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APPLICATION OF CENTERPOINT	§	BEFORE THE STATE OFFICE
ENERGY HOUSTON ELECTRIC, LLC	§	OF
FOR AUTHORITY TO CHANGE RATES	§	ADMINISTRATIVE HEARINGS

DIRECT TESTIMONY AND EXHIBITS

OF

DAVID J. GARRETT

ON BEHALF OF

TEXAS COAST UTILITIES COALITION

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JUNE 6, 2019

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EXHIBITS

WORKPAPERS

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I. INTRODUCTION

Q. STATE YOUR NAME AND OCCUPATION.

A. My name is David J. Garrett. I am a consultant specializing in public utility regulation. I am the managing member of Resolve Utility Consulting, PLLC. I focus my practice on the primary capital recovery mechanisms for public utility companies: cost of capital and depreciation.

Q. SUMMARIZE YOUR EDUCATIONAL BACKGROUND AND PROFESSIONAL EXPERIENCE.

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

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[1] Exhibit DJG-1.

Q. WHOSE BEHALF ARE YOU TESTIFYING IN THIS PROCEEDING?

A. I am testifying on behalf of the Texas Cost Utilities Coalition ("TCUC").

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

A. I am addressing the direct testimony and depreciation study of Dane A. Watson filed on behalf of CenterPoint Energy Houston Electric, LLC ("CenterPoint Houston" or the "Company"). My testimony proposes several adjustments to the Company's proposed depreciation rates.

II. EXECUTIVE SUMMARY

Q. SUMMARIZE THE KEY POINTS OF YOUR TESTIMONY.

A. In the context of utility ratemaking, "depreciation" refers to a cost allocation system designed to measure the rate by which a utility may recover its capital investments in a systematic and rational manner. I employed a well-established depreciation system and used actuarial and simulated plant record analyses to statistically analyze the Company's depreciable assets in order to develop reasonable depreciation rates in this case. The table below compares TCUC's and the Company's proposed depreciation accrual by plant function.[2]

Figure 1:
Summary Depreciation Accrual Comparison

Plant Function	Plant Balance 12/31/2017	Company Proposal	TCUC Proposal	TCUC Adjustment
Transmission	2,677,169,356	61,070,701	57,970,935	(3,099,766)
Distribution	6,819,502,483	213,587,251	183,151,605	(30,435,646)
General	884,241,963	51,104,951	50,063,481	(1,041,470)
Total	$ 10,380,913,802	$ 325,286,250	$ 290,709,368	**$ (34,576,882)**

2 Exhibit DJG-2

TCUC's total adjustment would reduce the Company's proposed annual depreciation accrual by $34.6 million.[3]

Q. PLEASE SUMMARIZE THE DEPRECIATION PARAMETERS YOU RECOMMEND TO THE ADJUSTED ACCOUNTS.

A. My proposed adjustments to the Company's depreciation accrual illustrated above are based on service life adjustments to nine of the Company's accounts. The table below contrasts Mr. Watson's position with my position for these accounts.

Figure 2:
Summary Depreciation Accrual Comparison

		Company's Position				TCUC's Position			
Account		**Iowa Curve**		**Depr**	**Annual**	**Iowa Curve**		**Depr**	**Annual**
No.	**Description**	**Type**	**AL**	**Rate**	**Accrual**	**Type**	**AL**	**Rate**	**Accrual**
	TRANSMISSION PLANT								
E35301	STATION EQUIPMENT	R0.5	53	2.05%	19,578,539	R0.5	56	1.93%	18,434,817
E35401	TOWERS & FIXTURES	R2.5	59	2.15%	14,051,620	R2	66	1.85%	12,071,203
	DISTRIBUTION PLANT								
E36201	STATION EQUIPMENT	R1	48	2.14%	24,485,519	R0.5	55	1.76%	20,165,356
E36401	POLES,TOWERS,FIXTURE	R0.5	35	3.84%	30,462,214	R0.5	45	2.84%	22,568,969
E36501	O/H CONDUCT DEVICES	R0.5	38	3.24%	31,217,383	R0.5	40	3.05%	29,339,028
E36601	UNDERGROUND CONDUIT	R2.5	62	1.96%	10,836,530	S1	65	1.83%	10,145,092
E36701	U/G CONDUCT/DEVICES	R0.5	38	3.34%	33,369,161	L0	42	2.87%	28,714,072
E36801	LINE TRANSFORMERS	R1	28	3.71%	48,878,877	L0	32	2.87%	37,875,814
	GENERAL PLANT								
E39001	STRUCT. & IMPROVEMTS	R4	50	2.05%	4,383,342	R2	58	1.56%	3,335,954

As shown in the table, I am recommending longer service lives for each of the nine accounts listed in the table, which results in lower annual depreciation accruals for each account. In my opinion, the Company has not met its burden to make a convincing showing that its proposed depreciation rate for these nine accounts is not excessive.

[3] *See* Exhibits DJG-2 and DJG-3.

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

A. The issue of depreciation is essentially one of timing. Under the rate-base, rate-of-return model, a utility is allowed to recover the original cost of its prudent investments used and useful to provide service. Depreciation systems are designed to allocate those costs in a systematic and rational manner – specifically, over the service life of the utility's assets. If depreciation rates are overestimated (i.e., service lives are underestimated), it encourages economic inefficiency. Unlike competitive firms, regulated utility companies are not always incentivized by natural market forces to make the most economically efficient decisions. If a utility is allowed to recover the cost of an asset before the end of its useful life, this could incentivize the utility to unnecessarily replace the asset in order to increase rate base and ultimately increase earnings; this results in economic waste. Thus, from a public policy perspective, it is preferable for regulators to ensure that assets are not depreciated before the end of their true useful lives.

While underestimating the useful lives of depreciable assets could financially harm current ratepayers and encourage economic waste, unintentionally overestimating depreciable lives (i.e., underestimating depreciation rates) does not harm the Company. This is because if an asset's life is overestimated, there are a variety of measures that regulators can use to ensure the utility is not financially harmed and recovers the full cost of its plant investment. One such measure would be the use of a regulatory asset account. In that case, the Company's original cost investment in these assets would remain in the Company's rate base until they are recovered. Thus, the process of depreciation strives for a perfect match between actual and estimated useful life. When these estimates are not exact, however, it is better from a public policy perspective that useful lives are not underestimated.

III. REGULATORY STANDARDS

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

A. In *Lindheimer v. Illinois Bell Telephone Co.*, the U.S. Supreme Court stated that "depreciation is the loss, not restored by current maintenance, which is due to all the factors causing the ultimate retirement of the property. These factors embrace wear and tear, decay, inadequacy, and obsolescence."[4] The *Lindheimer* Court also recognized that the original cost of plant assets, rather than present value or some other measure, is the proper basis for calculating depreciation expense.[5] Moreover, the *Lindheimer* Court found:

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

Thus, the Company bears the burden of making a convincing showing that its proposed depreciation rates are not excessive.

Q. IN THIS CASE, HAS THE COMPANY MADE A CONVINCING SHOWING THAT ITS PROPOSED DEPRECIATION RATES ARE NOT EXCESSIVE?

A. For some accounts, the Company has demonstrated that its proposed rates are reasonable; however, for several accounts the Company has not made a convincing showing that all of its proposed rates are not excessive in my opinion. That is, some of the Company's proposed depreciation rates are excessive and should be adjusted to a more reasonable level, pursuant to the recommendations made in this testimony and as further discussed below.

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

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

6 *Id.* at 169.

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

A. Yes. While the *Lindheimer* case and other early literature recognizes depreciation as a necessary expense, the language indicates depreciation is primarily a mechanism to determine loss of value.[7] Adoption of this "value concept" would require annual appraisals of extensive utility plant assets and is thus not practical in this context. Rather, the "cost allocation concept" recognizes that depreciation is a cost of providing service, and that in addition to receiving a "return on" invested capital through the allowed rate of return, a utility should also receive a "return of" its invested capital in the form of recovered depreciation expense. The cost allocation concept also satisfies several fundamental accounting principles, including verifiability, neutrality, and the matching principle.[8] The definition of "depreciation accounting" published by the American Institute of Certified Public Accountants ("AICPA") properly reflects the cost allocation concept:

> Depreciation accounting is a system of accounting that aims to distribute cost or other basic value of tangible capital assets, less salvage (if any), over the estimated useful life of the unit (which may be a group of assets) in a systematic and rational manner. It is a process of allocation, not of valuation.[9]

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

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

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

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

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

IV. ANALYTIC METHODS

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

A. The regulatory standards set forth above do not mandate a specific procedure for conducting depreciation analyses. These standards, however, direct that analysts use a system for estimating depreciation rates that will result in the "systematic and rational" allocation of capital recovery for the utility. Over the years, analysts have developed "depreciation systems" designed to analyze grouped property in accordance with this standard. A depreciation system may be defined by several primary parameters: 1) a method of allocation; 2) a procedure for applying the method of allocation; 3) a technique of applying the depreciation rate; and 4) a model for analyzing the characteristics of vintage property groups.[11] In this case, I used the straight-line method, the average life procedure, the remaining life technique, and the broad group model. This system would be denoted as an "SL-AL-RL-BG" system. This depreciation system conforms to the regulatory standards set forth above and is commonly used by depreciation analysts in regulatory proceedings. I provide a more detailed discussion of depreciation system parameters, theories, and equations in Appendix A.

Q. DID MR. WATSON USE A SIMILAR DEPRECIATION SYSTEM IN HIS ANALYSIS?

A. Yes. Essentially, Mr. Watson and I used the same depreciation system to develop our proposed depreciation rates. Thus, the discrepancy in our recommendations is not driven by the use of different depreciation systems.

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

A. The study of retirement patterns of industrial property is derived from the actuarial process used to study human mortality. Just as actuarial analysts study historical human mortality data to estimate how long people will survive, depreciation analysts study

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

historical plant retirement data to estimate how long property will survive. The most common actuarial method used by depreciation analysts is called the "retirement rate method." In the retirement rate method, original property data, including additions, retirements, transfers, and other transactions, are organized by vintage and transaction year.[12] The retirement rate method is ultimately used to develop an "observed life table," ("OLT") which shows the percentage of property surviving at each age interval. This pattern of property retirement is described as a "survivor curve." The survivor curve derived from the observed life table, however, must be fitted and smoothed with a complete curve in order to determine the ultimate average life of the group.[13] The most widely used survivor curves for this curve-fitting process were developed at Iowa State University in the early 1900s and are commonly known as the "Iowa curves."[14] A more detailed explanation of how the Iowa curves are used in the actuarial analysis of depreciable property is set forth in Appendix C.

Actuarial analysis, however, requires "aged" data. Aged data refers to a collection of property data for which the dates of placements, retirements, transfers, and other actions are known. In keeping aged data, when a utility retires an asset, it would not only record the year it was retired, but it would also track the year the asset was placed into service, or the "vintage" year. The Company, however, did not have aged data available for any of its transmission and distribution accounts. When aged data is not available, and the year-end balances of each account are known, analysts must "simulate" an actuarial analysis by estimating the proportion that each vintage group contributed to year-end balances. For this reason, simulated data is not as reliable as aged data. In order to analyze accounts that do not contain aged data, analysts use the "simulated plant record"

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

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

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

("SPR") method.[15] Thus, Mr. Watson and I both used the SPR method to analyze the Company's accounts for which aged data was unavailable.

V. SERVICE LIFE ANALYSIS

Q. DESCRIBE THE PROCESS YOU USED TO ESTIMATE SERVICE LIVES FOR THE COMPANY'S DEPRECIABLE ACCOUNTS.

A. To develop service life estimates for the Company's accounts, I obtained and analyzed the Company's actuarial and simulated plant data. Specifically, simulated plant analysis was used to analyze the Company's transmission and distribution assets, while actuarial analysis was used to analyze the Company's general plant assets. I will discuss each process separately below.

A. ACTUARIAL ANALYSIS

Q. PLEASE DESCRIBE THE ACTUARIAL ANALYSIS PROCESS.

A. I used the Company's historical property data and created an observed life table ("OLT") for each account. The data points on the OLT can be plotted to form a curve (the "OLT curve"). The OLT curve is not a theoretical curve, rather, it is actual observed data from the Company's records that indicate the rate of retirement for each property group. An OLT curve by itself, however, is rarely a smooth curve, and is often not a "complete" curve (i.e., it does not end at zero percent surviving). To calculate average life (the area under a curve), a complete survivor curve is required. The Iowa curves are empirically-derived curves based on the extensive studies of the actual mortality patterns of many different types of industrial property. The curve-fitting process involves selecting the best Iowa curve to fit the OLT curve. This can be accomplished through a combination of visual and mathematical curve-fitting techniques, as well as professional judgment. The first step of my approach to curve-fitting involves visually inspecting the OLT curve for any irregularities. For example, if the "tail" end of the curve is erratic and shows a sharp decline over a short period of time, it may indicate that this portion of the data is less reliable, as further discussed below. After visually inspecting the OLT curve, I use a

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15 The SPR Method is further discussed in Appendix D.

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 assessment of how well the curve fits. After selecting an Iowa curve, I observe the OLT curve along with the Iowa curve on the same graph to determine how well the curve fits. I may repeat this process several times for any given account to ensure that the most reasonable Iowa curve is selected.

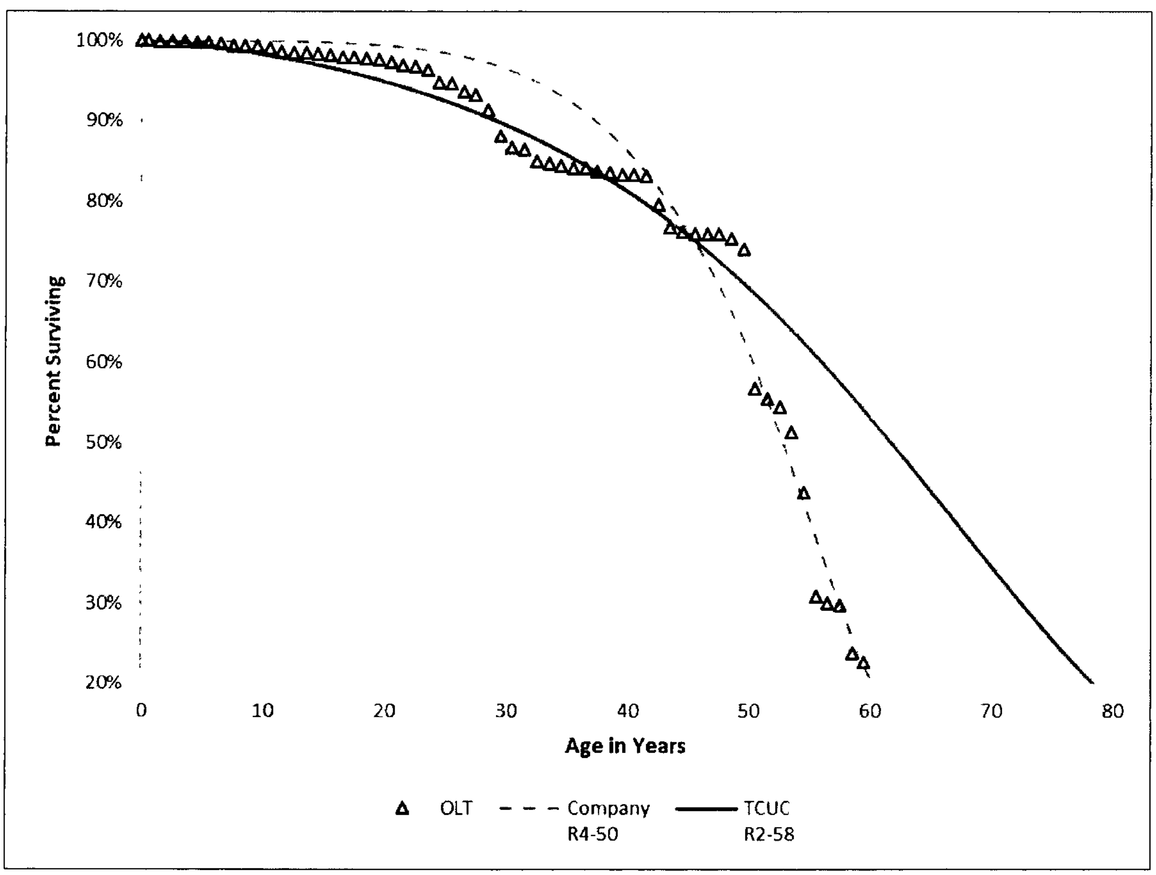
Q. ARE YOU RECOMMENDING ADJUSTMENTS TO ANY OF THE COMPANY'S GENERAL PLANT ACCOUNTS BASED ON YOUR ACTUARIAL ANALYSIS?

A. Yes. I am recommending a service life adjustment to Account 390, which is further discussed below. In addition, it is important to understand that actuarial analysis based on sufficient historical data will produce more reliable results than simulated plant analysis. This is important because, as discussed further below, the simulated plant analysis for many of the Company's transmission and distribution accounts produced service life estimates remarkably shorter than those observed among other utilities that use aged data and actuarial analysis. All else held constant, shorter service life estimates result in higher depreciation rates and expense for customers. In the discussion below regarding my simulated plant analysis, I provide examples of actuarial analysis conducted for the same accounts for other utilities to show the contrasting estimates in service lives. It is important for the Commission to balance the following two factors: 1) consideration of the service lives indicated by the Company's own historical data; and 2) recognition that because the Company's historical data for its transmission and distribution accounts is not "aged" (i.e., actuarial analysis cannot be performed on it), it will produce less reliable results than the service life estimates for other utilities that were based on aged data. Therefore, it is important for the Commission to give some weight and consideration to the service life estimates for other utilities that are based on actuarial analysis of aged data when determining the most reasonable service life estimates for the Company's accounts.

