of) the average life, and a relatively low mode. The graphs below show these 18 survivor curves, organized by modal family.

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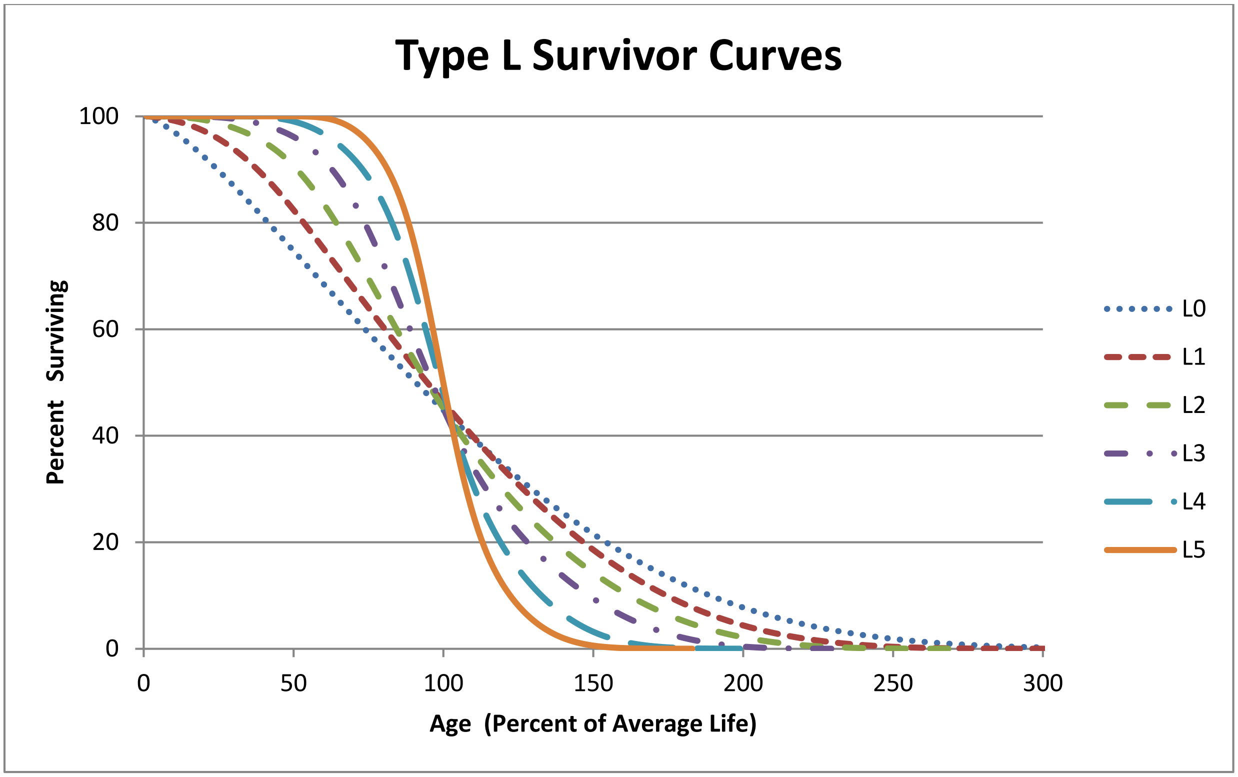
[59] Winfrey *supra* n. 75, at 60.

Figure 10:
Type L Survivor and Frequency Curves



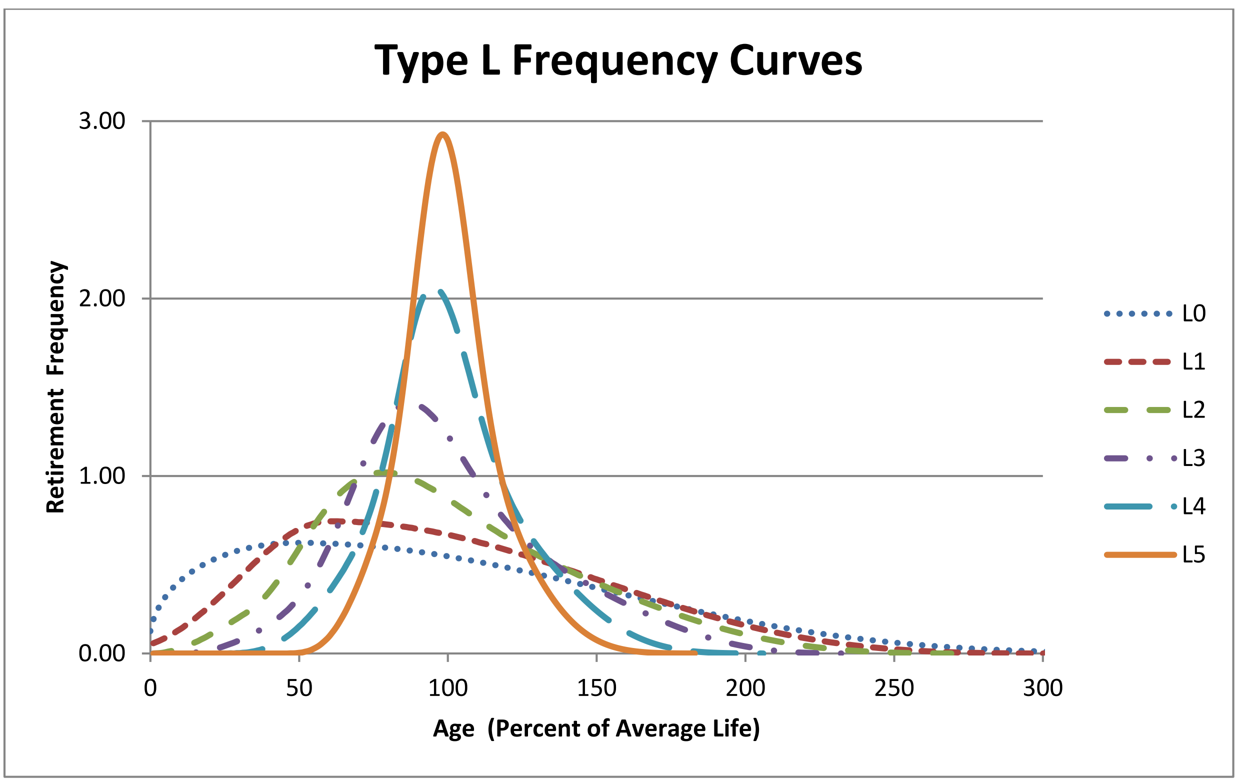
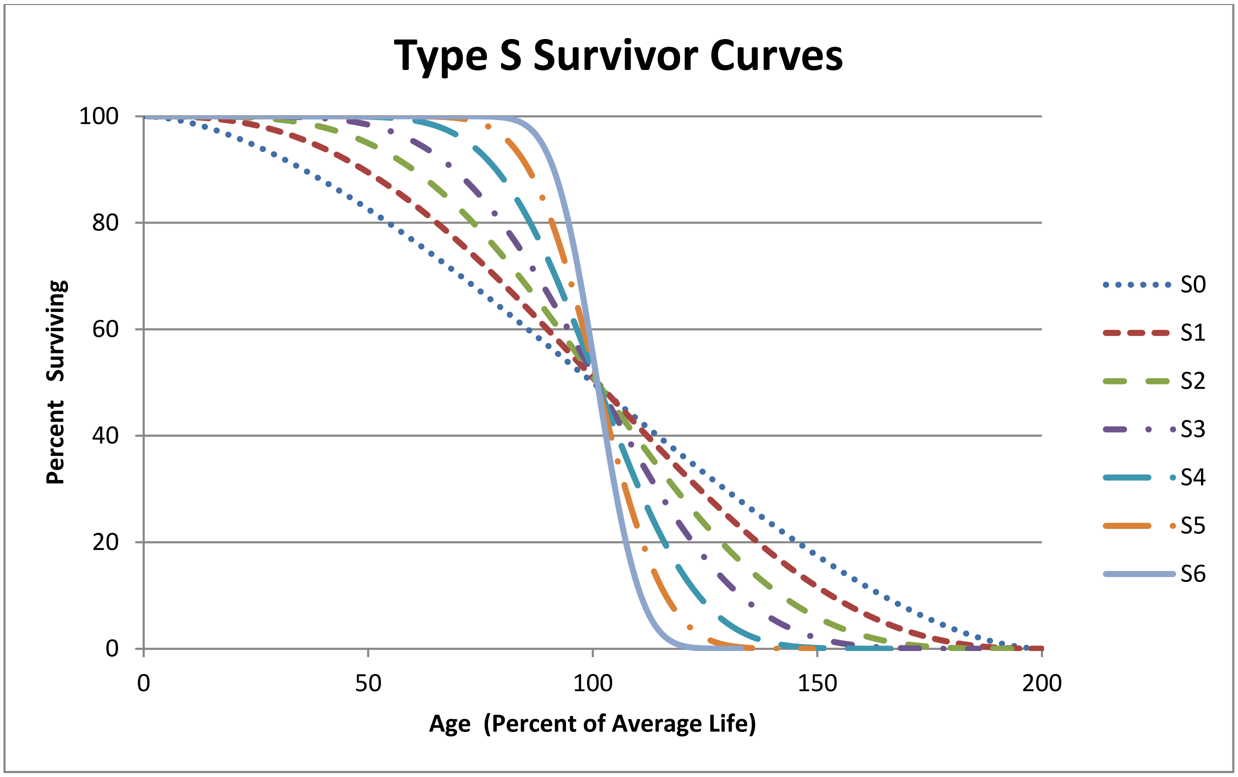


Figure 11:
Type S Survivor and Frequency Curves



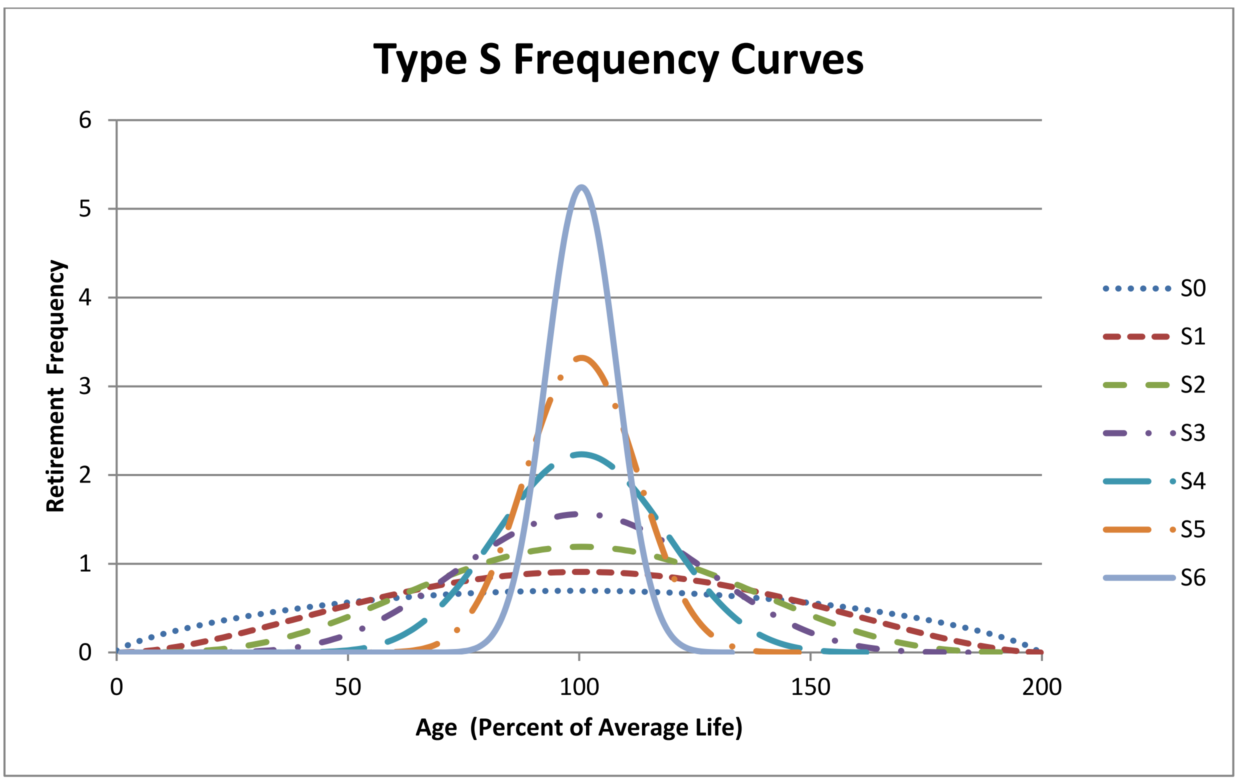
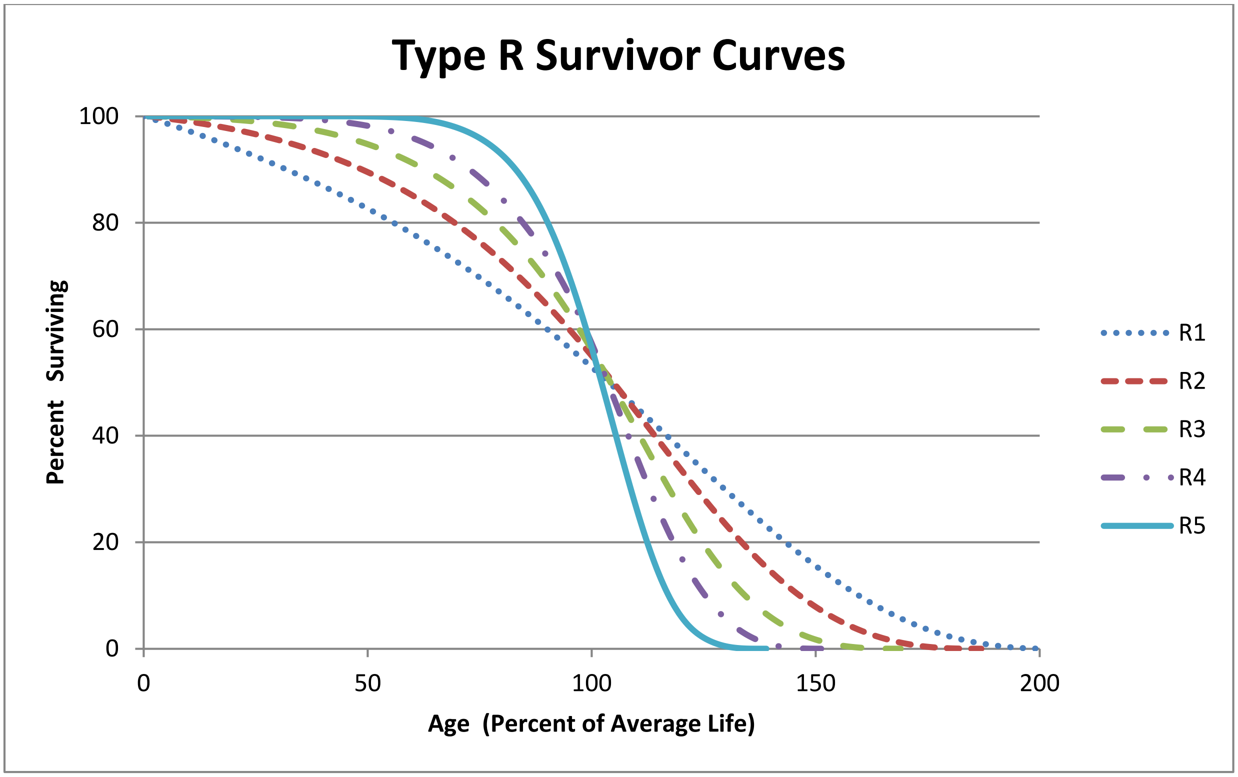
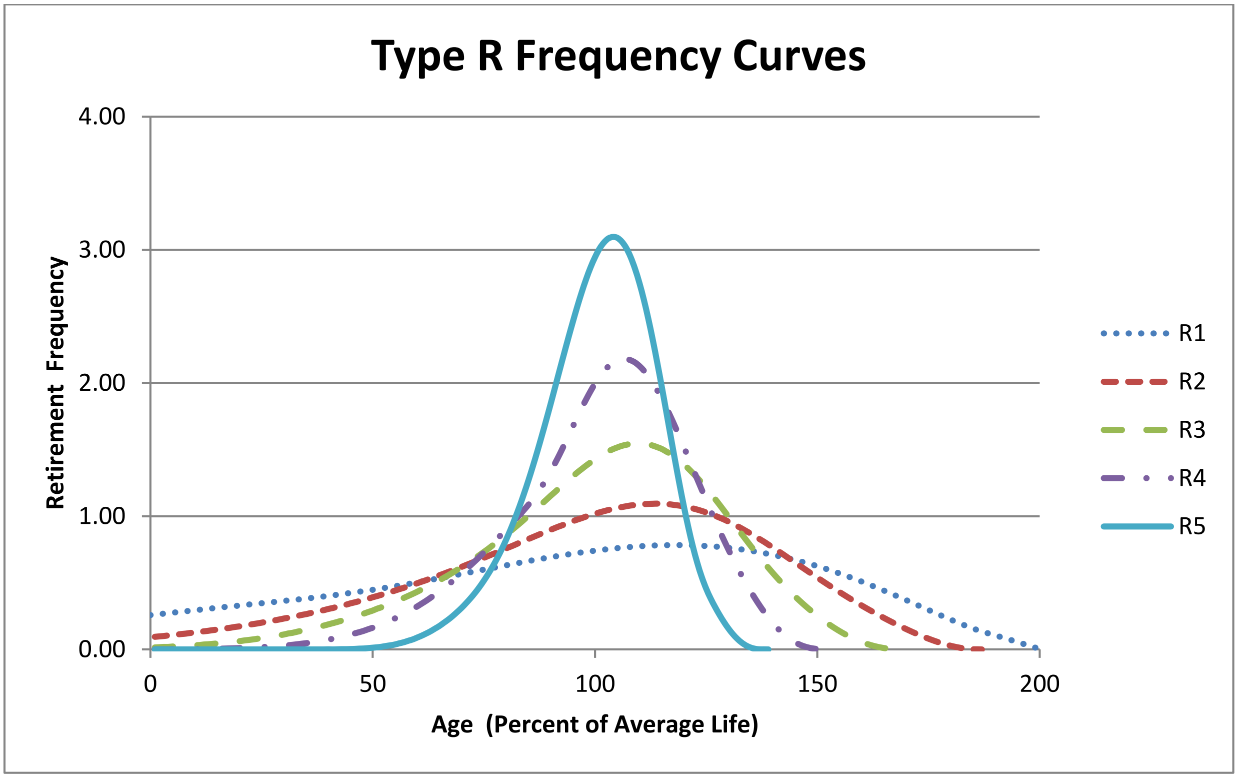


Figure 12:
Type R Survivor and Frequency Curves





As shown in the graphs above, the modes for the L family frequency curves occur to the left of average life (100% on the x-axis), while the S family modes occur at the average, and the R family modes occur after the average.

3. Types of Lives

Several other important statistical analyses and types of lives may be derived from an Iowa curve. These include: 1) average life; 2) realized life; 3) remaining life; and 4) probable life. Figure 8 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.[60]

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:[61]

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"

[60] 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.

[61] *See* NARUC *supra* n. 7, at 71.

survivor 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.[62] 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.[63] Remaining life is sometimes referred to as "average remaining life" and "life expectancy." To calculate average remaining life at age x, the area under the estimated future potion of the survivor curve is divided by the percent surviving at age x (denoted S_X). Thus, the average remaining life formula is:

Equation 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 in order to calculate the annual accrual under the remaining life technique.

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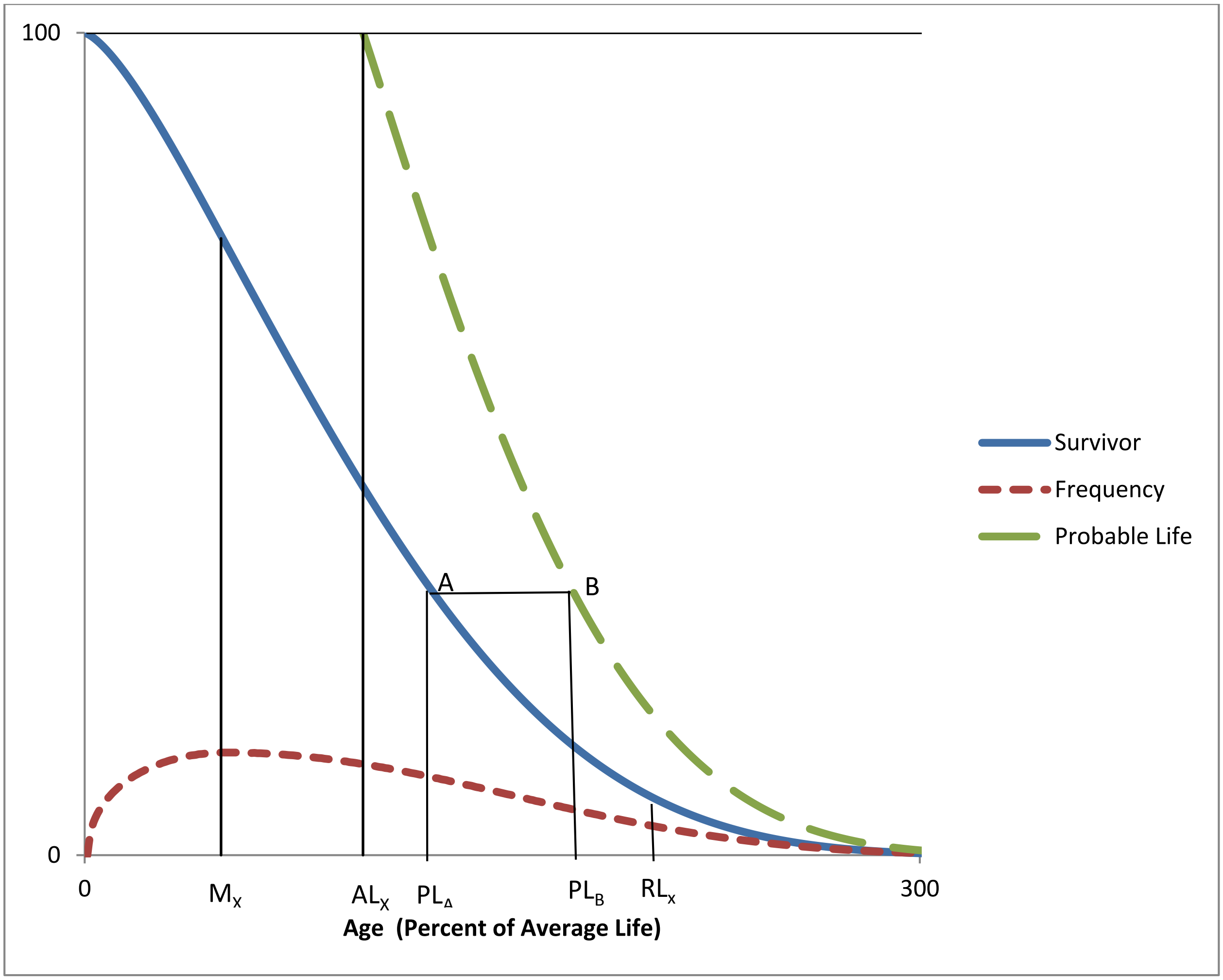
[62] *Id*. at 73.

[63] *Id*. at 74.

Figure 13:
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.[64] 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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[64] Wolf *supra* n. 6, 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 will live today. Insurance companies rely of actuarial analysis in determining premiums for life insurance policies.

The study of human mortality is analogous to estimating service lives of industrial property groups. While some humans die solely from chance, most deaths are related to age; that is, death rates generally increase as age increases. Similarly, physical plant is also subject to forces of retirement. These forces include physical, functional, and contingent factors, as shown in the table below.[65]

Figure 14:
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

[65] NARUC *supra* n. 7, at 14-15.

Continuing Property Records ("CPR"). Generally, a CPR should contain 1) an inventory of property record units; 2) the association of costs with such units; and 3) the dates of installation and removal of plant. Since actuarial analysis includes the examination of historical data to forecast future retirements, the historical data used in the analysis should not contain events that are anomalous or unlikely to recur.[66] Historical data is used in the retirement rate actuarial method, which is discussed further below.

The Retirement Rate Method

There are several systematic actuarial methods that use historical data in order to calculating observed survivor curves for property groups. Of these methods, the retirement rate method is superior, and is widely employed by depreciation analysts.[67] 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 in order to forecast average life. The observed survivor curve is calculated by using an observed life table ("OLT"). The figures below illustrate how the OLT is developed. First, historical property data are organized in a matrix format, with placement years on the left forming rows, and experience years on the top forming columns. The placement year (a.k.a. "vintage year" or "installation year") is the year of placement of a group of property. The experience year (a.k.a. "activity year") refers to the accounting data for a particular calendar year. The two matrices below use aged data – that is, data for which the dates of placements, retirements, transfers, and other transactions are known. Without aged data, the retirement rate actuarial method may not be employed.

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

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

The first matrix is the exposure matrix, which shows the exposures at the beginning of each year.[68] An exposure is simply the depreciable property subject to retirement during a period. The second matrix is the retirement matrix, which shows the annual retirements during each year. Each matrix covers placement years 2003–2015, and experience years 2008-2015. In the exposure matrix, the number in the 2009 experience column and the 2003 placement row is $192,000. This means at the beginning of 2012, there was $192,000 still exposed to retirement from the vintage group placed in 2003. Likewise, in the retirement matrix, $19,000 of the dollars invested in 2003 was retired during 2012.

Figure 15:
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	

[68] Technically, the last numbers in each column are "gross additions" rather than exposures. Gross additions do not include adjustments and transfers applicable to plant placed in a previous year. Once retirements, adjustments, and transfers are factored in, the balance at the beginning of the next account period is called an "exposure" rather than an addition.

Figure 16:
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.[69] 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).

[69] Wolf *supra* n. 6, at 22.

The same calculation is applied to each number in the column. The amounts retired during the year in the retirements matrix affect the exposures at the beginning of each year in the exposures matrix. For example, the amount exposed to retirement in 2008 from the 2003 vintage is $261,000. The amount retired during 2008 from the 2003 vintage is $16,000. Thus, the amount exposed to retirement in 2009 from the 2003 vintage is $245,000 ($261,000 - $16,000). The company's property records may contain other transactions which affect the property, including sales, transfers, and adjusting entries. Although these transactions are not shown in the matrices above, they would nonetheless affect the amount exposed to retirement at the beginning of each year.

The totaled amounts for each age interval in both matrices are used to form the exposure and retirement columns in the OLT, as shown in Figure 12 below. This figure 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 17:
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			

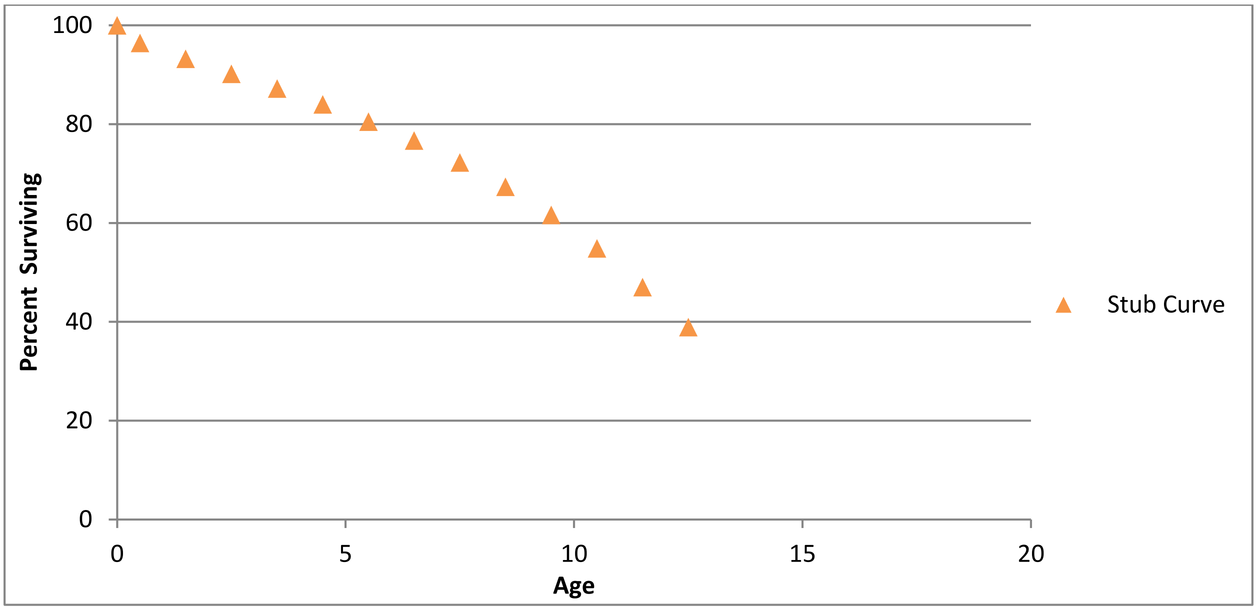
Column F on the right shows the percentages surviving at the beginning of each age interval. This column starts at 100% surviving. Each consecutive number below is calculated by multiplying the percent surviving from the previous age interval by the corresponding survivor ratio for that age interval. 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)[70].

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%

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

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

Figure 18:
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.

Banding

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.[71] 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.[72]

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.

[71] NARUC *supra* n. 7, at 113.

[72] *Id*.

**Figure 19:
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.[73] Placement bands allow analysts to isolate the effects of changes in technology and materials that occur in successive generations of plant. For example, if in 2005 an electric utility began placing transmission poles with a special chemical treatment that extended the service lives of the poles, an analyst could use placement bands to isolate and analyze the effect of that change in the property group's physical characteristics.

[73] Wolf *supra* n. 6, at 182.

While placement bands are very useful in depreciation analysis, they also possess an intrinsic dilemma. A fundamental characteristic of placement bands is that they yield fairly complete survivor curves for older vintages. However, with newer vintages, which are arguably more valuable for forecasting, placement bands yield shorter survivor curves. Longer "stub" curves are considered more valuable for forecasting average life. Thus, an analyst must select a band width broad enough to provide confidence in the reliability of the resulting curve fit, yet narrow enough so that an emerging trend may be observed.[74]

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.

Figure 20:
Experience 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	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	

[74] NARUC *supra* n. 7, at 114.

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.[75] 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 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.

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[75] *Id*.

Regardless of which bands are used, observed survivor curves in depreciation analysis rarely reach zero percent. This is because, as seen in the OLT above, relatively newer vintage groups have not yet been fully retired at the time the property is studied. An analyst could confine the analysis to older, fully retired vintage groups in order to get complete survivor curves, but such analysis would ignore some the property currently in service and would arguably not provide an accurate description of life characteristics for current plant in service. Because a complete curve is necessary to calculate the average life of the property group, however, curve fitting techniques using Iowa curves or other standardized curves may be employed in order to complete the stub curve.

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 used in the curve fitting process are the Iowa curves discussed above. As Wolf notes, if "the Iowa curves are adopted as a model, an underlying assumption is that the process describing the retirement pattern is one of the 22 [or more] processes described by the Iowa curves."[76]

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 from Figure 13 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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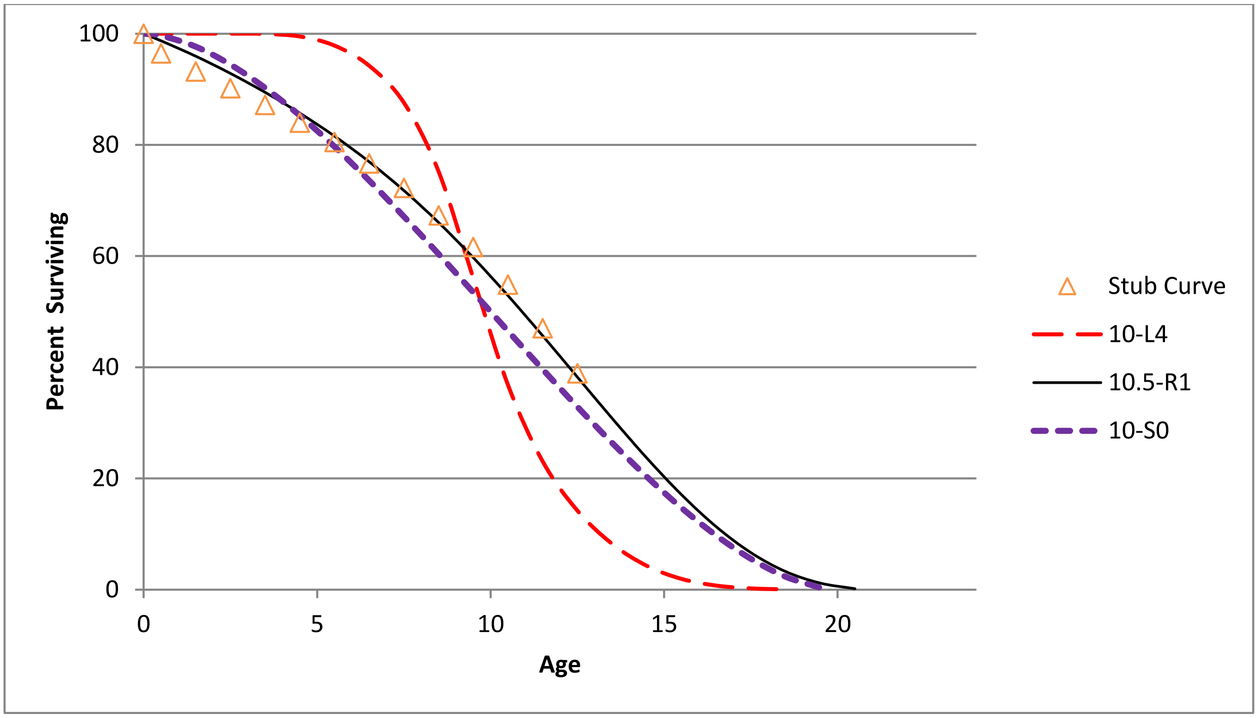
[76] Wolf *supra* n. 6, at 46 (22 curves includes Winfrey's 18 original curves plus Cowles's four "O" type curves).