Q. DESCRIBE YOUR SERVICE LIFE ESTIMATE FOR ACCOUNT 390 AND COMPARE IT WITH THE COMPANY'S ESTIMATE.

A. The observed survivor curve for Account 390 is relatively well-suited for conventional Iowa curve-fitting techniques. This is because the observed survivor curve derived from the Company's data for this account follows a relatively smooth pattern and is in the shape of a typical Iowa type curve. The OLT curve for this account is not an estimate; rather, it represents actual data and retirement experience. The OLT curve is represented by the black triangles in the graphs below. Mr. Watson selected the Iowa R4-50 curve to represent the mortality characteristics of this account, and I selected the Iowa R2-58 curve. Both Iowa curves are displayed in the following graph, along with the OLT curve.

Figure 3:
Account 390 – Structures and Improvements



The primary objective of Iowa-curve fitting is to find an Iowa curve that provides a close match to the pattern observed in the OLT curve. As shown in this graph, the R4-50 curve selected by Mr. Watson does not appear to provide a good fit to the OLT curve in the middle portion of the curve, but it does provide a good fit to several data points at the end of the OLT curve. In contrast, the R2-58 curve I selected provides a good fit to the OLT curve in the upper and middle potions of the curve, but it does not track closely with the few data points at the end of the OLT curve.

Q. SHOULD ALL PORTIONS OF THE OLT CURVE BE GIVEN THE SAME LEVEL OF WEIGHT OR CONSIDERATION FROM A VISUAL, STATISTICAL, OR MATHEMATICAL STANDPOINT?

A. No, not necessarily. In many instances, such as that observed in Account 390, the tail-end of the OLT curve will have less analytical value than other portions of the curve and therefore will be less reliable from a statistical standpoint. This has been confirmed by analysts' observations. Specifically, Wolf & Fitch's "Depreciation Systems," an authoritative treatise in the industry, states: "Points at the end of the curve are often based on fewer exposures and may be given less weight than points based on larger samples. The weight placed on those points will depend on the size of the exposures."[16] This statement reflects exactly what we are observing in Account 390 in this case.

Q. PLEASE DEMONSTRATE WHY THE TAIL END OF THE OLT CURVE FOR ACCOUNT 390 IS NOT STATISTICALLY RELEVANT.

A. First, we can observe from a visual perspective that an irregularity occurs in the OLT curve around age-interval 50. Before age 50, the OLT curve declines in a relatively smooth pattern, and the data points are close together (i.e., there are no sharp declines in the OLT curve). However, at age-interval 50, we can see a sharp decline in the OLT curve. This is highlighted in the graph below.

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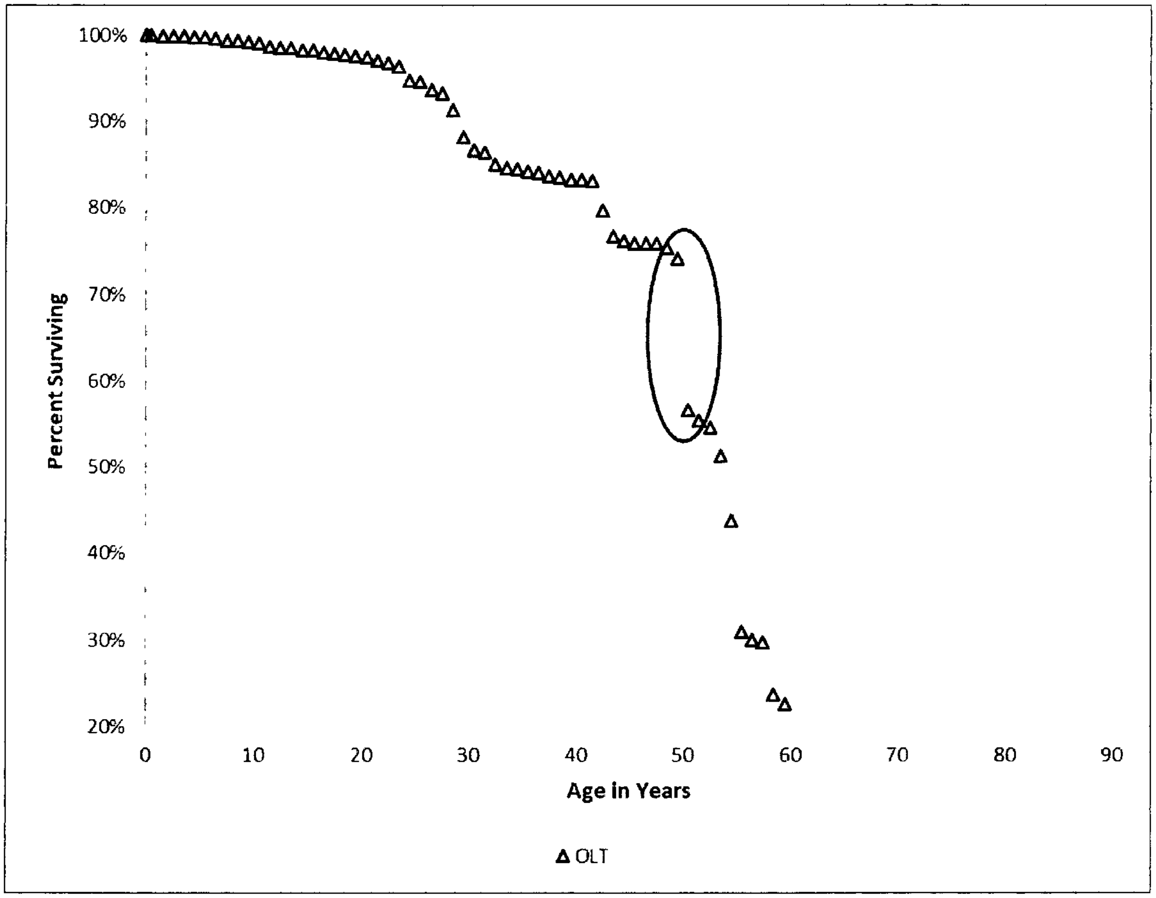
[16] Wolf *supra* n. 7, at 46.

Figure 4:
Account 390 – Observed Survivor Curve



We can look to the actual observed life table for this account to observe what is causing the sharp decline in the OLT curve for this account. The chart below shows portions of the observed life table for this account.

Figure 5:
Account 390 – Portion of Observed Life Table

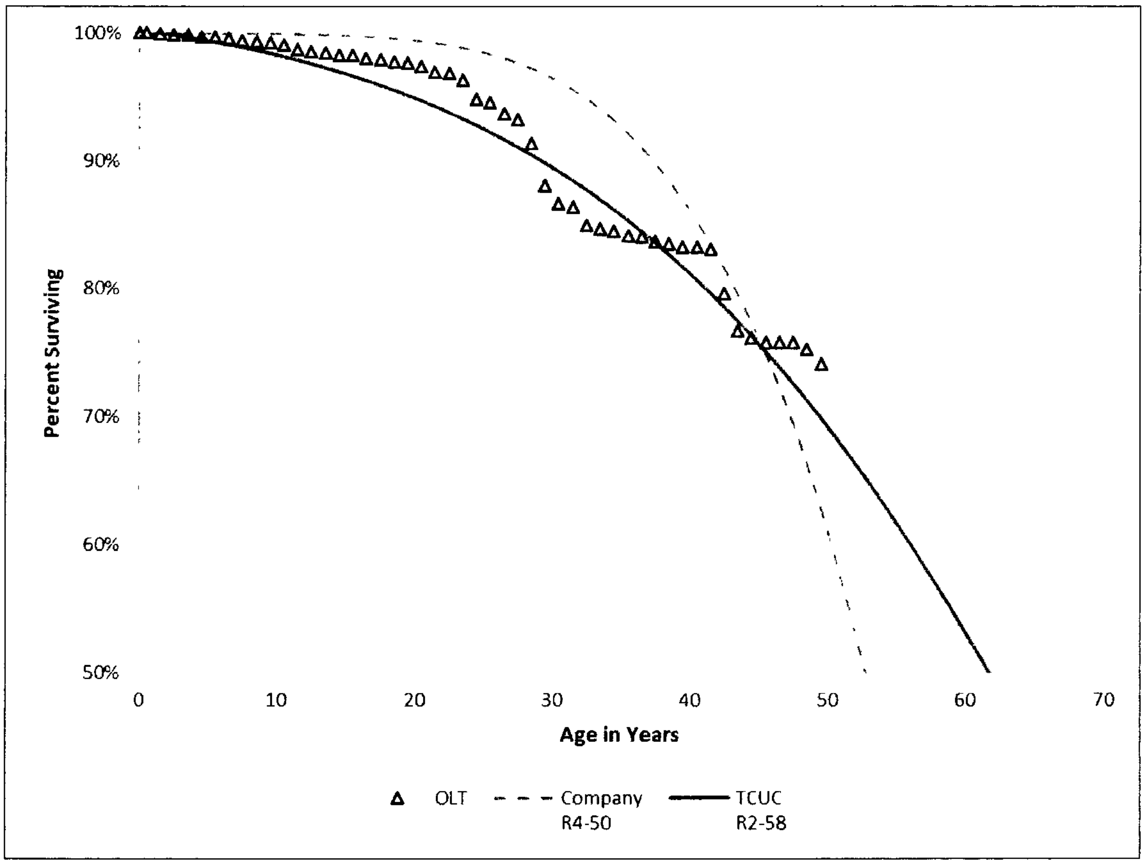
Age (Years)	Exposures (Dollars)	Observed Life Table (OLT)
0.0	291,550,513	100.00%
0.5	292,448,293	100.00%
1.5	290,278,714	99.93%
2.5	245,904,218	99.90%
3.5	237,264,196	99.84%
4.5	234,186,360	99.73%
46.5	27,628,945	75.84%
47.5	6,460,346	75.83%
48.5	4,981,085	75.27%
49.5	**4,881,547**	**74.09%**
50.5	**3,656,547**	**56.67%**
51.5	3,121,876	55.40%

The pertinent portions of the observed life table for this account shows the dollars exposed to retirement (or "exposures") at the beginning of each age interval. The beginning amount of dollars exposed to retirement in this account (at age interval zero) is $291.6 million. This number is significant because we will base the statistical relevance of further data points on the OLT curve on the amount of exposures at that age interval relative to the beginning exposures. The data show that in age intervals 0 – 4.5 years, there is a steady decline in the percentage surviving in the far-right column (100% to 99.73%). Then, the data show that for age interval 49.5 years there is a substantial drop in the percent surviving from 74.09% to 56.67%. At this age interval, the amount of exposures is far less ($3.6 million) than the amount of beginning exposures ($291.6 million). This is where the OLT curve starts to "fall apart" visually, and from a statistical standpoint, it is no longer relevant.

Q. ILLUSTRATE AND DESCRIBE THE IOWA CURVE ANALYSIS FOR THIS ACCOUNT WHEN CONDUCTED ON THE RELEVANT PORTIONS OF THE OLT CURVE.

A. The graph below shows the OLT curve for Account 390, including only the statistically relevant portions of the curve. The graph also shows the two proposed Iowa curves for this account.

Figure 6:
Account 390 – Relevant OLT curve with Iowa curves



As shown in the graph, the R2-58 curve I selected provides a much better fit to the observed data. As a result, the remaining life I estimated for this account is more reasonable than Mr. Watson's estimate.[17] Specifically, the R4-50 curve selected by Mr. Watson is too short to provide an accurate projection of remaining life, and thus results in an unreasonably higher depreciation rate proposal for this account.

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[17] *See* Exhibit DJG-7.

Q. DOES THE R2-58 CURVE YOU SELECTED PROVIDE A BETTER MATHEMATICAL FIT TO THE STATISTICALLY RELEVANT OBSERVED DATA THAN MR. WATSON'S CURVE?

A. Yes. While it is visually clear that my curve provides a better fit to the observed data, this conclusion can also be verified mathematically. Mathematical curve fitting essentially involves measuring the distance between the OLT curve and the selected Iowa curve. The best mathematically fitted curve is the one that minimizes the distance between the OLT curve and the Iowa curve, thus providing the closest fit. The "distance" between the curves is calculated using the "sum-of-squared differences" ("SSD") technique.[18] Specifically, the SSD for the Company's curve is 0.1442, while the SSD for the R2-58 curve I selected is only 0.0784 when excluding the tail-end of the OLT curve as discussed and illustrated above. Thus, the Iowa curve I selected for this account provides a better fit to the OLT and results in a more reasonable depreciation rate.[19]

B. SIMULATED PLANT RECORD ANALYSIS

Q. DESCRIBE THE SIMULATED PLANT RECORD METHOD OF ANALYSIS.

A. As discussed above, when aged data is not available, we must "simulate" the actuarial data required for remaining life analysis. For the Company's transmission and distribution accounts, both Mr. Watson and I conducted an analysis using the simulated plant record ("SPR") model, because the Company does not keep aged data for these accounts. The SPR method involves analyzing the Company's unaged data by choosing an Iowa curve that best simulates that actual year-end account balances in the account.[20]

Q. DESCRIBE THE METRICS USED TO ASSESS THE FIT OF A SELECTED IOWA CURVE IN THE SPR MODEL.

A. There are two primary metrics used to measure the fit of the Iowa curve selected to describe an SPR account. The first is the "conformance index" ("CI"). The CI is the average observed plant balance for the tested years, divided by the square root of the

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[18] A more detailed discussion of the SSD technique and mathematical curve fitting is provided in Appendix C.

[19] *See* Exhibit DJG-6.

[20] A detailed discussion of the SPR method is included in Appendix D.

average sum of squared differences between the simulated and actual balances plant balances.[21] A higher CI indicates a better fit. Alex Bauhan, who developed the CI, also proposed a scale for measuring the value of the CI, as follows.

Figure 7:
Conformance Index Scale

CI	Value
> 75	Excellent
50 – 75	Good
25 – 50	Fair
< 25	Poor

The second metric used to assess the accuracy of an Iowa curve chosen for SPR analysis is called the "retirement experience index" ("REI") which was also proposed by Bauhan. The REI measures the length of retirement experience in an account. A greater retirement experience indicates more reliability in the analytical results for an account. Bauhan proposed a similar scale for the REI, as follows.

Figure 8:
Retirement Experience Index Scale

REI	Value
> 75%	Excellent
50% – 75%	Good
33% – 50%	Fair
17% – 33%	Poor
0% – 17%	Valueless

According to Bauhan, "[i]n order for a life determination to be considered entirely satisfactory, it should be required that both the retirements experience index and the conformance index be "Good" or better."[22] However, for some of the Company's

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[21] Bauhan, A. E., "Life Analysis of Utility Plant for Depreciation Accounting Purposes by the Simulated Plant Record Method," 1947, Appendix of the EEl, 1952.

[22] *Id.* (emphasis added).

accounts there is no Iowa curve available that produces a result of at least "Good" under both scales. This further highlights the relative unreliability of the Company's unaged historical data for these accounts, and why it can be helpful to also consider the service life estimates approved for other utilities that were based on actuarial analyses of superior, aged data.

Q. PLEASE SUMMARIZE THE GENERAL DIFFERENCES BETWEEN YOUR SERVICE LIFE ESTIMATES AND THE COMPANY'S SERVICE LIFE ESTIMATES FOR THESE ACCOUNTS.

A. In this case I am proposing service life adjustments to eight of the Company's transmission and distribution accounts. In my opinion, Mr. Watson's proposed service lives for these accounts are too short and thus result in excessive depreciation accruals and expense amounts. My opinions are based in part on the Company's historical data, but because the Company's data is relatively unreliable, I also considered the approved service lives for the transmission and distribution assets for electric utilities that keep aged data for these accounts. As discussed below, the service lives estimated by Mr. Watson for some accounts are notably shorter than those approved for these other utilities. Mr. Watson's underestimation of these service lives results in unreasonably high depreciation rates and expense for the Company's customers. For the eight accounts discussed in this section, the Company has failed to meet its burden to show that its proposed depreciation rates for these accounts is not excessive.

Q. DO YOU HAVE ANY OTHER GENERAL CRITICISMS OF MR. WATSON'S SERVICE LIFE ESTIMATES?

A. Yes. In discussing his service life estimates for many of the Company's accounts, Mr. Watson has apparently relied heavily upon the expectations of Company personnel with regard to how long the assets will be in service. The Company is the applicant in this case, and it has hired an independent expert in Mr. Watson to develop service life estimates based on specialized, statistical analysis of the Company's historical retirement data. The results of Mr. Watson's analysis will directly and significantly affect the Company's cash flow. To the extent the Company employees have simply told the Company's depreciation expert how long they think the Company's assets will survive, I think that is problematic and calls into question the objectivity and accuracy of the Company's proposed depreciation rates. For these reasons, I believe it is more reasonable to focus on the statistical data indicating the remaining lives for these accounts. Further, since the Company's unaged data are relatively unreliable, it is also instructive and more reasonable to compare the Company's proposed service lives to those that were approved for utilities with more reliable data for the same accounts.

Q. PLEASE SUMMARIZE THE APPROVED SERVICE LIVES OF OTHER UTILITIES YOU CONSIDERED WHEN DEVELOPING YOUR RECOMMENDATIONS IN THIS CASE.

A. As discussed above, when the plant data provided by a utility is generally unreliable, it can be instructive to consider the approved service lives of other utilities for the same accounts to develop an objective basis for estimating the service life of an asset or group of assets. In addition to relying upon my general experience in depreciation analysis, I also considered the specific approved service lives for three companies – SWEPCO, Oklahoma Gas and Electric Company ("OG&E"), and Public Service Company of Oklahoma ("PSO"). I chose these companies in part because I conducted depreciation analysis and filed testimony in their most recent rate cases. The following table presents the eight accounts I propose adjustments to that were analyzed under the SPR method.[23]

[23] *See also* Exhibit DJG-8.

Figure 9:
Peer Group Comparison

Acct	Description	CEHE	Peer Group SWEPCO	OG&E	PSO	Peer Avg	Peer Avg less CEHE	TCUC
	TRANSMISSION PLANT							
353	STATION EQUIPMENT	53	60	63	60	61	8	56
354	TOWERS & FIXTURES	59	60	75	75	70	11	66
	DISTRIBUTION PLANT							
362	STATION EQUIPMENT	48	55	68	75	66	18	55
364	POLES,TOWERS,FIXTURE	35	55	55	53	54	19	45
365	O/H CONDUCT DEVICES	38	44	54	46	48	10	40
366	UNDERGROUND CONDUIT	62	70	65	78	71	9	65
367	U/G CONDUCT/DEVICES	38	45	64	65	58	20	42
368	LINE TRANSFORMERS	28	50	44	36	43	15	32
	Average	**45**	**55**	**61**	**61**	**59**	**14**	**50**

Figure 9 compares CenterPoint Houston's proposed service life for each account, the approved service lives for the three peer companies, and my service life recommendations on behalf of TCUC. Figure 9 also shows the average approved service lives of the peer group as well as the difference between those averages and CenterPoint Houston's proposed service lives. It is pertinent to note that each one of the Company's proposed service lives for these accounts is notably shorter than the average service lives of the peer group (in the third column from the right). The Company's proposed service lives for these accounts ranges from 8-20 years shorter than the average of the peer group (see the second column from the right). My recommended service lives are shown in the far-right column. I think it is also worth noting that while all of my proposed lives are longer than the Company's proposed lives for these accounts, none of my proposals exceed the average approved life of the peer group. This fact further highlights the overall reasonableness of my recommendation in this case.

1. Account 353 – Station Equipment

Q. DESCRIBE MR. WATSON'S SERVICE LIFE ESTIMATE FOR ACCOUNT 353.

A. Mr. Watson selected the R0.5-53 Iowa curve for this account, which means he estimates that the Company's transmission station equipment will have an average service life of 53 years. In making his recommendation, Mr. Watson relied on the opinions of Company personnel; he also relied on the SPR results, which he referred to as "sound."[24]

Q. DO YOU AGREE WITH MR. WATSON'S RECOMMENDATION FOR THIS ACCOUNT?

A. No. An average life estimate of only 53 years is remarkably short for this account, especially considering the approved service lives for other utilities for this account, which are as high as 73 years.

Q. ARE THE SPR RESULTS FOR THIS ACCOUNT SATISFACTORY OR "SOUND" AS MR. WATSON DESCRIBED THEM?

A. No. The <u>highest</u> CI score in the overall band for this account was only 26, which is barely above "poor" according to the standard scale. According to Bauhan, who created the SPR method of analysis, both the CI and REI score need to be above 50 to be considered "satisfactory."[25]

Q. PLEASE DISCUSS AND ILLUSTRATE THE ACTUARIAL ANALYSIS USED TO ANALYZE THE SERVICE LIFE FOR THIS ACCOUNT FOR A UTILITY THAT MAINTAINS AGED DATA.

A. Since the Company's SPR analysis is not satisfactory for this account, it is useful to consider the service life estimates approved for other utilities for this account. In the SWEPCO case, I conducted analysis on SWEPCO's aged, actuarial data. Based on a visual and mathematical Iowa curve fitting, that data indicated that the average service life for SWEPCO's Account 353 was 73 years. I presented my findings in testimony, and the Commission agreed with my position, finding that "[i]t is reasonable to apply an

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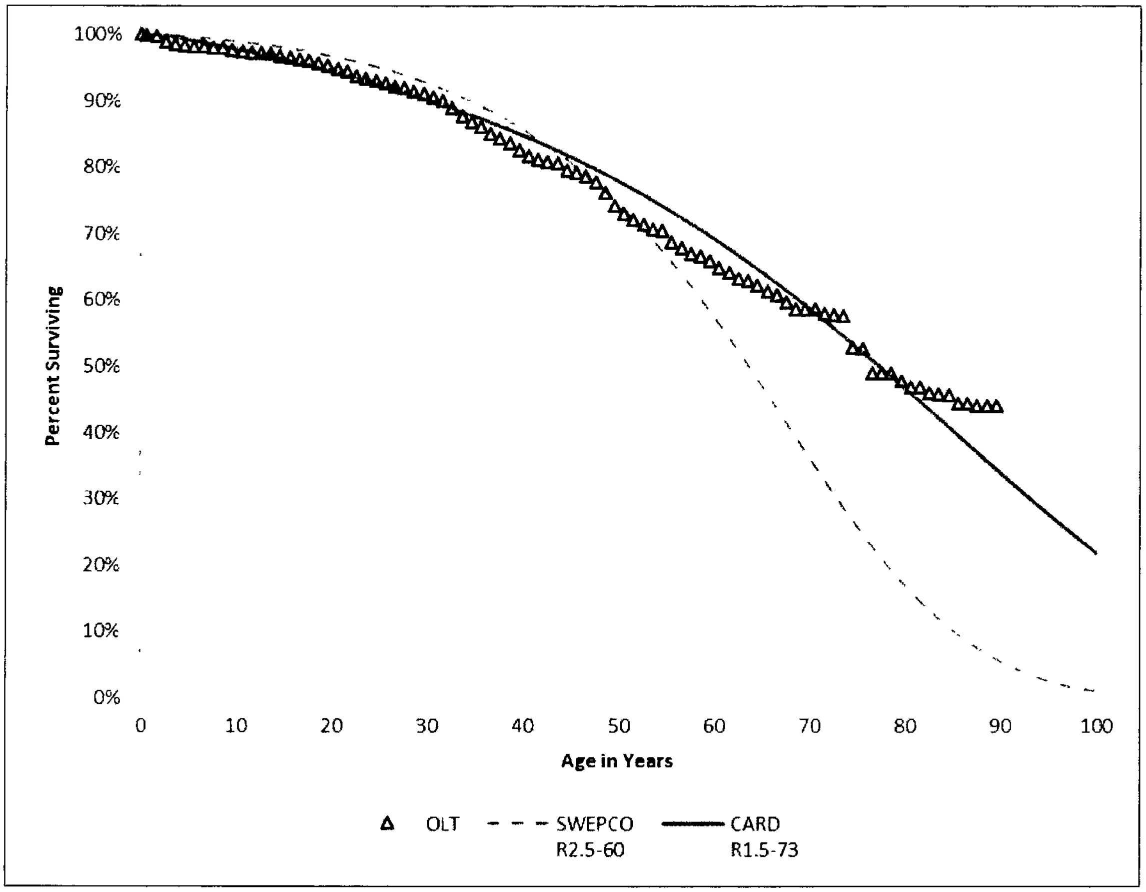
[24] Exhibit DAW-1, p. 27.

[25] Bauhan, A. E., "Life Analysis of Utility Plant for Depreciation Accounting Purposes by the Simulated Plant Record Method," 1947, Appendix of the EEI, 1952.

R1.5-73 Iowa-curve-life combination for FERC Account 353-*Transmission Station Equipment*."[26] The graph below shows the observed survivor curve that was derived from the historical aged data for SWEPCO's Account 353, along with the two competing Iowa curves.[27]

Figure 10:
SWEPCO Account 353 Service Life Estimate Based on Aged Data



In contrast, it is not possible to develop the same kind of reliable historical retirement pattern for the Company's Account 353 (i.e., the OLT curve in the graph above) because the Company does not maintain aged data for this account. Regardless, a service life estimate of only 53 years for this account is unreasonably short in my opinion.

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[26] *Application of Southwestern Electric Power Company for Authority to Change Rates*, Docket No. 46449, Order on Rehearing, Finding of Fact 183 (March 19, 2018).

[27] Direct Testimony and Exhibits of David J. Garrett, p. 18, Fig 3, *Application of Southwestern Electric Power Company for Authority to Change Rates*, Docket No. 46449 (April 25, 2017).

Q. ARE YOU AWARE OF OTHER APPROVED SERVICE LIVES FOR ACCOUNT 353 THAT ARE CLOSER TO THE COMPANY'S ESTIMATE?

A. Yes. The approved service life for OG&E's Account 353 is 56 years.[28] As with the SWEPCO case discussed above, OG&E's service life estimate was based on the study of more reliable actuarial data.

Q. WHAT IS YOUR RECOMMENDATION FOR THIS ACCOUNT?

A. I recommend the R0.5-56 curve for this account. This estimate considers the Company's own simulated historical data (though the data is lacking), as well as the service life indications typically observed for this account in the industry, which are generally higher than the 53-year service life proposed by Mr. Watson. The R0.5-56 curve would accept the curve shape recommended by Mr. Watson but would extend the average life closer to a reasonable level.

2. Account 354 – Towers and Fixtures

Q. DESCRIBE MR. WATSON'S SERVICE LIFE ESTIMATE FOR ACCOUNT 354.

A. Mr. Watson selected the R2.5-59 curve for this account. According to the SPR analysis, this curve results in a CI score of 73 and an REI score of 98.[29] Mr. Watson based his opinion on his SPR analysis as well as the opinions of Company personnel, stating that Company "engineers believe the towers should last up to 60 years under normal conditions."[30]

Q. DO YOU AGREE WITH MR. WATSON'S ESTIMATE?

A. No. The SPR analysis for this account has several Iowa curve options that could produce satisfactory results. I think it is also instructive to consider the fact that a 59-year average life is substantially shorter than the service life approved for this account for other utilities.

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[28] *See* Final Order No. 662059, p. 8, *Application of Oklahoma Gas and Electric Company*, Docket No. PUD 201500273, Before the Corporation Commission of Oklahoma (March 20, 2017).

[29] Exhibit DJG-10.

[30] Exhibit DAW-1, p. 29.

Q. ARE YOU AWARE OF AN APPROVED SERVICE LIFE FOR ACCOUNT 354 IN EXCESS OF 70 YEARS?

A. Yes. The currently approved service life for PSO's Account 354 is 75 years. This service life was recommended by PSO's witness based on the company's actuarial data.[31] No party opposed the PSO's recommendation for this account and it was adopted by the Oklahoma commission.[32]

Q. DOES CENTERPOINT HOUSTON'S OWN SPR ANALYSIS ALSO SUPPORT A LONGER SERVICE LIFE?

A. Yes. Unlike with Account 353 discussed above, there are several Iowa curve-life combinations for Account 354 that would produce "satisfactory" SPR results under the CI and REI scales. The Iowa curve selected by Mr. Watson (R2.5-59) has a CI score of 73 ("good") and an REI score of 98 ("excellent"). However, the Iowa R2-66 curve has an even higher CI score of 75 and still has an "excellent" REI score of 86.[33]

Q. WHAT IS YOUR RECOMMENDATION FOR THIS ACCOUNT?

A. I recommend the Iowa R2-66 curve be applied to this account. Approved service lives for Account 354 can range as high as 75 years. In addition, CenterPoint Houston's own SPR data, which is at least "satisfactory" for this account, also supports an increased average life of 66 years.

3. Account 362 – Station Equipment

Q. DESCRIBE MR. WATSON'S SERVICE LIFE ESTIMATE FOR ACCOUNT 362.

A. Mr. Watson selected the R1-48 curve for this account.

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31 *See* Final Order No. 672864, pp. 5-6, *Application of Public Service Company of Oklahoma*, Docket No. PUD 201700151, Before the Corporation Commission of Oklahoma (January 31, 2018); *see also* Direct Testimony of John J. Spanos, Exhibit JSS-2, p. VII-71, *Application of Public Service Company of Oklahoma*, Docket No. PUD 201700151, Before the Corporation Commission of Oklahoma (June 2017).

32 *See* Final Order No. 672864, pp. 5-6, *Application of Public Service Company of Oklahoma*, Docket No. PUD 201700151, Before the Corporation Commission of Oklahoma (January 31, 2018).

33 Exhibit DJG-10.

Q. DO YOU AGREE WITH MR. WATSON'S ESTIMATE?

A. No. As with the two accounts discussed above, Mr. Watson's recommended service life is markedly shorter than what is observed among other utilities for this account, which is typically closer to 60 years. Mr. Watson's low service life proposal would result in an unreasonably high depreciation rate.

Q. WAS A HIGHER SERVICE LIFE FOR ACCOUNT 362 APPROVED IN THE SWEPCO CASE?

A. Yes. In SWEPCO's rate case, the Commission found that "[i]t is reasonable to apply an S0.5-55 Iowa-curve-life combination for FERC Account 362-*Distribution Substation Equipment*."[34]

Q. ARE YOU AWARE OF EVEN LONGER APPROVED SERVICE LIVES FOR ACCOUNT 362?

A. Yes. PSO's currently approved service life for account 362 is 60 years.[35] As with SWEPCO, PSO's service life estimate was based on aged, actuarial data.

Q. WHAT IS YOUR RECOMMENDATION FOR THIS ACCOUNT?

A. I recommend applying the R0.5-55 curve for this account. This recommendation considers the Company's SPR data, but since the SPR data is relatively unreliable, it also considers the fact that service lives approved for utilities with actuarial data for this account typically exceed the 48-year service life proposed by Mr. Watson. The R0.5-55 curve I recommend has a "good" CI score of 55 and an "excellent" REI score of 89.[36] A 55-year average life is also reflective of the average life approved for SWEPCO for this account.

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[34] *See Application of Southwestern Electric Power Company for Authority to Change Rates*, Docket No. 46449, Order on Rehearing, Finding of Fact 186 (March 19, 2018).

[35] *See* Final Order No. 672864, pp. 5-6, *Application of Public Service Company of Oklahoma*, Docket No. PUD 201700151, Before the Corporation Commission of Oklahoma (January 31, 2018).

[36] Exhibit DJG-10.

4. Account 364 – Poles, Towers, and Fixtures

Q. DESCRIBE MR. WATSON'S SERVICE LIFE ESTIMATE FOR ACCOUNT 364.

A. Mr. Watson selected the R0.5-35 curve for this account, which means he is proposing an average service life of only 35 years. He bases his estimate on "discussions with Company engineers" and a "solid" SPR analysis.[37]

Q. DO YOU AGREE WITH MR. WATSON'S POSITION?

A. No. It is curious to me that Mr. Watson would describe the SPR analysis for this account as "solid." The R0.5-35 curve Mr. Watson selected has a CI score of only 16, which under the applicable SPR method criteria would be a "poor" fit.[38] A poor CI score renders the entire SPR analysis as unsatisfactory according to Bauhan.[39] When the SPR analysis is not reliable, it is instructive to consider the approved service lives for other utilities which were based on more reliable actuarial analysis.

Q. DID THE COMMISSION APPROVE A SUBSTANTIALLY HIGHER SERVICE LIFE THAN 35 YEARS FOR SWEPCO FOR ACCOUNT 364?

A. Yes. In the SWEPCO case, the Commission found that "[i]t is reasonable to apply an R0.5-55 Iowa-curve-life combination for FERC Account 364-*Distribution Poles*."[40] The mathematical Iowa curve analysis of SWEPCO's actuarial data for Account 364 indicated that the average service life could have been even higher – at 63 years. It is also worth noting that the analysis in the SWEPCO case was conducted on an observed survivor curve that was relatively smooth and had very sufficient retirement history. This analysis is illustrated in the graph below.