**Figure 21:
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.[77]

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."[78]

In Figure 16 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 figure 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 figure shows the differences between the points on each Iowa curve and the stub curve. These differences are summed at the bottom. Curve 10.5-R1 is the best fit because the sum of the squared differences for this curve is less than the same sum of the other two curves. Curve 10-L4 is the worst fit, which was also confirmed visually.

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[77] Wolf *supra* n. 6, at 47.

[78] *Id*. at 48.

Figure 22:
Mathematical Fitting

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

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EDUCATION

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

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

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

PROFESSIONAL DESIGNATIONS

Society of Depreciation Professionals
Certified Depreciation Professional (CDP)

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

The Mediation Institute
Certified Civil / Commercial & Employment Mediator

WORK EXPERIENCE

Resolve Utility Consulting PLLC — Oklahoma City, OK
Managing Member — 08/2016 – 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 — 02/2012 – 07/2016
Assistant General Counsel — 02/2011 – 01/2012
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
<u>Managing Member</u> — 09/2009 – 01/2011
Represented clients in the areas of family law, estate planning, debt negotiations, business organization, and utility regulation.

Moricoli & Schovanec, P.C. — Oklahoma City, OK
<u>Associate Attorney</u> — 08/2007 – 08/2009
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
<u>Board Member</u> — 2015 – Present
Participate in management of operations, attend meetings, review performance, compensation, and financial records. Assist in fundraising events.

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

St. Jude Children's Research Hospital — Oklahoma City, OK
<u>Oklahoma Fundraising Committee</u> — 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 – Vice President 2016
Participate in management of operations, attend meetings, review performance, organize presentation agenda.

Society of Utility Regulatory Financial Analysts 2014 – Present

CONTINUING PROFESSIONAL EDUCATION

Society of Depreciation Professionals New Orleans, LA
"Introduction to Depreciation" and "Extended Training" 2014
Week-long training seminar with 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.

Energy Management Institute Houston, TX
"Fundamentals of Power Trading" 2013
Instruction and practical examples on the power market complex, as well as comprehensive training on power trading.

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.

Energy Management Institute Houston, TX
"Introduction to Energy Trading and Hedging" 2012
Instruction in energy trading and hedging, including examination of various trading instruments and techniques.

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.

EXPERIENCE IN REGULATORY PROCEEDINGS

1. **Sierra Pacific Power Company, 2016** (Docket No. 16-06008) – Testified on depreciation rates and related issues.

2. **Oklahoma Gas and Electric Company, 2016** (Cause No. PUD 15-273) – Testified on cost of capital, capital structure, and depreciation rates.

3. **Public Service Company of Oklahoma, 2015** (Cause No. PUD 15-208) – Testified on cost of capital, capital structure, and depreciation rates.

4. **Oklahoma Natural Gas Company, 2015** (Cause No. PUD 15-213) – Testified on cost of capital, capital structure, and depreciation rates.

5. **Oak Hills Water System, Inc.** (Cause No. PUD 15-123) – Testified on cost of capital, capital structure, and depreciation rates.

6. **CenterPoint Energy Oklahoma Gas, 2014** (Cause No. PUD 14-227) – Testified on prudence of fuel-related costs and process in annual fuel audit and prudence review.

7. **Public Service Company of Oklahoma, 2014** (Cause No. PUD 14-233) – Testified on PSO's application for a certificate of authority to issue new debt securities.

8. **Empire District Electric Company, 2014** (Cause No. PUD 14-226) – Testified on prudence of fuel-related costs and process in annual fuel audit and prudence review.

9. **Fort Cobb Fuel Authority, 2014** (Cause No. PUD 14-219) – Testified on prudence of fuel-related costs and process in annual fuel audit and prudence review.

10. **Fort Cobb Fuel Authority, 2014** (Cause No. PUD 14-140) – Testified in FCFA's application for a rate increase on outside services, legislative advocacy, miscellaneous taxes, payroll expense and taxes, employee insurance expense, and insurance expense.

11. **Public Service Company of Oklahoma, 2013** (Cause No. PUD 13-217) – Lead auditor of PSO's application for a rate increase. Provided additional research support for cost of capital issue. Assisted in coordination of PUD staff analysts and issues.

12. **Public Service Company of Oklahoma, 2013** (Cause No. PUD 13-201) – Testified in PSO's application for authorization of a standby and supplemental service tariff.

13. **Fort Cobb Fuel Authority, 2013** (Cause No. PUD 13-134) – Testified on prudence of fuel-related costs and process in annual fuel audit and prudence review.

14. **Empire District Electric Company, 2013** (Cause No. PUD 13-131) – Testified on prudence of fuel-related costs and process in annual fuel audit and prudence review.

15. **CenterPoint Energy Oklahoma Gas, 2013** (Cause No. PUD 13-127) – Testified on prudence of fuel-related costs and process in annual fuel audit and prudence review.

16. **Oklahoma Gas & Electric Company, 2012** (Cause No. PUD 12-185) – Testified in OG&E's application for extension of a gas transportation contract.

17. **Empire District Electric Company, 2012** (Cause No. PUD 12-170) – Testified on prudence of fuel-related costs and process in annual fuel audit and prudence review.

18. **Oklahoma Gas & Electric Company, 2012** (Cause No. PUD 12-169) – Testified on prudence of fuel-related costs and process in annual fuel audit and prudence review.

Summary Adjustment

Summary Rate and Accrual Comparison

Account	Original Cost 12/31/2015	PGS Proposal Rate	PGS Proposal Accrual	OPC Proposal Rate	OPC Proposal Accrual	OPC Adjustment
37600 - Mains Steel	$ 385,317,174	2.6%	$ 10,018,247	2.0%	$ 7,804,962	$ (2,213,285)
37602 - Mains Plastic	401,310,012	3.0%	12,039,300	1.3%	5,106,690	(6,932,610)
38000 - Services Steel	46,376,347	5.3%	2,457,946	1.4%	640,781	(1,817,165)
38002 - Services Plastic	247,505,036	4.5%	11,137,727	1.9%	4,736,295	(6,401,432)
38100 - Meters	63,032,755	5.9%	3,718,933	3.8%	2,374,559	(1,344,374)
38200 - Meter Installation	49,175,177	4.5%	2,212,883	1.7%	834,339	(1,378,544)
Total						**$ (20,087,410)**

Detailed Rate Comparison

(as of study date)

Exhibit DJG 3

		[1]	[2]		[3]		[4]	
			PGS Proposed Rates		OPC Proposed Rates		Difference	
Account No.	Description	Original Cost	Rate	Annual Accrual	Rate	Annual Accrual	Rate	Annual Accrual
	Distribution Plant							
37402	Land Rights	2,836,412	1.3%	36,873	1.3%	36,873	0.04%	0
37500	Structures & Improvements	19,415,983	2.5%	485,400	2.5%	485,400	0.02%	0
37600	Mains Steel	385,317,174	2.6%	10,018,247	2.0%	7,804,962	-0.57%	-2,213,285
37602	Mains Plastic	401,310,012	3.0%	12,039,300	1.3%	5,106,690	-1.73%	-6,932,610
37800	Meas & Reg Station Eqp Gen	12,924,984	3.3%	426,524	3.3%	426,524	0.04%	0
37900	Meas & Reg Station Eqp City	34,586,108	3.3%	1,141,342	3.3%	1,141,342	0.02%	0
38000	Services Steel	46,376,347	5.3%	2,457,946	1.4%	640,781	-3.92%	-1,817,165
38002	Services Plastic	247,505,036	4.5%	11,137,727	1.9%	4,736,295	-2.59%	-6,401,432
38100	Meters	63,032,755	5.9%	3,718,933	3.8%	2,374,559	-2.13%	-1,344,374
38200	Meter Installations	49,175,177	4.5%	2,212,883	1.7%	834,339	-2.80%	-1,378,544
38300	House Regulators	14,633,325	3.6%	526,800	3.6%	526,800	-0.02%	0
38400	House Regulator Installs	19,915,060	4.4%	876,263	4.4%	876,263	0.04%	0
38500	Meas & Reg Station Eqp Ind	9,089,094	3.1%	281,762	3.1%	281,762	0.03%	0
38600	Other Property Cust Premise	-	6.7%	-	0.0%	-	-6.70%	0
38700	Other Equipment	5,889,159	6.3%	371,017	6.3%	371,017	-0.05%	0
	Total Distribution Plant	1,312,006,627	3.49%	45,731,017	1.96%	25,643,607	-1.53%	-20,087,410
	Transportation Equipment							
39201	Vehicles up to 1/2 Tons	8,035,686	11.4%	916,068	11.35%	916,068	-0.05%	0
39202	Vehicles from 1/2 - 1 Tons	6,569,197	13.0%	853,996	12.98%	853,996	-0.02%	0
39204	Trailers & Other	1,153,494	4.0%	46,140	3.99%	46,140	-0.01%	0
39205	Vehicles over 1 Ton	1,769,839	7.5%	132,738	7.04%	132,738	-0.46%	0
	General Plant							
30100	Organization Costs	12,620	0.0%	-	0.00%	-	0.00%	0
30200	Franchise & Consents	-	4.0%	-	4.00%	-	0.00%	0
30300	Misc Intangible Plant	815,325	4.0%	32,613	4.02%	32,613	0.02%	0
30301	Custom Intangible Plant	25,717,580	6.7%	1,723,078	6.67%	1,723,078	-0.03%	0
39000	Structures & Improvements	149,951	2.5%	3,749	2.53%	3,749	0.03%	0
39100	Office Furniture	1,470,244	6.7%	98,506	6.72%	98,506	0.02%	0
39101	Computer Equipment	5,293,685	12.3%	651,123	12.32%	651,123	0.02%	0
39102	Office Equipment	922,076	6.7%	61,779	6.66%	61,779	-0.04%	0
39300	Stores Equipment	1,283	3.9%	50	3.91%	50	0.01%	0
39400	Tools, Shop & Garage Equip	6,105,880	6.7%	409,094	6.68%	409,094	-0.02%	0
39401	CNG Station Equipment	-	5.0%	-	5.00%	-	0.00%	0
39500	Laboratory Equipment	-	5.0%	-	5.00%	-	0.00%	0
39600	Power Operated Equipment	2,775,668	6.3%	174,867	6.30%	174,867	0.00%	0
39700	Communication Equipment	4,841,709	8.2%	397,020	8.24%	397,020	0.04%	0
39800	Miscellaneous Equipment	468,234	6.0%	28,094	5.95%	28,094	-0.05%	0
	Total Transportation and General Plant	66,102,470	8.36%	5,528,915	8.33%	5,528,915	-0.03%	0
	TOTAL DEPRECIABLE PLANT	**1,378,109,097**	**3.72%**	**51,259,932**	**2.26%**	**31,172,522**	**-1.46%**	**-20,087,410**

[1] Original cost of plant at 12-31-15 from the Depreciation Study

[2] Proposed depreciation rates and annual accruals from the Depreciation Study

[3] Proposed rates and accruals from DJG 5 (annual accruals hard coded on unadjusted accounts due to rounding differences)

[4] = [3] - [2]

Depreciation Rate Development

		[1]	[2]		[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]	[13]
			Iowa Curve							Service Life		Net Salvage		Total	
Account No.	Description	Original Cost	Type	AL	Net Salvage	Depreciable Base	Book Reserve	Future Accruals	Remaining Life	Accrual	Rate	Accrual	Rate	Accrual	Rate
	Distribution Plant														
37402	Land Rights	2,836,412	SQ	75	0.0%	2,836,412	592,695	2,243,717	59.0	38,029	1.3%	-	0.0%	38,029	**1.34%**
37500	Structures & Improvements	19,415,983	R3	40	0.0%	19,415,983	7,684,556	11,731,427	24.0	488,809	2.5%	-	0.0%	488,809	**2.52%**
37600	Mains Steel	385,317,174	R2	55	-40.0%	539,444,044	183,944,998	355,499,046	45.5	4,421,115	1.1%	3,383,847	0.9%	7,804,962	**2.03%**
37602	Mains Plastic	401,310,012	R2	75	-25.0%	501,637,515	155,889,590	345,747,925	67.7	3,624,855	0.9%	1,481,835	0.4%	5,106,690	**1.27%**
37800	Meas & Reg Station Eqp Gen	12,924,984	R1	31	-5.0%	13,571,233	2,773,069	10,798,164	25.0	406,077	3.1%	25,850	0.2%	431,927	**3.34%**
37900	Meas & Reg Station Eqp City	34,586,108	R1	31	-5.0%	36,315,414	6,466,837	29,848,577	26.0	1,081,510	3.1%	66,512	0.2%	1,148,022	**3.32%**
38000	Services Steel	46,376,347	R0.5	50	-100.0%	92,752,695	57,964,560	34,788,135	54.3	(213,449)	-0.5%	854,230	1.8%	640,781	**1.38%**
38002	Services Plastic	247,505,036	R1.5	55	-55.0%	383,632,806	152,238,194	231,394,612	48.9	1,949,967	0.8%	2,786,328	1.1%	4,736,295	**1.91%**
38100	Meters	63,032,755	R1	21	5.0%	59,881,117	19,646,963	40,234,154	16.9	2,560,564	4.1%	(186,005)	-0.3%	2,374,559	**3.77%**
38200	Meter Installations	49,175,177	R0.5	43	-20.0%	59,010,212	25,507,475	33,502,737	40.2	589,411	1.2%	244,928	0.5%	834,339	**1.70%**
38300	House Regulators	14,633,325	R2	28	0.0%	14,633,325	5,932,047	8,701,278	16.6	524,173	3.6%	-	0.0%	524,173	**3.58%**
38400	House Regulator Installs	19,915,060	R4	27	-20.0%	23,898,072	10,020,798	13,877,274	15.7	630,208	3.2%	253,695	1.3%	883,903	**4.44%**
38500	Meas & Reg Station Eqp Ind	9,089,094	R4	32	0.0%	9,089,094	5,420,679	3,668,415	12.9	284,373	3.1%	-	0.0%	284,373	**3.13%**
38600	Other Property Cust Premise	-	R1	15	0.0%	-	-	-	15.0	-	0.0%	-	0.0%	-	**0.00%**
38700	Other Equipment	5,889,159	S2	16	0.0%	5,889,159	2,132,612	3,756,547	10.2	368,289	6.3%	-	0.0%	368,289	**6.25%**
	Total Distribution Plant	1,312,006,627				1,762,007,081	636,215,073	1,125,792,008		16,753,932	1.3%	8,911,220	0.7%	25,665,152	**1.96%**
	Transportation Equipment														
39201	Vehicles up to 1/2 Tons	8,035,686	S1	8	10.0%	7,232,118	3,127,353	4,104,765	4.5	1,090,741	13.6%	(178,571)	-2.2%	912,170	**11.35%**
39202	Vehicles from 1/2 - 1 Tons	6,569,197	S2	7	10.0%	5,912,277	3,098,777	2,813,500	3.3	1,051,642	16.0%	(199,067)	-3.0%	852,576	**12.98%**
39204	Trailers & Other	1,153,494	S3	20	20.0%	922,795	208,703	714,092	15.5	60,954	5.3%	(14,884)	-1.3%	46,070	**3.99%**
39205	Vehicles over 1 Ton	1,769,839	S4	12	10.0%	1,592,855	657,801	935,054	7.5	148,272	8.4%	(23,598)	-1.3%	124,674	**7.04%**
	General Plant														
30100	Organization Costs	12,620			0.0%	12,620	-	12,620	0.0		0.0%		0.0%		**0.00%**
30200	Franchise & Consents	-	SQ	25	0.0%	-	-	-	25.0	-	4.0%	-	0.0%	-	**4.00%**
30300	Misc Intangible Plant	815,325	SQ	25	0.0%	815,325	668,002	147,323	4.5	32,738	4.0%	-	0.0%	32,738	**4.02%**
30301	Custom Intangible Plant	25,717,580	SQ	15	0.0%	25,717,580	8,738,083	16,979,497	9.9	1,715,101	6.7%	-	0.0%	1,715,101	**6.67%**
39000	Structures & Improvements	149,951	R3	40	0.0%	149,951	20,841	129,110	34.0	3,797	2.5%	-	0.0%	3,797	**2.53%**
39100	Office Furniture	1,470,244	SQ	15	0.0%	1,470,244	896,947	573,297	5.8	98,844	6.7%	-	0.0%	98,844	**6.72%**
39101	Computer Equipment	5,293,685	SQ	8	0.0%	5,293,685	4,119,598	1,174,087	1.8	652,270	12.3%	-	0.0%	652,270	**12.32%**
39102	Office Equipment	922,076	SQ	15	0.0%	922,076	400,399	521,677	8.5	61,374	6.7%	-	0.0%	61,374	**6.66%**
39300	Stores Equipment	1,283	SQ	25	0.0%	1,283	180	1,103	22.0	50	3.9%	-	0.0%	50	**3.91%**
39400	Tools, Shop & Garage Equip	6,105,880	SQ	15	0.0%	6,105,880	1,577,372	4,528,508	11.1	407,974	6.7%	-	0.0%	407,974	**6.68%**
39401	CNG Station Equipment	-	SQ	20	0.0%	-	-	-	20.0	-	5.0%	-	0.0%	-	**5.00%**
39500	Laboratory Equipment	-	SQ	20	0.0%	-	-	-	20.0	-	5.0%	-	0.0%	-	**5.00%**
39600	Power Operated Equipment	2,775,668	S4	15	5.0%	2,636,885	1,238,693	1,398,192	8.0	192,122	6.9%	(17,348)	-0.6%	174,774	**6.30%**
39700	Communication Equipment	4,841,709	SQ	12	0.0%	4,841,709	3,005,855	1,835,854	4.6	399,099	8.2%	-	0.0%	399,099	**8.24%**
39800	Miscellaneous Equipment	468,234	SQ	17	0.0%	468,234	362,299	105,935	3.8	27,878	6.0%	-	0.0%	27,878	**5.95%**
	Total Transportation and General Plant	66,102,470				64,095,515	28,120,903	35,974,612		5,942,856	9.0%	(433,467)	-0.7%	5,509,389	**8.33%**
	TOTAL DEPRECIABLE PLANT	**1,378,109,097**				**1,826,102,596**	**664,335,976**	**1,161,766,620**		**22,696,787**	**1.6%**	**8,477,753**	**0.6%**	**31,174,540**	**2.26%**

[1] Original cost of plant at 12-31-15 from the Depreciation Study
[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
[6] = [4] - [5]
[7] Average remaining life based on Iowas Curve in Column [2]
[8] = ([1] - [5]) / [7]
[9] = [8] / [1]

Depreciation Rate Development

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

[10] = [12] - [8]
[11] = [13] - [9]
[12] = [6] / [7]
[13] = [12] / [1]. Some unadjusted rates may be hard coded to match the Company's proposed rate.

Account 37600 Curve Fitting

[1] Age (Years)	[2] Exposures (Dollars)	[3] Observed Life Table (OLT)	[4] PGS R3-50	[5] OPC R2-55	[6] PGS SSD	[7] OPC SSD
0.0	345,836,157	100.00%	100.00%	100.00%	0.0000	0.0000
0.5	341,883,042	99.99%	99.98%	99.91%	0.0000	0.0000
1.5	328,962,431	99.93%	99.95%	99.73%	0.0000	0.0000
2.5	294,853,941	99.78%	99.91%	99.54%	0.0000	0.0000
3.5	282,917,234	99.71%	99.86%	99.34%	0.0000	0.0000
4.5	272,036,540	99.26%	99.80%	99.12%	0.0000	0.0000
5.5	244,197,219	98.88%	99.74%	98.89%	0.0001	0.0000
6.5	220,364,931	98.70%	99.66%	98.65%	0.0001	0.0000
7.5	216,639,484	98.17%	99.57%	98.39%	0.0002	0.0000
8.5	216,330,166	98.00%	99.47%	98.12%	0.0002	0.0000
9.5	212,220,138	97.37%	99.36%	97.83%	0.0004	0.0000
10.5	210,208,342	97.01%	99.23%	97.53%	0.0005	0.0000
11.5	208,530,648	96.60%	99.09%	97.21%	0.0006	0.0000
12.5	202,145,558	95.86%	98.92%	96.87%	0.0009	0.0001
13.5	196,092,101	95.60%	98.73%	96.52%	0.0010	0.0001
14.5	101,810,432	95.31%	98.53%	96.14%	0.0010	0.0001
15.5	165,770,775	94.96%	98.29%	95.75%	0.0011	0.0001
16.5	137,697,628	94.75%	98.04%	95.33%	0.0011	0.0000
17.5	123,858,504	93.32%	97.75%	94.89%	0.0020	0.0002
18.5	119,165,593	92.94%	97.43%	94.43%	0.0020	0.0002
19.5	115,643,072	92.24%	97.08%	93.95%	0.0023	0.0003
20.5	108,641,620	92.01%	96.70%	93.44%	0.0022	0.0002
21.5	105,498,668	91.67%	96.28%	92.91%	0.0021	0.0002
22.5	104,261,342	91.28%	95.81%	92.35%	0.0021	0.0001
23.5	105,645,355	90.76%	95.31%	91.76%	0.0021	0.0001
24.5	93,815,748	90.41%	94.76%	91.15%	0.0019	0.0001
25.5	90,218,248	90.18%	94.16%	90.50%	0.0016	0.0000
26.5	96,771,053	89.77%	93.51%	89.83%	0.0014	0.0000
27.5	80,803,118	89.22%	92.81%	89.13%	0.0013	0.0000
28.5	77,237,569	88.71%	92.05%	88.39%	0.0011	0.0000
29.5	69,067,168	88.40%	91.23%	87.62%	0.0008	0.0001
30.5	66,743,837	88.14%	90.35%	86.81%	0.0005	0.0002
31.5	63,576,411	87.82%	89.40%	85.97%	0.0002	0.0003
32.5	60,650,582	87.19%	88.38%	85.10%	0.0001	0.0004
33.5	57,874,199	86.65%	87.28%	84.18%	0.0000	0.0006
34.5	53,447,631	86.23%	86.11%	83.23%	0.0000	0.0009
35.5	50,866,578	85.82%	84.85%	82.24%	0.0001	0.0013
36.5	47,484,097	85.24%	83.51%	81.20%	0.0003	0.0016
37.5	44,008,460	84.72%	82.07%	80.13%	0.0007	0.0021
38.5	42,242,343	84.33%	80.53%	79.01%	0.0014	0.0028
39.5	40,173,932	83.73%	78.89%	77.85%	0.0023	0.0035
40.5	37,580,006	83.27%	77.14%	76.64%	0.0038	0.0044
41.5	34,012,154	82.48%	75.28%	75.39%	0.0052	0.0050
42.5	31,108,513	81.37%	73.30%	74.09%	0.0065	0.0053
43.5	28,744,772	79.87%	71.21%	72.75%	0.0075	0.0051
44.5	27,706,541	78.98%	68.99%	71.36%	0.0100	0.0058
45.5	25,719,846	77.88%	66.66%	69.92%	0.0126	0.0063
46.5	22,785,252	73.97%	64.20%	68.43%	0.0095	0.0031
47.5	18,910,974	72.41%	61.63%	66.90%	0.0116	0.0030
48.5	17,542,854	71.63%	58.95%	65.32%	0.0161	0.0040
49.5	16,558,940	71.28%	56.17%	63.70%	0.0228	0.0057
50.5	14,865,562	68.65%	53.29%	62.03%	0.0236	0.0044
51.5	13,656,154	67.72%	50.34%	60.32%	0.0302	0.0055
52.5	12,679,266	66.41%	47.32%	58.57%	0.0364	0.0061
53.5	11,006,771	60.98%	44.25%	56.78%	0.0280	0.0018
54.5	10,154,278	59.48%	41.16%	54.95%	0.0335	0.0021
55.5	7,495,739	57.99%	38.07%	53.09%	0.0397	0.0024
56.5	5,511,780	55.60%	35.00%	51.20%	0.0424	0.0019
57.5	3,831,078	54.27%	31.98%	49.28%	0.0497	0.0025
58.5	3,480,943	53.73%	29.03%	47.33%	0.0610	0.0041
59.5	3,192,216	53.12%	26.17%	45.37%	0.0727	0.0060
60.5	3,032,005	52.22%	23.42%	43.40%	0.0829	0.0078
61.5	2,883,722	51.58%	20.81%	41.41%	0.0947	0.0103
62.5	2,662,411	50.33%	18.35%	39.42%	0.1023	0.0119
63.5	2,510,596	49.79%	16.05%	37.43%	0.1138	0.0153

Account 37600 Curve Fitting

[1] Age (Years)	[2] Exposures (Dollars)	[3] Observed Life Table (OLT)	[4] PGS R3-50	[5] OPC R2-55	[6] PGS SSD	[7] OPC SSD
64.5	2,383,724	49.06%	13.92%	35.45%	0.1235	0.0185
65.5	2,269,968	48.46%	11.97%	33.49%	0.1331	0.0224
66.5	2,198,558	47.33%	10.20%	31.54%	0.1379	0.0249
67.5	2,027,514	45.43%	8.60%	29.62%	0.1356	0.0250
68.5	1,737,122	44.47%	7.17%	27.73%	0.1391	0.0280
69.5	1,531,595	43.08%	5.91%	25.88%	0.1382	0.0296
70.5	1,489,182	42.51%	4.80%	24.08%	0.1422	0.0340
71.5	1,449,510	41.55%	3.84%	22.32%	0.1422	0.0370
72.5	1,409,329	41.07%	3.01%	20.62%	0.1449	0.0418
73.5	1,335,636	40.40%	2.31%	18.98%	0.1451	0.0459
74.5	1,242,212	39.91%	1.72%	17.40%	0.1458	0.0507
75.5	1,004,941	38.63%	1.24%	15.88%	0.1397	0.0517
76.5	906,565	35.97%	0.86%	14.44%	0.1233	0.0464
77.5	849,686	34.59%	0.56%	13.07%	0.1158	0.0463
78.5	749,255	32.91%	0.34%	11.77%	0.1060	0.0447
79.5	689,523	31.85%	0.19%	10.55%	0.1003	0.0454
80.5	681,148	31.52%	0.09%	9.40%	0.0988	0.0489
81.5	458,712	28.45%	0.04%	8.33%	0.0807	0.0405
82.5	404,485	25.14%	0.01%	7.33%	0.0631	0.0317
83.5	373,619	23.30%	0.00%	6.41%	0.0543	0.0285
84.5	355,273	22.33%		5.56%		
85.5	326,393	21.06%		4.78%		
86.5	296,644	19.42%		4.06%		
87.5	275,500	18.59%		3.41%		
88.5	171,751	18.32%		2.83%		
89.5	21,800	14.88%		2.32%		
90.5	1	3.37%		1.86%		
91.5	1	3.37%		1.46%		
92.5	1.0	3.37%		1.11%		
93.5	1.0	3.37%		0.82%		
94.5	1.0	3.37%		0.59%		
95.5	1.0	3.37%		0.40%		
96.5	1.0	3.37%		0.25%		
97.5	1.0	3.37%		0.14%		
98.5	1.0	3.37%		0.07%		
99.5	1.0	3.37%		0.03%		
100.5	1.0	3.37%		0.01%		
Sum of Squared Differences				[8]	3.3622	0.8875
Up to 1% of Beginning Exposures				[9]	0.4860	0.0942

[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 37600 Rate Development

Curve Type	R2	[1]	Composite RL	45.5	[4]
Average Life	55	[2]	Accrual Rate	2.03%	[5]
Net Salvage	-40%	[3]	Total Reserve	$ 183,944,998	[6]

[7] Year Installed	[8] Original Cost	[9] Calculated Accrued	[10] Allocated Book Reserve	[11] Future Book Accruals	[12] Remaining Life	[13] Annual Accrual
2015	$ 6,668,021	$ 16	$ 23	$ 9,335,206	55.0	$ 169,731
2014	17,346,600	199,854	288,054	23,997,186	54.5	439,933
2013	36,459,850	1,257,342	1,812,238	49,231,552	53.6	917,725
2012	15,207,289	871,902	1,256,694	20,033,511	52.7	379,800
2011	13,122,313	1,050,634	1,514,304	16,856,934	51.9	325,081
2010	28,496,989	2,925,882	4,217,146	35,678,639	51.0	700,042
2009	25,385,637	3,177,207	4,579,387	30,960,505	50.1	618,183
2008	5,150,015	759,651	1,094,904	6,115,117	49.2	124,278
2007	3,643,115	618,312	891,188	4,209,173	48.3	87,088
2006	6,066,988	1,163,665	1,677,220	6,816,563	47.5	143,613
2005	3,620,456	773,867	1,115,394	3,953,245	46.6	84,829
2004	3,649,801	859,728	1,239,147	3,870,574	45.7	84,610
2003	6,722,219	1,729,043	2,492,112	6,918,994	44.9	154,114
2002	7,496,866	2,089,528	3,011,688	7,483,924	44.1	169,895
2001	18,296,363	5,490,349	7,913,377	17,701,531	43.2	409,652
2000	17,330,203	5,567,952	8,025,228	16,237,057	42.4	383,148
1999	29,122,741	9,969,860	14,369,806	26,402,031	41.6	635,413
1998	13,076,391	4,749,815	6,846,026	11,460,921	40.7	281,388
1997	5,370,323	2,061,988	2,971,994	4,546,458	39.9	113,901
1996	3,546,532	1,434,644	2,067,788	2,897,357	39.1	74,086
1995	7,480,831	3,178,717	4,581,563	5,891,600	38.3	153,800
1994	3,535,358	1,573,732	2,268,259	2,681,242	37.5	71,476
1993	4,159,082	1,934,785	2,788,654	3,034,061	36.7	82,617
1992	3,295,834	1,598,703	2,304,250	2,309,917	35.9	64,265
1991	13,981,345	7,057,154	10,171,651	9,402,232	35.2	267,334
1990	3,746,580	1,964,185	2,831,029	2,414,183	34.4	70,172
1989	3,376,494	1,835,403	2,645,412	2,081,680	33.6	61,872
1988	5,573,469	3,136,285	4,520,405	3,282,452	32.9	99,791
1987	3,262,606	1,897,730	2,735,245	1,832,403	32.1	56,997
1986	8,079,785	4,851,058	6,991,950	4,319,749	31.4	137,514
1985	2,269,624	1,404,739	2,024,685	1,152,789	30.7	37,569
1984	3,018,347	1,923,486	2,772,368	1,453,318	30.0	48,501
1983	2,633,048	1,725,685	2,487,273	1,198,994	29.3	40,988
1982	2,471,746	1,664,267	2,398,750	1,061,694	28.5	37,189
1981	4,304,203	2,974,282	4,286,906	1,738,978	27.9	62,434
1980	2,643,173	1,872,674	2,699,131	1,001,311	27.2	36,859
1979	3,298,881	2,394,168	3,450,773	1,167,660	26.5	44,082
1978	3,279,738	2,436,140	3,511,270	1,080,364	25.8	41,843
1977	1,588,096	1,206,305	1,738,677	484,658	25.2	19,264
1976	1,811,773	1,406,240	2,026,849	509,634	24.5	20,795
1975	2,438,703	1,932,648	2,785,574	628,610	23.9	26,339
1974	3,304,470	2,671,907	3,851,086	775,172	23.2	33,363
1973	3,011,007	2,482,318	3,577,827	637,583	22.6	28,196
1972	1,962,441	1,648,469	2,375,980	371,438	22.0	16,884
1971	1,912,444	1,635,819	2,357,747	319,675	21.4	14,940
1970	1,689,746	1,470,820	2,119,929	245,715	20.8	11,811
1969	1,719,894	1,522,545	2,194,483	213,369	20.2	10,551
1968	3,557,823	3,201,375	4,614,221	366,731	19.7	18,663
1967	1,729,454	1,580,908	2,278,602	142,634	19.1	7,472
1966	897,930	833,403	1,201,205	55,897	18.5	3,015
1965	1,088,172	1,024,950	1,477,286	46,155	18.0	2,565
1964	1,020,173	974,649	1,404,786	23,456	17.5	1,343
1963	770,057	745,863	1,075,031	3,049	16.9	180
1962	648,565	636,575	917,512	(9,521)	16.4	(579)
1961	641,400	637,662	919,078	(21,118)	15.9	(1,325)
1960	2,604,002	2,621,077	3,777,823	(132,220)	15.5	(8,554)
1959	2,247,318	2,289,255	3,299,561	(153,316)	15.0	(10,234)
1958	1,705,593	1,757,590	2,533,258	(145,428)	14.5	(10,018)
1957	348,676	363,334	523,683	(35,536)	14.1	(2,527)
1956	256,224	269,887	388,994	(30,281)	13.6	(2,223)
1955	106,394	113,239	163,215	(14,263)	13.2	(1,082)