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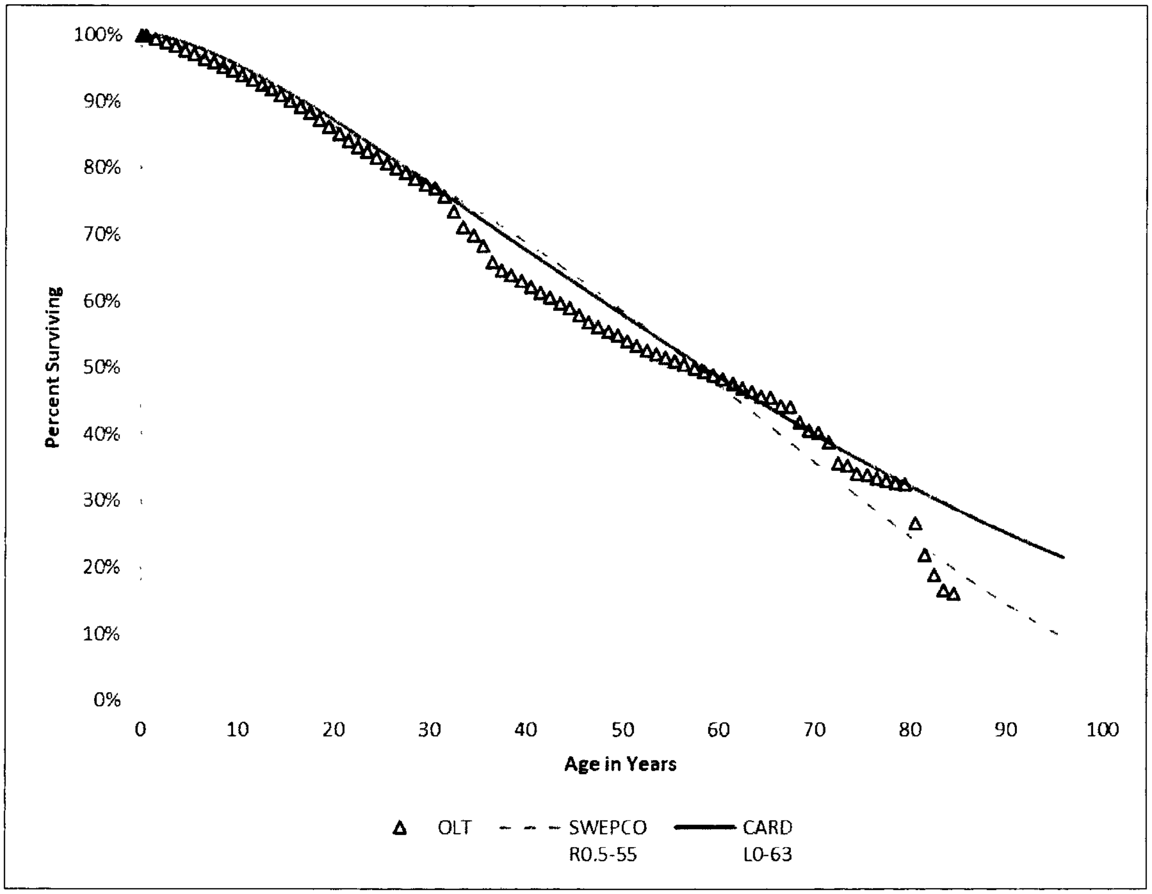
[37] Exhibit DAW-1, p. 43

[38] Bauhan, A. E., "Life Analysis of Utility Plant for Depreciation Accounting Purposes by the Simulated Plant Record Method," 1947, Appendix of the EEI, 1952; *see also* Exhibit DJG-10.

[39] *Id.*

[40] *See Application of Southwestern Electric Power Company for Authority to Change Rates*, Docket No. 46449, Order on Rehearing, Finding of Fact 187 (March 19, 2018).

Figure 11:
SWEPCO Account 364 Service Life Estimates Based on Aged Data



Although the Commission did not accept my recommended service life for this account made on behalf of CARD in the SWEPCO case, I acknowledged that SWEPCO's proposal of a 55-year service life was "within the range of reasonableness."[41] In contrast, I do not believe that Mr. Watson's 35-year estimate in this case, which is based on a "poor" and "unsatisfactory" SPR analysis, is within the range of reasonableness for this account.

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[41] Direct Testimony and Exhibits of David J. Garrett, p. 23, Fig 6, *Application of Southwestern Electric Power Company for Authority to Change Rates,* Docket No. 46449 (April 25, 2017).

Q. ARE YOU AWARE OF ANOTHER UTILITY WITH AN APPROVED SERVICE LIFE OF 55 YEARS FOR ACCOUNT 364?

A. Yes. The approved service life for OG&E's Account 364 is also 55 years – the same as SWEPCO.[42] As with the SWEPCO case discussed above, OG&E's service life estimate was based on the study of more reliable actuarial data.

Q. WHAT IS YOUR SERVICE LIFE RECOMMENDATION FOR ACCOUNT 364?

A. The 35-year service life recommend by Mr. Watson for this account is remarkably short. Not only was it based on a poor and unsatisfactory SPR analysis, but it is also 20 years shorter than the approved service lives of the utilities discussed above, including SWEPCO. I recommend applying the R0.5-45 curve for this account. An R0.5-45 curve accepts the curve shape proposed by Mr. Watson but also partially extends the service life – making it closer to the service lives typically approved for this account. It would not be unreasonable for the Commission to adopt a service life of 55 years for this account, however, I am conservatively recommending a service life of only 45 years.

5. Account 365 – Overhead Conductor and Devices

Q. DESCRIBE MR. WATSON'S SERVICE LIFE ESTIMATE FOR ACCOUNT 365.

A. Mr. Watson selected the R0.5-38 curve for this account, which means he is proposing an average service life of 38 years. Mr. Watson's recommendation is based on estimates of Company personnel as well as the R0.5-38 curve being the "top ranked choice by CI."[43]

Q. DO YOU AGREE WITH MR. WATSON'S ESTIMATE?

A. No. The fact that a particular curve is the "top ranked" in terms of either the CI or REI scale is immaterial if the result is not reliable. In this case, the Iowa curve selected by Mr. Watson results in a "poor" CI score of only 21, which means that the SPR analysis for this account is unsatisfactory and unreliable. In addition, a service life of only 38

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[42] *See* Final Order No. 662059, p. 8, *Application of Oklahoma Gas and Electric Company*, Docket No. PUD 201500273, Before the Corporation Commission of Oklahoma (March 20, 2017).

[43] Exhibit DAW-1, p. 44.

years is notably shorter than the service lives approved for utilities with reliable actuarial data, including SWEPCO, PSO and OG&E.

Q. DESCRIBE THE APPROVED SERVICE LIVES FOR OTHER UTILITIES FOR ACCOUNT 365.

A. The approved service lives for Account 365 for SWEPCO, PSO, and OG&E are 44 years, 46 years, and 54 years, respectively.[44] The approved service lives for these utilities were all based on reliable actuarial data.

Q. WHAT IS YOUR SERVICE LIFE RECOMMENDATION FOR ACCOUNT 365?

A. The 38-year service life recommend by Mr. Watson for this account is based on a poor and unreliable SPR analysis. The more reliable and objective analysis considered for other utilities has resulted in approved service lives of up to 54 years for this account, which is substantially longer than Mr. Watson's proposed service life. In the interest of reasonableness, I propose that the R0.5-40 Iowa curve be applied to this account. This recommendation gives some consideration to the arguments proposed by Mr. Watson while moving the average life closer to those observed in the industry for utilities with more reliable plant data.

6. Account 366 – Underground Conduit

Q. DESCRIBE MR. WATSON'S SERVICE LIFE ESTIMATE FOR ACCOUNT 366.

A. Mr. Watson selected the R2.5-62 curve for this account, which means he is proposing an average service life of 62 years.[45]

Q. DO YOU AGREE WITH MR. WATSON'S ESTIMATE?

A. No. As with the other accounts discussed above, Mr. Watson's recommended service life is significantly shorter than what is observed among other utilities for this account. In fact, the Commission recently ordered a 70-year average service life for SWEPCO's underground conduit account. In the SWEPCO case, the company's witness

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[44] Exhibit DJG-8.

[45] Exhibit DAW-1, p. 46.

recommended a 70-year average service life for this account and no party to the case disagreed with that estimate.[46] In PSO's rate case, the Oklahoma commission found that a 78-year average life was reasonable for this account.[47] Moreover, the estimates made for this account in the recent SWEPCO and PSO cases were based on adequate, aged historical plant data suitable for actuarial analysis and conventional Iowa curve-fitting techniques.

Q. PLEASE ILLUSTRATE THE RETIREMENT RATE YOU HAVE OBSERVED IN THIS ACCOUNT WHEN DERIVED FROM MORE RELIABLE AGED DATA.

A. In the PSO case discussed above, the company's witness recommended a 65-year average life for Account 366 and I recommended a 78-year average life on behalf of the OIEC as estimated through visual and mathematical Iowa curve-fitting techniques. The graph below shows the OLT curve (i.e., the curve derived from the utility's historical data in black triangles), along with the two Iowa curves proposed in the PSO case. As shown in the graph, the R1.5-78 curve tracks very well with the historical retirement pattern in this account.

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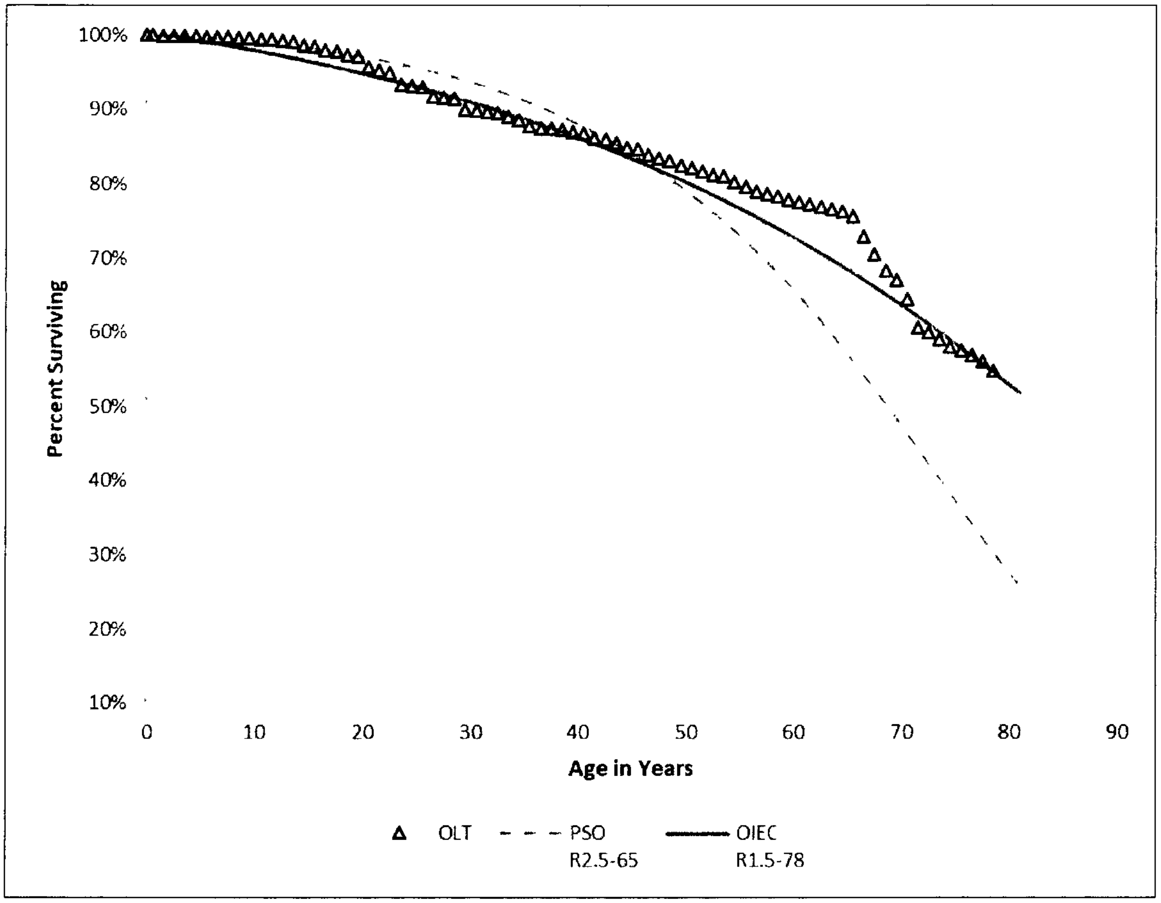
[46] *See Application of Southwestern Electric Power Company for Authority to Change Rates*, Docket No. 46449, Direct Testimony and Exhibits of David A. Davis, Exhibit DAD-2 (Dec. 16, 2016).

[47] *See* Final Order No. 672864 in Cause No. PUD 201700151 before the Corporation Commission of Oklahoma (Jan. 31, 2018), adopting Report and Recommendation of the Administrative Law Judge, p. 28 of 239, ¶ 109 (adopting depreciation rates proposed by the Oklahoma Attorney General); *see also* Responsive Testimony of William W. Dunkel, filed September 21, 2017 in Cause No. PUD 201700151 on behalf of the Oklahoma Attorney General.

Figure 12:
PSO Account 366 Service Life Estimates Based on Aged Data



When a utility keeps adequate aged data, depreciation analysts can use the actuarial retirement rate method to develop observed survivor curves like the OLT curve shown above. These curves make average life estimates more accurate and reliable. The Oklahoma commission ultimately ordered a 78-year average service life for Account 366.

Q. WHAT IS YOUR RECOMMENDATION FOR THIS ACCOUNT?

A. I recommend applying the S1-65 curve for this account. Unlike some of the accounts discussed above, the SPR analysis for this account has several Iowa curves that produce satisfactory results (though still less reliable than actuarial data). The S1-65 curve I selected scores as "excellent" in both the CI and REI scales.[48] Moreover, an average life

[48] Exhibit DJG-10.

of 65 years is more reflective of the approved service lives observed for some other utilities with more reliable data, including SWEPCO. Although it would not be unreasonable for the Commission to approve a longer service life, approving the S1-65 curve for this account would also result in a fair and reasonable depreciation rate.

7. Account 367 – Underground Conductor and Devices

Q. DESCRIBE MR. WATSON'S SERVICE LIFE ESTIMATE FOR ACCOUNT 367.

A. Mr. Watson selected the R0.5-38 curve for this account. According to Mr. Watson, it was the "top ranked" curve according to the SPR analysis. Mr. Watson also stated that "Company personnel indicated a 38 year life" is reasonable.[49]

Q. DO YOU AGREE WITH MR. WATSON'S ESTIMATE?

A. No. Although Mr. Watson's R0.5-38 curve may have been the "top ranked" curve in the SPR analysis, it nonetheless scored a "poor" CI score of only 23 in the overall test band. This means that the SPR analysis is unsatisfactory and unreliable for this account. In addition, the approved service lives for this account among other utilities with more reliable data are substantially longer – some more than 25 years.

Q. DESCRIBE THE APPROVED SERVICE LIVES FOR THIS ACCOUNT FOR SOME OTHER UTILITIES.

A. The approved service lives for Account 367 for SWEPCO, PSO, and OG&E are 45 years, 65 years, and 55 years, respectively.[50] The approved service lives for these utilities were all based on reliable, actuarial data, and are all notably longer than the 38-year service life proposed by Mr. Watson for this account.

Q. WHAT IS YOUR RECOMMENDATION FOR THIS ACCOUNT?

A. I recommend applying the L0-42 curve for this account. Since the SPR analysis produces unreliable results, it is instructive to consider the approved service lives for this account from other utilities when determining a reasonable estimate for the Company's account. I

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49 Exhibit DAW-1, p. 48.

50 *See* Exhibit DJG-8.

recommend the L0-42 curve for this account. The L0-42 curve is derived from the Company's SPR analysis, but more importantly, a 42-year average life moves the Company's proposed closer to the range of reasonableness for this account.

8. Account 368 – Line Transformers

Q. DESCRIBE MR. WATSON'S SERVICE LIFE ESTIMATE FOR ACCOUNT 369.

A. Mr. Watson selected the R1-28 curve for this account. Mr. Watson notes that the R1-28 curve is the "top ranked" curve in the SPR analysis.[51]

Q. DO YOU AGREE WITH MR. WATSON'S ESTIMATE?

A. No. In my experience, the average service life for this account typically utilized by utilities is about 43, years is a substantial 15 years longer than Mr. Watson's proposal. Addition, even though the R1-28 curve may be the top ranked curve according to the SPR analysis, it nonetheless has a CI score of only 51, which is just slightly above a "fair" score.[52]

Q. DESCRIBE THE APPROVED SERVICE LIVES FOR THIS ACCOUNT FOR SOME OTHER UTILITIES.

A. The approved service lives for Account 368 for SWEPCO, PSO, and OG&E are 50 years, 36 years, and 44 years, respectively.[53] The approved service lives for these utilities were all based on reliable, actuarial data, and are all notably longer than the 28-year service life proposed by Mr. Watson for this account. In the litigated SWEPCO case, the Commission found that "[i]t is reasonable to apply an L0.5-55 Iowa-curve-life combination for FERC Account 368-*Distribution Line Transformers*."[54]

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[51] Exhibit DAW-1, p. 50.

[52] *See* Exhibit DJG-10.

[53] *See* Exhibit DJG-8.

[54] *See Application of Southwestern Electric Power Company for Authority to Change Rates*, Docket No. 46449, Order on Rehearing, Finding of Fact 189 (March 19, 2018).

Q. WHAT IS YOUR RECOMMENDATION FOR THIS ACCOUNT?

A. I recommend applying the L0-32 curve for this account. The L0-32 has a CI score of 40 and an REI score of 100. Although a 32-year service life estimate is substantially shorter than the approved service lives for this account for other utilities, it is nonetheless more reasonable than the Company's proposal. It does not make sense that CenterPoint Houston's line transformers should be expected to survive nearly half as long as SWEPCO's line transformers. The evidence presented by SWEPCO in its rate case included reliable, detailed actuarial analysis. SWEPCO's witness recommended a 50-year average life based on that analysis.[55] I testified in that case and did not dispute SWEPCO's recommendation, as I found it to be reasonable. The Commission also agreed with SWEPCO's proposal. In contrast, an average life proposal of only 28 years is far too short for this account.

VIII. CONCLUSION AND RECOMMENDATION

Q. SUMMARIZE THE KEY POINTS OF YOUR TESTIMONY.

A. In my opinion, adjustments should be made to the Company's proposed depreciation rates for several accounts due to the Company's failure to make a convincing showing that the proposed depreciation rates for these accounts is not excessive. Specifically, I recommend service life adjustments to nine accounts. It is clear that the Company's proposed service lives for these accounts are unreasonably short, which would result in unreasonably high depreciation rates for customers. The historical data provided by the Company to support these service life proposals are less reliable than the aged historical data maintained by the other utilities discussed in this testimony. My recommended service lives represent a balance between the shorter service lives indicated by the Company's unaged historical data and the longer service lives utilized by utilities that maintain superior, aged historical data.