Account 37600 Rate Development

	Curve Type	R2	[1]	Composite RL	45.5	[4]
	Average Life	55	[2]	Accrual Rate	2.03%	[5]
	Net Salvage	-40%	[3]	Total Reserve	$ 183,944,998	[6]

[7] Year Installed	[8] Original Cost	[9] Calculated Accrued	[10] Allocated Book Reserve	[11] Future Book Accruals	[12] Remaining Life	[13] Annual Accrual
1954	138,688	149,102	214,904	(20,741)	12.8	(1,625)
1953	152,429	165,473	238,500	(25,099)	12.4	(2,032)
1952	124,438	136,360	196,538	(22,325)	12.0	(1,868)
1951	90,969	100,592	144,986	(17,629)	11.6	(1,525)
1950	83,542	93,193	134,321	(17,362)	11.2	(1,554)
1949	22,840	25,695	37,035	(5,059)	10.8	(468)
1948	88,952	100,897	145,426	(20,893)	10.4	(2,001)
1947	270,273	309,016	445,392	(67,010)	10.1	(6,646)
1946	152,131	175,285	252,643	(39,659)	9.7	(4,074)
1945	23,802	27,631	39,825	(6,502)	9.4	(692)
1944	9,533	11,147	16,067	(2,720)	9.1	(300)
1943	32,977	38,834	55,972	(9,804)	8.7	(1,122)
1942	50,709	60,129	86,665	(15,672)	8.4	(1,862)
1941	77,140	92,088	132,728	(24,732)	8.1	(3,053)
1940	197,268	237,048	341,664	(65,489)	7.8	(8,405)
1939	29,338	35,482	51,141	(10,068)	7.5	(1,345)
1938	22,029	26,811	38,644	(7,803)	7.2	(1,086)
1937	59,149	72,439	104,408	(21,599)	6.9	(3,136)
1936	35,747	44,049	63,488	(13,443)	6.6	(2,040)
1935	1,109	1,375	1,982	(429)	6.3	(68)
1934	156,144	194,739	280,682	(62,081)	6.0	(10,340)
1933	831	1,043	1,503	(339)	5.7	(59)
1932	1,272	1,605	2,314	(533)	5.4	(98)
1931	2,753	3,495	5,037	(1,183)	5.1	(230)
1930	8,685	11,089	15,982	(3,823)	4.8	(790)
1929	4,399	5,649	8,142	(1,983)	4.6	(436)
1928	8,405	10,855	15,645	(3,878)	4.3	(909)
1927	99,780	129,587	186,777	(47,085)	4.0	(11,835)
1926	117,700	153,717	221,556	(56,776)	3.7	(15,376)
1925	4,931	6,476	9,334	(2,430)	3.4	(713)
Totals	**$ 385,317,174**	**$ 127,622,167**	**$ 183,944,998**	**$ 355,499,046**	**45.5**	**$ 7,804,962**

[1], [2] Selected Iowa curve type and average life through mathematical and visual curve fitting-techniques and professional judgment.
[3] Selected net salvage rate based on historical records and professional judgment.
[4] = total of [11] / total of [13]
[5] = total of [13] / total of [8]
[6] From the Company's property records
[7] Year of property installation
[8] Original cost of plant from the Company's property records
[9] = (1 - [12] / [2]) * ([8] * (1 - [3]))
[10] = [6] * [9] / total of [9]
[11] = [8] * (1 - [3]) - [10]
[12] Average remaining life based on selected Iowa curve in [1] and [2]
[13] = [11] / [12]

Account 37602 Curve Fitting

[1] Age (Years)	[2] Exposures (Dollars)	[3] Observed Life Table (OLT)	[4] PGS R3-40	[5] OPC R2-75	[6] PGS SSD	[7] OPC SSD
0.0	387,856,903	100.00%	100.00%	100.00%	0.0000	0.0000
0.5	366,083,267	99.99%	99.98%	99.94%	0.0000	0.0000
1.5	340,479,993	99.95%	99.93%	99.81%	0.0000	0.0000
2.5	315,032,274	99.91%	99.88%	99.67%	0.0000	0.0000
3.5	299,812,241	99.85%	99.81%	99.53%	0.0000	0.0000
4.5	275,639,602	99.75%	99.73%	99.38%	0.0000	0.0000
5.5	249,038,038	99.58%	99.63%	99.22%	0.0000	0.0000
6.5	231,108,823	99.49%	99.51%	99.06%	0.0000	0.0000
7.5	223,722,374	99.29%	99.38%	98.89%	0.0000	0.0000
8.5	216,887,274	98.91%	99.21%	98.72%	0.0000	0.0000
9.5	210,987,950	98.62%	99.03%	98.53%	0.0000	0.0000
10.5	205,003,293	98.49%	98.81%	98.34%	0.0000	0.0000
11.5	197,150,928	98.31%	98.55%	98.14%	0.0000	0.0000
12.5	188,125,522	98.15%	98.26%	97.93%	0.0000	0.0000
13.5	176,024,929	97.96%	97.93%	97.72%	0.0000	0.0000
14.5	154,745,279	97.84%	97.56%	97.49%	0.0000	0.0000
15.5	126,470,843	97.59%	97.13%	97.25%	0.0000	0.0000
16.5	106,242,459	97.03%	96.65%	97.01%	0.0000	0.0000
17.5	91,171,702	96.88%	96.11%	96.76%	0.0001	0.0000
18.5	82,909,940	96.60%	95.50%	96.49%	0.0001	0.0000
19.5	77,385,458	96.41%	94.83%	96.22%	0.0003	0.0000
20.5	69,705,068	96.24%	94.08%	95.93%	0.0005	0.0000
21.5	62,945,650	95.99%	93.25%	95.64%	0.0008	0.0000
22.5	56,393,364	95.64%	92.34%	95.33%	0.0011	0.0000
23.5	52,830,061	95.30%	91.34%	95.01%	0.0016	0.0000
24.5	49,056,066	94.90%	90.23%	94.68%	0.0022	0.0000
25.5	41,318,356	94.71%	89.02%	94.34%	0.0032	0.0000
26.5	36,651,258	94.41%	87.70%	93.98%	0.0045	0.0000
27.5	31,163,504	93.94%	86.26%	93.61%	0.0059	0.0000
28.5	26,653,433	93.63%	84.69%	93.23%	0.0080	0.0000
29.5	20,875,384	93.20%	82.97%	92.83%	0.0104	0.0000
30.5	17,229,431	92.66%	81.11%	92.42%	0.0133	0.0000
31.5	13,943,734	92.46%	79.10%	92.00%	0.0178	0.0000
32.5	11,512,517	91.97%	76.91%	91.56%	0.0227	0.0000
33.5	9,694,006	91.80%	74.55%	91.10%	0.0297	0.0000
34.5	8,320,055	91.56%	72.01%	90.63%	0.0382	0.0001
35.5	7,089,002	91.15%	69.28%	90.15%	0.0479	0.0001
36.5	4,948,833	90.55%	66.36%	89.65%	0.0586	0.0001
37.5	3,718,956	90.16%	63.25%	89.13%	0.0724	0.0001
38.5	2,911,593	89.66%	59.97%	88.59%	0.0882	0.0001
39.5	2,540,871	89.27%	56.52%	88.03%	0.1073	0.0002
40.5	1,839,211	88.81%	52.92%	87.46%	0.1288	0.0002
41.5	1,156,667	88.49%	49.21%	86.87%	0.1543	0.0003
42.5	883,136	85.58%	45.40%	86.26%	0.1614	0.0000
43.5	637,617	85.18%	41.55%	85.63%	0.1904	0.0000
44.5	452,371	84.54%	37.69%	84.98%	0.2195	0.0000
45.5	250,904	79.71%	33.87%	84.31%	0.2102	0.0021
46.5	126,129	78.45%	30.13%	83.62%	0.2335	0.0027

Account 37602 Curve Fitting

[1]	[2]	[3]	[4]	[5]	[6]	[7]
Age (Years)	**Exposures (Dollars)**	**Observed Life Table (OLT)**	**PGS R3-40**	**OPC R2-75**	**PGS SSD**	**OPC SSD**
47.5	16,308	77.43%	26.52%	82.90%	0.2592	0.0030
48.5	8,167	72.22%	23.09%	82.17%	0.2413	0.0099
49.5	5,772	72.22%	19.88%	81.41%	0.2740	0.0085
50.5	4,807	72.22%	16.90%	80.63%	0.3060	0.0071
51.5	4,806	72.22%	14.18%	79.83%	0.3368	0.0058
52.5	1	72.22%	11.74%	79.01%	0.3657	0.0046
53.5	1	72.22%	9.58%	78.16%	0.3923	0.0035
54.5	1	72.22%	7.69%	77.29%	0.4164	0.0026
55.5	1	72.22%	6.06%	76.39%	0.4377	0.0017
Sum of Squared Differences				[8]	4.8621	0.0530
Up to 1% of Beginning Exposures				[9]	0.2669	0.0006

[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 37602 Rate Development

Curve Type	R2	[1]	Composite RL	67.7	[4]
Average Life	75	[2]	Accrual Rate	1.27%	[5]
Net Salvage	-25%	[3]	Total Reserve	$ 155,889,590	[6]

[7] Year Installed	[8] Original Cost	[9] Calculated Accrued	[10] Allocated Book Reserve	[11] Future Book Accruals	[12] Remaining Life	[13] Annual Accrual
2015	$ 25,640,754	$ 38	$ 91	$ 32,050,852	75.0	$ 427,345
2014	28,855,720	217,680	524,707	35,544,943	74.5	476,810
2013	27,871,938	630,083	1,518,782	33,321,140	73.6	452,465
2012	16,930,733	636,669	1,534,658	19,628,758	72.7	269,834
2011	25,248,563	1,326,817	3,198,226	28,362,478	71.8	394,762
2010	27,390,977	1,847,336	4,452,909	29,785,813	71.0	419,794
2009	19,928,908	1,639,501	3,951,934	20,959,201	70.1	299,144
2008	8,165,651	792,368	1,909,962	8,297,102	69.2	119,939
2007	6,862,957	766,936	1,848,661	6,730,036	68.3	98,544
2006	5,669,277	716,545	1,727,194	5,359,402	67.4	79,497
2005	6,440,231	907,903	2,188,453	5,861,836	66.5	88,093
2004	8,244,020	1,281,926	3,090,017	7,215,008	65.7	109,867
2003	8,971,167	1,524,607	3,674,987	7,538,972	64.8	116,336
2002	12,041,815	2,219,690	5,350,450	9,701,818	63.9	151,733
2001	21,237,993	4,219,077	10,169,871	16,377,620	63.1	259,630
2000	28,074,107	5,977,028	14,407,320	20,685,314	62.2	332,423
1999	19,797,981	4,495,783	10,836,855	13,910,621	61.4	226,650
1998	15,156,092	3,655,645	8,811,746	10,133,369	60.5	167,416
1997	8,088,130	2,064,351	4,976,013	5,134,149	59.7	86,019
1996	5,370,352	1,445,690	3,484,761	3,228,179	58.8	54,856
1995	7,546,959	2,136,524	5,149,983	4,283,716	58.0	73,839
1994	6,579,712	1,953,571	4,708,983	3,515,657	57.2	61,478
1993	6,325,122	1,964,899	4,736,289	3,170,113	56.4	56,247
1992	3,360,929	1,090,023	2,627,445	1,573,716	55.5	28,334
1991	3,552,030	1,200,238	2,893,112	1,546,926	54.7	28,267
1990	7,639,381	2,684,554	6,470,980	3,078,246	53.9	57,094
1989	4,592,235	1,675,455	4,038,600	1,701,694	53.1	32,041
1988	5,304,290	2,006,002	4,835,365	1,794,997	52.3	34,315
1987	4,407,346	1,725,254	4,158,636	1,350,546	51.5	26,218
1986	5,654,900	2,288,193	5,515,572	1,553,053	50.7	30,619
1985	3,525,038	1,472,509	3,549,407	856,890	49.9	17,160
1984	3,248,481	1,399,252	3,372,825	687,776	49.2	13,992
1983	2,357,898	1,046,138	2,521,662	425,710	48.4	8,799
1982	1,796,840	820,264	1,977,205	268,845	47.6	5,647
1981	1,349,069	633,054	1,525,945	160,391	46.8	3,424
1980	1,193,974	575,400	1,386,973	105,494	46.1	2,289
1979	2,093,588	1,035,238	2,495,388	121,597	45.3	2,682
1978	1,208,336	612,573	1,476,577	33,843	44.6	759
1977	786,868	408,658	985,049	(1,464)	43.8	(33)
1976	358,042	190,345	458,816	(11,264)	43.1	(261)
1975	688,591	374,469	902,638	(41,899)	42.4	(989)
1974	675,804	375,695	905,594	(60,839)	41.6	(1,461)
1973	235,567	133,781	322,472	(28,013)	40.9	(685)
1972	241,408	139,970	337,391	(35,631)	40.2	(886)
1971	180,397	106,725	257,256	(31,760)	39.5	(804)
1970	175,640	105,963	255,419	(35,869)	38.8	(924)
1969	120,809	74,284	179,058	(28,047)	38.1	(736)

Account 37602 Rate Development

Curve Type	R2	[1]	Composite RL	67.7	[4]
Average Life	75	[2]	Accrual Rate	1.27%	[5]
Net Salvage	-25%	[3]	Total Reserve	$ 155,889,590	[6]

[7] Year Installed	[8] Original Cost	[9] Calculated Accrued	[10] Allocated Book Reserve	[11] Future Book Accruals	[12] Remaining Life	[13] Annual Accrual
1968	108,182	67,763	163,340	(28,113)	37.4	(751)
1967	7,043	4,492	10,827	(2,023)	36.7	(55)
1966	2,395	1,554	3,747	(753)	36.1	(21)
1965	966	638	1,537	(330)	35.4	(9)
1964	-	-	-	-	34.7	-
1963	4,806	3,279	7,903	(1,895)	34.1	(56)
Totals	**$ 401,310,012**	**$ 64,672,430**	**$ 155,889,590**	**$ 345,747,925**	**67.7**	**$ 5,106,690**

[1], [2] Selected Iowa curve type and average life through mathematical and visual curve fitting-techniques and professional judgment.
[3] Selected net salvage rate based on historical records and professional judgment.
[4] = total of [11] / total of [13]
[5] = total of [13] / total of [8]
[6] From the Company's property records
[7] Year of property installation
[8] Original cost of plant from the Company's property records
[9] = (1 - [12] / [2]) * ([8] * (1 - [3]))
[10] = [6] * [9] / total of [9]
[11] = [8] * (1 - [3]) - [10]
[12] Average remaining life based on selected Iowa curve in [1] and [2]
[13] = [11] / [12]

Account 38000 Curve Fitting

[1] Age (Years)	[2] Exposures (Dollars)	[3] Observed Life Table (OLT)	[4] PGS R3-32	[5] OPC R0.5-50	[6] PGS SSD	[7] OPC SSD
0.0	36,273,203	100.00%	100.00%	100.00%	0.0000	0.0000
0.5	35,151,494	99.99%	99.98%	99.62%	0.0000	0.0000
1.5	34,148,963	99.80%	99.91%	98.86%	0.0000	0.0001
2.5	32,813,359	99.44%	99.84%	98.09%	0.0000	0.0002
3.5	32,221,981	99.06%	99.74%	97.31%	0.0000	0.0003
4.5	32,193,218	98.50%	99.62%	96.52%	0.0001	0.0004
5.5	31,683,582	97.71%	99.46%	95.73%	0.0003	0.0004
6.5	31,128,399	96.68%	99.28%	94.93%	0.0007	0.0003
7.5	30,675,879	95.87%	99.05%	94.12%	0.0010	0.0003
8.5	30,639,566	94.98%	98.78%	93.31%	0.0014	0.0003
9.5	31,161,937	93.56%	98.45%	92.49%	0.0024	0.0001
10.5	31,151,942	92.39%	98.06%	91.66%	0.0032	0.0001
11.5	31,197,186	91.38%	97.61%	90.82%	0.0039	0.0000
12.5	30,905,013	90.49%	97.07%	89.98%	0.0043	0.0000
13.5	29,922,366	89.28%	96.45%	89.13%	0.0051	0.0000
14.5	30,202,859	88.19%	95.74%	88.28%	0.0057	0.0000
15.5	28,516,410	86.90%	94.92%	87.41%	0.0064	0.0000
16.5	27,929,024	85.89%	93.98%	86.54%	0.0065	0.0000
17.5	26,915,472	84.88%	92.92%	85.67%	0.0065	0.0001
18.5	26,129,024	84.05%	91.72%	84.78%	0.0059	0.0001
19.5	25,523,236	82.91%	90.38%	83.89%	0.0056	0.0001
20.5	24,837,511	81.70%	88.87%	82.99%	0.0051	0.0002
21.5	23,836,206	80.70%	87.18%	82.08%	0.0042	0.0002
22.5	23,568,855	79.76%	85.29%	81.17%	0.0031	0.0002
23.5	23,827,484	78.62%	83.20%	80.24%	0.0021	0.0003
24.5	22,566,077	77.36%	80.87%	79.30%	0.0012	0.0004
25.5	21,529,502	76.28%	78.30%	78.36%	0.0004	0.0004
26.5	20,606,649	75.34%	75.46%	77.40%	0.0000	0.0004
27.5	19,678,003	74.23%	72.34%	76.44%	0.0004	0.0005
28.5	18,888,029	73.25%	68.92%	75.46%	0.0019	0.0005
29.5	18,214,709	72.32%	65.21%	74.47%	0.0051	0.0005
30.5	17,430,000	71.54%	61.22%	73.47%	0.0106	0.0004
31.5	16,854,342	70.62%	56.96%	72.45%	0.0187	0.0003
32.5	16,286,804	69.69%	52.47%	71.43%	0.0297	0.0003
33.5	15,671,318	68.76%	47.79%	70.39%	0.0440	0.0003
34.5	15,061,037	67.83%	43.00%	69.34%	0.0616	0.0002
35.5	14,685,604	66.88%	38.17%	68.27%	0.0824	0.0002
36.5	13,952,720	66.19%	33.39%	67.20%	0.1076	0.0001
37.5	13,081,532	65.37%	28.76%	66.11%	0.1340	0.0001
38.5	12,574,434	64.68%	24.36%	65.01%	0.1626	0.0000
39.5	12,013,556	63.95%	20.27%	63.89%	0.1908	0.0000
40.5	11,184,830	63.06%	16.55%	62.76%	0.2164	0.0000
41.5	10,041,592	62.30%	13.24%	61.62%	0.2407	0.0000
42.5	8,816,250	61.50%	10.36%	60.47%	0.2616	0.0001
43.5	8,005,529	60.60%	7.91%	59.30%	0.2776	0.0002
44.5	7,361,132	59.79%	5.87%	58.12%	0.2907	0.0003
45.5	6,916,511	58.85%	4.21%	56.93%	0.2985	0.0004
46.5	6,333,617	57.93%	2.89%	55.73%	0.3029	0.0005
47.5	5,754,840	56.99%	1.88%	54.52%	0.3037	0.0006
48.5	4,950,545	56.04%	1.13%	53.30%	0.3015	0.0008
49.5	4,208,327	54.85%	0.61%	52.07%	0.2942	0.0008
50.5	3,861,706	53.86%	0.28%	50.83%	0.2872	0.0009
51.5	3,582,020	52.88%	0.10%	49.58%	0.2786	0.0011
52.5	3,392,965	51.31%	0.02%	48.32%	0.2631	0.0009
53.5	3,123,877	50.17%	0.00%	47.06%	0.2517	0.0010
54.5	2,897,488	49.13%		45.79%		
55.5	2,492,574	48.18%		44.52%		
56.5	1,439,157	47.48%		43.24%		
57.5	1,246,100	46.35%		41.96%		
58.5	1,111,823	44.97%		40.68%		
59.5	998,013	43.71%		39.39%		
60.5	923,194	42.89%		38.11%		
61.5	871,180	41.97%		36.83%		
62.5	794,421	40.35%		35.55%		
63.5	712,544	38.04%		34.27%		
64.5	566,226	33.29%		33.00%		

Account 38000 Curve Fitting

[1]	[2]	[3]	[4]	[5]	[6]	[7]
Age (Years)	**Exposures (Dollars)**	**Observed Life Table (OLT)**	**PGS R3-32**	**OPC R0.5-50**	**PGS SSD**	**OPC SSD**
65.5	521,839	31.59%		31.73%		
66.5	483,791	30.49%		30.48%		
67.5	396,435	29.60%		29.23%		
68.5	364,932	29.03%		27.99%		
69.5	339,521	28.44%		26.76%		
70.5	331,125	27.86%		25.55%		
71.5	316,718	27.34%		24.35%		
72.5	288,394	27.12%		23.16%		
73.5	277,111	26.84%		22.00%		
74.5	262,328	26.17%		20.85%		
75.5	257,615	25.71%		19.72%		
76.5	246,933	24.85%		18.61%		
77.5	202,055	24.19%		17.52%		
78.5	191,316	23.60%		16.45%		
79.5	183,571	23.44%		15.41%		
80.5	182,892	23.35%		14.40%		
81.5	178,499	23.27%		13.41%		
82.5	167,928	22.48%		12.44%		
83.5	153,056	20.69%		11.51%		
84.5	108,241	19.87%		10.60%		
85.5	33,936	19.60%		9.72%		
86.5	33,909	19.58%		8.87%		
87.5	32,335	18.83%		8.06%		
88.5	17,293	17.50%		7.27%		
89.5	1	16.03%		6.51%		
90.5	1	16.03%		5.77%		
91.5	1	16.03%		5.07%		
92.5	1	16.03%		4.39%		
93.5	1	16.03%		3.74%		
94.5	1	16.03%		3.11%		
95.5	1	16.03%		2.50%		
96.5	1	16.03%		1.91%		
97.5	1	16.03%		1.34%		
98.5	1	16.03%		0.79%		
99.5	1	16.03%		0.26%		
100.5	1	16.03%		0.00%		
101.5	1	16.03%		0.00%		
102.5	1	16.03%		0.00%		
103.5	1	16.03%		0.00%		
104.5	1	16.03%		0.00%		
Sum of Squared Differences				[8]	4.7930	0.0156
Up to 1% of Beginning Exposures				[9]	4.7930	0.0156

[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 38000 Rate Development

	Curve Type	R0.5 [1]		Composite RL	54.3 [4]	
	Average Life	50 [2]		Accrual Rate	1.37% [5]	
	Net Salvage	-100% [3]		Total Reserve	$ 57,964,560 [6]	

[7] Year Installed	[8] Original Cost	[9] Calculated Accrued	[10] Allocated Book Reserve	[11] Future Book Accruals	[12] Remaining Life	[13] Annual Accrual
2015	$ 1,835,027	$ (23)	$ (54)	$ 3,670,108	50.0	$ 73,402
2014	1,827,839	22,630	52,894	3,602,784	49.7	72,505
2013	1,912,733	71,123	166,234	3,659,232	49.1	74,571
2012	1,424,624	88,207	206,166	2,643,082	48.5	54,550
2011	886,896	76,786	179,472	1,594,320	47.8	33,329
2010	873,694	97,131	227,024	1,520,364	47.2	32,197
2009	886,167	120,253	281,066	1,491,268	46.6	31,996
2008	1,102,243	176,537	412,618	1,791,868	46.0	38,957
2007	1,143,027	210,955	493,064	1,792,990	45.4	39,505
2006	758,079	158,357	370,126	1,146,032	44.8	25,594
2005	718,683	167,572	391,664	1,045,702	44.2	23,674
2004	637,008	163,952	383,204	890,812	43.6	20,448
2003	749,780	211,089	493,377	1,006,183	43.0	23,420
2002	1,249,064	381,758	892,281	1,605,847	42.4	37,910
2001	43,906	14,475	33,832	53,980	41.8	1,293
2000	2,171,338	767,957	1,794,943	2,547,733	41.2	61,901
1999	1,159,308	437,786	1,023,234	1,295,382	40.6	31,938
1998	1,189,989	477,809	1,116,780	1,263,198	40.0	31,610
1997	944,258	401,657	938,791	949,725	39.4	24,126
1996	567,791	255,026	596,071	539,511	38.8	13,915
1995	609,954	288,436	674,159	545,749	38.2	14,295
1994	1,014,635	503,807	1,177,545	851,725	37.6	22,660
1993	900,246	468,241	1,094,418	706,074	37.0	19,085
1992	1,011,356	549,806	1,285,058	737,654	36.4	20,260
1991	1,193,339	676,686	1,581,615	805,063	35.8	22,473
1990	871,591	514,570	1,202,702	540,480	35.2	15,337
1989	798,480	489,954	1,145,166	451,794	34.7	13,035
1988	728,662	463,960	1,084,412	372,912	34.1	10,942
1987	595,906	393,141	918,886	272,926	33.5	8,145
1986	523,737	357,515	835,618	211,856	32.9	6,433
1985	700,927	494,423	1,155,612	246,242	32.4	7,608
1984	477,432	347,576	812,388	142,476	31.8	4,480
1983	436,663	327,716	765,969	107,357	31.2	3,437
1982	490,428	379,025	885,893	94,963	30.7	3,095
1981	577,225	458,916	1,072,623	81,827	30.1	2,716
1980	263,184	215,042	502,616	23,752	29.6	803
1979	665,804	558,582	1,305,570	26,038	29.0	897
1978	754,629	649,489	1,518,049	(8,791)	28.5	(309)
1977	390,124	344,176	804,441	(24,193)	27.9	(866)
1976	457,004	412,948	965,182	(51,174)	27.4	(1,867)
1975	698,301	645,789	1,509,400	(112,798)	26.9	(4,196)
1974	1,053,798	996,709	2,329,603	(222,007)	26.4	(8,424)
1973	1,167,628	1,128,711	2,638,132	(302,876)	25.8	(11,724)
1972	782,863	772,947	1,806,605	(240,879)	25.3	(9,515)
1971	634,490	639,448	1,494,578	(225,598)	24.8	(9,095)
1970	367,521	377,852	883,151	(148,109)	24.3	(6,096)
1969	497,241	521,218	1,218,240	(223,758)	23.8	(9,404)
1968	512,899	547,850	1,280,487	(254,689)	23.3	(10,933)
1967	732,640	797,026	1,862,884	(397,604)	22.8	(17,437)
1966	656,912	727,486	1,700,350	(386,526)	22.3	(17,322)
1965	282,663	318,505	744,440	(179,114)	21.8	(8,205)
1964	269,512	308,856	721,887	(182,863)	21.4	(8,565)
1963	207,915	242,217	566,132	(150,302)	20.9	(7,200)
1962	199,333	235,970	551,531	(152,865)	20.4	(7,492)
1961	187,652	225,639	527,385	(152,081)	19.9	(7,627)
1960	436,511	532,933	1,245,622	(372,600)	19.5	(19,130)
1959	1,097,639	1,360,167	3,179,112	(983,834)	19.0	(51,725)
1958	221,419	278,387	650,673	(207,835)	18.6	(11,193)
1957	103,802	132,371	309,390	(101,786)	18.1	(5,618)

Account 38000 Rate Development

Curve Type	R0.5	[1]	Composite RL	54.3	[4]
Average Life	50	[2]	Accrual Rate	1.37%	[5]
Net Salvage	-100%	[3]	Total Reserve	$ 57,964,560	[6]

[7] Year Installed	[8] Original Cost	[9] Calculated Accrued	[10] Allocated Book Reserve	[11] Future Book Accruals	[12] Remaining Life	[13] Annual Accrual
1956	88,966	115,033	268,866	(90,934)	17.7	(5,145)
1955	56,327	73,823	172,546	(59,892)	17.2	(3,475)
1954	32,530	43,202	100,976	(35,916)	16.8	(2,138)
1953	43,899	59,060	138,041	(50,243)	16.4	(3,070)
1952	36,369	49,553	115,821	(43,083)	15.9	(2,703)
1951	57,368	79,141	184,975	(70,239)	15.5	(4,528)
1950	15,444	21,566	50,406	(19,518)	15.1	(1,293)
1949	19,819	28,007	65,460	(25,822)	14.7	(1,760)
1948	73,188	104,640	244,575	(98,199)	14.3	(6,888)
1947	24,000	34,710	81,127	(33,127)	13.8	(2,393)
1946	18,032	26,374	61,644	(25,580)	13.4	(1,904)
1945	1,458	2,156	5,040	(2,124)	13.0	(163)
1944	8,254	12,340	28,843	(12,335)	12.6	(977)
1943	28,010	42,328	98,933	(42,913)	12.2	(3,512)
1942	8,297	12,671	29,616	(13,022)	11.8	(1,102)
1941	7,960	12,283	28,710	(12,790)	11.4	(1,120)
1940	81	126	295	(133)	11.0	(12)
1939	2,089	3,290	7,690	(3,512)	10.6	(330)
1938	38,310	60,942	142,439	(65,819)	10.2	(6,433)
1937	5,689	9,140	21,362	(9,984)	9.8	(1,015)
1936	6,522	10,581	24,732	(11,688)	9.4	(1,238)
1935	-	-	-	-	9.0	-
1934	3,787	6,264	14,641	(7,067)	8.6	(817)
1933	4,486	7,492	17,511	(8,539)	8.2	(1,035)
1932	1,479					
1931	38,742					
1930	72,850					
1929	-					
1928	270					
1927	12,760					
1926	15,842					
Totals	**$ 46,376,347**	**$ 24,799,846**	**$ 57,964,560**	**$ 34,504,248**	**54.3**	**$ 635,552**

[1], [2] Selected Iowa curve type and average life through mathematical and visual curve fitting-techniques and professional judgment.
[3] Selected net salvage rate based on historical records and professional judgment.
[4] = total of [11] / total of [13]
[5] = total of [13] / total of [8]
[6] From the Company's property records
[7] Year of property installation
[8] Original cost of plant from the Company's property records
[9] = (1 - [12] / [2]) * ([8] * (1 - [3]))
[10] = [6] * [9] / total of [9]
[11] = [8] * (1 - [3]) - [10]
[12] Average remaining life based on selected Iowa curve in [1] and [2]
[13] = [11] / [12]