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[55] *See Application of Southwestern Electric Power Company for Authority to Change Rates*, Docket No. 46449, Direct Testimony and Exhibits of David A. Davis, Exhibit DAD-2 (Dec. 16, 2016).

Q. WHAT IS TCUC'S RECOMMENDATION TO THE COMMISSION REGARDING THE COMPANY'S DEPRECIATION RATES?

A. TCUC recommends that the Commission adopt the proposed depreciation rates presented in Exhibit DJG-3 for the nine accounts listed therein. Adopting these adjustments would result in an reduction of $34.6 million to the Company's proposed annual depreciation accrual.[56]

Q. DOES THIS CONCLUDE YOUR TESTIMONY?

A. Yes. I reserve the right to supplement this testimony as needed with any additional information that has been requested from the Company but not yet provided. To the extent I did not address an opinion expressed by the Company, it does not constitute an agreement with such opinion.

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[56] *See* Exhibit DJG-2.

SOAH DOCKET NO. 473-19-3864
PUC DOCKET NO. 49421

APPLICATION OF CENTERPOINT	**§**	**BEFORE THE STATE OFFICE**
ENERGY HOUSTON ELECTRIC, LLC	**§**	**OF**
FOR AUTHORITY TO CHANGE RATES	**§**	**ADMINISTRATIVE HEARINGS**

DIRECT TESTIMONY AND EXHIBITS OF

DAVID J. GARRETT

APPENDIX A:

THE DEPRECIATION SYSTEM

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.[57] 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.[58] The figure below illustrates the basic concept of a depreciation system and includes some of the available parameters.[59]

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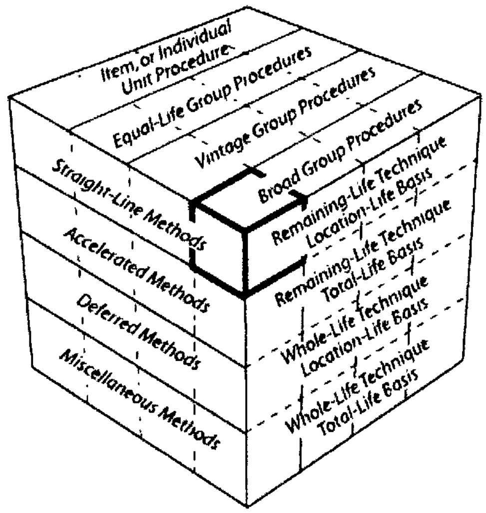
[57] Wolf *supra* n. 7, at 69-70.

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

[59] 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 13:
The Depreciation System Cube



1. <u>Allocation Methods</u>

The "method" refers to the pattern of depreciation in relation to the accounting periods. The method most commonly used in the regulatory context is the "straight-line method" – a type of age-life method in which the depreciable cost of plant is charged in equal amounts to each accounting period over the service life of plant.[60] 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.[61] The basic formula for the straight-line method is as follows:[62]

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

[61] *Id.*

[62] *Id.*

Equation 1:
Straight-Line Accrual

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

Gross plant is a known amount from the utility's records, while both net salvage and service life must be estimated 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.[63] 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:[64]

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.[65] 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 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

[63] *Id.* at 57.

[64] *Id.* at 56.

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

characteristics of the group must be described statistically.[66] 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.[67]

The "average life" and "equal life" grouping procedures are the two most common. In the average life procedure, a constant annual accrual rate based on the average life of all property in the group is applied to the surviving property. While property having shorter lives than the group average will not be fully depreciated, and likewise, property having longer lives than the group average will be over-depreciated, the ultimate result is that the group will be fully depreciated by the time of the final retirement.[68] 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.[69] Under the equal life procedure the property is divided into subgroups that each has a common life.[70]

3. Application Techniques

The third factor of a depreciation system is the "technique" for applying the depreciation rate. There are two commonly used techniques: "whole life" and "remaining life." The whole life technique applies the depreciation rate on the estimated average service life of a group, while the remaining life technique seeks to recover undepreciated costs over the remaining life of the plant.[71]

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[66] *Id.* at 74.

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

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

[69] *Id.* at 75.

[70] *Id.*

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

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.[72] Analysts can calculate the level of imbalance in the accumulated depreciation account by determining the "calculated accumulated depreciation," (a.k.a. "theoretical reserve" and referred to in these appendices as "CAD"). The CAD is the calculated balance that would be in the accumulated depreciation account at a point in time using current depreciation parameters.[73] 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 in the annual accrual.[74] 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:[75]

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

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

[74] NARUC *supra* n. 8, at 65 ("The desirability of using the remaining life technique is that any necessary adjustments of [accumulated depreciation] . . . are accrued automatically over the remaining life of the property. Once commenced, adjustments to the depreciation reserve, outside of those inherent in the remaining life rate would require regulatory approval.").

[75] *Id.* at 64.

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.[76]

4. Analysis Model

The fourth parameter of a depreciation system, the "model," relates to the way of viewing the life and salvage characteristics of the vintage groups that have been combined to form a continuous property group for depreciation purposes.[77] A continuous property group is created when vintage groups are combined to form a common group. Over time, the characteristics of the property may change, but the continuous property group will continue. The two analysis models used among practitioners, the "broad group" and the "vintage group," are two ways of viewing the life and salvage characteristics of the vintage groups that have been combined to form a continuous property group.

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

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

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

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

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DAVID J. GARRETT

APPENDIX B:

IOWA CURVES

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.[78] 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.[79] A frequency curve is a graph of the frequency of retirements as a function of age. Several types of survivor and frequency curves are illustrated in the figures below.

1. Development

The survivor curves used by analysts today were developed over several decades from extensive analysis of utility and industrial property. In 1931 Edwin Kurtz and Robley Winfrey used extensive data from a range of 65 industrial property groups to create survivor curves representing the life characteristics of each group of property.[80] They generalized the 65 curves into 13 survivor curve types and published their results in *Bulletin 103: Life Characteristics of Physical Property*. The 13 type curves were designed to be used as valuable aids in forecasting

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

[79] *Id.* at 23.

[80] *Id.* at 34.

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.[81] 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."[82] 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.[83] Rather than using the original formulas, analysts typically rely on the published tables containing the percentages surviving. This is because absent knowledge of the integration technique applied to each age interval, it is not possible to recreate the exact original published table values. In the 1970s, John Russo collected data from over 2,000 property accounts reflecting 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

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[81] *Id.*

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

[83] Robley Winfrey, Bulletin 155: *Depreciation of Group Properties* 121-28, Vol XLI, No. 1 (The Iowa State College Bulletin 1942); *see also* Wolf supra n. 7, at 305-38 (publishing the percent surviving for each Iowa curve, including "O" type curve, at one percent intervals).

several decades after Winfrey published the original Iowa curves. Russo drew three major conclusions from his research:[84]

> 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.[85]

Over the years, several more curve types have been added to Winfrey's 18 Iowa curves. In 1967, Harold Cowles added four origin-modal curves. In addition, a square curve is sometimes used to depict retirements which are all planned to occur at a given age. Finally, analysts commonly rely on several "half curves" derived from the original Iowa curves. Thus, the term "Iowa curves" could be said to describe up to 31 standardized survivor curves.

2. <u>Classification</u>

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

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

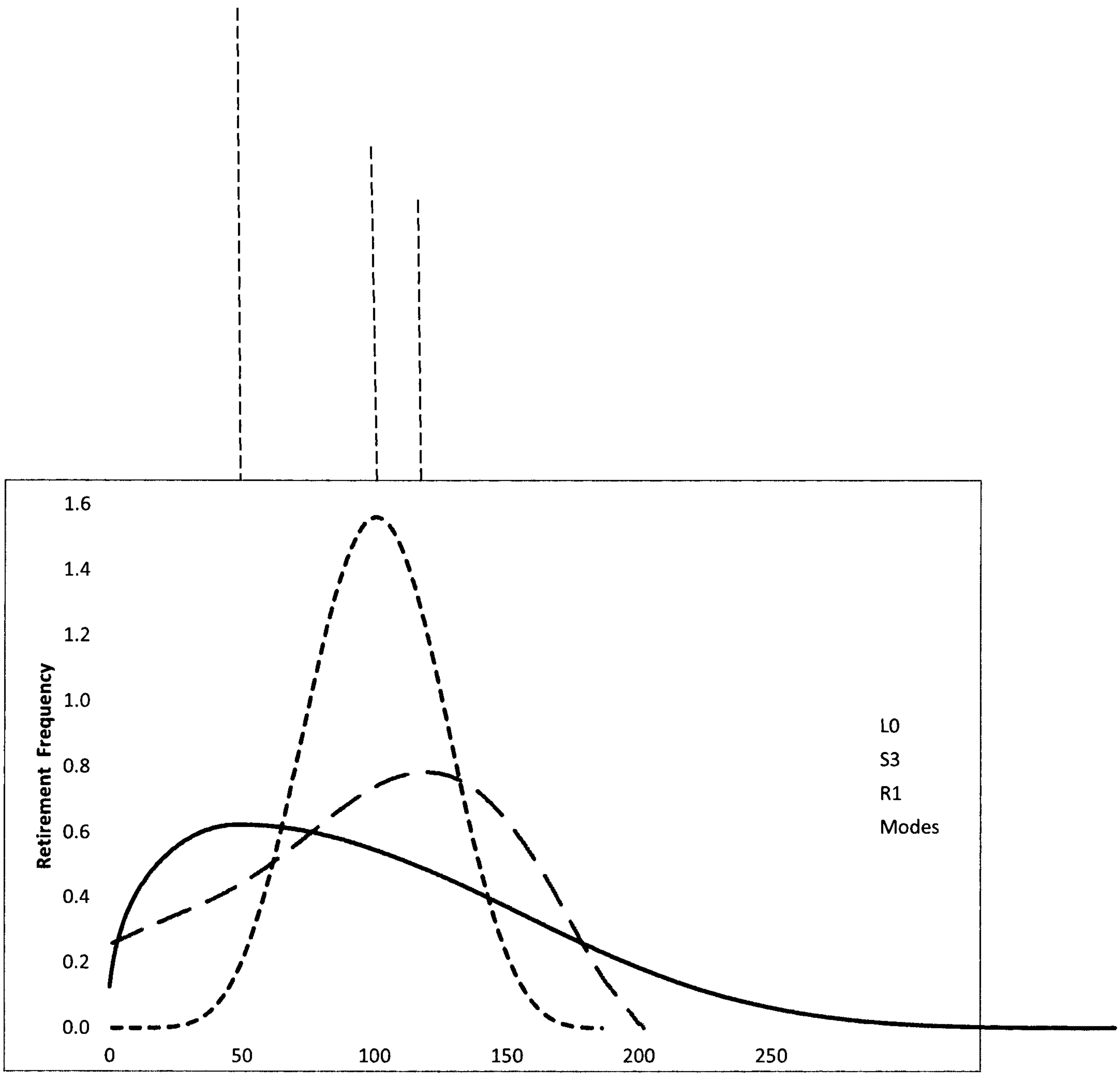
[85] *Id.*

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).[86] 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.

[86] In 1967, Harold A. Cowles added four origin-modal curves known as "O type" curves. There are also several "half" curves and a square curve, so the total amount of survivor curves commonly called "Iowa" curves is about 31 (see NARUC supra n. 8, at 68).

Figure 14:
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."[87]

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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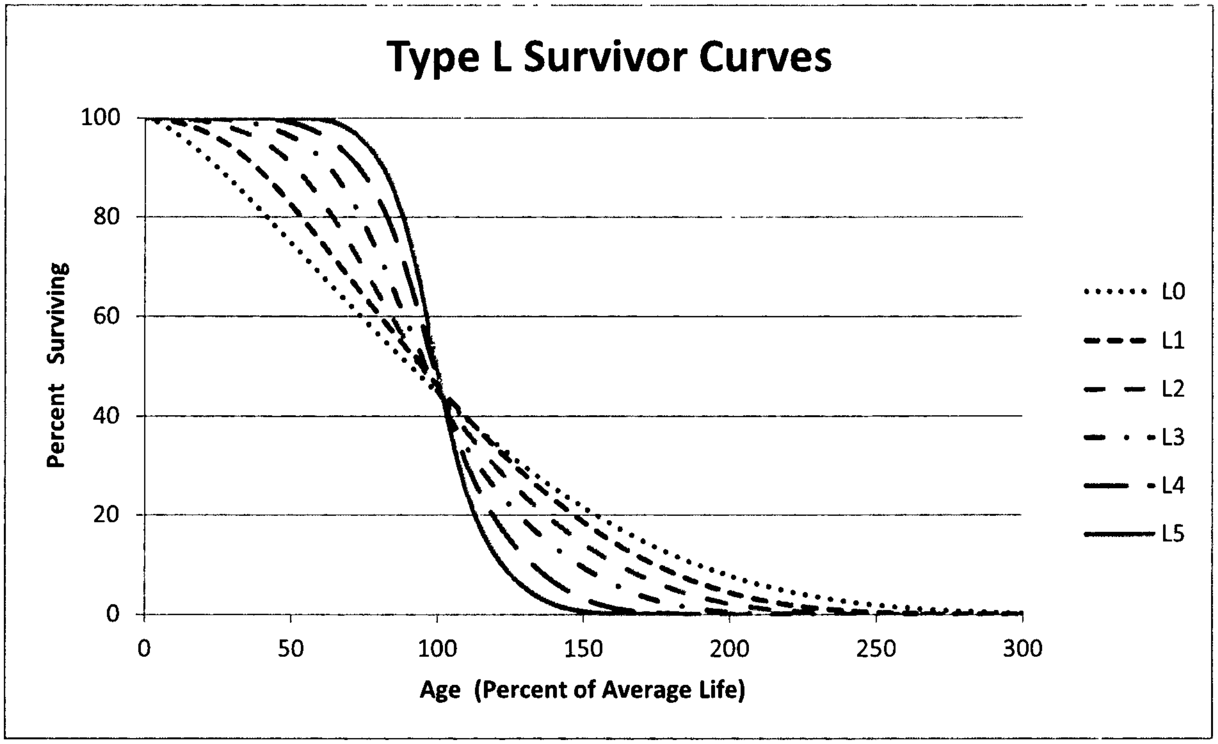
[87] Winfrey, *Bulletin 125: Statistical Analyses of Industrial Property Retirements* 60, Vol. XXXIV, No. 23 (Iowa State College of Agriculture and Mechanic Arts 1935).

Figure 15:
Type L Survivor and Frequency Curves



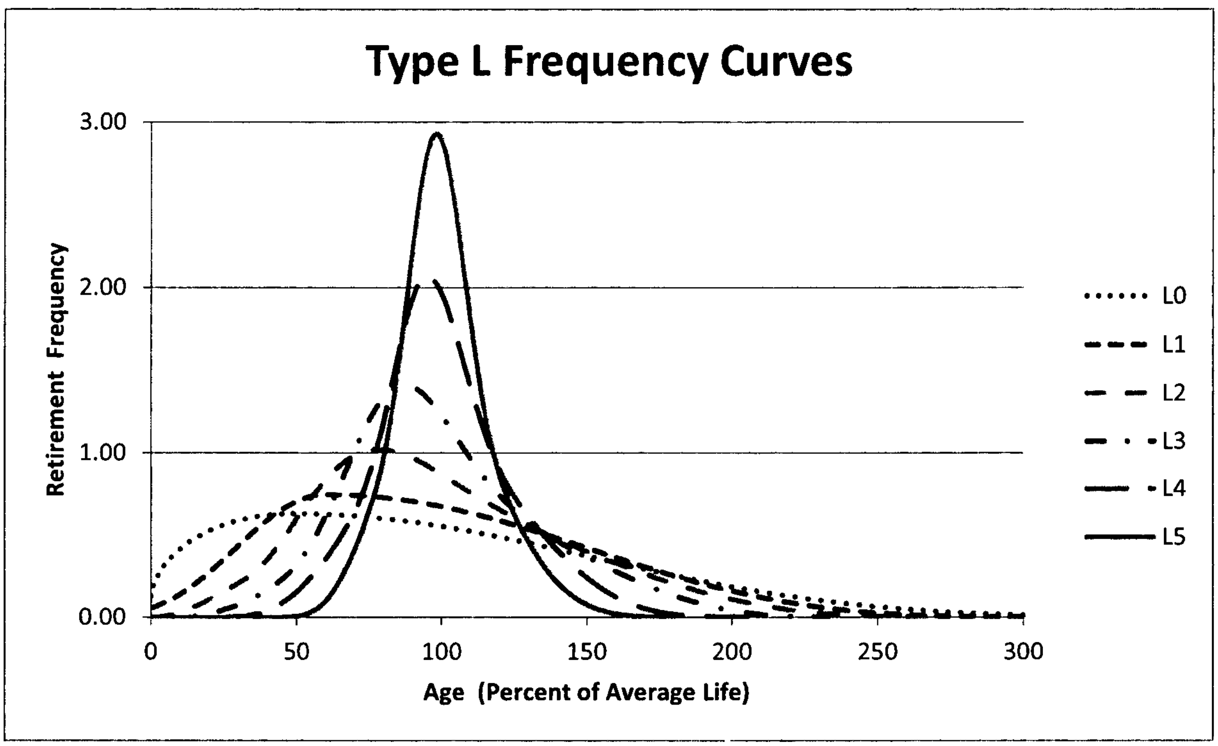
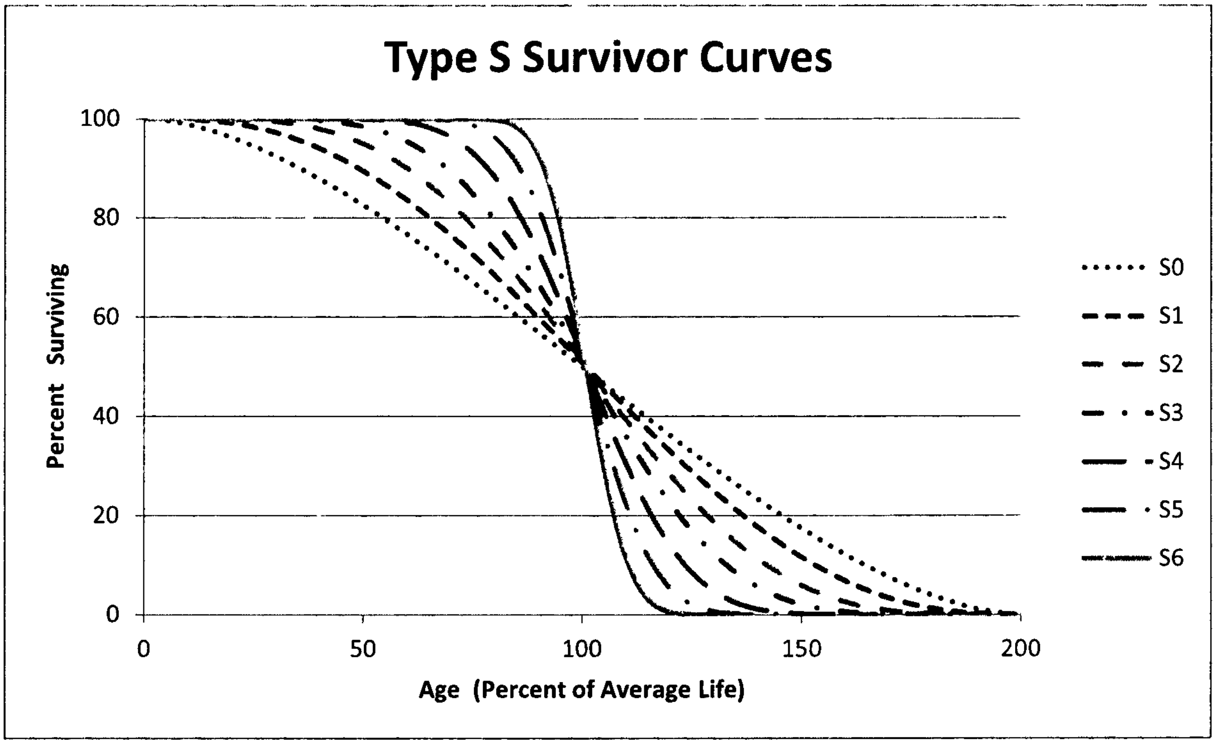