Account 38002 Curve Fitting

[1] Age (Years)	[2] Exposures (Dollars)	[3] Observed Life Table (OLT)	[4] PGS R3-32	[5] OPC R1.5-55	[6] PGS SSD	[7] OPC SSD
0.0	244,604,810	100.00%	100.00%	100.00%	0.0000	0.0000
0.5	230,796,377	100.00%	99.98%	99.84%	0.0000	0.0000
1.5	219,125,075	99.91%	99.91%	99.51%	0.0000	0.0000
2.5	207,278,056	99.79%	99.84%	99.17%	0.0000	0.0000
3.5	197,299,634	99.65%	99.74%	98.82%	0.0000	0.0001
4.5	189,312,056	99.47%	99.62%	98.45%	0.0000	0.0001
5.5	181,870,901	99.17%	99.46%	98.07%	0.0000	0.0001
6.5	176,137,256	98.77%	99.28%	97.68%	0.0000	0.0001
7.5	168,280,648	98.41%	99.05%	97.28%	0.0000	0.0001
8.5	158,373,152	98.00%	98.78%	96.86%	0.0001	0.0001
9.5	147,265,180	97.65%	98.45%	96.43%	0.0001	0.0001
10.5	136,853,346	97.33%	98.06%	95.99%	0.0001	0.0002
11.5	125,870,231	96.87%	97.61%	95.53%	0.0001	0.0002
12.5	114,780,839	96.42%	97.07%	95.06%	0.0000	0.0002
13.5	104,753,338	95.83%	96.45%	94.57%	0.0000	0.0002
14.5	101,814,092	95.29%	95.74%	94.06%	0.0000	0.0002
15.5	79,172,007	94.69%	94.92%	93.55%	0.0000	0.0001
16.5	71,549,937	93.95%	93.98%	93.01%	0.0000	0.0001
17.5	65,368,573	93.22%	92.92%	92.46%	0.0000	0.0001
18.5	59,026,117	92.61%	91.72%	91.89%	0.0001	0.0001
19.5	53,463,075	91.84%	90.38%	91.30%	0.0002	0.0000
20.5	48,323,067	91.17%	88.87%	90.70%	0.0005	0.0000
21.5	42,878,662	90.47%	87.18%	90.08%	0.0011	0.0000
22.5	37,519,770	89.63%	85.29%	89.43%	0.0019	0.0000
23.5	33,533,621	88.95%	83.20%	88.77%	0.0033	0.0000
24.5	29,485,976	88.21%	80.87%	88.08%	0.0054	0.0000
25.5	25,256,912	87.32%	78.30%	87.38%	0.0081	0.0000
26.5	21,982,435	86.47%	75.46%	86.65%	0.0121	0.0000
27.5	18,445,232	85.62%	72.34%	85.90%	0.0176	0.0000
28.5	15,577,373	84.90%	68.92%	85.12%	0.0255	0.0000
29.5	12,930,368	84.35%	65.21%	84.31%	0.0366	0.0000
30.5	11,002,367	83.60%	61.22%	83.48%	0.0501	0.0000
31.5	9,378,163	82.98%	56.96%	82.63%	0.0677	0.0000
32.5	7,825,197	82.35%	52.47%	81.74%	0.0893	0.0000
33.5	6,450,558	81.53%	47.79%	80.83%	0.1139	0.0000
34.5	5,233,670	80.59%	43.00%	79.89%	0.1413	0.0000
35.5	4,325,491	79.69%	38.17%	78.92%	0.1724	0.0001
36.5	3,480,816	78.94%	33.39%	77.91%	0.2075	0.0001
37.5	2,907,350	77.47%	28.76%	76.88%	0.2372	0.0000
38.5	2,580,167	76.22%	24.36%	75.81%	0.2690	0.0000
39.5	2,312,034	75.18%	20.27%	74.71%	0.3015	0.0000
40.5	2,020,582	74.42%	16.55%	73.58%	0.3350	0.0001
41.5	1,614,004	73.70%	13.24%	72.42%	0.3656	0.0002
42.5	1,446,755	72.54%	10.36%	71.22%	0.3866	0.0002
43.5	1,156,260	70.30%	7.91%	69.98%	0.3892	0.0000
44.5	867,971	67.60%	5.87%	68.72%	0.3810	0.0001
45.5	474,844	66.35%	4.21%	67.41%	0.3861	0.0001
46.5	135,952	65.62%	2.89%	66.08%	0.3935	0.0000

Account 38002 Curve Fitting

[1]	[2]	[3]	[4]	[5]	[6]	[7]
Age (Years)	**Exposures (Dollars)**	**Observed Life Table (OLT)**	**PGS R3-32**	**OPC R1.5-55**	**PGS SSD**	**OPC SSD**
47.5	12,318	65.61%	1.88%	64.71%	0.4062	0.0001
48.5	190	65.61%	1.13%	63.31%	0.4158	0.0005
49.5	112	65.61%	0.61%	61.88%	0.4225	0.0014
50.5	112	65.61%	0.28%	60.41%	0.4268	0.0027
51.5	111	65.61%	0.10%	58.92%	0.4292	0.0045
52.5	1	65.61%	0.02%	57.39%	0.4302	0.0068
53.5	1	65.61%		55.84%		
54.5	1	65.61%		54.26%		
55.5	1	65.61%		52.65%		
Sum of Squared Differences				[8]	6.9305	0.0191
Up to 1% of Beginning Exposures				[9]	1.4614	0.0025

[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 38002 Rate Development

Curve Type	R1.5	[1]	Composite RL	48.9	[4]
Average Life	55	[2]	Accrual Rate	1.91%	[5]
Net Salvage	-55%	[3]	Total Reserve	$ 152,238,194	[6]

[7]	[8]	[9]	[10]	[11]	[12]	[13]
Year Installed	Original Cost	Calculated Accrued	Allocated Book Reserve	Future Book Accruals	Remaining Life	Annual Accrual
2015	$ 16,104,752	$ (171)	$ (406)	$ 24,962,772	55.0	$ 453,865
2014	13,446,333	155,867	369,513	20,472,304	54.6	375,028
2013	13,439,026	466,723	1,106,454	19,724,036	53.8	366,838
2012	11,292,798	652,161	1,546,072	15,957,765	53.0	301,370
2011	9,121,970	735,737	1,744,204	12,394,850	52.1	237,731
2010	8,235,452	851,912	2,019,619	10,745,332	51.3	209,341
2009	6,158,919	776,744	1,841,418	7,704,907	50.5	152,497
2008	7,969,624	1,184,780	2,808,744	9,544,173	49.7	191,940
2007	9,625,487	1,646,817	3,904,091	11,015,413	48.9	225,130
2006	10,890,121	2,106,134	4,992,988	11,886,700	48.1	246,932
2005	10,304,401	2,221,522	5,266,536	10,705,285	47.4	226,088
2004	10,865,727	2,582,371	6,121,997	10,719,880	46.6	230,204
2003	10,728,281	2,785,169	6,602,770	10,026,066	45.8	218,967
2002	9,654,967	2,717,227	6,441,699	8,523,500	45.0	189,354
2001	2,680,678	812,610	1,926,446	2,228,605	44.2	50,371
2000	22,632,222	7,349,106	17,422,442	17,657,502	43.5	406,128
1999	7,571,643	2,621,157	6,213,947	5,522,100	42.7	129,274
1998	5,876,206	2,159,632	5,119,816	3,988,303	42.0	95,053
1997	5,935,123	2,307,148	5,469,530	3,729,911	41.2	90,518
1996	5,079,509	2,081,626	4,934,887	2,938,352	40.5	72,626
1995	4,759,849	2,050,352	4,860,748	2,517,018	39.7	63,377
1994	5,076,457	2,292,420	5,434,615	2,433,893	39.0	62,446
1993	4,958,394	2,341,655	5,551,336	2,134,175	38.2	55,807
1992	3,701,880	1,824,269	4,324,773	1,413,141	37.5	37,670
1991	3,771,325	1,935,355	4,588,125	1,257,429	36.8	34,178
1990	3,929,631	2,096,090	4,969,177	1,121,751	36.1	31,097
1989	3,027,945	1,675,907	3,973,054	720,260	35.4	20,369
1988	3,321,216	1,904,361	4,514,648	633,237	34.7	18,273
1987	2,713,913	1,609,729	3,816,167	390,398	34.0	11,498
1986	2,545,006	1,559,325	3,696,675	248,085	33.3	7,459
1985	1,814,183	1,146,715	2,718,505	93,479	32.6	2,870
1984	1,541,522	1,003,970	2,380,101	9,258	31.9	290
1983	1,481,859	993,291	2,354,783	(57,901)	31.2	(1,855)
1982	1,297,346	894,032	2,119,472	(108,586)	30.5	(3,555)
1981	1,142,467	808,573	1,916,875	(146,052)	29.9	(4,887)
1980	849,861	617,128	1,463,020	(145,735)	29.2	(4,985)
1979	803,966	598,436	1,418,706	(172,558)	28.6	(6,036)
1978	508,253	387,465	918,559	(130,767)	27.9	(4,679)
1977	280,597	218,900	518,944	(84,019)	27.3	(3,076)
1976	232,766	185,673	440,172	(79,385)	26.7	(2,974)
1975	268,138	218,531	518,069	(102,455)	26.1	(3,928)
1974	387,076	322,078	763,547	(163,580)	25.5	(6,421)
1973	141,803	120,381	285,387	(65,592)	24.9	(2,637)
1972	245,765	212,722	504,297	(123,361)	24.3	(5,079)
1971	243,891	215,094	509,920	(131,889)	23.7	(5,564)
1970	377,083	338,639	802,807	(218,328)	23.1	(9,438)
1969	333,680	304,955	722,953	(205,749)	22.6	(9,116)

Account 38002 Rate Development

Curve Type	R1.5	[1]	
Average Life	55	[2]	
Net Salvage	-55%	[3]	
Composite RL	48.9	[4]	
Accrual Rate	1.91%	[5]	
Total Reserve	$ 152,238,194	[6]	

[7] Year Installed	[8] Original Cost	[9] Calculated Accrued	[10] Allocated Book Reserve	[11] Future Book Accruals	[12] Remaining Life	[13] Annual Accrual
1968	123,607	114,896	272,383	(80,792)	22.0	(3,670)
1967	12,128	11,460	27,167	(8,369)	21.5	(390)
1966	79	76	180	(57)	20.9	(3)
1965	-	-	-	-	20.4	-
1964	-	-	-	-	19.9	-
1963	111	111	264	(92)	19.4	(5)
Totals	**$ 247,505,036**	**$ 64,216,863**	**$ 152,238,194**	**$ 231,394,612**	**48.9**	**$ 4,736,295**

[1], [2] Selected Iowa curve type and average life through mathematical and visual curve fitting-techniques and professional judgment.
[3] Selected net salvage rate based on historical records and professional judgment.
[4] = total of [11] / total of [13]
[5] = total of [13] / total of [8]
[6] From the Company's property records
[7] Year of property installation
[8] Original cost of plant from the Company's property records
[9] = (1 - [12] / [2]) * ([8] * (1 - [3]))
[10] = [6] * [9] / total of [9]
[11] = [8] * (1 - [3]) - [10]
[12] Average remaining life based on selected Iowa curve in [1] and [2]
[13] = [11] / [12]

Account 38100 Curve Fitting

[1] Age (Years)	[2] Exposures (Dollars)	[3] Observed Life Table (OLT)	[4] PGS L1-16	[5] OPC R1-21	[6] PGS SSD	[7] OPC SSD
0.0	76,630,542	100.00%	100.00%	100.00%	0.0000	0.0000
0.5	72,373,260	99.99%	99.79%	99.38%	0.0000	0.0000
1.5	69,345,775	99.09%	99.14%	98.08%	0.0000	0.0001
2.5	65,294,295	97.45%	98.06%	96.69%	0.0000	0.0001
3.5	59,110,776	95.65%	96.44%	95.22%	0.0001	0.0000
4.5	58,441,657	93.75%	94.22%	93.68%	0.0000	0.0000
5.5	51,721,158	91.88%	91.35%	92.05%	0.0000	0.0000
6.5	49,017,903	90.33%	87.87%	90.35%	0.0006	0.0000
7.5	45,000,032	88.79%	83.87%	88.56%	0.0024	0.0000
8.5	41,498,480	87.35%	79.48%	86.69%	0.0062	0.0000
9.5	37,565,346	85.75%	74.86%	84.73%	0.0119	0.0001
10.5	33,538,283	83.36%	70.21%	82.67%	0.0173	0.0000
11.5	29,835,728	80.58%	65.58%	80.48%	0.0225	0.0000
12.5	26,323,998	78.45%	60.99%	78.17%	0.0305	0.0000
13.5	23,354,210	76.95%	56.48%	75.73%	0.0419	0.0001
14.5	22,963,387	75.40%	52.06%	73.15%	0.0545	0.0005
15.5	18,042,467	74.16%	47.75%	70.42%	0.0698	0.0014
16.5	16,778,769	72.61%	43.58%	67.54%	0.0843	0.0026
17.5	16,082,978	71.64%	39.56%	64.52%	0.1029	0.0051
18.5	15,339,777	70.62%	35.72%	61.36%	0.1219	0.0086
19.5	11,841,875	69.60%	32.06%	58.06%	0.1410	0.0133
20.5	11,790,659	68.97%	28.59%	54.64%	0.1630	0.0205
21.5	11,317,589	65.92%	25.34%	51.12%	0.1647	0.0219
22.5	10,521,045	59.49%	22.30%	47.51%	0.1383	0.0143
23.5	6,697,013	46.09%	19.48%	43.83%	0.0708	0.0005
24.5	6,889,448	36.39%	16.89%	40.11%	0.0381	0.0014
25.5	5,551,844	29.36%	14.52%	36.38%	0.0220	0.0049
26.5	4,855,177	26.07%	12.37%	32.67%	0.0188	0.0044
27.5	4,015,555	21.85%	10.44%	29.00%	0.0130	0.0051
28.5	3,731,655	20.44%	8.72%	25.43%	0.0138	0.0025
29.5	3,374,665	19.09%	7.20%	21.97%	0.0141	0.0008
30.5	2,981,291	17.34%	5.87%	18.67%	0.0131	0.0002
31.5	2,707,351	15.98%	4.73%	15.56%	0.0127	0.0000
32.5	2,483,365	14.64%	3.76%	12.67%	0.0118	0.0004
33.5	2,245,165	13.21%	2.93%	10.05%	0.0106	0.0010
34.5	1,981,555	11.58%	2.25%	7.71%	0.0087	0.0015
35.5	1,671,087	9.73%	1.69%	5.68%	0.0065	0.0016
36.5	1,172,222	6.81%	1.25%	3.98%	0.0031	0.0008
37.5	242,636	4.25%	0.90%	2.62%	0.0011	0.0003
38.5	126,949	2.20%	0.63%	1.58%	0.0002	0.0000
39.5	77,676	1.09%	0.42%	0.84%	0.0000	0.0000
40.5	61,316	0.86%	0.27%	0.33%	0.0000	0.0000
41.5	51,511	0.70%	0.17%	0.06%	0.0000	0.0000
42.5	43,589	0.51%	0.10%	0.00%	0.0000	0.0000
43.5	41,019	0.45%	0.06%		0.0000	0.0000
44.5	46,747	0.40%	0.03%		0.0000	0.0000
45.5	41,758	0.36%	0.01%		0.0000	0.0000
46.5	40,371	0.32%	0.01%		0.0000	0.0000
47.5	39,808	0.30%	0.00%		0.0000	0.0000
48.5	33,034	0.24%				
49.5	34,911	0.21%				
50.5	32,449	0.20%				
51.5	29,931	0.18%				
52.5	26,045	0.15%				
53.5	23,822	0.12%				
54.5	29,105	0.10%				
55.5	27,555	0.10%				
56.5	26,567	0.09%				
57.5	23,529	0.08%				
58.5	20,055	0.07%				
59.5	35,273	0.06%				
60.5	33,563	0.06%				

Account 38100 Curve Fitting

[1] Age (Years)	[2] Exposures (Dollars)	[3] Observed Life Table (OLT)	[4] PGS L1-16	[5] OPC R1-21	[6] PGS SSD	[7] OPC SSD
61.5	33,091	0.06%				
62.5	31,618	0.05%				
63.5	29,949	0.05%				
64.5	27,908	0.05%				
65.5	27,231	0.05%				
66.5	27,037	0.05%				
67.5	24,993	0.04%				
68.5	21,647	0.04%				
69.5	18,278	0.03%				
70.5	17,052	0.03%				
71.5	16,190	0.03%				
72.5	12,399	0.02%				
73.5	8,212	0.01%				
74.5	1,804	0.00%				
75.5	1	0.00%				
76.5	1	0.00%				
77.5	1	0.00%				
78.5	1	0.00%				
79.5	1	0.00%				
80.5	1	0.00%				
81.5	1	0.00%				
82.5	1	0.00%				
83.5	1	0.00%				
84.5	1	0.00%				
85.5	1	0.00%				
86.5	1	0.00%				
87.5	1	0.00%				
88.5	1	0.00%				
89.5	1	0.00%				
90.5	1	0.00%				
91.5	1	0.00%				
92.5	1.0	0.00%				
93.5	1.0	0.00%				
94.5	1.0	0.00%				
95.5	1.0	0.00%				
96.5	1.0	0.00%				
97.5	1.0	0.00%				
Sum of Squared Differences				[8]	1.4322	0.1144
Up to 1% of Beginning Exposures				[9]	1.4307	0.1139

[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 38100 Rate Development

Curve Type	R1	[1]	Composite RL	16.9	[4]
Average Life	21	[2]	Accrual Rate	3.77%	[5]
Net Salvage	5%	[3]	Total Reserve	$ 19,646,963	[6]