Figure 16:
Type S Survivor and Frequency Curves



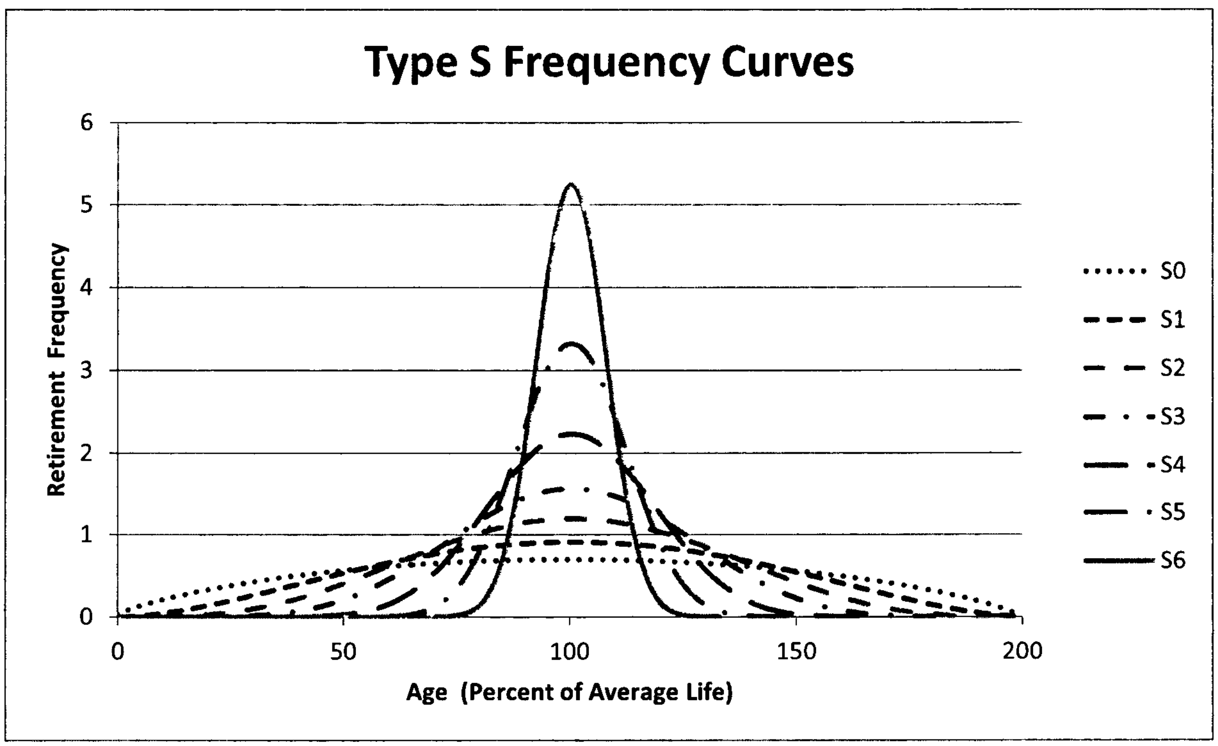
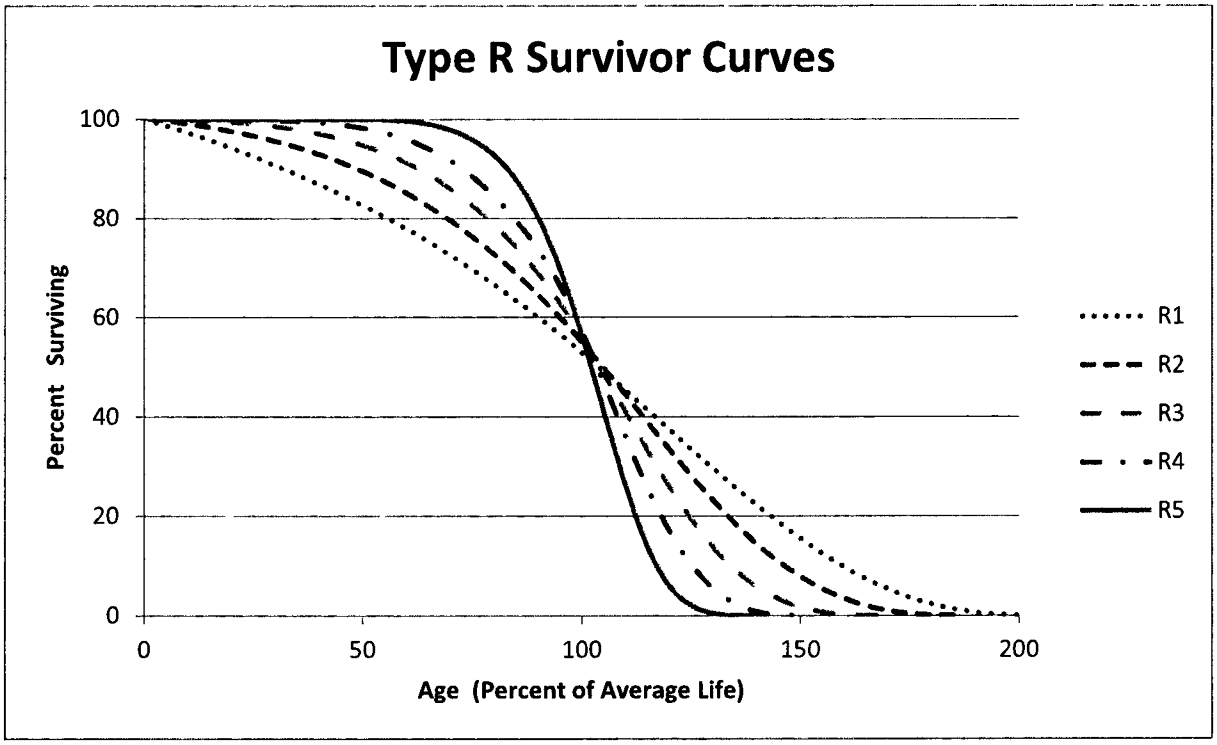
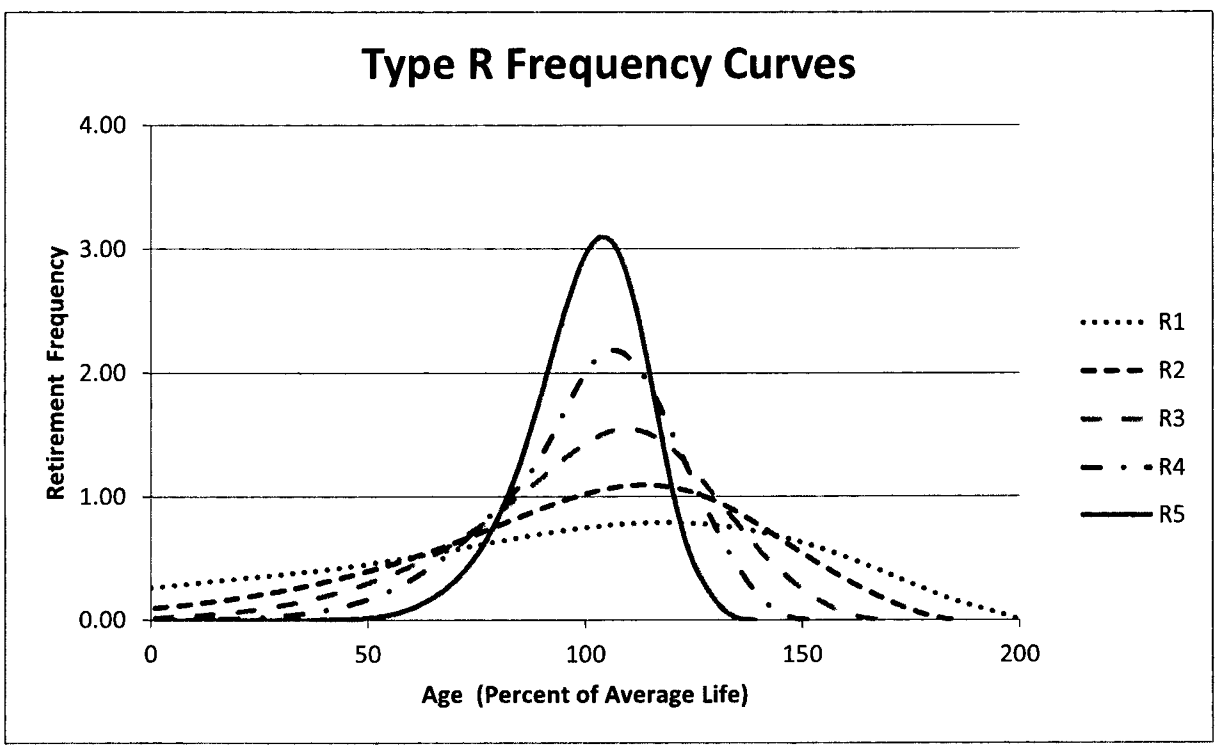


Figure 17:
Type R Survivor and Frequency Curves





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

3. Types of Lives

Several other important statistical analyses and types of lives may be derived from an Iowa curve. These include: 1) average life; 2) realized life; 3) remaining life; and 4) probable life. The figure below illustrates these concepts. It shows the frequency curve, survivor curve, and probable life curve. Age M_x on the x-axis represents the modal age, while age AL_x represents the average age. Thus, this figure illustrates an "L type" Iowa curve since the mode occurs before the average.[88]

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:[89]

Equation 4:
Average Life

$$Average\ Life = \frac{Area\ Under\ Survivor\ Curve\ from\ Age\ 0\ to\ Max\ Life}{100\%}$$

Thus, average life may not be determined without a complete survivor curve. Many property groups being analyzed will not have experienced full retirement. This results in a "stub" survivor 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).

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[88] 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.

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

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.[90] 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.[91] Remaining life is sometimes referred to as "average remaining life" and "life expectancy." To calculate average remaining life at age x, the area under the estimated future portion of the survivor curve is divided by the percent surviving at age x (denoted S_X). Thus, the average remaining life formula is:

Equation 5:
Average Remaining Life

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

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

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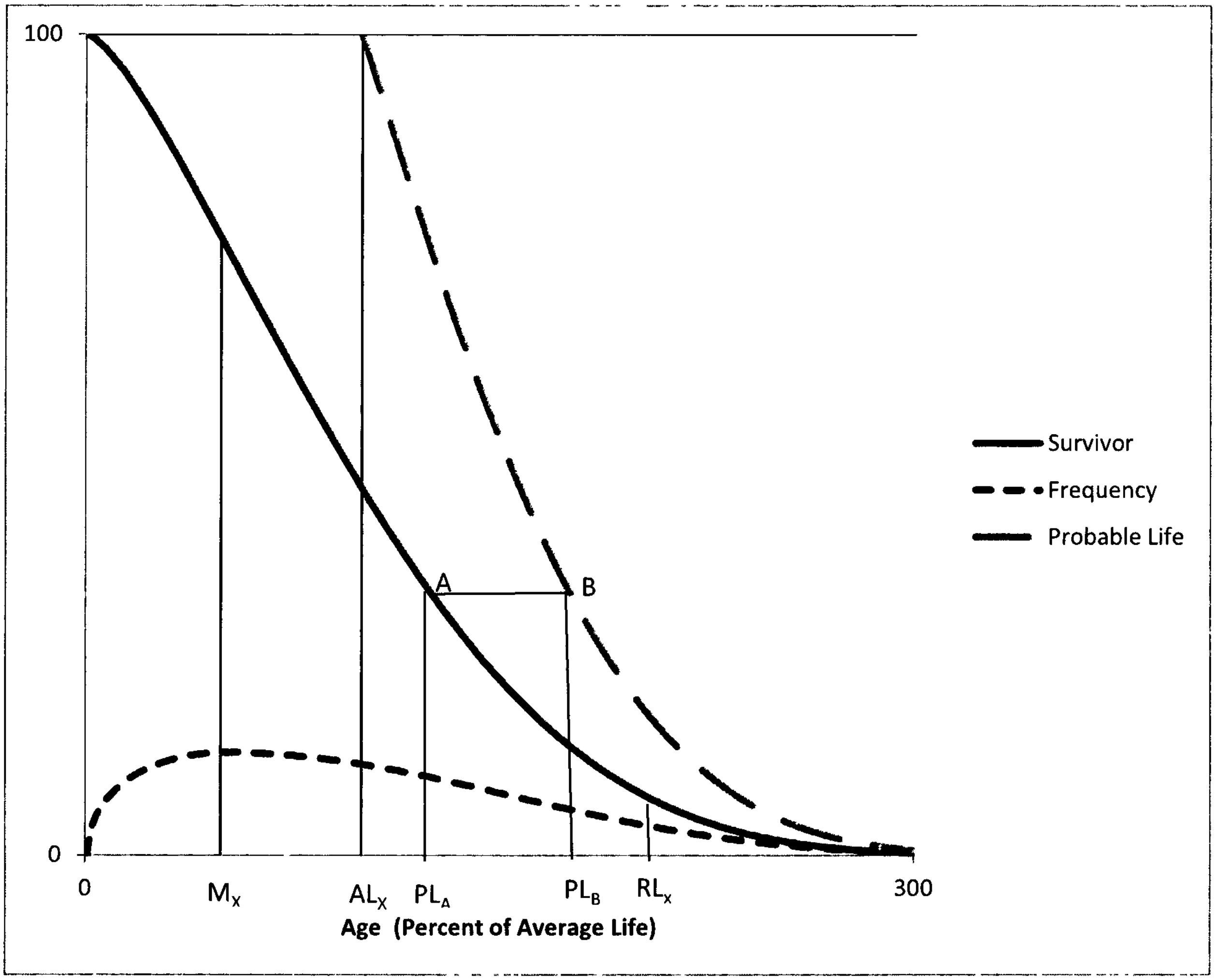
[90] *Id.* at 73.

[91] *Id.* at 74.

Figure 18:
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.[92] The probable life is also illustrated in this figure. The probable life at age PL_A is the age at point PL_B. Thus, to read the probable life at age PL_A, see the corresponding point on the survivor curve above at point "A," then horizontally to point "B" on the probable life curve, and back down to the age corresponding to point "B." It is no

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

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.

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DAVID J. GARRETT

APPENDIX C:

ACTUARIAL ANALYSIS

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 on actuarial analysis in determining premiums for life insurance policies.

The study of human mortality is analogous to estimating service lives of industrial property groups. While some humans die solely from chance, most deaths are related to age; that is, death rates generally increase as age increases. Similarly, physical plant is also subject to forces of retirement. These forces include physical, functional, and contingent factors, as shown in the table below.[93]

Figure 19:
Forces of Retirement

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

While actuaries study historical mortality data in order to predict how long a group of people will live, depreciation analysts must look at a utility's historical data in order to estimate the average lives of property groups. A utility's historical data is often contained in the Continuing Property Records ("CPR"). Generally, a CPR should contain 1) an inventory of property record units; 2) the association of costs with such units; and 3) the dates of installation

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

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.[94] 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 calculate observed survivor curves for property groups. Of these methods, the retirement rate method is superior, and is widely employed by depreciation analysts.[95] 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. The first matrix is the exposure matrix, which shows the exposures at the beginning of each year.[96] An exposure is simply the

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

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

[96] 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.

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 20:
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	

Figure 21:
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.[97] 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). The same calculation is applied to each number in the column. The

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

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

The totaled amounts for each age interval in both matrices are used to form the exposure and retirement columns in the OLT, as shown in the chart below. This chart also shows the retirement ratio and the survivor ratio for each age interval. The retirement ratio for an age interval is the ratio of retirements during the interval to the property exposed to retirement at the beginning of the interval. The retirement ratio represents the probability that the property surviving at the beginning of an age interval will be retired during the interval. The survivor ratio is simply the complement to the retirement ratio (1 – retirement ratio). The survivor ratio represents the probability that the property surviving at the beginning of an age interval will survive to the next age interval.

Figure 22:
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			

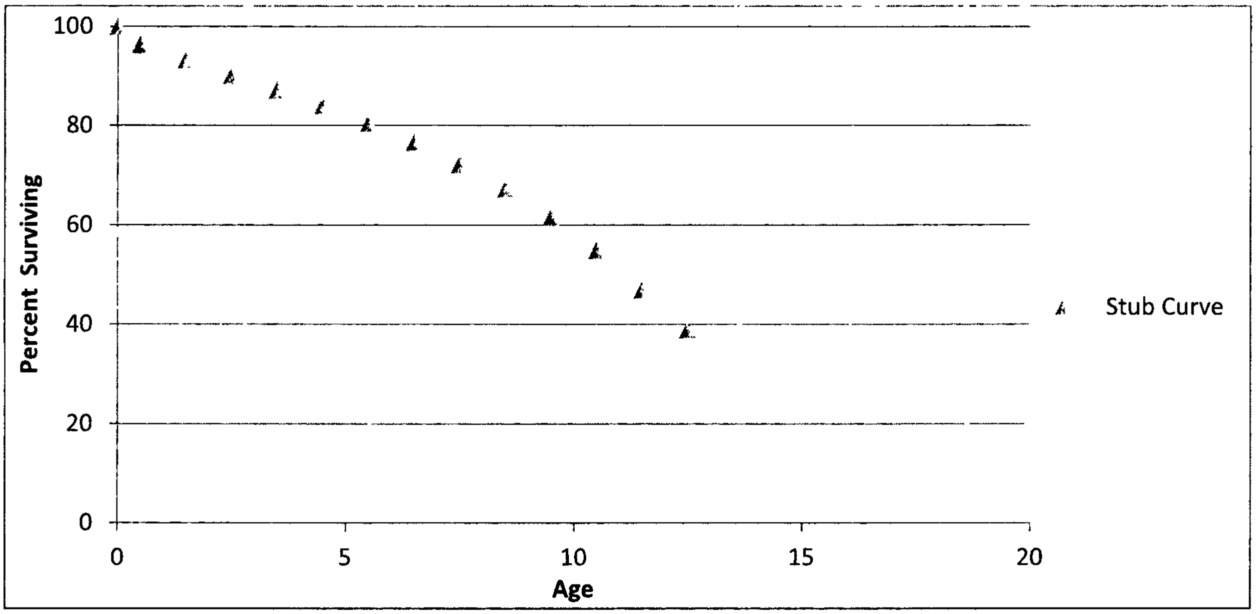
Column F on the right shows the percentages surviving at the beginning of each age interval. This column starts at 100% surviving. Each consecutive number below is calculated by multiplying the percent surviving from the previous age interval by the corresponding survivor ratio for that age interval. 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)[98].

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

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

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

Figure 23:
Original "Stub" Survivor Curve



The matrices used to develop the basic OLT and stub survivor curve provide a basic illustration of the retirement rate method in that only a few placement and experience years were used. In reality, analysts may have several decades of aged property data to analyze. In that case, it may be useful to use a technique called "banding" in order to identify trends in the data.

<u>Banding</u>

The forces of retirement and characteristics of industrial property are constantly changing. A depreciation analyst may examine the magnitude of these changes. Analysts often use a technique called "banding" to assist with this process. Banding refers to the merging of several years of data into a single data set for further analysis, and it is a common technique associated with the retirement rate method.[99] 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.[100]

Two common types of banding methods are the "placement band" method and the "experience band" method." A placement band, as the name implies, isolates selected placement years for analysis. The figure below illustrates the same exposure matrix shown above, except that only the placement years 2005-2008 are considered in calculating the total exposures at the beginning of each age interval.

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

[100] *Id.*

Figure 24:
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.[101] Placement bands allow analysts to isolate the effects of changes in technology and materials that occur in successive generations of plant. For example, if in 2005 an electric utility began placing transmission poles with a special chemical treatment that extended the service lives of the poles, an analyst could use placement bands to isolate and analyze the effect of that change in the property group's physical characteristics. While placement bands are very useful in depreciation analysis, they also

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

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.[102]

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 25:
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	

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

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

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.[103] 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. 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 of the property

[103] *Id.*

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.

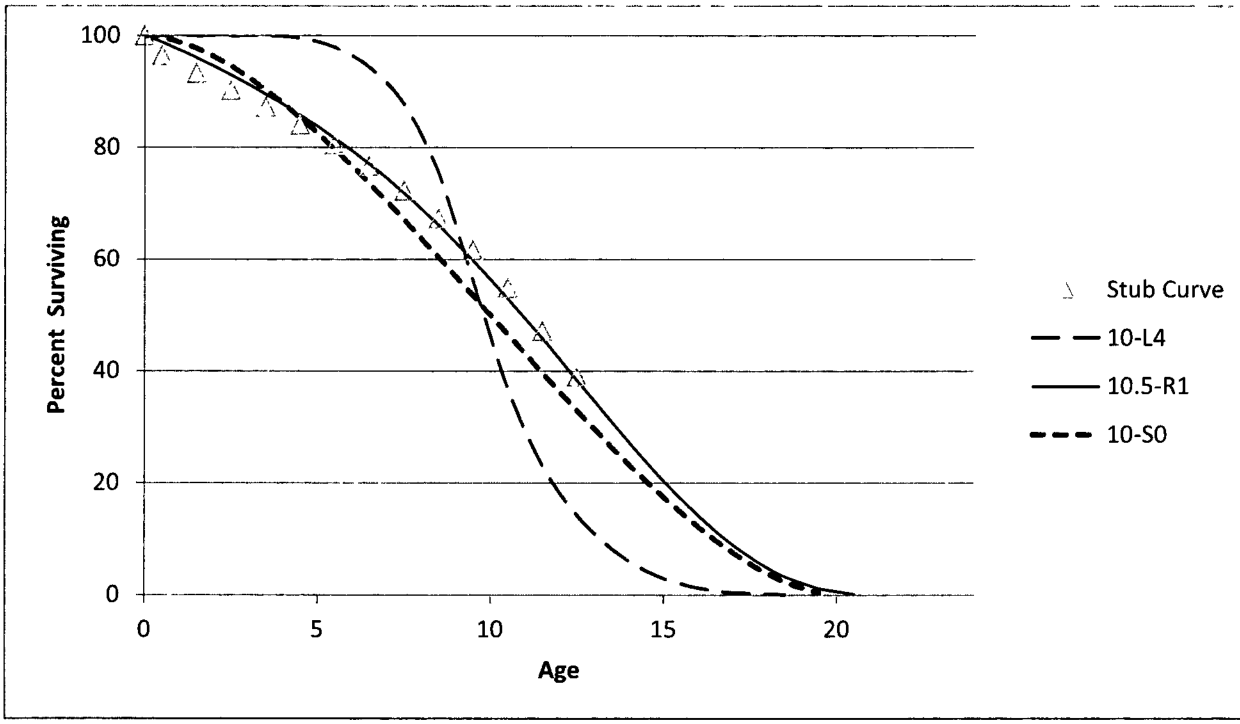
Curve Fitting

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."[104]

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

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

**Figure 26:
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.[105]

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."[106]

In the graph above, visual fitting was sufficient to determine that the 10.5-R1 Iowa curve was a better fit than the 10-L4 and the 10-S0 curves. Using the sum of least squares method, mathematical fitting confirms the same result. In the chart below, the percentages surviving from the OLT that formed the original stub curve are shown in the left column, while the corresponding percentages surviving for each age interval are shown for the three Iowa curves. The right portion of the chart shows the differences between the points on each Iowa curve and the stub curve. These differences are summed at the bottom. Curve 10.5-R1 is the best fit because the sum of the squared differences for this curve is less than the same sum of the other two curves. Curve 10-L4 is the worst fit, which was also confirmed visually.

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

[106] *Id.* at 48.

Figure 27:
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**

SOAH DOCKET NO. 473-19-3864
PUC DOCKET NO. 49421

APPLICATION OF CENTERPOINT	**§**	**BEFORE THE STATE OFFICE**
ENERGY HOUSTON ELECTRIC, LLC	**§**	**OF**
FOR AUTHORITY TO CHANGE RATES	**§**	**ADMINISTRATIVE HEARINGS**

DIRECT TESTIMONY AND EXHIBITS OF

DAVID J. GARRETT

APPENDIX D:

SIMULATED LIFE ANALYSIS

SIMULATED LIFE ANALYSIS

Aged data is required to perform actuarial analysis. That is, the collection of property data must contain the dates of placements, retirements, transfers, and other actions. When a utility's property records do not contain aged data, however, analysts may use another analytical method to simulate the missing data. The contrast between aged and unaged data is illustrated in the matrices below.[107] The first matrix is similar to the matrices in Appendix C used to demonstrate actuarial analysis.

Figure 28:
Aged Data Matrix

		End of Year Balances ($)								
Vintage	Installations	1997	1999	2001	2003	2005	2007	2009	2011	2013
1997	220	220	220	220	213	194	152	95	19	0
			250	250	248	235	198	143	31	4
1999	270		270	270	270	262	238	186	57	9
				285	285	282	268	225	91	26
2001	300			300	300	300	291	264	145	42
					320	320	317	301	241	103
2003	350				350	350	350	340	284	157
						375	375	371	325	219
2005	390					390	390	390	362	286
							405	405	392	344
2007	450						450	450	441	416
								480	480	478
2009	500							500	500	500
									580	580
2011	670								670	670
										790
2013	750									750
Balance		220	740	1325	1986	2708	3434	4150	4618	5374

The aged data matrix contains installation or "vintage" years in the first column and experience years in the top row. (Only every other year is shown in order to save space). This matrix

[107] See SDP Fundamentals 2014 pdf. 152.

contains aged data, meaning that the utility kept track of the age of plant when it was retired. In 2007, for example, $291 were remaining in service from the 2001 installation of $300. Likewise, in 2011, it was known that $57 were remaining in service from the 1999 vintage installation of $270. The amounts in each experience year column are added to arrive the year-end balances. Now assume that the amount of installations and retirements are the same for each year, but that the utility did not keep track of the age of plant when it was retired. The data matrix below contains the same data, except it is not aged. Thus, while the year-end balances are the same, the amount retired from each vintage in a given year is unknown.

Figure 29:
Unaged Data Matrix

		End of Year Balances ($)								
Vintage	Installations	1997	1999	2001	2003	2005	2007	2009	2011	2013
1997	220									
1999	270									
2001	300									
2003	350									
2005	390									
2007	450									
2009	500									
2011	670									
2013	750									
Balance		220	740	1325	1986	2708	3434	4150	4618	5374

Thus, in 2007 the company still had a year-end balance $3,434, but it is unknown how much of this amount surviving is attributable to each vintage group of property.

The method that depreciation analysts use to examine unaged data is called the "simulated plant record" method ("SPR").[108] The SPR method is used to simulate the retirement pattern for each vintage and to indicate the Iowa curve that best represent the life characteristics of the property being analyzed.[109] In other words, the SPR model may be used to "fill in" the unaged data matrix with simulated vintage balances for each experience year. The SPR model assumes that all vintages' additions retire in accordance with the same retirement pattern.[110]

Unlike with actuarial analysis, which indicates the best fitting Iowa curve type based on the input data, the SPR model requires the analyst or computer program to first choose an Iowa curve and test the results. This process is repeated until the analyst finds the curve that best matches the observed data is found.[111] Although the SPR method may be conducted manually, analysts typically rely on computer programs to make the process more efficient.

In the example presented below, the best fitting curve is the one that most closely simulates the actual balance of $4,150 for 2009. The chart below compares the actual and simulated vintage balances for the 2009 experience year using an Iowa 10-S3 curve. The 2009 simulated balances using the 10-S3 curve produce a year-end balance of $3,775. The actual balance, however, is $4,150. Thus, the 10-S3 curve produces a simulated balance that is $375 short of the actual balance.

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[108] Wolf 220. Cyrus Hill is generally credited with developing the principles used in the SPR method. In 1947, Alex Bauhan expanded the SPR method and developed several criteria used to measure the accuracy of simulated data, which he called the SPR method (See Bauhan, A. E., "Life Analysis of Utility Plant for Depreciation Accounting Purposes by the Simulated Plant Record Method," 1947, Appendix of the EEl, 1952.)

[109] NARUC *supra* n. 8, at 106.

[110] *Id.* at 107.

[111] Wolf 222.

Figure 30:
SPR Calculation Using Iowa Curve 10-S3

Age Interval	Vintage Year	Installations	10-S3 % Surviving	Sim. Bal. 2009
12.5	1997	220	16	35
11.5	1998	250	28	69
10.5	1999	270	42	114
9.5	2000	285	58	165
8.5	2001	300	72	217
7.5	2002	320	84	269
6.5	2003	350	92	323
5.5	2004	375	97	363
4.5	2005	390	99	386
3.5	2006	405	100	404
2.5	2007	450	100	450
1.5	2008	480	100	480
0.5	2009	500	100	500
	Total Simulated Balance			3,775
	Total Actual Balance			4,150
	Difference			(375)

The process is repeated with another curve until the best fitting curve is found. Specifically, a curve with a longer average life should be chosen in order to increase the simulated balance. For this example, the 12-S3 curve produces a perfect fit for 2009, as shown in the figure below.

Figure 31:
SPR Calculation Using Iowa Curve 12-S3

Age Interval	Vintage Year	Installations	12-S3 % Surviving	Sim. Bal. 2009
12.5	1997	220	43	95
11.5	1998	250	57	143
10.5	1999	270	69	186
9.5	2000	285	79	225
8.5	2001	300	88	264
7.5	2002	320	94	301
6.5	2003	350	97	340
5.5	2004	375	99	371
4.5	2005	390	100	390
3.5	2006	405	100	405
2.5	2007	450	100	450
1.5	2008	480	100	480
0.5	2009	500	100	500
	Total Simulated Balance			4,150
	Total Actual Balance			4,150
	Difference			0

It is not a coincidence that there was an Iowa curve that produced a perfect fit. This is because when only one year is tested under the SPR model, there is always an Iowa curve that will produce a perfect simulation. Thus, it is important that more than one year is tested. The figures below will demonstrate that even though a particular curve may have fit perfectly for one test year, it may not necessarily be the best choice when multiple years are tested. The chart below shows the results of the Iowa 12-S3 curve when 2009, 2011, and 2013 are tested.

Figure 32:
SPR: Curve 12-S3: 2009, 2011, 2013

Vintage	Insts.	% Surv.	2009	% Surv.	2011	% Surv.	2013
1997	220	43	95	21	46	6	13
1998	250	57	143	31	78	12	30
1999	270	69	186	43	116	21	57
2000	285	79	225	57	162	31	88
2001	300	88	264	69	207	43	129
2002	320	94	301	79	253	57	182
2003	350	97	340	88	308	69	242
2004	375	99	371	94	353	79	296
2005	390	100	390	97	378	88	343
2006	405	100	405	99	401	94	381
2007	450	100	450	100	450	97	437
2008	480	100	480	100	480	99	475
2009	500	100	500	100	500	100	500
2010	580			100	580	100	580
2011	670			100	670	100	670
2012	790					100	790
2013	750					100	750
Simulated Balances			$ 4,150		$ 4,982		$ 5,963
Actual Balances			4,150		4,618		5,374
Difference			0		364		589
Difference Squared			0		132,496		346,921

SSD = 479,417 **MSD = 159,806** **√MSD = 400**

CI = Average Actual Bal / √MSD = 4,714 / 400 = **12** IV = 1000 / CI = **85**

While the 12-S3 curve provided a perfect simulation for 2009, it did not for years 2011 and 2013 because the life characteristics were different in these years. Since the 12-S3 curve produced simulated balances that were greater than the actual balances, a curve with a shorter average life should be analyzed. The figure below shows the SPR results from the same test years using an Iowa 10-S3 curve.