[7]	[8]	[9]	[10]	[11]	[12]	[13]
Year Installed	Original Cost	Calculated Accrued	Allocated Book Reserve	Future Book Accruals	Remaining Life	Annual Accrual
2015	$ 4,357,370	$ 19	$ 25	$ 4,139,477	21.0	$ 197,119
2014	2,438,310	40,698	54,664	2,261,731	20.6	109,628
2013	3,051,973	152,092	204,283	2,695,092	19.9	135,443
2012	5,116,238	422,098	566,943	4,293,483	19.2	223,896
2011	8,627,408	989,765	1,329,407	6,866,630	18.5	371,893
2010	5,634,277	825,625	1,108,942	4,243,621	17.8	238,932
2009	1,863,115	331,588	445,374	1,324,586	17.1	77,616
2008	3,505,569	732,926	984,433	2,345,857	16.4	143,229
2007	2,867,561	687,777	923,790	1,800,393	15.7	114,688
2006	3,406,861	920,773	1,236,740	1,999,778	15.0	133,091
2005	3,030,058	909,906	1,222,144	1,656,411	14.4	115,333
2004	2,648,673	873,684	1,173,492	1,342,747	13.7	97,951
2003	2,771,609	994,705	1,336,043	1,296,986	13.1	99,259
2002	2,546,594	986,411	1,324,902	1,094,362	12.4	87,988
2001	-	-	-	-	11.8	-
2000	4,614,774	2,041,214	2,741,666	1,642,369	11.2	146,348
1999	966,436	453,026	608,484	309,630	10.6	29,106
1998	502,312	248,376	333,608	143,589	10.1	14,259
1997	577,288	299,860	402,758	145,666	9.5	15,304
1996	3,348,964	1,820,624	2,445,379	736,136	9.0	81,950
1995	32,609	18,492	24,838	6,141	8.5	725
1994	9,534	5,623	7,553	1,505	8.0	189
1993	125	76	103	16	7.5	2
1992	41,008	25,958	34,866	4,092	7.0	584
1991	62,676	40,962	55,018	4,524	6.6	690
1990	53,772	36,210	48,636	2,448	6.1	400
1989	103,567	71,730	96,344	2,044	5.7	359
1988	58,191	41,382	55,583	(301)	5.3	(57)
1987	33,530	24,446	32,834	(981)	4.9	(201)
1986	126,716	94,581	127,037	(6,657)	4.5	(1,479)
1985	92,595	70,664	94,913	(6,948)	4.1	(1,682)
1984	45,758	35,661	47,898	(4,428)	3.8	(1,174)
1983	-	-	-	-	3.4	-
1982	-	-	-	-	3.1	-
1981	-	-	-	-	2.8	-
1980	-	-	-	-	2.5	-
1979	-	-	-	-	2.2	-
1978	497,284	430,524	578,261	(105,841)	1.9	(56,832)
Totals	**$ 63,032,755**	**$ 14,627,477**	**$ 19,646,963**	**$ 40,234,154**	**16.9**	**$ 2,374,559**

[1], [2] Selected Iowa curve type and average life through mathematical and visual curve fitting-techniques and professional judgment.
[3] Selected net salvage rate based on historical records and professional judgment.
[4] = total of [11] / total of [13]
[5] = total of [13] / total of [8]

Account 38100 Rate Development

Curve Type	R1	[1]	Composite RL	16.9	[4]
Average Life	21	[2]	Accrual Rate	3.77%	[5]
Net Salvage	5%	[3]	Total Reserve	$ 19,646,963	[6]

[7] Year Installed	[8] Original Cost	[9] Calculated Accrued	[10] Allocated Book Reserve	[11] Future Book Accruals	[12] Remaining Life	[13] Annual Accrual

[6] From the Company's property records
[7] Year of property installation
[8] Original cost of plant from the Company's property records
[9] = (1 - [12] / [2]) * ([8] * (1 - [3]))
[10] = [6] * [9] / total of [9]
[11] = [8] * (1 - [3]) - [10]
[12] Average remaining life based on selected Iowa curve in [1] and [2]
[13] = [11] / [12]

Account 38200 Curve Fitting

[1]	[2]	[3]	[4]	[5]	[6]	[7]
Age (Years)	**Exposures (Dollars)**	**Observed Life Table (OLT)**	**PGS R4-27**	**OPC R0.5-43**	**PGS SSD**	**OPC SSD**
0.0	53,613,490	100.00%	100.00%	100.00%	0.0000	0.0000
0.5	51,645,623	99.98%	100.00%	99.56%	0.0000	0.0000
1.5	49,076,718	98.81%	99.99%	98.67%	0.0001	0.0000
2.5	46,599,537	96.71%	99.99%	97.77%	0.0011	0.0001
3.5	44,457,793	94.86%	99.97%	96.86%	0.0026	0.0004
4.5	41,838,074	93.23%	99.95%	95.94%	0.0045	0.0007
5.5	39,595,892	91.36%	99.92%	95.01%	0.0073	0.0013
6.5	37,245,704	90.43%	99.87%	94.08%	0.0089	0.0013
7.5	34,505,798	88.99%	99.79%	93.13%	0.0117	0.0017
8.5	32,155,720	87.85%	99.68%	92.17%	0.0140	0.0019
9.5	29,160,371	86.57%	99.52%	91.20%	0.0168	0.0021
10.5	26,075,899	85.50%	99.30%	90.23%	0.0190	0.0022
11.5	23,646,496	84.56%	99.00%	89.24%	0.0209	0.0022
12.5	21,179,702	83.56%	98.59%	88.25%	0.0226	0.0022
13.5	18,952,127	82.37%	98.04%	87.24%	0.0245	0.0024
14.5	18,700,178	81.18%	97.32%	86.23%	0.0260	0.0025
15.5	14,934,472	80.26%	96.39%	85.21%	0.0260	0.0025
16.5	11,993,188	79.22%	95.21%	84.17%	0.0256	0.0024
17.5	10,987,183	78.55%	93.73%	83.13%	0.0231	0.0021
18.5	10,205,110	77.99%	91.91%	82.07%	0.0194	0.0017
19.5	9,782,266	77.58%	89.69%	81.01%	0.0147	0.0012
20.5	9,024,356	77.37%	87.05%	79.93%	0.0094	0.0007
21.5	8,094,286	77.04%	83.94%	78.83%	0.0048	0.0003
22.5	7,522,293	76.66%	80.34%	77.73%	0.0014	0.0001
23.5	7,142,390	76.29%	76.21%	76.60%	0.0000	0.0000
24.5	7,007,532	75.98%	71.38%	75.47%	0.0021	0.0000
25.5	6,605,170	75.52%	65.68%	74.32%	0.0097	0.0001
26.5	6,281,189	75.03%	59.03%	73.15%	0.0256	0.0004
27.5	5,956,156	74.27%	51.55%	71.97%	0.0516	0.0005
28.5	5,639,235	73.58%	43.58%	70.76%	0.0900	0.0008
29.5	5,357,225	72.67%	35.55%	69.55%	0.1378	0.0010
30.5	4,850,672	72.01%	27.91%	68.31%	0.1945	0.0014
31.5	4,462,759	71.24%	21.03%	67.06%	0.2522	0.0018
32.5	4,024,180	70.60%	15.13%	65.79%	0.3077	0.0023
33.5	3,624,970	69.09%	10.31%	64.50%	0.3455	0.0021
34.5	3,219,448	67.80%	6.57%	63.20%	0.3749	0.0021
35.5	2,612,047	67.00%	3.83%	61.87%	0.3991	0.0026
36.5	2,270,936	64.87%	1.96%	60.53%	0.3958	0.0019
37.5	1,806,595	63.62%	0.82%	59.18%	0.3944	0.0020
38.5	1,692,395	62.42%	0.25%	57.80%	0.3865	0.0021
39.5	1,622,695	60.81%	0.04%	56.42%	0.3692	0.0019
40.5	1,411,047	59.61%	0.00%	55.01%	0.3553	0.0021
41.5	1,352,347	58.07%		53.60%		
42.5	1,154,576	54.53%		52.17%		
43.5	1,096,552	53.51%		50.73%		
44.5	962,065	52.11%		49.27%		
45.5	927,505	51.14%		47.81%		
46.5	887,946	50.00%		46.34%		
47.5	845,257	49.74%		44.86%		
48.5	444,930	48.83%		43.37%		
49.5	411,245	48.38%		41.88%		
50.5	392,474	47.73%		40.39%		
51.5	355,595	47.30%		38.90%		
52.5	310,425	45.20%		37.41%		
53.5	261,096	43.86%		35.92%		
54.5	230,694	42.17%		34.43%		
55.5	180,395	40.65%		32.96%		

Account 38200 Curve Fitting

[1]	[2]	[3]	[4]	[5]	[6]	[7]
Age (Years)	**Exposures (Dollars)**	**Observed Life Table (OLT)**	**PGS R4-27**	**OPC R0.5-43**	**PGS SSD**	**OPC SSD**
56.5	106,985	38.33%		31.49%		
57.5	75,249	34.74%		30.03%		
58.5	51,684	33.61%		28.58%		
59.5	35,013	33.36%		27.15%		
60.5	19,710	31.55%		25.73%		
61.5	8,820	31.43%		24.33%		
62.5	1	31.43%		22.96%		
63.5	1	31.43%		21.61%		
64.5	1	31.43%		20.28%		
65.5	1	31.43%		18.98%		
66.5	1	31.43%		17.71%		
67.5	1	31.43%		16.46%		
68.5	1	31.43%		15.26%		
69.5	1	31.43%		14.08%		
70.5	1	31.43%		12.94%		
71.5	1	31.43%		11.84%		
72.5	1	31.43%		10.78%		
73.5	1	31.43%		9.75%		
74.5	1	31.43%		8.77%		
75.5	1	31.43%		7.82%		
76.5	1	24.85%		6.92%		
77.5	1	24.19%		6.05%		
				5.23%		
				4.43%		
				3.68%		
				2.95%		
				2.25%		
				1.57%		
				0.92%		
				0.30%		
				0.00%		
Sum of Squared Differences				[8]	4.3962	0.0573
Up to 1% of Beginning Exposures				[9]	4.3962	0.0573

[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 38200 Rate Development

Curve Type	R0.5	[1]	Composite RL	40.2	[4]
Average Life	43	[2]	Accrual Rate	1.70%	[5]
Net Salvage	-20%	[3]	Total Reserve	$ 25,507,475	[6]

[7] Year Installed	[8] Original Cost	[9] Calculated Accrued	[10] Allocated Book Reserve	[11] Future Book Accruals	[12] Remaining Life	[13] Annual Accrual
2015	$ 2,463,695	$ (19)	$ (49)	$ 2,956,483	43.0	$ 68,755
2014	2,335,571	20,160	50,951	2,751,734	42.7	64,457
2013	1,835,919	47,599	120,301	2,082,802	42.1	49,507
2012	1,920,239	82,890	209,496	2,094,791	41.5	50,534
2011	2,198,795	132,697	335,378	2,303,176	40.8	56,399
2010	2,009,987	155,727	393,583	2,018,401	40.2	50,179
2009	2,048,063	193,648	489,425	1,968,251	39.6	49,688
2008	2,178,810	243,099	614,408	2,000,164	39.0	51,284
2007	2,148,284	276,148	697,937	1,880,004	38.4	48,966
2006	2,557,529	372,034	940,277	2,128,758	37.8	56,335
2005	2,910,611	472,512	1,194,226	2,298,507	37.2	61,816
2004	2,194,647	393,211	993,800	1,639,776	36.6	44,827
2003	2,365,962	463,618	1,171,748	1,667,406	36.0	46,345
2002	1,948,835	414,513	1,047,640	1,290,962	35.4	36,490
2001	860	197	499	533	34.8	15
2000	3,602,665	886,477	2,240,482	2,082,716	34.2	60,929
1999	3,177,344	834,628	2,109,439	1,703,374	33.6	50,715
1998	949,062	265,025	669,823	469,051	33.0	14,216
1997	719,954	212,938	538,180	325,765	32.4	10,054
1996	407,347	127,185	321,447	167,370	31.8	5,261
1995	763,223	250,809	633,895	281,972	31.2	9,030
1994	917,610	316,522	799,978	301,154	30.6	9,829
1993	576,433	208,202	526,210	165,509	30.1	5,506
1992	423,245	159,711	403,655	104,239	29.5	3,536
1991	356,275	140,166	354,256	73,274	28.9	2,535
1990	406,394	166,378	420,503	67,170	28.3	2,371
1989	318,830	135,589	342,687	39,909	27.8	1,438
1988	289,228	127,559	322,393	24,681	27.2	908
1987	280,862	128,266	324,179	12,856	26.6	483
1986	251,601	118,810	300,279	1,642	26.1	63
1985	491,048	239,445	605,172	(15,914)	25.5	(623)
1984	350,077	176,054	444,958	(24,865)	25.0	(995)
1983	412,321	213,600	539,852	(45,067)	24.4	(1,844)
1982	321,389	171,316	432,984	(47,318)	23.9	(1,980)
1981	354,002	193,965	490,227	(65,424)	23.4	(2,800)
1980	598,750	336,883	851,438	(132,938)	22.8	(5,821)
1979	273,085	157,631	398,397	(70,695)	22.3	(3,168)
1978	428,129	253,306	640,206	(126,452)	21.8	(5,801)
1977	80,367	48,698	123,079	(26,638)	21.3	(1,251)
1976	25,980	16,110	40,715	(9,539)	20.8	(459)
1975	179,718	113,952	288,003	(72,342)	20.3	(3,567)
1974	22,162	14,359	36,290	(9,696)	19.8	(490)
1973	115,532	76,433	193,177	(54,539)	19.3	(2,827)
1972	37,599	25,383	64,154	(19,035)	18.8	(1,012)
1971	106,259	73,158	184,901	(57,390)	18.3	(3,131)
1970	16,537	11,604	29,329	(9,485)	17.9	(531)
1969	18,823	13,455	34,006	(11,418)	17.4	(657)

Account 38200 Rate Development

Curve Type	R0.5	[1]	Composite RL	40.2	[4]
Average Life	43	[2]	Accrual Rate	1.70%	[5]
Net Salvage	-20%	[3]	Total Reserve	$ 25,507,475	[6]

[7] Year Installed	[8] Original Cost	[9] Calculated Accrued	[10] Allocated Book Reserve	[11] Future Book Accruals	[12] Remaining Life	[13] Annual Accrual
1968	38,241	27,830	70,337	(24,448)	16.9	(1,445)
1967	384,780	284,948	720,177	(258,441)	16.5	(15,698)
1966	29,569	22,272	56,289	(20,806)	16.0	(1,300)
1965	13,227	10,128	25,598	(9,726)	15.6	(625)
1964	33,370	25,965	65,625	(25,581)	15.1	(1,692)
1963	29,389	23,228	58,706	(23,439)	14.7	(1,597)
1962	20,155	16,174	40,878	(16,692)	14.2	(1,172)
1961	39,516	32,185	81,345	(33,926)	13.8	(2,456)
1960	41,983	34,694	87,685	(37,305)	13.4	(2,786)
1959	63,139	52,920	133,749	(57,982)	13.0	(4,472)
1958	21,707	18,447	46,623	(20,574)	12.5	(1,640)
1957	21,118	18,191	45,975	(20,633)	12.1	(1,700)
1956	16,283	14,213	35,921	(16,381)	11.7	(1,397)
1955	13,412	11,859	29,973	(13,879)	11.3	(1,227)
1954	10,810	9,681	24,467	(11,495)	10.9	(1,054)
1953	8,820	7,998	20,213	(9,629)	10.5	(916)
Totals	**$ 49,175,177**	**$ 10,092,381**	**$ 25,507,475**	**$ 33,502,737**	**40.2**	**$ 834,339**

[1], [2] Selected Iowa curve type and average life through mathematical and visual curve fitting-techniques and professional judgment.
[3] Selected net salvage rate based on historical records and professional judgment.
[4] = total of [11] / total of [13]
[5] = total of [13] / total of [8]
[6] From the Company's property records
[7] Year of property installation
[8] Original cost of plant from the Company's property records
[9] = (1 - [12] / [2]) * ([8] * (1 - [3]))
[10] = [6] * [9] / total of [9]
[11] = [8] * (1 - [3]) - [10]
[12] Average remaining life based on selected Iowa curve in [1] and [2]
[13] = [11] / [12]