Figure 33:
SPR: Curve 10-S3: 2009, 2011, 2013

Vintage	Insts.	% Surv.	2009	% Surv.	2011	% Surv.	2013
1997	220	16	35	3	7	0	0
1998	250	28	70	8	20	1	3
1999	270	42	113	16	43	3	8
2000	285	58	165	28	80	8	23
2001	300	72	216	42	126	16	48
2002	320	84	269	58	186	28	90
2003	350	92	322	72	252	42	147
2004	375	97	364	84	315	58	218
2005	390	99	386	92	359	72	281
2006	405	100	405	97	393	84	340
2007	450	100	450	99	446	92	414
2008	480	100	480	100	480	97	466
2009	500	100	500	100	500	99	495
2010	580			100	580	100	580
2011	670			100	670	100	670
2012	790					100	790
2013	750					100	750
Simulated Balances			$ 3,775		$ 4,457		$ 5,323
Actual Balances			4,150		4,618		5,374
Difference			(375)		(161)		(51)
Difference Squared			140,625		25,921		2,601

SSD = 169,147 **MSD = 56,382** **√MSD = 237**

CI = $\frac{\text{Average Actual Bal}}{\sqrt{\text{MSD}}} = \frac{4{,}714}{237} =$ **20** **IV =** $\frac{1000}{\text{CI}} =$ **50**

The 10-S3 curve resulted in a better fit than the 12-S3 curve, despite the fact that the 12-S3 provided a perfect fit for one year. Several useful tools to measure the accuracy of SPR results in discussed below.

There are several indices used to measure the fit of the chosen curve. Alex Bauhan developed the conformance index ("CI") to rank the optimal curves.[112] The CI is the average

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[112] Bauhan, A. E., "Life Analysis of Utility Plant for Depreciation Accounting Purposes by the Simulated Plant Record Method," 1947, Appendix of the EEl, 1952.

observed plant balance for the tested years, divided by the square root of the average sum of squared differences between the simulated and actual balances. The formula for the CI is shown below.

Equation 6:
Conformance Index

$$Conformance\ Index\ = \frac{Average\ of\ Actual\ Balances}{\sqrt{Average\ of\ Sum\ of\ Squared\ Differences}}$$

The previous figure above demonstrates the CI calculation. The difference between the actual and simulated balances was \$375 in 2009, \$161 in 2011, and \$51 in 2013. The sum of these differences squared ("SSD") is 169,147 and the average of the SSD is 56,382 ("MSD"). The square root of the MSD is 237. The CI is the average of the three actual balances (\$4,714) divided by 237, which equals 20. Bauhan proposed a scaled for measuring the value of the CI, which is shown below.

Figure 34:
Conformance Index Scale

CI	Value
> 75	Excellent
50 – 75	Good
25 – 50	Fair
< 25	Poor

Thus, the CI of 20 calculated above indicates that the 12-S3 curve is a poor fit. According to Bauhan, any CI value less than 50 would be considered unsatisfactory.[113]

[113] SDP pdf. 210.

A related measure to the CI is the "index of variation" ("IV").[114] The IV is equal to 1,000 divided by the CI, as shown in the Figures above. Although the IV does not use a definite scale like the CI, it follows that the highest ranking curves are those with the lowest IVs. When divided by ten, the IV approximates the average difference between simulated and actual balances expressed as a percent of the average actual balance.[115] The IV resulting from the 12-S3 curve is 85, while the IV from the 10-S3 is 50, as shown above.

Another important statistical measure is the "retirements experience index" ("REI"), which measures the maturity of the account.[116] According to Bauhan, the CI alone cannot truly measure the validity of the chosen curve because the CI provides no indication of the sufficiency of the retirement experience.[117] A small REI implies that the history of the account may be too short to determine a best fitting Iowa curve. In other words, there may be many potential Iowa curves that could be fitted to a stub curve that is too short. This concept is illustrated in the graph below. This graph shows a stub survivor curve (the diamond-shaped points on the graph). The first seven data points of the stub survivor curve represent a small REI score. If an analyst was looking at only the first seven data points, it appears that several Iowa curves would provide a good fit, including the 10-S1, 8-L3, and 8-R3 (and several others not shown on the graph). These curves, however, have significantly different life characteristics and average lives. Once the longer stub curve is taken into account, it is obvious that the 10-S1 curve provides the best fit.

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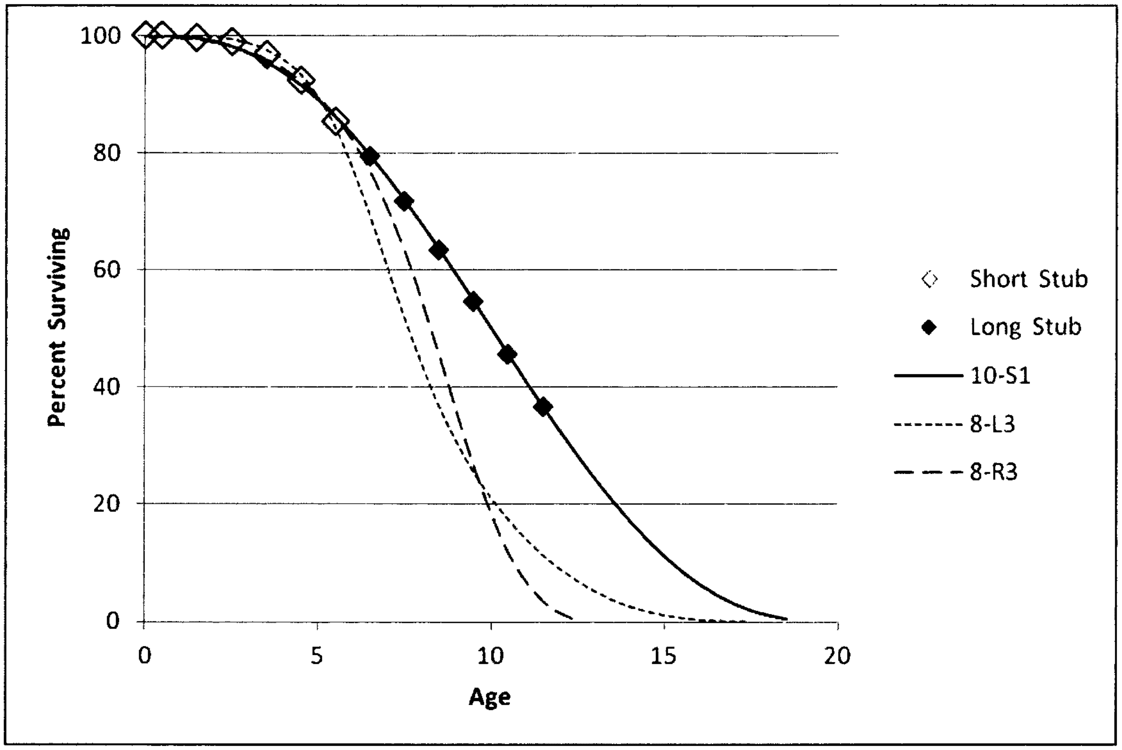
[114] White, R.E. and H. A. Cowles, "A Test Procedure for the Simulated Plant Record Method of Life Analysis," Journal of the American Statistical Association, vol. 70 (1970): 1204-1212.

[115] NARUC supra n. 8 at 111.

[116] *See* SDP 210.

[117] SDP 210.

Figure 35:
REI Illustration



Although the REI only applies to simulated analysis, the concept that a longer stub curve provides for better-fitting Iowa curves also applies to actuarial analysis.

The REI is mathematically calculated by dividing the balance from the oldest vintage in the test year at the end of the year by the initial installation amount. Referring to the top row of the SPR figure above, there were $220 of installations in 1997, and only $13 remaining in 2013. The REI for this account using the 12-S3 curve would be 94% (1 – (13/220)). An REI of 100% indicates that a complete curve was used in the simulation.

As with the CI, Bauhan also proposed a scale for the REI, as shown in the figure below. Thus, the REI of 94% from the account above using the 12-S3 curve would be considered excellent. This makes sense because the oldest vintage from that account had been nearly fully retired in the final test year.

Figure 36:
REI Scale

REI	Value
> 75%	Excellent
50% – 75%	Good
33% – 50%	Fair
17% – 33%	Poor
0% – 17%	Valueless

Both the REI and CI, however, must be considered when assessing the value of an Iowa curve under the SPR method. So while the REI of 94% is excellent, the same curve (12-S3) produced a CI of only 12, which is poor. According to Bauhan, in order for a curve to be considered entirely satisfactory, both the REI and CI should be "Good" or better (i.e., both above 50).

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PUC DOCKET NO. 49421

APPLICATION OF CENTERPOINT ENERGY HOUSTON ELECTRIC, LLC FOR AUTHORITY TO CHANGE RATES	§ § § §	**BEFORE THE STATE OFFICE OF ADMINISTRATIVE HEARINGS**

DIRECT TESTIMONY AND EXHIBITS

OF

DAVID J. GARRETT

EXHIBIT DJG-1:

Curriculum Vitae

101 Park Avenue, Suite 1125
Oklahoma City, OK 73102

DAVID J. GARRETT

405.249.1050
dgarrett@resolveuc.com

EDUCATION

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

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

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

PROFESSIONAL DESIGNATIONS

Society of Depreciation Professionals
Certified Depreciation Professional (CDP)

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

The Mediation Institute
Certified Civil / Commercial & Employment Mediator

WORK EXPERIENCE

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

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

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

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

TEACHING EXPERIENCE

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

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

PUBLICATIONS

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

VOLUNTEER EXPERIENCE

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

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

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

PROFESSIONAL ASSOCIATIONS

Oklahoma Bar Association 2007 – Present

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

Society of Utility Regulatory Financial Analysts 2014 – Present

SELECTED CONTINUING PROFESSIONAL EDUCATION

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

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

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

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

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

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

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

Utility Regulatory Proceedings

Regulatory Agency	Utility Applicant	Docket Number	Issues Addressed	Parties Represented
Public Service Commission of the State of Montana	Montana-Dakota Utilities Company	D2018.9.60	Depreciation rates, service lives, net salvage	Montana Consumer Counsel and Denbury Onshore
Indiana Utility Regulatory Commission	Northern Indiana Public Service Company	45159	Depreciation rates, grouping procedure, demolition costs	Indiana Office of Utility Consumer Counselor
Public Service Commission of the State of Montana	NorthWestern Energy	D2018.2.12	Depreciation rates, service lives, net salvage	Montana Consumer Counsel
Oklahoma Corporation Commission	Public Service Company of Oklahoma	PUD 201800097	Depreciation rates, service lives, net salvage	Oklahoma Industrial Energy Consumers and Wal-Mart
Nevada Public Utilities Commission	Southwest Gas Corporation	18-05031	Depreciation rates, service lives, net salvage	Nevada Bureau of Consumer Protection
Public Utility Commission of Texas	Texas-New Mexico Power Company	PUC 48401	Depreciation rates, service lives, net salvage	Alliance of Texas-New Mexico Power Municipalities
Oklahoma Corporation Commission	Oklahoma Gas & Electric Company	PUD 201700496	Depreciation rates, service lives, net salvage	Oklahoma Industrial Energy Consumers and Oklahoma Energy Results
Maryland Public Service Commission	Washington Gas Light Company	9481	Depreciation rates, service lives, net salvage	Maryland Office of People's Counsel
Indiana Utility Regulatory Commission	Citizens Energy Group	45039	Depreciation rates, service lives, net salvage	Indiana Office of Utility Consumer Counselor
Public Utility Commission of Texas	Entergy Texas, Inc.	PUC 48371	Depreciation rates, decommissioning costs	Texas Municipal Group
Washington Utilities & Transportation Commission	Avista Corporation	UE-180167	Depreciation rates, service lives, net salvage	Washington Office of Attorney General
New Mexico Public Regulation Commission	Southwestern Public Service Company	17-00255-UT	Cost of capital and authorized rate of return	HollyFrontier Navajo Refining; Occidental Permian
Public Utility Commission of Texas	Southwestern Public Service Company	PUC 47527	Depreciation rates, plant service lives	Alliance of Xcel Municipalities
Public Service Commission of the State of Montana	Montana-Dakota Utilities Company	D2017.9.79	Depreciation rates, service lives, net salvage	Montana Consumer Counsel
Florida Public Service Commission	Florida City Gas	20170179-GU	Cost of capital, depreciation rates	Florida Office of Public Counsel
Washington Utilities & Transportation Commission	Avista Corporation	UE-170485	Cost of capital and authorized rate of return	Washington Office of Attorney General
Wyoming Public Service Commission	Powder River Energy Corporation	10014-182-CA-17	Credit analysis, cost of capital	Private customer

Utility Regulatory Proceedings

Regulatory Agency	Utility Applicant	Docket Number	Issues Addressed	Parties Represented
Oklahoma Corporation Commission	Public Service Co. of Oklahoma	PUD 201700151	Depreciation, terminal salvage, risk analysis	Oklahoma Industrial Energy Consumers
Public Utility Commission of Texas	Oncor Electric Delivery Company	PUC 46957	Depreciation rates, simulated analysis	Alliance of Oncor Cities
Nevada Public Utilities Commission	Nevada Power Company	17-06004	Depreciation rates, service lives, net salvage	Nevada Bureau of Consumer Protection
Public Utility Commission of Texas	El Paso Electric Company	PUC 46831	Depreciation rates, interim retirements	City of El Paso
Idaho Public Utilities Commission	Idaho Power Company	IPC-E-16-24	Accelerated depreciation of North Valmy plant	Micron Technology, Inc.
Idaho Public Utilities Commission	Idaho Power Company	IPC-E-16-23	Depreciation rates, service lives, net salvage	Micron Technology, Inc.
Public Utility Commission of Texas	Southwestern Electric Power Company	PUC 46449	Depreciation rates, decommissioning costs	Cities Advocating Reasonable Deregulation
Massachusetts Department of Public Utilities	Eversource Energy	D.P.U. 17-05	Cost of capital, capital structure, and rate of return	Sunrun Inc.; Energy Freedom Coalition of America
Railroad Commission of Texas	Atmos Pipeline - Texas	GUD 10580	Depreciation rates, grouping procedure	City of Dallas
Public Utility Commission of Texas	Sharyland Utility Company	PUC 45414	Depreciation rates, simulated analysis	City of Mission
Oklahoma Corporation Commission	Empire District Electric Company	PUD 201600468	Cost of capital, depreciation rates	Oklahoma Industrial Energy Consumers
Railroad Commission of Texas	CenterPoint Energy Texas Gas	GUD 10567	Depreciation rates, simulated plant analysis	Texas Coast Utilities Coalition
Arkansas Public Service Commission	Oklahoma Gas & Electric Company	160-159-GU	Cost of capital, depreciation rates, terminal salvage	Arkansas River Valley Energy Consumers; Wal-Mart
Florida Public Service Commission	Peoples Gas	160-159-GU	Depreciation rates, service lives, net salvage	Florida Office of Public Counsel
Arizona Corporation Commission	Arizona Public Service Company	E-01345A-16-0036	Cost of capital, depreciation rates, terminal salvage	Energy Freedom Coalition of America
Nevada Public Utilities Commission	Sierra Pacific Power Company	16-06008	Depreciation rates, net salvage, theoretical reserve	Northern Nevada Utility Customers
Oklahoma Corporation Commission	Oklahoma Gas & Electric Co.	PUD 201500273	Cost of capital, depreciation rates, terminal salvage	Public Utility Division

Utility Regulatory Proceedings

Regulatory Agency	Utility Applicant	Docket Number	Issues Addressed	Parties Represented
Oklahoma Corporation Commission	Public Service Co. of Oklahoma	PUD 201500208	Cost of capital, depreciation rates, terminal salvage	Public Utility Division
Oklahoma Corporation Commission	Oklahoma Natural Gas Company	PUD 201500213	Cost of capital, depreciation rates, net salvage	Public Utility Division

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DIRECT TESTIMONY AND EXHIBITS

OF

DAVID J. GARRETT

EXHIBIT DJG-2:

Summary Depreciation Accrual Adjustment

Summary Depreciation Accrual Adjustment

Plant Function	Plant Balance 12/31/2017	Company Proposal	TCUC Proposal	TCUC Adjustment
Transmission	2,677,169,356	61,070,701	57,970,935	(3,099,766)
Distribution	6,819,502,483	213,587,251	183,151,605	(30,435,646)
General	884,241,963	51,104,951	50,063,481	(1,041,470)
Total	$ 10,380,913,802	$ 325,286,250	$ 290,709,368	**$ (34,576,882)**

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OF

DAVID J. GARRETT

EXHIBIT DJG-3:

Depreciation Parameter Comparison

Depreciation Parameter Comparison

Account No.	Description	Company's Position Iowa Curve Type	AL	Depr Rate	Annual Accrual	TCUC's Position Iowa Curve Type	AL	Depr Rate	Annual Accrual
	TRANSMISSION PLANT								
E35301	STATION EQUIPMENT	R0.5	53	2.05%	19,578,539	R0.5	56	1.93%	18,434,817
E35401	TOWERS & FIXTURES	R2.5	59	2.15%	14,051,620	R2	66	1.85%	12,071,203
	DISTRIBUTION PLANT								
E36201	STATION EQUIPMENT	R1	48	2.14%	24,485,519	R0.5	55	1.76%	20,165,356
E36401	POLES,TOWERS,FIXTURE	R0.5	35	3.84%	30,462,214	R0.5	45	2.84%	22,568,969
E36501	O/H CONDUCT DEVICES	R0.5	38	3.24%	31,217,383	R0.5	40	3.05%	29,339,028
E36601	UNDERGROUND CONDUIT	R2.5	62	1.96%	10,836,530	S1	65	1.83%	10,145,092
E36701	U/G CONDUCT/DEVICES	R0.5	38	3.34%	33,369,161	L0	42	2.87%	28,714,072
E36801	LINE TRANSFORMERS	R1	28	3.71%	48,878,877	L0	32	2.87%	37,875,814
	GENERAL PLANT								
E39001	STRUCT. & IMPROVEMTS	R4	50	2.05%	4,383,342	R2	58	1.56%	3,335,954